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D21: REPORT ON ONSHORE TSUNAMI RECORDS ANNEXE 1 – HISTORICAL CARDFILES

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D21: REPORT ON *ONSHORE TSUNAMI RECORDS* ANNEXE 1 – HISTORICAL CARDFILES

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Responsible Task 6.1:
Onshore sedimentological evidence of tsunami records

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Card File Nº	H1
Location	Odeceixe
Adapted translation	*"During the earthquake, the river rose with great thrust more than one league*[1] *inland, flooding all meadows, and leaving in them much fish of various nature (...)"* (Lopes, 1841).
Observations	[1] 1 Portuguese terrestrial league = 2805.83 Portuguese fathoms = 6172.836m (Barreiro, 1838)
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Costa, A., Andrade, C., Seabra, C., Matias, L., Baptista, M.A. & Nunes, S., 2005. *1755 – Terramoto no Algarve*, Faro, Centro Ciência Viva do Algarve, 237p. (p.115) Lopes, J.B.L., 1841*. Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.206) Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (p.24)

Card File Nº	H2
Location	Aljezur
Adapted translation	*"The river[1] was half full and suddenly dried out, the water disappeared through great cracks that opened in the stream bed, being expelled instantly in the neighborhoods, with violent irruptions, flooding everything. The streams dried out and the meadows flooded during a few days. The land cracked, thrusting unseen fine-grained white sand in many places. In other places, pieces of coal, fine and medium brown sand, and soil named "pisarra" appeared."* (Lopes, 1841). *"One league to the south of Aljezur stream is a ruined fortress named fortress of Arrifana. Due to the earthquake, the sea withdrew about 30 fathoms[2], stroking immediately after, with such thrust, that from the south of the tip rose to an enormous height and from the north rose about 30 fathoms, rose merely two, repeating the same flux and reflux three times within a few minutes. In the reflux, the sea dragged big rocks, and split to half a stone named Agulha, leaving great distances that we can see today between the cliffs that are nearby Anixa: crushed the fortress, leaving only part of it standing."* (Lopes, 1841).[3] *"The effect of the tsunami in the small and narrow promontory, 60m high and E-W direction, of the Arrifana Cape is curious. The sea withdrew about 60 meters[4] and afterwards thrusted with impetuosity against the cliffs; but while to the S, the sea was elevated to a great height, destroying the fortress, to the N barely rose from 4 meters, therefore, there was a bigger flux from the S than from the N (...)"* (Sousa, 1919). *"According Baptista Lopes, in Aljezur, the river suddenly dried out. The fast return of the water was so violent that flooded everything. That displacement in the stream left stagnant waters in several localities that became insalubrious."* (Costa *et al.*, 2005).
Observations	[1] Aljezur stream [2] 1 Portuguese fathom = 2.2m (Barreiro, 1838) ⇒ 30 fathoms = 66m. [3] *"In this text is not clear what occurred in the north side of Arrifana Cape. Pereira de Sousa (1919, p.111) considers that the wave rose only 4 meters, which would be unlikely, because the earthquake was generated SW of Cape São Vicente. However, one can consider that the author intended to give the idea of recovery relatively to the sea withdraw, saying that the difference was two times 30 fathoms, what would signify that the wave would have reached by North 30 fathoms of height, approximately 60 meters. The fortress, situated to a high quota,*

	was destroyed by the wave that reached it from the south, passing over it. Alternatively, it can be interpreted that only two of the waves that devastated the coast reached from the north 30 fathom in height, although this interpretation might be less probable because Silva Lopes mentions the subsequently reflux of the waves." (Costa *et al*., 2005, p.115). **[4]** In documents searched by Pereira de Sousa the distance was presented in fathom not in meters (1 fathom = 2.2m), and even though 1 fathom is a little more than 2 meters, Sousa (1919) considered it equal to 2 meters due to people's tendency to exaggerate when in panic.
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Costa, A., Andrade, C., Seabra, C., Matias, L., Baptista, M.A. & Nunes, S., 2005. *1755 – Terramoto no Algarve*, Faro, Centro Ciência Viva do Algarve, 237p. (p.115) Lopes, J.B.S., 1841. *Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.203) Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (p.23 & 89)

Card File Nº	H3
Location	Cape São Vicente
Adapted translation	"*6 or 7 minutes* after[1] *the sea withdrew; however, although by the N the sea lowered about 6 fathoms*[2]*, it didn't exceed its limits; by the E, in a distance of ½ league* [3] *seaward, the seafloor dried up entirely to a depth of up to 8 fathoms* [2]*; and rose afterwards with such a fury, that levelled with the cliffs and walls of the fort of Beliche, which should have some 30 fathoms* [2] *of height. There were 3 major sea pulses."* (Lopes, 1841). *"In the mega seism of 1755, N of Cape São Vicente, the sea started to fall about 12m, but didn't exceed its limits; whereas to the E, in a distance of ½ league* [3] *and up to a maximum depth of 16m, it withdrew entirely and rose afterwards with such a thrust that, rushing against the cliffs, touched the walls of the fort of Beliche, that is, rose to an elevation of 60m."* (Sousa, 1919).
Observations	[1] the earthquake [2] 1 Portuguese fathom = 2.2m (Barreiro, 1838) ⇒ 6 fathoms = 13.2m [3] 1 Portuguese terrestrial league = 2805.83 Portuguese fathoms = 6172.836m (Barreiro, 1838) ⇒ ½ league = 3086.418m
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Costa, A., Andrade, C., Seabra, C., Matias, L., Baptista, M.A. & Nunes, S., 2005. *1755 – Terramoto no Algarve*, Faro, Centro Ciência Viva do Algarve, 237p. (p.116) Lopes, J.B.L., 1841. *Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.217) Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (p.76 & 89)

Card File Nº	H4
Location	Sagres
Adapted translation	*"(...) after the earthquake, maritime people witnessed the sea raising from northwest, surging out of its course with extraordinary vehemence, such that in the town of Sagres the sea rose more than thirty "palmos"*[1]*, where it swashed and where it found cliffs for more then forty "côvados"*[2] *of height, and extended for more than ½ league*[3] *inland and in that town unroofed several buildings and some brick and tile ovens (...)"* (Rocha, 1909). *"The sea withdrew about one league*[3][4] *drying out all the bays in which ships drop anchor; the sea returned afterwards with such a thrust, that by the N and E overwashed rocks standing at 60 and 80 fathoms*[5] *high, respectively, throwing many fishes and big stones in the Sagres fort; and the backwash ripped off the vegetation. The sea flooded a beach called Mortinhal*[6]*, facing eastward, by about ½ league ripping off vineyards and leaving the land as if it was a beach, covered with several types of fish and big "penedias"*[7] *of which one, weighting more than 300 "arrobas"*[8] *showed many shellfish stuck on its surface. Three times the sea struck and withdrew, the first wave being the largest. The water height in the mareta*[9] *rose 7 "palmos"*[1]*, but it soon lowered to its usual condition."* (Lopes, 1841). *"Close to this fort, the sea, after having withdrawn for ½ league* [3]*, struck the 30 m high cliffs with such violence, that overtopped them, mainly from the E, bringing to the fort fish, big stones and in the backwash ripped plants."* (Sousa, 1919). *"About 5km to the NE of Sagres is situated Mortinhal's beach, facing SE, protected against SW waves, and next to which the fortress of Balieira is located. The sea rushed inland to a distance of ½ league*[3]*, destroying crops and leaving several fish and many rocks, one of which weighed 300 "arrobas"*[8]*."* (Pereira de Sousa, 1919).
Observations	[1] 1 "palmo" = 0.22m (Barreiro, 1838) ⇒ 30 "palmos" = 6,6m; 7"palmos" = 1.54m [2] 1 "côvado" = 0.68m (Barreiro, 1838) ⇒ 40 "côvados" = 27.2m [3] 1 Portuguese terrestrial league = 2805.83 Portuguese fathoms = 6172.836m (Barreiro, 1838) ⇒ ½ league = 3086.418m [4] This distance is quoted differently in two sources, both citing Lopes (1841): 1 league in Sousa (1919) and ½ league in Costa *et al*. (2005) [5] 1 Portuguese fathom = 2.2m (Barreiro, 1838) ⇒ 60 fathoms = 132m and 80 fathoms = 176m

	[6] Mortinhal is Martinhal beach [7] penedias are large boulders [8] 1 "arroba" = 14.688Kg (Barreiro, 1838) $\Rightarrow$ 300 "arrobas" = 4406.4kg [9] Mareta beach located to the east of Sagres point.
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Costa, A., Andrade, C., Seabra, C., Matias, L., Baptista, M.A. & Nunes, S., 2005. *1755 – Terramoto no Algarve*, Faro, Centro Ciência Viva do Algarve, 237p. (p.116) Lopes, J.B.S., 1841. *Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.216) Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (p.41, 42, 76 & 89) Rocha, M.J.P. 1909. *Monografia de Lagos*. Reedição de 1991 de Algarve em Foco Editora, Vila Real de Santo António, 484p. (p.94)

Card File Nº	H5
Location	Zavial
Adapted translation	*"Zavial fortress, further to the E, was also destroyed"* (Sousa, 1919).
Observations	This description was found in the chapter relative to the tsunami inundation effects, not in the earthquake effects chapter.
References	Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (p.89.)

Card File Nº	H6
Location	Almadena/Budens (Boca do Rio)
Adapted translation	*"(...) and in Almadena, distant of this city* [1]*, two leagues, the sea uncovered a big settlement that the general of this kingdom went to see it and several constructions were observed, some of them large in size."* (Rocha, 1909). *"In the occasion of the 1755 earthquake, next to the fortress of Almadena, the sea surged out of its limits, ejecting sand from a nearby beach located close to a narrow opening* [2] *that allows the tide to rush in, named river Almadena, and uncovered foundations of a large settlement that extended farther seawards, when the sea withdrew it was possible to see stones and destroyed constructions that were submerged by the sea, and in the small part of the inlet where the waves took the sand, I saw and observed many pieces of well manufactured masonry, and parts of constructions, that apparently protected the settlement against floods and tides; today this place is again covered with sand as it was before, and is assumed this was an ancient settlement named Buda, that gave the name Budens to a nearby region (...)"* (IANTT *in* Sousa, 1919). "*In the day of the earthquake, the sea invaded the fresh water creek that outlets there into the sea, for more than ½ league* [3] *with a water height of 10-12 "varas"*[4] *destroying some large sand "médãos"* [5] *and carrying along 50 of the heaviest anchors more than ¼ league inland. The backwash uncovered great and noble buildings in the beach, next to the coastline, of which no memory existed. It wasn't possible to determine the extension because a part of the buildings were located underwater and the other part, near the tide limits: however it appeared to belong to a big village".* (Lopes, 1841). *"Around 1715 a pier was discovered, due to another impulse from the sea, next to all the buildings that appeared again*[6]*. The sea left behind a large lake whose depth was not investigated but is not disturbed neither by the flood nor by the ebb"* (Lopes, 1841).[7] *"Next to the fortress of Almadena, SE of Budens, a large and deep lake was formed by a sinking phenomenon."*[8] (Sousa, 1919).
Observations	[1] The city mentioned in this transcription is Lagos. [2] Inlet [3] 1 Portuguese terrestrial league = 2805.83 Portuguese fathoms = 6172.836m (Barreiro, 1838) ⇒ ½ league = 3086.418m [4] 1 "vara" = 1.1m (Barreiro, 1838) ⇒ 10 to 12 "varas" = 11 to

	13.2m [5] Foredunes [6] In the occasion of the 1755 tsunami. [7] According to Sousa (1919), in the original description the occasion in which the sea impulse took place is not clear. Lopes (1841) refers to the year 1715, however, Sousa (1919) thinks it is more likely that it happened in 1755, due to the tsunami. [8] According to Sousa (1919) the occasion in which the "sinking" phenomenon occurred, described by Lopes (1841), is not clear. One interprets that it occurred in 1715, due to the sea impulse; but according to the same author it most likely occurred in 1755.
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Lopes, J.B.S., 1841. *Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.222, 223 & 87-91) Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (Pag.42, 72, 73 & 91) Rocha, M.J.P. 1909. *Monografia de Lagos*. Reedição e 1991 de Algarve em Foco Editora, Vila Real de Santo António, 484p. (p.95)

Card File Nº	H7
Location	Lagos
Adapted translation	*"Lagos was another particular victim to the sea and earthquake. Almost all temples and houses were devastated resulting in a big loss of lives and wealth. (...) The sea attacked the Fortress of Meia Praia, splitting it in half and cutting the bulwark that faces West. Afterwards forced the thick walls of Lagos fortification. All the walls reached by the sea collapsed, divided in huge pieces that one thousand bulls wouldn't be able to move. Some pieces, the sea carried to a distance of 30, 40 "passos"*[1] *from their foundations. The respectable fortress of Ponta da Bandeira was unharmed even after many assaults from the sea: the fortress of Penhão*[2] *was ruined, breaking apart from the cliffs that sustained it."* (Castro *in* Sousa, 1919). *"The city of Lagos didn't experienced minor misfortune; because not only was entirely devastated, except just one house located in the Castle, where Governors used to reside, but also the sea grew in a unfamiliar way, as never seen, and attacked furious and haughty that wretched City with such impetus, that did not only submerged it, and hided it below the waves; but also equally coveted it's inhabitants lives and wealth, and stayed long enough to conceal in its bowels every inhabitants, all their utensils, and everything else that simple mortals need to keep the life they lost."* (Collecção Universal do Terremoto *in* Sousa, 1919). *"(...) the sea entered inland in a height of 7 "varas"*[3]*: the strong walls of the city also suffered this misfortune, were violently driven by the waters, up to the warehouses, that were ruined by the arrogant Neptune*[4] *(...)"* (D.J.F.M. em A. e Oliveira, F *in* Sousa, 1919). *"Also in this city the sea did enough damage, destroying the city walls, with wave heights over thirty "palmos"*[5] *and devastating and incapacitating crops and carrying small boats to incredible distances, of more than half a league*[6] *inland."* (Rocha, 1909). *"(...) and after the earthquake, about 15 minutes later, the sea rose so high that looked like it was touching the clouds, and everyone ran in to the fields, the sea broke down part of the city walls with such violence that threw entire pieces of it, as big as buildings, inside the city, with such thrust that destroyed many houses, like the one Captain Simão Manuel da Villa Lobos owned and others, located in the central square, carrying everything ahead, like boats and everything else, to the farms that were very distant from the sea, and destroyed completely the church of S. Roque and we cant tell where it was located before; opened several cracks in the river bed and we can still see them filled with water in low tide and can't find its bottom."* [7]

	(Rocha, 1909). *"There were five churches in this neighbourhood and all of them located outside the city walls, the first one was of S. Roque built on the other side of the river, in the beach next to the sea, that served as isolation hospital where the infested were cured, and was completely destroyed by the sea leaving no trace of existence – S. Pedro's church located ⅛ league*[6] *to the north of the city was supposedly ruined in the same earthquake, but remained able to be repaired – S. João's church also located to the North was demolished by the earthquake and by the sea's thrust"... "in the west part of this neighbourhood is located Santo Amaro church that suffered no damage in the earthquake."* [8] (IANTT *in* Sousa, 1919). *"The sea rose up to a height of 5 fathoms*[9]*; and all the walls that faced the sea were destroyed by it, transporting, through a distance superior to 50 "passos"*[1]*, pieces of the city walls that weighted more then one thousand "arrobas"*[10]*; the sea entered ½ league*[6] *inland transporting 5 boats through the same distance. Along with the bridge, crops that were close to it were ruined, as well as S. João Baptista church"..." S. Roque church, located in the beach, was also destroyed, and the sea flooded the farms. The old Pinhão fort*[2] *was completely ruined; causing also the destruction of 3 pieces of the artillery battery."* (Lopes, 1841). *"S. João Baptista church, located to E of Lagos, 400m to the W of the bridge" ... "Some previous documents only mentioned this church demolition, however, now was concluded that this demolition was due to the tsunami wave." ... "The same thing happened to S. Roque church, situated in the beach to E of S. Sebastião church, of which the foundations barely exist."* (Sousa, 1919). *"In the 1º of November of 1755, at 9 in the morning, God sent a horrible earthquake that altered the sea, devastating the city of Lagos and it's walls in a few minutes, rising to the height of 13.5 "palmos"*[5]*, taking all the valuable furniture (...)"* (Rocha, 1909). *"This city's port is located in the outlet of Bensafrim stream, which has NW-SE direction, and is protected from SW waves. The tsunami did, however, huge damages. The sea, after withdrawn in great extent, rushed through the valley with great vehemence, more then half league*[6]*, transporting small ships that distance inland, devastating the crops, destroying a church and a bridge and rising 11 meters up to the city walls that were destroyed in certain parts, mainly those facing SE. The sea rushed with such energy against the city walls facing E, that in the places where the walls were destroyed, the water entered the city and transported pieces of the wall that weighted more then one thousand "arrobas"*[10] *for more then 50 "passos"*[1]*. The*

	artillery battery of Pinhão fortification, also facing E was completely destroyed." (Sousa, 1919). *"(...) and the only church standing was the church of Stº Amaro, located outside of the walls. Where the Divine trades are celebrated, and the church of São Roque was swallowed by the sea. The house of the generals was demolished; the fortification of peham*[2]*, and meia Praia were ruined; most of the city walls and it's barbican facing the sea were devastated by it's fury"* (Relaçam *in* Costa *et al*., 2005).
Observations	[1] 1 "passo" = 1.65m (Barreiro, 1838) ⇒ 30 to 40 "passos" = 49.5 to 66m; 50 "passos" = 82.5m [2] Pinhão's Fort was an additional fortified defensive structure to Ponta da Bandeira fortress. It was destructed by the 1755 earthquake and part of the cliff where it was settled broke of from the rest of the coast. One can still see parts of the fort wall. [a] [3] 1 "vara" = 1.1m (Barreiro, 1838) ⇒ 7 "varas" = 7.7m [4] Neptun, in Roman mythology, is god of the sea. [5] 1 "palmo" = 0.22m (Barreiro, 1838) ⇒ 30 "palmos" = 6.6m; 7"palmos" = 1.54m; 13.5 "palmos" = 2.97m [6] 1 Portuguese terrestrial league = 2805.83 Portuguese fathoms = 6172.836m (Barreiro, 1838) ⇒ ½ league = 3086.418m; ⅛ league = 771.6045m [7] About Santa Maria neighbourhood in Lagos [8] About São Sebastião neighbourhood in Lagos [9] 1 Portuguese fathom = 2.2m (Barreiro, 1838) ⇒ 5 fathoms = 11m [10] 1 "arroba" = 14.688Kg (Barreiro, 1838) ⇒ 1000 "arrobas" = 14688kg
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Lopes, J.B.S., 1841. *Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.231 & 232) Rocha, M.J.P. 1909. *Monografia de Lagos*. Reedição de 1991 de Algarve em Foco Editora, Vila Real de Santo António, 484p. (p.68-71 & 95) Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e*

	Évora, Lisboa, Tipografia do Comércio, 277p. (p.13, 15, 16, 42, 45, 47, 48 & 89) [a]http://www.visitalgarve.pt/visitalgarve/vPT/DescubraARegiao/Concelhos/Lagos/Cidade/?res=1280x800

Card File Nº	H5
Location	Alvor
Adapted translation	*"The sea that ran over the beach of Alvor, swallowed everything. It took fishermen that pulled the fishing nets; buildings, of which there's no sign of existence; assaulted the Fortress of the Meya praia, and spited in half the bulwark that faces W."* (Castro in Sousa, 1919). *"(...) The sea entered 300 fathoms[1] inland, and completely covered the town with water, located 30 fathoms[1] above sea level; it took from the foundations the church of N. Snr.ª da Ajuda, located in the beach near the outlet, of which there's no sign of existence"…"Also, the watch tower named Facho, built over a rock located E of the inlet, was completely destroyed"…"the port was once of the main ports in the Algarve"…" where boats that weighted 8 thousand "arrobas"[2] entered and left full"…"it was covered with sand by the earthquake, and today only small boats enter."*(Lopes, 1841). *"Next to this village the sea entered about 600 meters inland, rising to the same height as the town, which was found above rock at 30 meters height. It struck with such rush that took N.S.ª da Ajuda church from the foundations, that was located in the beach, near the outlet."* (Sousa, 1919). *"(...) The sea consumed the crops, and the big sand hills[3] of the nearby beaches; taking from under the floor the church of Nossa Senhora da Ajuda, the recognition of the place where was located became impossible (...)"* (Relaçam *in* Costa *et al*., 2005).
Observations	[1] 1 Portuguese fathom = 2.2m (Barreiro, 1838) ⇒ 300 fathoms = 660m; 30 fathoms = 66m [2] 1 "arroba" = 14.688Kg (Barreiro, 1838) ⇒ 8000 "arrobas" = 117 594kg [3] dunes
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Costa, A., Andrade, C., Seabra, C., Matias, L., Baptista, M.A. & Nunes, S., 2005. *1755 – Terramoto no Algarve*, Faro, Centro Ciência Viva do Algarve, 237p. (p.122) Lopes, J.B.S., 1841. *Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.271 & 272)

	Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (p.13, 79 & 89)

Card File Nº	H9
Location	Portimão
Adapted translation	*"About the destruction in the Village of Portimão, that everyone pitifully suffered, the battle between the waves was horrendous. The river outlet forms a big mouth between two high rocks, where there are, facing each other, the fortress of Santa Catharina and the fortress of S. João. Through the outlet, the consecutive waves entered inland and went upriver for more than a league. The waves rushed against the walls of barbican [1], destroying everything. Many boats were transported inland in such a distance that it's not possible to remove. The sea flooded the outlying areas of the village, knocking down all the houses and drowning many people that looked for refuge there."* (Castro *in* Sousa, 1919). *"The city walls with its towers, mainly the part facing the river, named Barbacam[1], were severely destroyed, uncovering a great extent of the interior of the walls due to the vehemence of the earthquake and the water impulse."..." the rapid flood created by the sea waves caused a lot of damage, flooding throughout distances sometimes bigger then 800 "varas"[2] , destroying this village salt marshes (..) the sea flooded all the houses that existed in the Asopal neighborhood, and the water entered in the Church of Misericordia, in heights of 12 "palmos"[3]. It also destroyed in the same occasion, three mills (...)"* (IANTT *in* Sousa, 1919). *"(...) the sea entered with amazing fury flooding both sides of the river in a great extent and rising to a height of 6 fathoms[4]; the sea dragged big stones and millstones when it withdrew, in the river margin, destroyed the fortress of S. João, convent of Capuchos: and uncovered, in the beach, ruins of a settlement, that could not be examined, because it was instantly covered with water."* (Lopes, 1841). *"The sea, entering upriver, surged out of its limits, in parts more then 800 meters, devastating the town salt marshes and crops, devastating the 80 houses that existed in Sapal neighbourhood, and rising in such a way that flooded the church of Misericórdia, to a height of 12 "palmos"[3] and destroyed three mills. When it withdrew destroyed the fortress of S. João and the convent of Capuchos."* (Sousa, 1919). *"The city walls and the barbican suffered great damage, due to the earthquake and to the inundation"…"The violent inundation entered about 880m inland, destroying the villa's salt evaporation pans, the place where the boats used to cross the river were and the House of the Infante[5]. All the 80 houses located in the Sapal neighbourhood were destroyed, as well as all the vegetable-*

	gardens that existed in that area. The water entered the Misericórdia church to an approximate height of 2,5m and destroyed five watermills, two of which belonged to the villa's count. Due to the water invasion, 40 people died drowned [6] (Carrapiço *et al.*, 1974). *…"the sea water thrusted through the inlet in the first day of November of 1755 uncovering places covered by sand for many years"…"The city walls, with its towers and barbican, facing the river were partly destroyed"…"caused by the earthquake and by the waters thrust"…"The rapid inundation inland, exceeding the natural limits of the sea, penetrating more then eight hundred "varas"*[2] *in some places, destroyed the salt evaporation ponds, the place were the boats used to cross the river were, and the house of the "Infante"* [5]*, in such a way that no more salt was produced in the salt ponds ever since, all the houses and vegetable-gardens which existed in the asapal*[7]*, entering water in the Misericordia church and reaching twelve "palmos"*[3] *in height, destroying also three watermills, two of which belonged to the villa's count"…"The Sante Catarina fortress also suffered a great deal of damage and noting was repaired so far, except for the chapel and the captain's houses"…"in this inundation, forty people died."* (IANTT *in* Carrapiço *et al.*, 1974).
Observations	[1] Barbacam is the name that was given to the walls of a fort. In English is called barbican. [2] 1 "vara" = 1.1m (Barreiro, 1838) $\Rightarrow$ 800 "varas" = 880m [3] 1 "palmo" = 0.22m (Barreiro, 1838) $\Rightarrow$ 12 "palmos" = 2.64m; [4] 1 Portuguese fathom = 2.2m (Barreiro, 1838) $\Rightarrow$ 6 fathoms = 13.2m [5] son of a King [6] Síntese baseada parcialmente na transcrição do documento original de referente ao inquérito sobre Vila Nova de Portimão feito pelo Marquês de Pombal [7] also known as Sapal neighbourhood
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Carrapiço, F., Palhinha, J. A. & Brázoi, J. M., 1974. *As muralhas de Portimão subsídios para o estudo da história local*, Câmara Municipal de Portimão, 49p (p.14, 15, 39 & 40). Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e*

	Évora, Lisboa, Tipografia do Comércio, 277p. (p.13, 80, 89 e 90) Lopes, J.B.S., 1841. *Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.268 & 269)

Card File Nº	H10
Location	Ferragudo
Adapted translation	*"When the earthquake struck 60 houses existed, the sea entered inland, flooded everything and knocked down a third of the houses, sweeping away all the utensils."* (Lopes, 1841). *"Despite the absence of records that describe this fact* **[1]** *in the Parochial memories or in Relaçam, this description of Silva Lopes makes sense, given that Ferragudo is located in Arade river's outlet in front of Portimão, and that Mexilhoeira da Carregação, located upstream, was also reached by the water according to the descriptions existent in Relaçam."* (Costa *et al*., 2005).
Observations	**[1]** The situation mentioned by Silva Lopes was the flooding of peoples houses.
References	Costa, A., Andrade, C., Seabra, C., Matias, L., Baptista, M.A. & Nunes, S., 2005. *1755 – Terramoto no Algarve*, Faro, Centro Ciência Viva do Algarve, 237p. (p.124) Lopes, J.B.S., 1841. *Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.296)

Card File Nº	H11
Location	Armação de Pêra
Adapted translation	*"(...)in the above described Armação, the fortress was destroyed by the sea, and due to it's impetus, took the Church of Santo António leaving only a few stones, as also sixty-two persons, that the sea took and afterwards threw them dead (...)"* (IANTT *in* Sousa, 1919). *"Pera Debaixo or Armação, located in the beach a ¼ of league*[1] *from another village named Pera. The sea left one house standing in the earthquake; rushed more then ½ league*[1] *inland, flooding everything, leaving salty water lakes in the lowlands, creating islands and drowning 84 people (...)"* (Lopes, 1841). *"The sea entered more then half a league, flooding everything, transforming the floodplains in salty fields."* (Sousa, 1919). *"Armação de Pera, had fifty-five houses, none of which fell with the earthquake, but were swallowed by the sea destroying more then half of the houses, the fortress and the Church of Santo Antonio, leaving no trace of its location; taking sixty-seven people in the backwash."*(Relaçam *in* Costa *et al*., 2005).
Observations	*"Armação de Pera inlet should have been in other times much more extensive in depth; It seems that a sand cord, brought by the sea created a barrier that in turn generated a lagoon, today represented by two lagoons where Peras and Espiche streams outlet."* (Sousa, 1919). [1] 1 Portuguese terrestrial league = 2805.83 Portuguese fathoms = 6172.836m (Barreiro, 1838) ⇒ ½ league = 3086.418m; ¼ league = 1543.209m
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Costa, A., Andrade, C., Seabra, C., Matias, L., Baptista, M.A. & Nunes, S., 2005. *1755 – Terramoto no Algarve*, Faro, Centro Ciência Viva do Algarve, 237p. (p.124) Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (p.61, 62 & 90) Lopes, J.B.S., 1841. *Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.290)

Card File Nº	19
Location	Albufeira
Adapted translation	*"Most inhabitants of Albofeira, a village located in a eminent rock, came down to the beach to be safer during the earthquake. The sea rushed in and swallowed everybody."* (Castro *in* Sousa, 1919). *"Albufeira was equally devastated, and the ones that escaped the earthquake were caught by the sea."* (D.J.F.M. em A e Oliveira, F. *in* Sousa, 1919). *"...the main Church is in the same state since the earthquake"…"the sea surged out of its limits, entering in the outskirts of town, and destroyed Santa Anna's neighbourhood that was composed of seven streets, and many houses, and the sea flux and reflux left no sign of where the houses were, with loss of many lives, destroyed three towers facing W and S, part of the three towers facing N and parts of the city walls, and of the Castle and all the houses that were in it; destroying the aqueducts and reservoirs..."* (IANTT *in* Sousa, 1919). *"Also the construction of the church of Santa Ana began near the town, because the sea destroyed the Town's church located in the outskirts during the 1755 earthquake (...)"* (IANTT *in* Sousa, 1919). *"One can see the huge effect of the tsunami, curious fact, the towers situated to the west of Albufeira and facing SE suffered the most with the waves, which can be attributed to a larger energy of the sea in the SE-NW direction"* (Sousa, 1919). *"There were few good houses around the town, that were rebuilt after the earthquake that left the town impossible to live in: the sea entered with such impetus by the stream outlet and beach, that rose up to the huge height of 15 "covados"*[1]*; the flux and reflux repeated for 3 times, more violently, in few minutes, and continued out of limits until 4 o'clock in the afternoon: carried from the foundations all the houses with the exception of 27 which were ruined. Everyone that was in the church, ran to the street when it fell, finding their death there 27 people."* (Lopes 1841). *"It's located near an inlet facing SE, and was defended by two military batteries and several watchtowers. Those towers, situated to the W of Albufeira and facing SE, were the ones that suffered the most with the impulse of the sea. "* (Sousa, 1919). *"(...) the sea took the Church by it's foundations, and the neighbourhood of Santa Anna causing the complete destruction of buildings, registries, wine cellars, and granaries: the Church of Misericórdia, the one with the miraculous image of Sam*

	Sebastiam, fell: the Churches of Piedade, Sam Joam, and Nossa Senhora da Orada (...) in the waves that submerged most of this Town, 197 people drowned 197, in a total of 204." (Relaçam *in* Costa *et al*., 2005). *"In that coastline, the sea rose so many "varas"*[2] *over the usual surface, that flooded many fields, and in the backwash ruined part of the fortress, and the whole village of Albufeira, leaving many fishes inland"* (Mendonça, 1758).
Observations	[1] 1 "covado" = 0.68m (Barreiro, 1838) ⇒ 15 "covados" = 10.2m [2] 1 "vara" = 1.1m (Barreiro, 1838)
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Costa, A., Andrade, C., Seabra, C., Matias, L., Baptista, M.A. & Nunes, S., 2005. *1755 – Terramoto no Algarve*, Faro, Centro Ciência Viva do Algarve, 237p. (p.126) Mendonça, J.J.M., 1758. *Historia universal dos terremotos que tem havido no mundo de que ha noticia, desde a sua creação até o seculo presente: com huma narraçam individual do terremoto de Novembro de 1755, e noticia verdadeira dos seus effeitos em Lisboa, todo Portugal, Algarves, e mais partes da Europa, Africa, e America, aonde se estendeu: E huma dissertação physica sobre as causas geraes dos terremotos, seus effeitos, differenças e Prognosticos; e as particulares do ultimo*. Na Offic. De Antonio Vicente da Silva, Lisboa, 272p. (p.156). Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (p.13, 16, 18 19, 20, 90) Lopes, J.B.S., 1841. *Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.301)

Card File Nº	H13
Location	Boliqueime (Povo Velho)
Adapted translation	*"It's the village of Algarve that suffered the most with the earthquake, being initially called Boliqueime Velho*[1]*, and was destroyed by the earthquake, it's location and name changed to the current village of Boliqueime."* (Sousa, 1919). *"...inside the locality, with one league*[2] *in diameter, nine houses were destroyed, and the rest sustained significant loss: In the beach that belongs to this locality* [3] *the sea took all 38 houses and sheds."* (IANTT *in* Sousa, 1919). *"After the earthquake, the sea surged out of its limits 5 times, causing in the first and second wave the described damage, along a distance of half a league*[2] *inland over the hills, 6 fathoms*[4] high*, taking 6 hours to grow, and taking the usual time to decrease..."* (IANTT *in* Sousa, 1919).
Observations	[1] Where Boliqueime used to be, before the 1755 earthquake. It's now called Povo Velho [2] 1 Portuguese terrestrial league = 2805.83 Portuguese fathoms = 6172.836m (Barreiro, 1838) ⇒ ½ league = 3086.418m [3] Quarteira beach [4] 1 Portuguese fathom = 2.2m (Barreiro, 1838) ⇒ 6 fathoms = 13.2m The central office of this region was located in Boliqueime. The damage caused by the sea described by the authors could have been referred to a smaller locality within this region, such as Quarteira.
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (p.51 & 52) [a]http://www.cm-loule.pt/index.php?option=com_content&task=view&id=129&Itemid=133

Card File Nº	H14
Location	Quarteira
Adapted translation	*"…inside the locality* [1]*, which presents one league*[2] *in diameter, nine houses were destroyed, and the rest sustained significant loss: In the beach that belongs to this locality*[1] *the sea took all 38 houses and sheds."* (IANTT *in* Sousa, 1919). *"After the earthquake, the sea surged out of its limits 5 times, causing in the first and second wave the described damage, along a distance of half a league*[2] *inland over the hills, 6 fathoms*[3] high*, taking 6 hours to grow, and taking the usual time to decrease..."* (IANTT *in* Sousa, 1919). *"Since 1836 that the village of Quarteira belongs to Boliqueime, where, according to Silva Lopes, «due to the earthquake the sea entered inland about half a league*[2] *killing 52 people». People say that the sea got to the old estate of Loulé's Duke, about three kilometres inland from the beach."* (Sousa, 1919). *"...a place called Quarteyra occupied by sheds in which fishermen live, that caught abundant sardine, and were already establishing the village as their home, when the sea destroyed and took fifty five houses in the Earthquake, doing more damage in the backwash, the sea surged out of its limits seven to eight-hundred "passos"*[4] *was a vicious coast, no harbour could allow in boats."* (IANTT *in* Sousa, 1919). *"It was mainly populated with sheds, when the tsunami occurred. The sea rushed inland about half a league*[2]*, passing over hills 12 meters high, taking all the houses and sheds."* (Sousa, 1919).
Observations	[1] Boliqueime [2] 1 Portuguese terrestrial league = 2805.83 Portuguese fathoms = 6172.836m (Barreiro, 1838) ⇒ ½ league = 3086.418m [3] 1 Portuguese fathom = 2.2m (Barreiro, 1838) ⇒ 6 fathoms = 13.2m [4] 1 "passo" = 1.65m (Barreiro, 1838) ⇒ 800 "passos" = 1320m
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Sousa, F.L.P., 1919. O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora, Lisboa, Tipografia do Comércio, 277p. (p.51, 52 & 90)

Card File Nº	H15
Location	Faro
Adapted translation	*"Faro city was lucky because there was low tide. The distance between the city and the beach is one league*[1]*, where several islands are present, separated by three bars, and divided in pieces land, that are covered in high tide. We saw the waves rising in the coast, with such height, that went over the islands without breaking. While entering the river, the waves collided with the islands and were then divided in several bubbling waves which represented a frightful scene. The waves caused little damage to the city, and the waters did not exceed the limits of a high tide, due to the low tide, as I already said."* (Castro *in* Sousa, 1919). *"Faro suffered the same calamity, submerging half of the central square, with all the houses, and so far weren't seen."* (D.J.F.M. em A. e Oliveira, F. *in* Sousa, 1919). *"The sea surged little out of its limits perhaps because the waves broke and swashed over the islands."* (Lopes, 1841). *"It is not surprising that the waves didn't produce in Faro the same effect that produced in the others ports of the Algarve, situated to West. Mr. Baldaque da Silva said that the currents follow the channel in the main direction with low intensity, due to the big surface available."* (Sousa, 1919). *"The tsunami was less intense in this city, in part due to the sandy islands, which exist in front of the city that protected it from tidal currents."* (Sousa, 1919).
Observations	[1] 1 Portuguese terrestrial league = 2805.83 Portuguese fathoms = 6172.836m (Barreiro, 1838) There is no coherence between the second description and the remaining ones.
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (p.12, 16, 33 & 90) Lopes, J.B.S., 1841. *Corografia ou Memória Económica, Estatística e Topográfica do Reino do Algarve*, Lisboa, 528p. (p.329).

Card File Nº	H16
Location	Tavira
Adapted translation	*"At about 9,30h AM, a loud thunder echoed, and after 3 minutes, the earth started to shake with immense violence. The sea withdrew about 20 fathom*[1]*, stroking after with such thrust that flooded more then half a league*[2] *inland, repeating this movement 3 times. After this catastrophe there was a long period of storms and cold, as well as a bad year for farmers and fishermen, followed by several diseases."* (Chagas, 2004).
Observations	According to the author this description was made by an anonymous from Tavira. However, there is no reference to the location of this observation. [1] 1 Portuguese fathom = 2.2m (Barreiro, 1838) ⇒ 20 fathoms = 44m [2] 1 Portuguese terrestrial league = 2805.83 Portuguese fathoms = 6172.836m (Barreiro, 1838) ⇒ ½ league = 3086.418m
References	Barreiro, F.J., 1838. *Memoria sobre os pesos e medidas de Portugal, Espanha, Inglaterra, e França, que se empregão nos trabalhos do Corpo de Engenheiros e da Arma de Artilharia; e noticia das principais medidas da mesma espécie, usadas para fins militares em outras nações*. Tipografia da Academia Real das Sciencias, Lisboa, 80p. Chagas, O., 2004. *Tavira Memórias de uma cidade*. Tipografia Tavirense, Lda., 350p. (p.89)

Card File Nº	H17
Location	Monte Gordo
Adapted translation	*"The waves took all the sheds from Monte Gordo beach, where fish selling took place, all the way to Conceição de Tavira, and wiped out all the islands along the coastline all the way to Quarteira beach, opening big cracks, but Olhão and Faro were miraculously saved."* (Relaçam *in* Costa *et al.*, 2005).
Observations	
References	Costa, A., Andrade, C., Seabra, C., Matias, L., Baptista, M.A. & Nunes, S., 2005. *1755 – Terramoto no Algarve*, Faro, Centro Ciência Viva do Algarve, 237p. (p.130)

Card File Nº	H18
Location	Castro Marim
Adapted translation	*"Castro Marim was devastated, the rushing in of the sea did noticeable damage, more then 180 people died".* (D.J.F.M. em A. e Oliveira, F. *in* Sousa, 1919.) *One description"..."refers to the sea flooding and that it caused great damage, 180 people dying. Maybe the 3 deaths mentioned by Lopes (1841) are relative to the villa, and the others relative to the surrounding fields and Santo António d' Arnilha* [1]*, where the sea should have caused destruction."* (Sousa, 1919).
Observations	[1] *"The parish archives of Castro Marim name this small village*[2] *of Santo António d' Arnilha, name that was used in this discrption. However, Silva Lopes called Santo António de Arenilha."* (Sousa, 1919). [2] Vila Real de Santo António
References	Costa, A., Andrade, C., Seabra, C., Matias, L., Baptista, M.A. & Nunes, S., 2005. *1755 – Terramoto no Algarve*, Faro, Centro Ciência Viva do Algarve, 237p. (p.16 & 27) Sousa, F.L.P., 1919. *O terremoto do 1º de Novembro de 1755 em Portugal e um estudo demográfico: Distritos de Faro, Beja e Évora*, Lisboa, Tipografia do Comércio, 277p. (p.16, 27 & 83)

Project n. 037110

NEAREST

"Integrated observations from NEAR shore sourcES of Tsunamis: towards an early warning system"

Instrument: STREP

Thematic priority: 1.1.6.3 GOCE (GlObal Change and Ecosystems)

D21: REPORT ON ONSHORE TSUNAMI RECORDS
ANNEXE 2 – GEOMORPHOLOGICAL CARDFILES

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Dissemination level		
PU	Public	
PP	Restricted to other programme participants (including Commission Services)	
RE	Restricted to a group specified by the Consortium (including Commission Services)	RE
CO	Confidential, only for members of the Consortium (including Commission Services)	

D21: REPORT ON *ONSHORE TSUNAMI RECORDS*

ANNEXE 2 – GEOMORPHOLOGICAL CARDFILES

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Onshore sedimentological evidence of tsunami records

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Card File Nº	1
Location	Odeceixe beach
Criteria	Location near the coastline, within a distance inferior to 1km and altitude varying between 2 and 4m relative to mean sea level (MSL); Alluvium deposits in a lowland area that corresponds to Seixe stream floodplain.
Geological / Geomorphological Setting	Seixe stream features a well developed watershed extending inland (Marques, 1997). The stream's main course, between S. Miguel and the outlet presents a ESE-WNW general direction and flows to WNW to the ocean, at sea level altitudes. In the terminal part, the stream runs in a flat–floored valley limited by steep slopes, cut in carboniferous rocks, namely in the Brejeira Formation, which, according to Ribeiro *et al*. (1987), is composed of turbiditic sequences with decimetric layers of greywackes. The sediments that deposit in these valleys usually comprise gravel with angular clasts of quartz, slate, greywacke, etc, combined with a more or less clayey coarse sand and clay from slate erosion (Rocha *et al*. 1979).
Observations	
Maps and aerial photos	IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Odeceixe (Aljezur), Folha 568*. Edição 3, Instituto Geográfico do Exército. SGP, 1984. *Carta Geológica de Portugal na escala de 1/200 000, Folha 7*. Serviços Geológicos de Portugal, Lisboa.
References	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Ribeiro, A., Oliveira, J.T., Ramalho, M., Ribeiro. M.L. & Silva, L., 1987. *Notícia Explicativa da Folha 48-D Bordeira*, Serviços Geológicos de Portugal, Lisboa, 30p. Rocha, R.B., Ramalho, M.M., Manuppella, G., Zbyszewski, G. & Coelho, A.V.P., 1979. *Notícia explicativa da Folha 51-B Vila do Bispo*, Serviços Geológicos de Portugal, Lisboa, 118p.

Card File Nº	2
Location	Amoreira beach
Criteria	Location near the coastline, within a distance inferior to 1km and altitude of 1m (MSL); Alluvium deposits in a lowland area that corresponds to Aljezur stream floodplain, limited seawards by a dune field.
Geological / Geomorphological Setting	Aljezur stream presents a well developed watershed extending inland (Marques, 1997). The stream's main course, between Aljezur and the outlet, presents a ESE-WNW general direction and flows to the ocean at sea level altitudes. In the terminal part of the stream, the valley is flat–floored and limited by steep slopes cut in carboniferous rocks, namely the Brejeira Formation, which, according to Ribeiro *et al*. (1987), is composed of turbiditic sequences with decimetric layers of greywackes, partially covered by Holocene sand dune deposits. The sediments that deposit in these valleys usually comprise gravel with angular clasts of quartz, slate, greywacke, etc, combined with a more or less clayey coarse sand and clay from slate erosion (Rocha *et al*. 1979).
Observations	
Maps and aerial photos	IGeoE, 2006. Carta Militar de Portugal, Série M888 / Escala 1:25000, Rogil (Aljezur), Folha 576, Edição 3, Instituto Geográfico do Exército. SGP, 1984. Carta Geológica de Portugal na escala de 1/200 000, Folha 7. Serviços Geológicos de Portugal, Lisboa.
References	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Ribeiro, A., Oliveira, J.T., Ramalho, M., Ribeiro. M.L. & Silva, L., 1987. *Notícia Explicativa da Folha 48-D Bordeira*, Serviços Geológicos de Portugal, Lisboa, 30p. Rocha, R.B., Ramalho, M.M., Manuppella, G., Zbyszewski, G. & Coelho, A.V.P., 1979. *Notícia explicativa da Folha 51-B Vila do Bispo*, Serviços Geológicos de Portugal, Lisboa, 118p.

Card File Nº	3
Location	Monte Clérigo beach
Criteria	Location near the coastline, within a distance inferior to 1km and altitude below 10m (MSL); Alluvium deposits in a lowland area which corresponds to Barranco de Monte Clérigo canyon floodplain.
Geological / Geomorphological Setting	Barranco de Monte Clérigo canyon is one of the many watercourses responsible for the west coastal area drainage presenting a length inferior to 6km. This canyon presents a SE-NW general direction and flows to the ocean at sea level altitudes. These valleys present a typical morphology of geomorphological unit “Relevos Interiores”, characterized by valleys with rounded ridges and convex slopes (Marques, 1997). In the terminal part, the Barranco de Monte Clérigo canyon corresponds to a flat-floored valley confined by steep slopes cut in carboniferous rocks, namely in the Brejeira Formation, which, according to Ribeiro *et al.* (1987), is composed of turbiditic sequences with decimetric layers of greywackes, partially covered by Holocene’s sand dune deposits. The sediments that deposit in these valleys usually comprise gravel with angular clasts of quartz, slate, greywacke, etc, combined with a more or less clayey coarse sand and clay from slate erosion (Rocha *et al*. 1979).
Observations	This floodplain is protected from SW waves due to the valley main direction, which reduces the probability of flooding and deposition of sediments by an extreme event with such direction.
Maps and aerial photos	IGeoE, 2006. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Rogil (Aljezur), Folha 576*, Edição 3, Instituto Geográfico do Exército. SGP, 1984. *Carta Geológica de Portugal na escala de 1/200 000, Folha 7*. Serviços Geológicos de Portugal, Lisboa.
References	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Ribeiro, A., Oliveira, J.T., Ramalho, M., Ribeiro. M.L. & Silva, L., 1987. *Notícia Explicativa da Folha 48-D Bordeira*, Serviços Geológicos de Portugal, Lisboa, 30p.

	Rocha, R.B., Ramalho, M.M., Manuppella, G., Zbyszewski, G. & Coelho, A.V.P., 1979. *Notícia explicativa da Folha 51-B Vila do Bispo*, Serviços Geológicos de Portugal, Lisboa, 118p.

Card File Nº	4
Location	Canal beach (Canal de Baixo - Arrifana)
Criteria	Location near the coastline with an altitude varying between 2 and 7m (MSL), which corresponds to Barranco do Canal canyon; There might be alluvium deposits in the canyon's terminal part.
Geological / Geomorphological Setting	Barranco do Canal canyon is one of the many watercourses responsible for the west coastal area drainage, with a lenght inferior to 3km. This canyon presents an ENE-WSW general direction and flows to the ocean at sea level altitudes. These valleys present a typical morphology of the geomorphological unit "Relevos Interiores", characterized by valleys with rounded ridges and convex slopes (Marques, 1997). In the terminal part, the Barranco do Canal canyon corresponds to a flat-floored valley confined by steep slopes cut in carboniferous rocks, namely in the Brejeira Formation, which, according to Ribeiro *et al*. (1987), is composed of turbiditic sequences with decimetric layers of greywackes. The sediments that deposit in these valleys usually comprise gravel with angular clasts of quartz, slate, greywacke, etc, combined with a more or less clayey coarse sand and clay from slate erosion (Rocha *et al*. 1979).
Observations	The surface which fulfils the criteria presents a much to small surface.
Maps and aerial photos	IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Arrifana (Aljezur), Folha 583-A*, Edição 3, Instituto Geográfico do Exército. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Aljezur, Folha 584*, Edição 3, Instituto Geográfico do Exército. SGP, 1985. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 48-D Bordeira*, Serviços Geológicos de Portugal, Lisboa.
References	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Ribeiro, A., Oliveira, J.T., Ramalho, M., Ribeiro. M.L. & Silva, L., 1987. *Notícia Explicativa da Folha 48-D Bordeira*,

	Serviços Geológicos de Portugal, Lisboa, 30p. Rocha, R.B., Ramalho, M.M., Manuppella, G., Zbyszewski, G. & Coelho, A.V.P., 1979. *Notícia explicativa da Folha 51-B Vila do Bispo*, Serviços Geológicos de Portugal, Lisboa, 118p.

Card File Nº	5
Location	Penedo beach
Criteria	Location near the coastline within a distance inferior to 1km inland at an altitude varying between 2 and 7m (MSL), corresponding to Barranco do Pendedo canyon; Alluvium deposits were mapped in the canyon's terminal part, corresponding to the stream floodplain.
Geological / Geomorphological Setting	Barranco do Penedo canyon is one of the many watercourses responsible for the west coastal area drainage, with presenting a length inferior to 3km. This canyon presents an ESE-WNW general direction and flows to the ocean at sea level altitudes. These valleys present a typical morphology of the geomorphological unit of "Relevos Interiores", characterized by valleys with rounded ridges and convex slopes (Marques, 1997). The Barranco do Penedo canyon corresponds to a V-shaped valley confined by steep slopes cut in carboniferous rocks, namely in the Bordalete Formation, which comprises siltstones and phyllites, and the Brejeira Formation, which comprises slates and decimentric layers of greywackes (Ribeiro *et al*., 1987). The sediments that deposit in these valleys usually comprise gravel with angular clasts of quartz, slate, greywacke, etc, combined with a more or less clayey coarse sand and clay from slate erosion (Rocha *et al*. 1979).
Observations	Although alluvium deposits were mapped in the floodplain area, the existence of extreme event deposits seems unlikely due to the relatively low surface area which fulfils the criteria.
Maps and aerial photos	IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Arrifana (Aljezur), Folha 583-A*, Edição 3, Instituto Geográfico do Exército. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Aljezur, Folha 584*, Edição 3, Instituto Geográfico do Exército. SGP, 1985. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 48-D Bordeira*, Serviços Geológicos de Portugal, Lisboa.
References	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p.

	Ribeiro, A., Oliveira, J.T., Ramalho, M., Ribeiro. M.L. & Silva, L., 1987. *Notícia Explicativa da Folha 48-D Bordeira*, Serviços Geológicos de Portugal, Lisboa, 30p. Rocha, R.B., Ramalho, M.M., Manuppella, G., Zbyszewski, G. & Coelho, A.V.P., 1979. *Notícia explicativa da Folha 51-B Vila do Bispo,* Serviços Geológicos de Portugal, Lisboa, 118p.

Card File Nº	6
Location	Bordeira beach (Carrapateira)
Criteria	Location near the coastline, within a distance inferior to 1km and altitude varying between 1 and 8m (MSL); Alluvium deposits in a lowland area that corresponds to Bordeira and Carrapaterira streams floodplain.
Geological / Geomorphological Setting	Carrapateira stream presents a well developed drainage basin extending inland (Marques, 1997). One of its tributaries is Bordeira stream, which flows into it at a distance of 1km inland from the coastline in Bordeira beach, where the outlet is located. The sediments that deposit in this lowland are transported by both streams, which run in flat-floored valleys limited by intermediate slopes. These valleys are cut in carboniferous rocks, namely in the Brejeira Formation, which according to Ribeiro *et al*. (1987), is composed of turbiditic sequences with decimetric layers of greywackes. The sediments that deposit in these valleys usually comprise gravel with angular clasts of quartz, slate, greywacke, etc, combined with a more or less clayey coarse sand and clay from slate erosion (Rocha *et al*. 1979).
Observations	Cape Carrapateira shields the floodplain area from extreme marine events coming from SW.
Maps and aerial photos	IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Bordeira (Aljezur)*, Folha 592, Edição 3, Instituto Geográfico do Exército. SGP, 1985, *Carta Geológica de Portugal na escala de 1/50 000 – Folha 48-D Bordeira*, Serviços Geológicos de Portugal, Lisboa.
References	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Ribeiro, A., Oliveira, J.T., Ramalho, M., Ribeiro. M.L. & Silva, L., 1987. *Notícia Explicativa da Folha 48-D Bordeira*, Serviços Geológicos de Portugal, Lisboa, 30p. Rocha, R.B., Ramalho, M.M., Manuppella, G., Zbyszewski, G. & Coelho, A.V.P., 1979. *Notícia explicativa da Folha 51-B Vila do Bispo*, Serviços Geológicos de Portugal, Lisboa, 118p.

Card File Nº	7
Location	Amado beach
Criteria	Location near the coastline within a distance inferior to 1km and elevation below 10m (MSL) In the terminal part of the stream appears to occur fine sediment deposition, corresponding to the stream floodplain.
Geological / Geomorphological Setting	Several watercourses outlet in Amado beach, such as: Barranco do Lavadouro, presenting three tributaries (Barranco das Aguilhadas, do Algarve and da Junqueira); Barranco da Silveira, presenting one tributaries (Barranco da Covanca); and Barranco do Vale Covanca. These watercourses extend to a maximum of 4km inland, with a SE-NW general direction pending to NW and outlet in the coastline in flat surface areas at sea level altitudes (Marques, 1997). The valleys where these watercourses run are cut in cut in carboniferous rocks, namely in the Bordalete Formation, which comprises siltstones and phyllites, and the Brejeira Formation, composed of turbiditic sequences with decimetric layers of greywackes (Ribeiro *et al.*, 1987). The sediments that deposit in these valleys usually comprise gravel with angular clasts of quartz, slate, greywacke, etc, combined with a more or less clayey coarse sand and clay from slate erosion (Rocha *et al*. 1979).
Observations	Although alluvium deposits were mapped in the floodplain area, the existence of extreme event deposits seems unlikely due to the relatively low surface area which fulfils the criteria.
Maps and aerial photos	IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Bordeira (Aljezur), Folha 592*, Edição 3, Instituto Geográfico do Exército. SGP, 1985. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 48-D Bordeira*, Serviços Geológicos de Portugal, Lisboa.

References	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Ribeiro, A., Oliveira, J.T., Ramalho, M., Ribeiro. M.L. & Silva, L., 1987. *Notícia Explicativa da Folha 48-D Bordeira*, Serviços Geológicos de Portugal, Lisboa, 30p. Rocha, R.B., Ramalho, M.M., Manuppella, G., Zbyszewski, G. & Coelho, A.V.P., 1979. *Notícia explicativa da Folha 51-B Vila do Bispo*, Serviços Geológicos de Portugal, Lisboa, 118p.

Card File Nº	8
Location	Martinhal Beach (Baleeira Cove – Sagres)
Criteria	Alluvial floodplain, located near the coastline, to a distance less than 1km and elevation below 10m (MSL).
Geological / Geomorphological Setting	Martinhal lowland is a small flat-floored valley which corresponds to the outlet of the Mós stream. It cuts Middle and Upper Jurassic limestones, dolomitic limestones and marly limestones. The lowland is roughly triangular in shape and is separated from the sea by a sandy barrier formed by a beach/(small) foredune ridge system (Andrade *et al.*, 1997). During storms the barrier may be breached and marine water floods the lowland.
Observations	Confirmed extreme marine flooding and sediment deposition site (*cf*. Andrade *et al*., 1997; Kortekaas *et al*., 1998; Kortekaas, 2002; Kortekaas & Dawson, 2007; Cunha *et al.,* in press).
Maps and aerial photos	Aerial photo FA703, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Sagres (Vila do Bispo)*, Folha 609, Edição 4, Instituto Geográfico do Exército. SGP, 1972. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 51-B Vila do Bispo*, Serviços Geológicos de Portugal, Lisboa.
References	Andrade, C., Andrade, A., Kortekaas, S. & Dawson, A., 1997. *Sedimentological traces of tsunamigenic overwash of the Martinhal lowland (Western Algarve - Portugal)*. Proceedings. Sem. Zona Costeira do Algarve, Faro, 10-12 Julho 1997, Eurocoast-Portugal, pp. 11-18. Cunha, P.P., Buylaert, J.-P., Murray, A.S., Andrade, C., Freitas, M.C., Fatela, F., Munhá, J.M., Martins, A.M. & Sugisaki, S., (in press). Optical dating of clastic deposits generated by an extreme marine coastal flood: the 1755 tsunami deposit in the Algarve (Portugal). *Quaternary Geochronology*. Kortekaas, S., 2002. *Tsunamis, storms and earthquakes: Distinguishing coastal flooding events*. Coventry, Coventry University, PhD. Thesis, 171p. Kortekaas, S., Andrade, C. & Andrade, A.M., 1998. *Litoestratigrafia e Foraminíferos do enchimento sedimentar da baixa do Martinhal - Algarve (Portugal) - dados preliminares*. Proceedings V Congresso Nacional de

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Card File Nº	9
Location	Barranco beach (Vila do Bispo)
Criteria	Location near the coastline within a distance inferior to 1km and elevation below 10m (MSL); Lowland with active low energy deposition processes in the terminal part of Benaçoitão stream (floodplain).
Geological / Geomorphological Setting	Barranco beach is located in the terminal part of a valley, where Benaçoitão stream runs and outlets, which presents typical aspects of evolution in carbonated subtract, such as flat-floored valleys with steep slopes (Marques, 1997), cut in upper Jurassic limestone, marly and dolomitic limestone. The alluvial deposits consist in a mixture of more or less rounded Mesozoic limestone pebbles, angulated Palaeozoic pebbles, and sand to muddy sand.
Observations	Evidence of extreme marine event was found (*cf*. Costa *et al.,* 2008; Oliveira, 2009). Based on the data produced so far it is not possible to establish what extreme event caused it (storm or tsunami).
Maps and aerial photos	Aerial Photo FA703, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Sagres (Vila do Bispo)*, Folha 609, Edição 4, Instituto Geográfico do Exército. SGP, 1972. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 51-B Vila do Bispo*, Serviços Geológicos de Portugal, Lisboa.
References	Costa, P., Andrade, C., Freitas, M.C., Oliveira, M.A., Taborda, R. & Silva, C.M., 2008. *High energy boulder deposition in Barranco and Furnas lowlands, western Algarve (south Portugal)*. 2nd International Tsunami Field Symposium Puglia – Ionian Islands 2008. Bari, Italia, pp.19-22. Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Oliveira, M. A., 2009. *Influência da geomorfologia local na preservação de assinaturas sedimentares de eventos de alta energia no Algarve ocidental*. MSc Thesis, Universidade de Lisboa, 252p.

Card File Nº	10
Location	Zavial beach (Vila do Bispo)
Criteria	Location near the coastline within a distance inferior to 1km and elevation below 10m (MSL); Lowland with active low energy deposition processes in the terminal part of Outeiros stream (floodplain).
Geological / Geomorphological Setting	Zavial beach is located in the terminal part of a valley, where Outeiros stream runs and outlets, which presents typical aspects of evolution in carbonated subtract, such as flat-floored valleys with steep slopes (Marques, 1997), cut in upper Jurassic limestone, marly and dolomitic limestone. The alluvial deposits consist in a mixture of more or less rounded Mesozoic limestone pebbles, angulated Palaeozoic pebbles, and sand to muddy sand.
Observations	General field survey was conducted, samples collected and processed for sedimentology. One discontinuous sandy layer was found within the alluvial fluvial sediments, but its origin and deposition process was not established based on the data produced so far (*cf*. Oliveira, 2009).
Maps and aerial photos	Aerial photo FA704, 1980. scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Sagres (Vila do Bispo)*, Folha 609, Edição 4, Instituto Geográfico do Exército. SGP, 1972. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 51-B Vila do Bispo*, Serviços Geológicos de Portugal, Lisboa.
References	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Oliveira, M. A., 2009. *Influência da geomorfologia local na preservação de assinaturas sedimentares de eventos de alta energia no Algarve ocidental*. MSc Thesis, Universidade de Lisboa, 252p.

Card File Nº	11
Location	Furnas beach (Vila do Bispo)
Criteria	Alluvial floodplain, located near the coastline, to a distance less than 1km and elevation less than 10m (MSL).
Geological / Geomorphological Setting	Furnas beach is located in the terminal part of a valley, where Vale Pocilgão stream runs and outlets, which presents typical aspects of evolution in carbonated subtract, such as flat-floored valleys with steep slopes (Marques, 1997), cut in upper Jurassic limestone, marly and dolomitic limestone. The alluvial deposits consist in a mixture of more or less rounded Mesozoic limestone pebbles, angulated Palaeozoic pebbles, and sand to muddy sand.
Observations	Evidence of extreme marine event was found (*cf*. Costa *et al.,* 2008; Oliveira, 2009). Based on the data produced so far it is not possible to establish what extreme event caused it (storm or tsunami).
Maps and aerial photos	Aerial photo FA707, 1980. scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Vila do Bispo, Folha 601*, Edição 3, Instituto Geográfico do Exército. SGP, 1972. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 51-B Vila do Bispo*, Serviços Geológicos de Portugal, Lisboa.
References	Costa, P., Andrade, C., Freitas, M.C., Oliveira, M.A., Taborda, R. & Silva, C.M., 2008. *High energy boulder deposition in Barranco and Furnas lowlands, western Algarve (south Portugal)*. 2nd International Tsunami Field Symposium Puglia – Ionian Islands 2008. Bari, Italia, pp.19-22. Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Oliveira, M. A., 2009. *Influência da geomorfologia local na preservação de assinaturas sedimentares de eventos de alta energia no Algarve ocidental*. MSc Thesis, Universidade de Lisboa, 252p.

Card File Nº	12
Location	Figueira beach (Budens)
Criteria	Alluvial floodplain, located near the coastline, to a distance less than 1km and elevation less than 10m.
Geological / Geomorphological Setting	Figueira beach is located in the terminal part of a valley, where Figueira stream runs and outlets, which presents typical aspects of evolution in carbonated subtract, such as flat-floored valleys with steep slopes (Marques, 1997), cut in upper Jurassic limestone, marly and dolomitic limestone and in lower cretaceous marl, dolomite and limestone. The alluvial deposits consist in a mixture of more or less rounded Mesozoic limestone pebbles, angulated Palaeozoic pebbles, and sand to muddy sand.
Observations	General field survey was conducted, samples collected and processed for sedimentology. Based on the data produced so far, no evidence of extreme marine flooding was detected (*cf*. Oliveira, 2009).
Maps and aerial photos	Aerial photo FA707, 1980. scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Lagos, Folha 602*, Edição 3, Instituto Geográfico do Exército. SGP, 1975. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa.
References	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Oliveira, M. A., 2009. *Influência da geomorfologia local na preservação de assinaturas sedimentares de eventos de alta energia no Algarve ocidental*. MSc Thesis, Universidade de Lisboa, 252p.

Card File Nº	13
Location	Boca do Rio
Criteria	Alluvial floodplain, located near the coastline, to a distance less than 1km and elevation varying between 2m and 3m.
Geological / Geomorphological Setting	The Boca do Rio lowland is al flat-floored valley that corresponds to the outlet of the Vale de Barão, Vale de Boi and Budens streams. This lowland area consists of an active supratidal floodplain, occasionally flooded during the rainy season and separated from the sea by a shingle and sandy beach (Hindson *et al.*, 1996, 1999). Boca do Rio corresponds to a flat-floored valley with steep slopes (Marques, 1997) cut in upper Jurassic and lower Cretaceous marl, dolomite and limestone. The alluvial deposits essentially consist of homogeneous mud resting upon marine sand (Hindson *et al*., 1996; 1999).
Observations	Confirmed extreme marine flooding and sediment deposition site (*cf*. Dawson *et al*., 1995; Hindson *et al*., 1996; Da Silva *et al.,* 1996; Andrade *et al*., 1998; Andrade & Hindson, 1999; Hindson & Andrade, 1999; Hindson *et al*., 1999; Oliveira *et al.*, 2009; Cunha *et al.*, in press).
Maps and aerial photos	Aerial photo FA710, 1980. scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Lagos, Folha 602*, Edição 3, Instituto Geográfico do Exército. SGP, 1975. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa.
References	Andrade, C., Munhá, J.M. & Paulino, J., 1998. *Geochemical signature of extreme marine flooding in the Boca do Rio lowland (Algarve, Portugal).* Proceedings, V Congresso Nacional de Geologia, Com. Inst. Geológ. e Mineiro, Tomo 84, fasc. 1, Lisboa, pp. C-51-C-54. Andrade, C. & Hindson, R., 1999. *A short field guide to the tsunamigenic deposits of the Boca do Rio lowland – western Algarve*, Portugal. European Research Conference on Glacial- Interglacial sea level in four dimensions: Quaternary sea levels, climate change and crustal dynamics (Albufeira, Portugal), 24p. Cunha, P.P., Buylaert, J.-P., Murray, A.S., Andrade, C., Freitas, M.C., Fatela, F., Munhá, J.M., Martins, A.M. & Sugisaki, S., (in press). Optical dating of clastic deposits

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Card File Nº	14
Location	Luz (Lagos)
Criteria	Location near the coastline within a distance inferior to 1km and elevation below to 10m (MSL); Lowland corresponds to Luz stream floodplain where low energy sediment deposition occurs.
Geological / Geomorphological Setting	Luz beach is located in a valley with an intermediate W slope and a steep E slope. The geomorphology consists of a softly inclined surface, as a direct result of contrast in the resistance to erosion of lower Cretaceous marl and limestone, and due to the tabular, monoclinal structure, diving softly to SE (Marques, 1997).
Observations	Area with elevation below 10m (MSL) is completely occupied with construction, hence coring in the area which complies with the criteria becomes impossible.
Maps and aerial photos	Aerial photo FA714, 1980. scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Lagos, Folha 602*, Edição 3, Instituto Geográfico do Exército. SGP, 1975. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa.
References	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p.

Card File Nº	15
Location	Lagos
Criteria	Location near the coastline within a distance inferior to 1km and elevation below 10m (MSL); Lowland corresponds to Bensafrim stream floodplain where low energy sediment deposition occurs.
Geological / Geomorphological Setting	Bensafrim stream presents a well developed watershed extending inland, which drains rocks from the whole geological sequence from Paleozoic slates and greywakes to red sandy deposits from the Pliocene and Pleistocene. In the terminal part, Bensafrim stream presents a well developed floodplain, limited by intermediate slopes cut in Jurassic and Cretaceous limestones and by a lower and flatter area to the NE, composed of red sandy deposits from the Pliocene and Pleistocene. Bensafrim stream outlet is located E of Lagos and W of Meia-Praia, in a bay anchored in Piedade Tip, which is cut in miocenic sandy limestones (CCDR Algarve, 2006), covered by Pliocene and Pleistocene sandy deposits (Marques, 1997; Rocha *et al*., 1983). This stream presents an active estuary with a marsh and a sandy tidal flat in the terminal part of the stream (less than 1km inland). This part of the stream presents evidences of human activities due to the high construction indexes. Further up north, within a distance superior to 1km inland, there is a flat wider area, presenting high marsh typical vegetation.
Observations	Piedade Tip shields Bensafrim stream outlet and floodplain from SW waves. However, there are historical descriptions of flooding by the 1755 tsunami inundation which reached S. João bridge, where occurs low energy sediment deposition, which gave origin to a marsh.
Maps and aerial photos	Aerial photo FA721, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Portimão, Folha 603*, Edição 3, Instituto Geográfico do Exército. SGP, 1975. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa.

References	CCDR Algarve, 2006. *PROT Algarve - Plano Nacional de Ordenamento do Território, Caracterização e Diagnóstico da Faixa Costeira*, Comissão de Coordenação e de Desenvolvimento Regional do Algarve - Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional, Volume II, Anexo I, 26p. Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Rocha, R.B., Ramalho, M.M., Antunes, M.T. & Coelho, A.V.P., 1983. *Notícia explicativa da Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa, 57p.

Card File Nº	16
Location	Meia Praia (Lagos)
Criteria	Area within a distance inferior to 1km of the coastline and elevation below 10m (MSL).
Geological / Geomorphological Setting	Meia Praia is a sandy beach located in a recent dune deposit, forming part of a bay, accumulated to the E of Piedade Tip, which is shaped in Miocene sandy and calcareous rocks (CCDR Algarve, 2006) partially covered by Pliocene and Pleistocene sandy deposits (Marques, 1997).
Observations	The area that complies with the criteria is located to the north of the railroad, which presents a small surface area and intense human activity.
Maps and aerial photos	Aerial photo FA722, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Portimão, Folha 603*, Edição 3, Instituto Geográfico do Exército. SGP, 1975. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa.
References	CCDR Algarve, 2006. *PROT Algarve - Plano Nacional de Ordenamento do Território, Caracterização e Diagnóstico da Faixa Costeira*, Comissão de Coordenação e de Desenvolvimento Regional do Algarve - Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional, Volume II, Anexo I, 26p. Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Rocha, R.B., Ramalho, M.M., Antunes, M.T. & Coelho, A.V.P., 1983. *Notícia explicativa da Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa, 57p.

Card File Nº	17
Location	Alvor
Criteria	Location near the coastline within a distance inferior to 1km and elevation below 10m (MSL); Lowland corresponds to Odiáxere stream and Alvor river outlet in Ria de Alvor lagoon.
Geological / Geomorphological Setting	Ria de Alvor lagoonal system occupies a surface area of about 3,5Km^2, most of which undergoes periodic immersion due to tide oscillation. The lagoon main body, about 3km wide, develops parallel to the coastline presenting two major channels that make the transition from the lagoonal to the fluvial system. Ria de Alvor acts as storage for several watersheds, from W to E, the Odiáxere stream, Arão stream, Farelo stream and Torre stream watersheds (Cabral *et al*. *in* CCDR Algarve, 2006). Limiting Ria de Alvor lagoon are intermediate slopes cut in Jurassic calcareous rocks, Miocene sandy and calcareous rocks and sandy Pliocene and Pleistocene deposits.
Observations	Area that complies with the criteria is very large. The places mostly prone to flooding and preservation of a sedimentary signature of a high energy event are the backbarrier and the marshes which develop next to the barrier and in the northern margin of the lagoon.
Maps and aerial photos	Aerial photo FA726, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Portimão, Folha 603*, Edição 3, Instituto Geográfico do Exército. SGP, 1975. Carta Geológica de Portugal na escala de 1/50 000 – Folha 52-A Portimão, Serviços Geológicos de Portugal, Lisboa.
References	CCDR Algarve, 2006. *PROT Algarve - Plano Nacional de Ordenamento do Território, Caracterização e Diagnóstico da Faixa Costeira*, Comissão de Coordenação e de Desenvolvimento Regional do Algarve - Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional, Volume II, Anexo I, 26p. Rocha, R.B., Ramalho, M.M., Antunes, M.T. & Coelho, A.V.P., 1983. *Notícia explicativa da Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa, 57p.

Card File Nº	18
Location	Três Irmãos Beach (Torralta - Alvor)
Criteria	Location near the coastline within a distance inferior to 1km and elevation below 10m (MSL); Lowland corresponds to two valleys where alluvium deposits are mapped..
Geological / Geomorphological Setting	Três irmãos beach corresponds to a sand accumulation limited to the W by Alvor beach, which corresponds to the Ria de Alvor lagoon sandy barrier, to the E by the João Arens Tip and inland by Torralta. Torralta is limited to both E and W by two watercourses in which, in the terminal parts, exist alluvium deposits, representing low energy sediment deposition processes. These valleys present mild but gradual slopes cut in Miocene sandy limestones and Pliocene and Pleistocene sandy deposits (Rocha *et al.*, 1983).
Observations	The lowland that complies with the criteria presents a small surface area, which is apparently modified by anthropogenic actions.
Maps and aerial photos	Aerial photo FA727, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Portimão, Folha 603*, Edição 3, Instituto Geográfico do Exército. SGP, 1975. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa.
References	Rocha, R.B., Ramalho, M.M., Antunes, M.T. & Coelho, A.V.P., 1983. *Notícia explicativa da Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa, 57p.

Card File Nº	19
Location	Rocha Beach
Criteria	Location near the coastline within a distance inferior to 1km and elevation below 10m (MSL). Alluvium deposits are mapped in a lowland area located in the W river margin.
Geological / Geomorphological Setting	Lowland located to the E from Portimão marina, in Arade river W margin, near the outlet. This location presents alluvium deposits covering mild to intermediate slopes of sandy and calcareous miocenic rocks and sandy Pliocene and Pleistocene rocks (Rocha *et al*., 1983).
Observations	The lowland which complies with the criteria presents a small surface area and appears to be significantly modified by anthropogenic action.
Maps and aerial photos	Aerial photo FA731, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Portimão, Folha 603*, Edição 3, Instituto Geográfico do Exército. SGP, 1975. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa.
References	Rocha, R.B., Ramalho, M.M., Antunes, M.T. & Coelho, A.V.P., 1983. *Notícia explicativa da Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa, 57p.

Card File Nº	20
Location	Ferragudo
Criteria	Location near the coastline with elevation below to 10m (MSL), in Arade river E margin, where low energy sediment deposition processes occur.
Geological / Geomorphological Setting	Lowland located to the SE of the fishing dock in Arade river E margin, composed of alluvium deposits covering mild to intermediate slopes cut in sandy and calcareous miocenic rocks and sandy Pliocene and Pleistocene deposits (Rocha *et al*, 1983).
Observations	This location appears to have been significantly modified by the construction of a fishing harbour and a large landfill.
Maps and aerial photos	Aerial photo FA731, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Portimão, Folha 603*, Edição 3, Instituto Geográfico do Exército. SGP, 1975. *Carta Geológica de Portugal na escala de 1/50 000 – Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa.
References	Rocha, R.B., Ramalho, M.M., Antunes, M.T. & Coelho, A.V.P., 1983. *Notícia explicativa da Folha 52-A Portimão*, Serviços Geológicos de Portugal, Lisboa, 57p.

Card File Nº	21
Location	Armação de Pêra
Criteria	Wide lowland near the coastline within a distance inferior to 1km and elevation below 10m (MSL); Limited to the W by Alcantarilha stream and Salgados lagoon and to the W by Espiche stream, where low energy sediment deposition occurs.
Geological / Geomorphological Setting	The area located between Armação de Pêra and Galé corresponds to a wide bay where a continuous beach and foredune accumulates and develops along 6km, sustained by consolidated sand dunes. This continuous beach is interrupted by Alcantarilha and Espiches stream outlets. Inland of the continuous dunar cord occurs sediment deposition in a fluvial system, generated in the stream watersheds, which drain respectively $204km^2$ and $41km^2$ surface areas (CCDR Algarve, 2006).

	This wide bay is limited by mild slopes cut in miocenic calcareous rocks (early Miocene), sandstone and siltstone (late Miocene) (Rocha *et al*., 1989). Along the stream floodplain, mainly near the outlet, occurs alluvium material deposition in extended lowlands.
Observations	Confirmed extreme marine flooding and sediment deposition site (*cf*. Costa *et al*, 2009).
Maps and aerial photos	Aerial photo FA746, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Lagoa, Folha 604*, Edição 3, Instituto Geográfico do Exército. SGP, 1981. *Carta Geológica de Portugal, Folha 52-B Albufeira*, Serviços Geológicos de Portugal, Lisboa.
References	CCDR Algarve, 2006. *PROT Algarve - Plano Nacional de Ordenamento do Território, Caracterização e Diagnóstico da Faixa Costeira*, Comissão de Coordenação e de Desenvolvimento Regional do Algarve - Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional, Volume II, Anexo I, 26p. Costa, P.J.M., Andrade, C., Freitas, M.C., Oliveira, M.A. & Jouanneau, J.-M., 2009. Preliminary Results of exoscopic analysis of quartz grains deposited by a paleotsunami in Salgados lowland (Algarve, Portugal). *Journal of Coastal Research*, SI 56, pp.39-43. Rocha, R.B., Marques, B.L., Antunes, M.T. & Pais, J., 1989. *Notícia Explicativa da Folha 52-B Albufeira,* Serviços Geológicos de Portugal, Lisboa, 36p.

Card File Nº	22
Location	Várzeas da Orada (Albufeira)
Criteria	Location near the coastline, to a distance inferior to 1km and altitude inferior to 10m;
Geological / Geomorphological Setting	Vázeas da Orada comprises a lowland presenting a roughly triangular shape, elongated in a E-W direction. This area corresponds to a tectonic valley, filled with recent alluvium deposits, limited by faults that form steep scarps cut in upper Jurassic limestone, marly and dolomitic limestone. The bottom of the depression is pending towards W and presents altitudes below 10m (MSL) in its central and western region (Marques, 1997). Limiting the depression to the N are steep slopes cut in Upper Jurassic rocks, to the S and W by intermediate slopes cut in miocenic calcareous rocks (early Miocene), sandstone and siltstone (late Miocene), as well as few Upper Jurassic rocks patches (Rocha *et al*., 1989).
Observations	This area was partially occupied by Albufeira marina construction, which could have caused the removal of any sedimentary signature of a high energy event. Additionally, Ponta da Baleeira cape Shield the lowland from extreme marine flooding originated to the SW.
Maps and aerial photos	Aerial photo FA749, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2006. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Albufeira, Folha 605*, Edição 3, Instituto Geográfico do Exército. SGP, 1981. *Carta Geológica de Portugal, Folha 52-B Albufeira*, Serviços Geológicos de Portugal, Lisboa.
References	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Rocha, R.B., Marques, B.L., Antunes, M.T. & Pais, J., 1989. *Notícia Explicativa da Folha 52-B Albufeira,* Serviços Geológicos de Portugal, Lisboa, 36p.

Card File Nº	23
Location	Várzea da Quarteira
Criteria	Location near the coastline within distance inferior to 1km and elevation below 10m (MSL); Corresponds to Quarteira stream floodplain where low energy sediment deposition occurs.
Geological / Geomorphological Setting	Várzea da Quarteira corresponds to a flat lowland with an average altitude inferior to 6m (MSL), where alluvium deposition occurs, functioning as Quarteira stream floodplain. This lowland is surrounded by an also flat surface, at altitudes varying from 30m to 40m (MSL), cut in Pliocene and Pleistocene sandy deposits. To the W of Várzea da Quarteira, the elevated surface presents a mild pending towards NE; and to the E pending towards SW (Marques, 1997).
Observations	Schneider *et al*. (in press) found and associated a coarse sand deposit at approximately 1m depth, interbedded in estuarine mud, with the 1755 tsunami flooding.
Maps and aerial photos	Aerial photo FA758, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. Aerial photo FA759, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2006. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Albufeira, Folha 605*, Edição 3, Instituto Geográfico do Exército. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Portimão, Folha 606*, Edição 3, Instituto Geográfico do Exército. SGP, 1981. *Carta Geológica de Portugal, Folha 52-B Albufeira*, Serviços Geológicos de Portugal, Lisboa SGP, 1985. *Carta Geológica de Portugal, Folha 53-A Faro*, Serviços Geológicos de Portugal, Lisboa.
Reference	Marques, F.M.S.F., 1997. *As Arribas do Litoral do Algarve – Dinâmica, processos e mecanismos*. PhD Thesis, Universidade de Lisboa, 560p. Schneider, H., Höfer, D., Trog, C, Busch, S., Schneider, M., Baase, J., Daut, G. & Mäusbacher, R., in press. Holocene estuary development in the Algarve Region (Southern Portugal) - A reconstruction of sedimentological and ecological evolution. *Quaternary International*.

Card File Nº	24
Location	Quarteira
Criteria	Location near the coastline within a distance inferior to 1km and elevation below 10m (MSL).
Geological / Geomorphological Setting	Quarteira is located between the alluvium deposits of Quarteira stream floodplain and an elevated surface cut in Pleistocene sandy deposits from Areias de Faro-Quarteira formation, which, according to Oliveira (1992), are composed of fine do medium sand. Quarteira is separated from the sea by Quarteira beach and a discontinuous sand dune cord.
Observations	This area is completely occupied construction. Additionally, the surface area complying to the criteria is very small.
Maps and aerial photos	Aerial photo FA761, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Portimão, Folha 606*, Edição 3, Instituto Geográfico do Exército. SGP, 1985. *Carta Geológica de Portugal, Folha 53-A Faro*, Serviços Geológicos de Portugal, Lisboa.
References	Oliveira, J.T. (coord.), 1992. *Notícia explicativa da Carta Geológica de Portugal, na escala de 1:200 000, Folha 8*, Serviços Geológicos de Portugal, 91p.

Card File Nº	25
Location	Forte Novo
Criteria	Location near the coastline within a distance inferior to 1km and elevation below 10m (MSL). Lowland corresponds to a floodplain where low energy sediment deposition occurs.
Geological / Geomorphological Setting	This area corresponds to a valley with mild slopes limited by flat elevated surface at altitudes varying from 30m to 50m (MSL), cut in sandy Pliocene and Pleistocene deposits from Areias de Faro-Quarteira formation, which, according to Oliveira (1992), are composed of fine do medium sand. Recent alluvium deposits are mapped along the valley. The water that run in this valley accumulates in a lagoon located E of Forte Novo, separated from the sea by Quarteira beach and an apparent dune cord.
Observations	This watercourse drains sandy Pliocene and Pleistocene deposits. Additionally, the lagoon seems to be located in the middle of sand dunes. This will present a major difficulty in the identification of a sedimentological signature of a high energy event, due to the similarity between the source sediments that deposit in the everyday regime and in an extreme marine event.
Maps and aerial photos	Aerial photo FA762, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2006. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Loulé, Folha 606*, Edição 3, Instituto Geográfico do Exército. SGP, 1985. *Carta Geológica de Portugal, Folha 53-A Faro*, Serviços Geológicos de Portugal, Lisboa.
References	Oliveira, J.T. (coord.), 1992. *Notícia explicativa da Carta Geológica de Portugal, na escala de 1:200 000, Folha 8*, Serviços Geológicos de Portugal, 91p.

Card File Nº	26
Location	Trafal (Quarteira)
Criteria	Location near the coastline within a distance inferior to 1km and elevation below 10m (MSL); Lowland corresponds to Carcavai stream floodplain where low energy sediment deposition occurs.
Geological / Geomorphological Setting	Carcavai stream cuts through a flat elevated surface pending south at elevation below 50m (MSL) composed by sandy Pliocene and Pleistocene deposits from Areias de Faro-Quarteira formation. According to Oliveira (1992), these deposits are composed of fine do medium sand. Recent alluvium deposits are mapped along the watercourse, mainly in the western margin of the lagoon. The water that run in this valley accumulates in a lagoon located W of Vale do Lobo, separated from the sea by Vale do Lobo beach.
Observations	Schneider *et al.* (in press) found and associate a coarse sand deposit, at approximately 1m depth, interbedded in estuarine mud, with the 1755 tsunami flooding. However, this watercourse drains sandy Pliocene and Pleistocene deposits. Additionally, the lagoon seems to be located in the middle of sand dunes. This will present a major difficulty in the identification of a sedimentological signature of a high energy event, due to the similarity between the source sediments that deposit in the everyday regime and in an extreme marine event.
Maps and aerial photos	Aerial photo FA3706, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2006. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Loulé, Folha 606*, Edição 3, Instituto Geográfico do Exército. IGeoE, 2006. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Montenegro (Faro),* Folha 610, Edição 3, Instituto Geográfico do Exército. SGP, 1985. *Carta Geológica de Portugal, Folha 53-A Faro*, Serviços Geológicos de Portugal, Lisboa.
References	Oliveira, J.T. (coord.), 1992. *Notícia explicativa da Carta Geológica de Portugal, na escala de 1:200 000, Folha 8*, Serviços Geológicos de Portugal, 91p. Schneider, H., Höfer, D., Trog, C, Busch, S., Schneider, M., Baase, J., Daut, G. & Mäusbacher, R., in press. Holocene

	estuary development in the Algarve Region (Southern Portugal) - A reconstruction of sedimentological and ecological evolution. *Quaternary International*.

Card File Nº	27
Location	Vale do Garrão SW (Quarteira)
Criteria	Location near the coastline within a distance inferior to 1km and elevation below to 10m (MSL); Lagoon that forms Inland of a dune cord in the end of a small watercourse, where low energy sediment deposition occurs.
Geological / Geomorphological Setting	The small watercourse cuts through a flat elevated surface pending south at elevation below 50m (MSL) composed by sandy Pliocene and Pleistocene deposits from Areias de Faro-Quarteira formation. According to Oliveira (1992), these deposits are composed of fine do medium sand. Recent alluvium deposits are mapped along the watercourse. The water that runs in this small valley accumulates in a lagoon located SW of Vale do Garrão, separated from the sea by Garrão beach and a dunar cord.
Observations	This watercourse drains sandy Pliocene and Pleistocene deposits. Additionally, the lagoon seems to be located in the middle of sand dunes. This will present a major difficulty in the identification of a sedimentological signature of a high energy event, due to the similarity between the source sediments that deposit in the everyday regime and in an extreme marine event.
Maps and aerial photos	Aerial photo FA3708, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2006. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Montenegro (Faro)*, Folha 610, Edição 3, Instituto Geográfico do Exército. SGP, 1985. *Carta Geológica de Portugal, Folha 53-A Faro*, Serviços Geológicos de Portugal, Lisboa.
References	Oliveira, J.T. (coord.), 1992. *Notícia explicativa da Carta Geológica de Portugal, na escala de 1:200 000, Folha 8*, Serviços Geológicos de Portugal, 91p.

Card File Nº	28
Location	Vale do Garrão SE (Quarteira)
Criteria	Location near the coastline within a distance inferior to 1km and elevation below to 10m (MSL); Lagoon that forms Inland of a dune cord in the end of a small watercourse, where low energy sediment deposition occurs.
Geological / Geomorphological Setting	The small watercourse cuts through a flat elevated surface pending south at elevation varying from 30m to 50m (MSL) composed by sandy Pliocene and Pleistocene deposits from Areias de Faro-Quarteira formation. According to Oliveira (1992), these deposits are composed of fine do medium sand. Recent alluvium deposits are mapped along the watercourse. The water that runs in this small valley accumulates in a lagoon located SE of Vale do Garrão, separated from the sea by Garrão beach and s dunar cord.
Observations	This watercourse drains sandy Pliocene and Pleistocene deposits. Additionally, the lagoon seems to be located in the middle of sand dunes. This will present a major difficulty in the identification of a sedimentological signature of a high energy event, due to the similarity between the source sediments that deposit in the everyday regime and in an extreme marine event.
Maps and aerial photos	Aerial photo FA3708, 1980. Scale 1/15 000, BAIFAP flight, Força Aérea Portuguesa. IGeoE, 2006. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Montenegro (Faro), Folha 610*, Edição 3, Instituto Geográfico do Exército. SGP, 1985. *Carta Geológica de Portugal, Folha 53-A Faro*, Serviços Geológicos de Portugal, Lisboa.
References	Oliveira, J.T. (coord.), 1992. *Notícia explicativa da Carta Geológica de Portugal, na escala de 1:200 000, Folha 8*, Serviços Geológicos de Portugal, 91p.

Card File Nº	29
Location	Armona Island (Ria Formosa)
Criteria	Lowland located near the coastline within a distance inferior to 1km and elevation below 10m (MSL).
Geological / Geomorphological Setting	The Ria Formosa is a small barrier chain and lagoon in the central and eastern Algarve coast. Five sandy barrier islands and two spits form a roughly triangular chain, with maximum width of 6km near Sta Maria Cape. The average depth relative to mean sea level is 2m and there are no significant fluvial inputs of water and coarse sediment. Cohesive sediment, fine sand and silt from the terrestrial margin as suspended load, are partly exported to the shelf during each tidal cycle and partly retained in intertidal flats and marshes (Andrade *et al*., 2004). Andrade (1992) suggests that the barrier internal structure presents depositional features generated by the 1755 tsunami flooding and consequent re-organization of the lagoon drainage system.
Observations	
Maps and aerial photos	IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000*, *Faro, Folha 611*, Edição 3, Instituto Geográfico do Exército. IGeoE, 2006. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Fuseta (Olhão), Folha 612*, Edição 3, Instituto Geográfico do Exército. SGP, 1984. *Carta Geológica de Portugal, Folha 53-B Tavira*, Serviços Geológicos de Portugal, Lisboa SGP, 1985. *Carta Geológica de Portugal, Folha 53-A Faro*, Serviços Geológicos de Portugal, Lisboa.
References	Andrade, C., 1992. Tsunami generated forms in the Algarve Barrier islands (south Portugal). *Science of Tsunami Hazards*, 10 (1), pp.21-33. Andrade, C., Freitas, M.C., Moreno, J. e Craveira, S.C., 2004. Stratigraphical evidence of Late Holocene barrier breaching and extreme storms in lagoonal sediments of Ria Formosa, Algarve, Portugal, *Marine Geology*, 210, pp.339-362.

Card File Nº	30
Location	Tavira Island (Ria Formosa)
Criteria	Lowland located near the coastline within a distance inferior to 1km and elevation below 10m (MSL).
Geological / Geomorphological Setting	The Ria Formosa is a small barrier chain and lagoon in the central and eastern Algarve coast. Five sandy barrier islands and two spits form a roughly triangular chain, with maximum width of 6km near Sta Maria Cape. The average depth relative to mean sea level is 2m and there are no significant fluvial inputs of water and coarse sediment. Cohesive sediment, fine sand and silt from the terrestrial margin as suspended load, are partly exported to the shelf during each tidal cycle and partly retained in intertidal flats and marshes (Andrade *et al*., 2004). Andrade (1992) suggests that the barrier internal structure presents depositional features generated by the 1755 tsunami flooding and consequent re-organization of the lagoon drainage system.
Observations	
Maps and aerial photos	IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Tavira, Folha 608*, Edição 3, Instituto Geográfico do Exército. SGP, 1987. *Carta Geológica de Portugal, Folha 53-B Tavira*, Serviços Geológicos de Portugal, Lisboa.
References	Andrade, C., 1992. Tsunami generated forms in the Algarve Barrier islands (south Portugal). *Science of Tsunami Hazards*, 10 (1), pp.21-33. Andrade, C., Freitas, M.C., Moreno, J. e Craveira, S.C., 2004. Stratigraphical evidence of Late Holocene barrier breaching and extreme storms in lagoonal sediments of Ria Formosa, Algarve, Portugal, *Marine Geology*, 210, pp.339-362.

Card File Nº	31
Location	Monte Gordo
Criteria	Location near the coastline within a distance inferior to 1km and elevation below 10m (MSL); Occurs low energy sediment deposition.
Geological / Geomorphological Setting	North of Monte Gordo beach and dune field there is wide and flat lowland comprising recent alluvium deposits, associated to the watercourse named Esteiro da Carrasqueira and Guadiana river floodplain
Observations	
Maps and aerial photos	IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Vila Real de Santo António, Folha 600*, Edição 3, Instituto Geográfico do Exército. SGP, 1992. *Carta Geológica de Portugal na escala de 1/200 000, Folha 8*, Serviços Geológicos de Portugal, Lisboa.
References	

Card File Nº	32
Location	Castro Marim
Criteria	Location near the coastline with elevation below 5m (MSL); Occurs low energy sediment deposition.
Geological / Geomorphological Setting	West of Castro Marim there is wide and flat lowland comprising recent alluvium deposits, associated to the watercourse named Esteiro da Lezíria and Guadiana river floodplain.
Observations	
Maps and aerial photos	IGeoE, 2005. *Carta Militar de Portugal, Série M888 / Escala 1:25000, Vila Real de Santo António, Folha 600*, Edição 3, Instituto Geográfico do Exército. SGP, 1992. *Carta Geológica de Portugal na escala de 1/200 000, Folha 8*, Serviços Geológicos de Portugal, Lisboa.
References	

Project n. 037110

NEAREST

"Integrated observations from NEAR shore sourcES of Tsunamis: towards an early warning system"

Instrument: STREP

Thematic priority: 1.1.6.3 GOCE (GlObal Change and Ecosystems)

D21: REPORT ON ONSHORE TSUNAMI RECORDS ANNEXE 3 – RESULTS ON LITHOSTRATIGRAPHY

Due date of deliverable: 30 November 2009 (26 months)

Actual submission date: 5 June 2010

Start date of project: 1/10/2006

Duration: 36 + 6 months

Organisation name of lead contractor for this deliverable: **CSIC**

Revision: template

Project Co founded By the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination level		
PU	Public	
PP	Restricted to other programme participants (including Commission Services)	
RE	Restricted to a group specified by the Consortium (including Commission Services)	RE
CO	Confidential, only for members of the Consortium (including Commission Services)	

WP6 - Paleotsunami and Paleoseismic records

D21: REPORT ON *ONSHORE TSUNAMI RECORDS* ANNEXE 3 – RESULTS ON LITHOSTRATIGRAPHY

Leader WP 6: CSIC

Dr Eulalia Gracia

Unitat de Tecnologia Marina - CSIC
Centre Mediterrani d'Investigacions Marines i Ambientals (CMIMA)
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Responsible Task 6.1:

Onshore sedimentological evidence of tsunami records

C. Andrade

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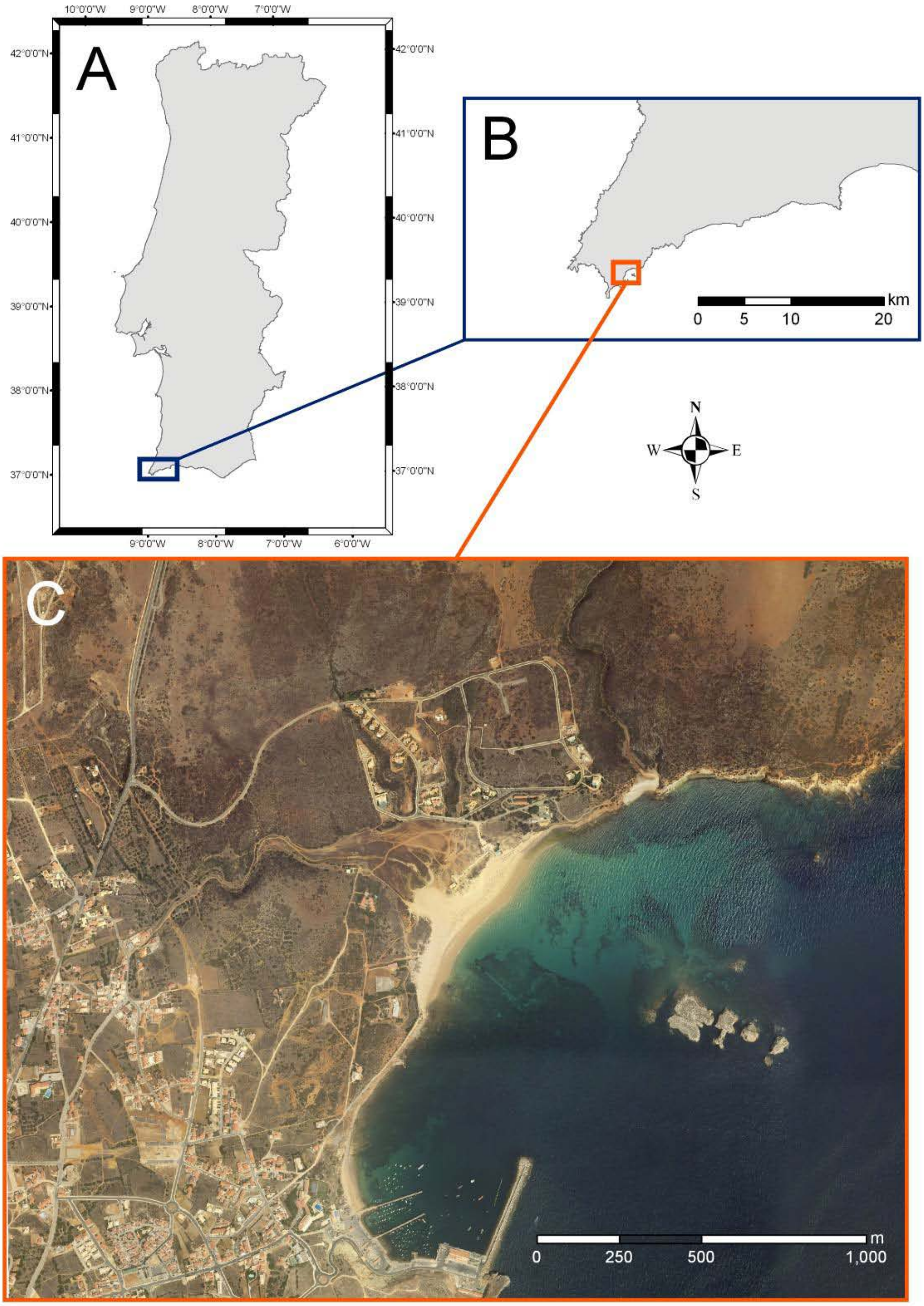
Responsible Scientists for contents of this Annexe:
C. Andrade, M. C. Freitas, M.A. Oliveira, P. Costa (CeGUL, FCUL, FFCUL)

MARTINHAL



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38°0'0"N
37°0'0"N
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7°0'0"W
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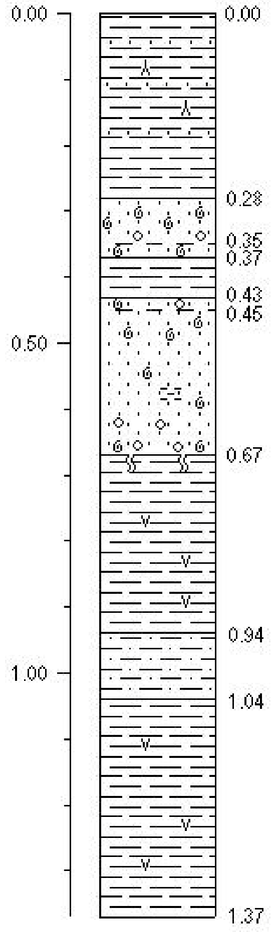
Reference: MRT 09 C			Date: 12-07-2009
Coordinates	UTM (ED50) 29S	M: 0506461 P: 4097335	Location: Martinhal lowland
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Laminated mud with rootlets, centimetric quartz pebbles and fine sand intercalations. The contact with the underlying sandy layer is undulated, showing resemblance to ripples.

(Yellow). Medium to coarse sand with frequent aligned bioclasts and small angulated litoclasts, lying over the biggest surface area (horizontal).

(Orange). Fine well sorted sand, with bioclasts, heavy minerals and slightly larger grains.

(Brown). Compact mud.

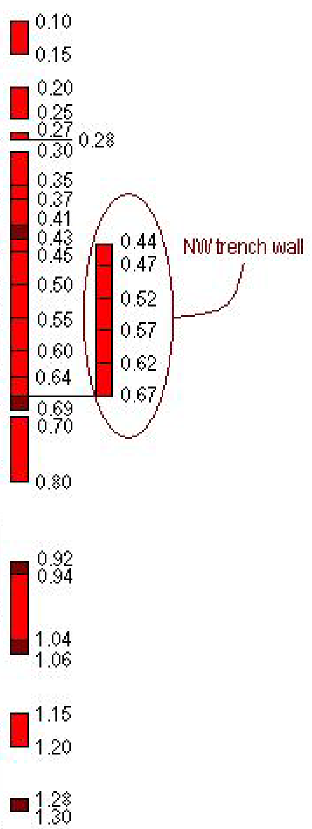
Fining upward sequence composed, in the base, by very coarse sand, poorly sorted, with pebbles and big bioclasts lying over the biggest surface area (horizontal) and in the top by medium clean beach sand with heavy minerals, bioclasts and mud-balls. The lower limit of this layer varies in depth about 20cm in a 2.25m horizontal section, pending inland, resulting in an increase of the layer thickness in the same direction. This cross-bedding possibly represents a reactivation surface.

Fining upward sequence composed of medium well sorted sand with plaque shaped shell fragments and milimetric pebbles in the base, and medium well sorted sand in the top, with rounded grains, bioclasts, heavy minerals and mud balls. One limestone pebble (5x3x2cm) was found in the middle of the layer. The contact with the underlying layer is erosive.

(Borwn). Mud with plant remains. Bioturbations features are present in the upper limit, in the form of vertical burrows.

(Brown). Sandy mud.

(Dark brown). Mud with plant remains.

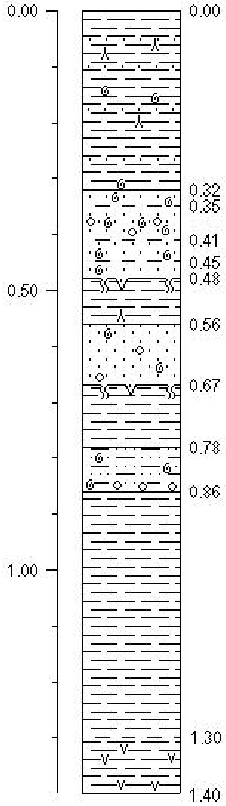


Sedimentology samples

^{14}C dating samples

Reference: MRT 09 D			Date: 12-07-2009
Coordinates	UTM (ED50) 29S	M: 0506443 P: 4097342	Location: Martinhal lowland

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Laminated mud with sand, rootlets, scarce quartz grains and shell fragments, intercalated with fine sand laminae.

(Yellow). Medium clean sand with shell fragments, mud balls and laminae (2-5mm thickness), pending towards the inlet, composed of very coarse quartz, quartzite, volcanic and limestone grains and plaque shaped shell fragments. Mud balls show alignments also pending towards the ocean.

Medium sand with frequent plaque shaped shell fragments, lying over the biggest surface area, slightly pending towards the inlet, and flattened milimetric to centimetric schist, quartz and limestone pebbles (<0.5cm).

Consolidated moderately sorted medium clean sand with litoclasts and bioclasts and very coarse quartz and limestone grains, bigger than the matrix. In some places shows lamination pending towards the inlet.

(Orange). Fine to medium, well sorted sand, with few bioclasts and heavy minerals. Limit with the underlying layer is irregular.

(Brown). Mud with scarce sand grains, rootlets. Limit with the overlying layer is irregular, containing bioturbations features in the form of vertical burrows, mud-cracks and ravine-structures, filled with sand from the overlying layer.

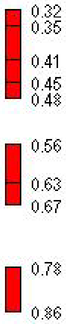
(Yellow). Fining upward sequence composed of medium clean sand, with limestone and quartzite small pebbles and shell fragments. The contact with the underlying layer varies in depth, between 0,43m to 0.67, pending towards inland.

(Brown). Mud with scarce quartz sand grains. Mud cracks and vertical burrows in the upper contact are filled with sand from the overlying layer.

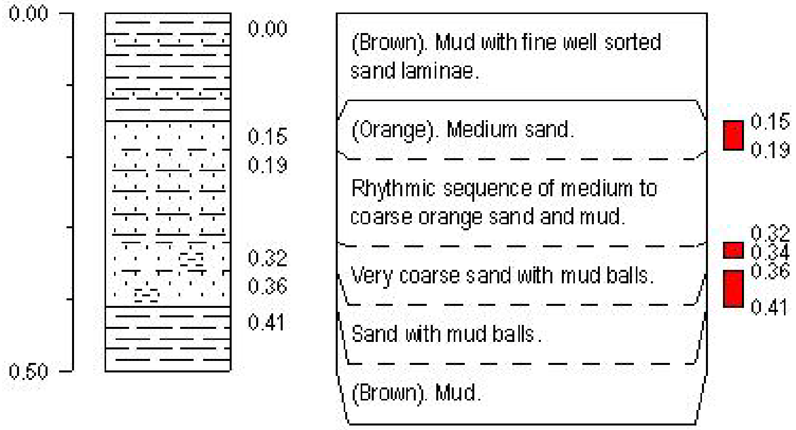
Medium muddy sand, with frequent shell fragments, whole shells (Cerastoderma) and limestone pebbles nearest to the base.

(Brown). Mud with scarce quartz sand grains.

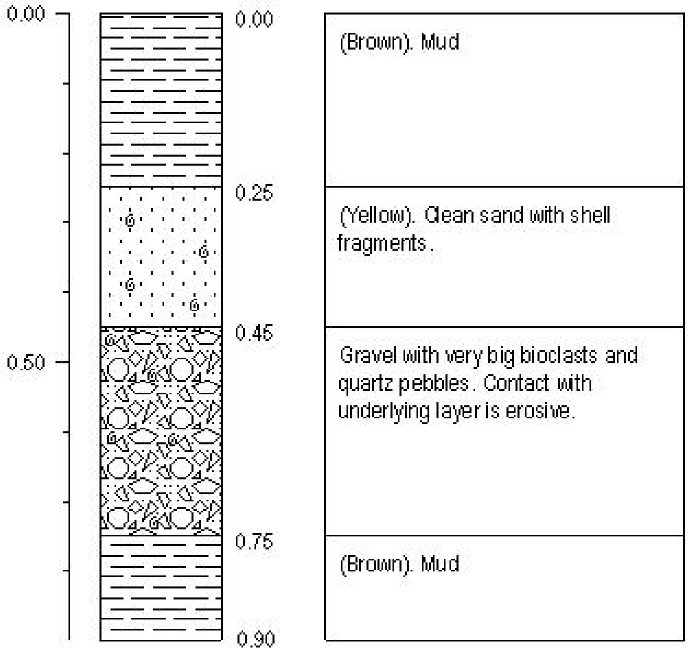
(Grey). Mud with scarce quartz sand grains and fermented plant remains.



Reference: MRT 09 D'			Date: 13-07-2009
Coordinates	UTM (ED50) 29S	**M:** 0506443 **P:** 4097342	**Location:** Martinhal lowland
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**

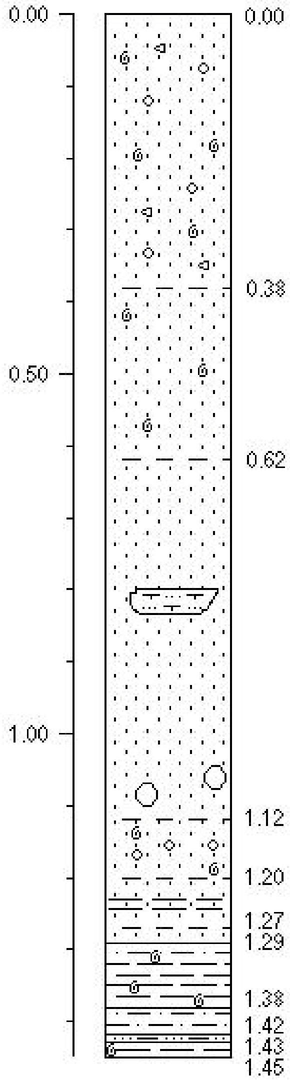


Reference: MRT 09 E			Date: 13-07-2009
Coordinates	UTM (ED50) 29S	**M:** 0506583 **P:** 4097317	**Location:** Martinhal lowland
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: MRT 09 F			Date: 13-07-2009
Coordinates	UTM (ED50) 29S	M: 0506629 P: 4097328	Location: Martinhal lowland

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Chaotic layer composed of sand, shell fragments, roof-tile fragments and pebbles, lacking any structure. Apparent land fill.

(Yellow). Sand with frequent bioclasts. Coarser and finner sand laminae causes sub-horizontal lamination, pending inland.

(Yellow). Sand with faint structure due to the existence of coarser sand laminae, simillar to wave ripple cross lamination. At 0,75m depth a sandstone boulder with carbonated cement was found. Towards the base of the layer there were limestone cobbles (10-20cm) showing evidence of bioerosion.

Beach medium to coarse sand with frequent bioclasts, almond shaped limestone and quartzite pebbles (1cm). Sharp contact with the underlying layer.

Intercalation of clean well sorted sand with mud and very coarse sand.

(Yellow). Medium sand with several sub-horizontal mud laminae, pending inland.

(Brown). Mud with gasteropods and litoclasts that becomes a sandy mud towards the top.

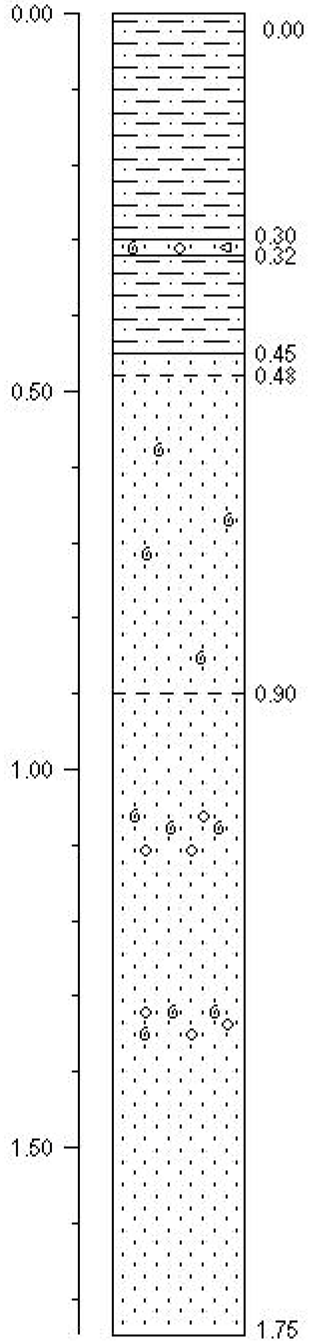
(Brown). Sandy mud.

(Brown). Muddy sand.

(Brown). Mud with gasteropods and litoclasts.

Reference: MRT 09 G			Date: 13-07-2009
Coordinates	UTM (ED50) 29S	M: 0506577 P: 4097280	Location: Martinhal lowland

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Sandy mud with quartz grains and several thin sandy layers, pending 3-4° inland.

Medium sand with frequent coarser bioclasts, rounded and angulated limestone pebbles, schist pebbles and almond shaped quartz pebbles.

Sandy mud with quartz grains and several thin sandy layers, pending 3-4° inland.

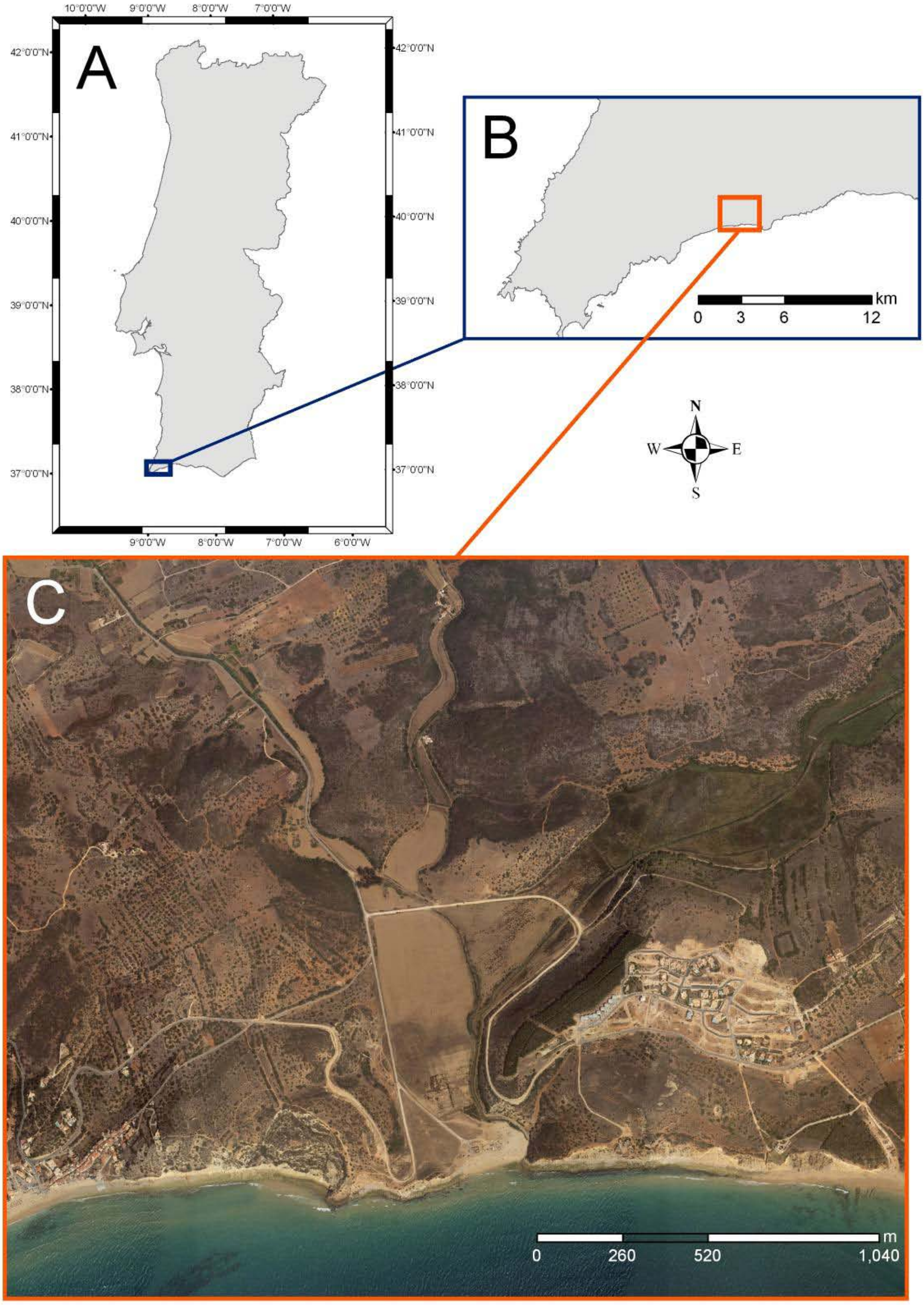
Aeolian sand with charcoal.

Medium bioclastic unclean sand with brown sandy mud laminae, pending 3-4° inland.

(Yellow). Well sortet clean sand with heavy minerals. Coarser laminae, composed of oriented rounded pebbles and plaque shaped shell fragments fom tipical beach lamination, pending 8° towards the sea.

Sampling depths (m):
- 0.37 – 0.39
- 0.45 – 0.48
- 0.80 – 0.82
- 1.04 – 1.06
- 1.70 – 1.72

BOCA DO RIO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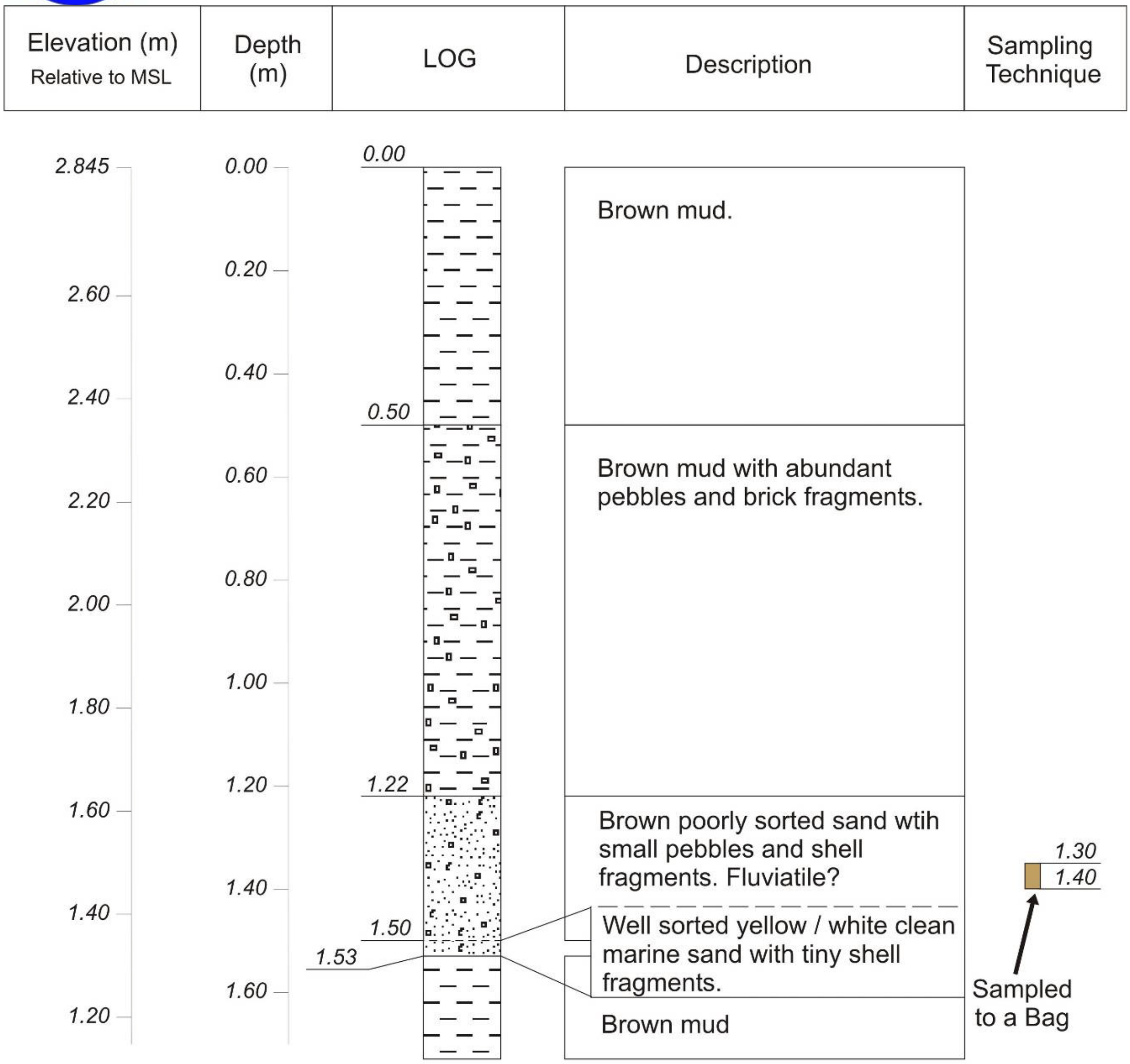


BDRSA Coordinates

UTM (ED 50) 29S M: 0516745
P: 4103237

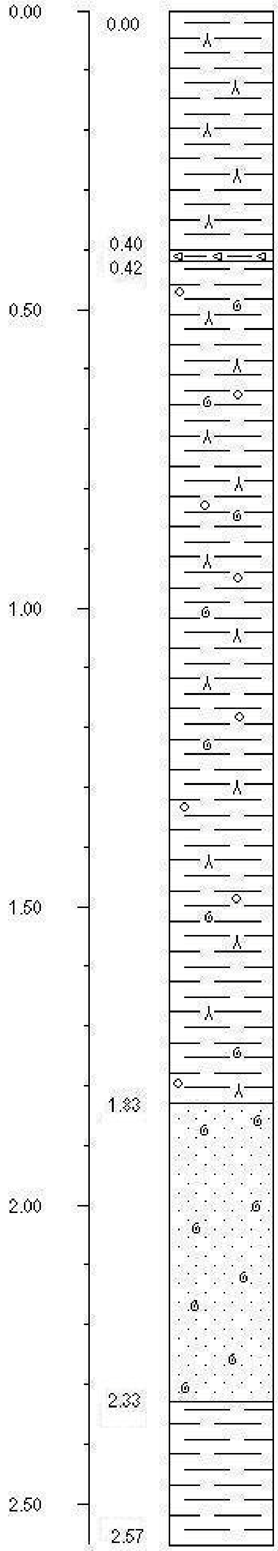
29SNB1674503237

LEGEND

Gauge auger

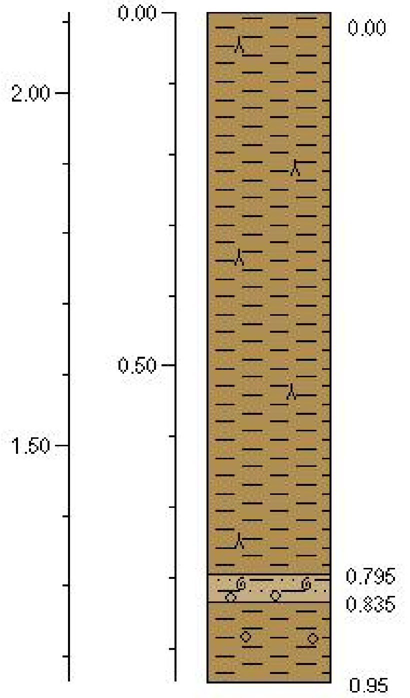
Reference: BDR-SAA			Date: 18-07-2007
Coordinates EPE: 3m	UTM (WGS 84) 29S	**M:** 0516689 **P:** 4103118	**Location:** Boca do Rio

Depth (m) -0.0625m below benchmark	LOG	Description	Sampling
0.00 – 0.40		Brown mud with rootlets.	
0.40 – 0.42		Brown mud with centimetric angular pebbles.	
0.42 – 1.83		Brown mud with charcoal, rootlets, gasteropod shells and milimetric sub-rounded pebbles.	
1.83 – 2.33		Yellow clean medium sand with shell fragments.	
2.33 – 2.57		Very plastic brown mud.	



Reference: **BDR-SAB**			**Date:** 06-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0516891.23 **P:** 4102772.54	**Location:** Boca do Rio

Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



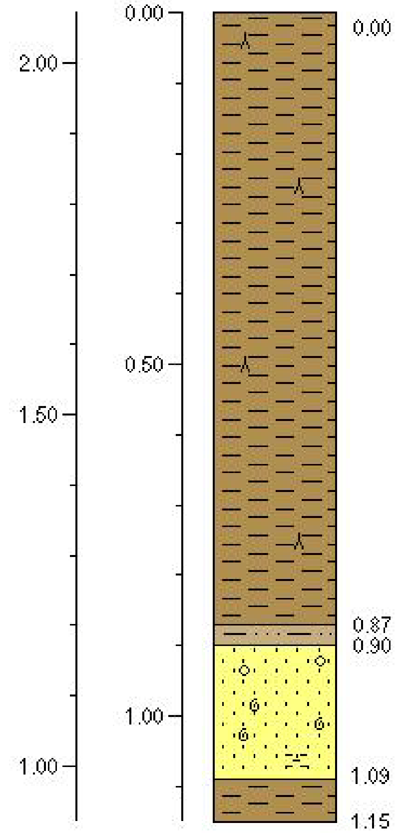
(Brown) Mud. Compact. With roots and charcoal.

Sandy Mud. Medium size grains. Poorly sorted. With shells. With pebbles (up to 2cm) at base.

(Brown) Mud. Compact. With charcoal. With rare millimetric pebbles.

Reference: BDR-SAC			Date: 06-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0516983.23 **P:** 4102838.54	**Location:** Boca do Rio

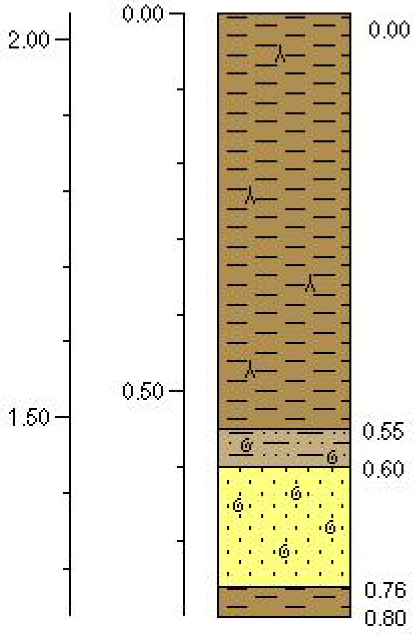
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Depth (m)	Description	Sampling Depth (m)
0.00 – 0.87	(Brown) Mud. Compact. With roots and charcoal.	
0.87 – 0.90	Sandy Mud. With charcoal.	0.90
0.90 – 1.09	Medium sand. Poorly sorted. With centimetric shells. With pebbles (up to 2cm) at the top. With mud balls.	1.09
1.09 – 1.15	(Brown) Mud.	

Reference: BDR-SAD			Date: 06-11-2007
Coordinates	UTM (ED50) 29S	M: 0516853.23 P: 4102822.54	Location: Boca do Rio

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



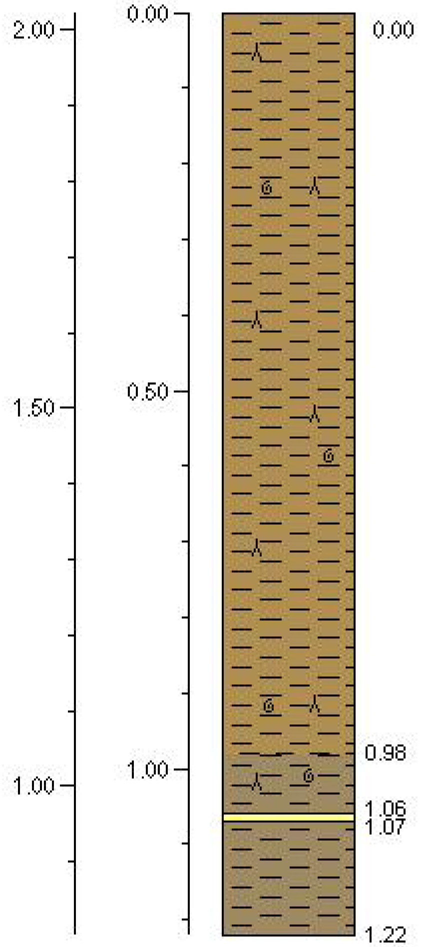
(Brown) Mud. Compact. With roots and charcoal.

(Brown). Sandy Mud. With small shells. With charcoal

Medium sand. Poorly sorted. Many broken shells.

(Brown) Mud. Plastic. With charcoal. Sharp contact with overlying unit.

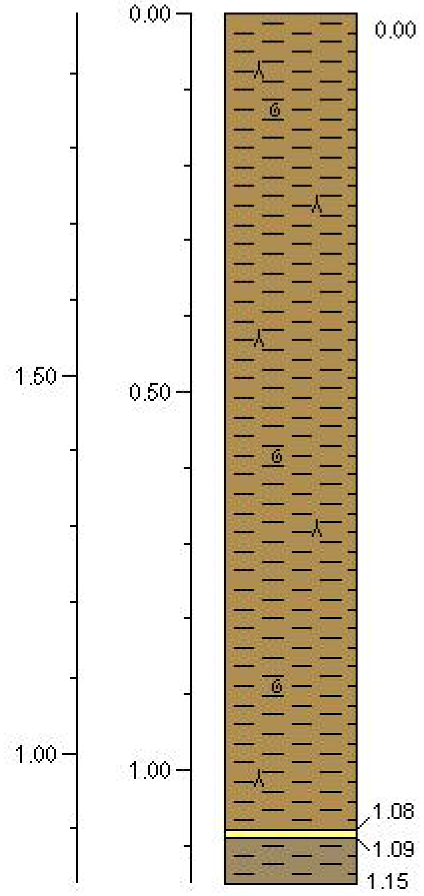
Reference: **BDR-SAE**		**Date:** 06-11-2007	
Coordinates UTM (ED50) 29S	**M:** 0517345.24 **P:** 4103241.55	**Location:** Boca do Rio	
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Description
(Brown) Mud. Plastic. With roots and charcoal. With Gastropod shells.
(Greyish Brown) Mud. Plastic. With less roots than overlying unit. With charcoal. With Gastropod shells.
Medium to fine sand. Poorly sorted. With shells.
Mud.

Reference: BDR-SAF			Date: 06-11-2007
Coordinates	UTM (ED50) 29S	M: 0517358.24 P: 4103256.55	Location: Boca do Rio

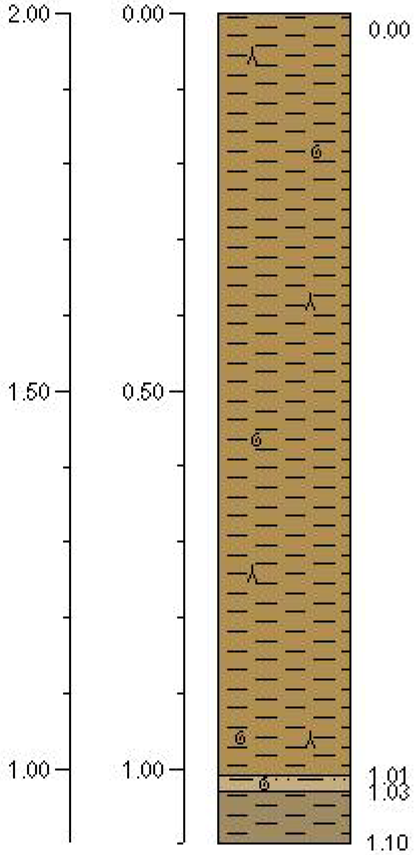
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Description
(Brown) Mud. Plastic. With roots and charcoal. With Gastropod shells.
Fine to medium muddy sand. Poorly sorted. With shells.
(Greyish Brown) Mud. Very plastic.

Reference: BDR-SAG			Date: 06-11-2007
Coordinates	UTM (ED50) 29S	M: 0517370.24 P: 4103269.55	Location: Boca do Rio

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



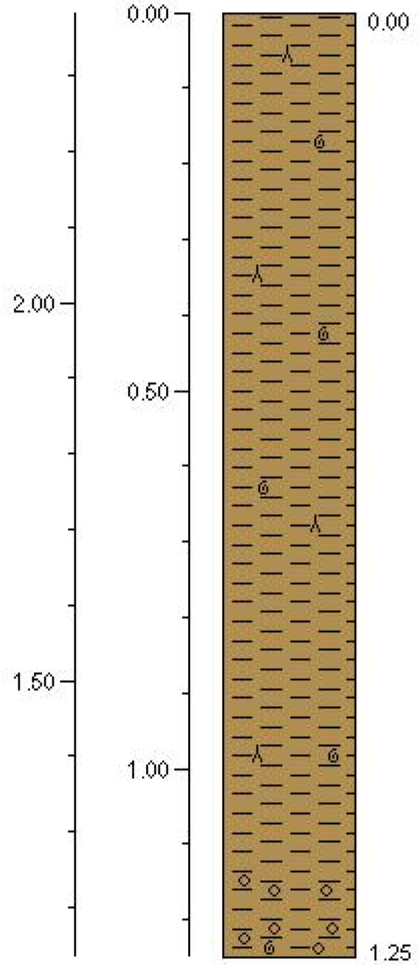
(Brown) Mud. Plastic. With roots and charcoal. With Gastropod shells.

Fine to medium muddy sand. Poorly sorted. With shells.

(Greyish Brown) Mud. Plastic.

Reference: **BDR-SAH**			**Date:** 06-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0517327.24 **P:** 4103163.55	**Location:** Boca do Rio

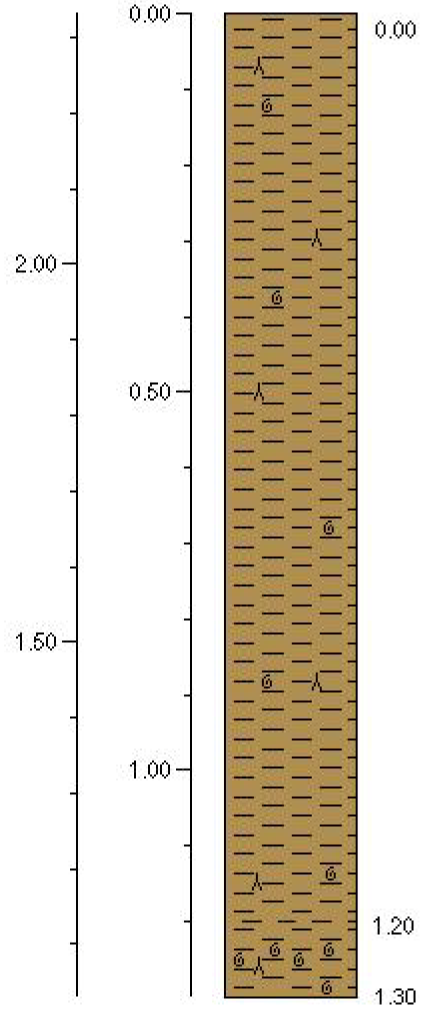
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



(Brown) Mud. More plastic to base. With roots and charcoal. With Gastropod shells. With layers of millimetric pebbles (and water) at depths of 0.94m and 1.17m.

Reference: **BDR-SAI**			Date: 06-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0517288.24 **P:** 4103122.55	**Location:** Boca do Rio

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

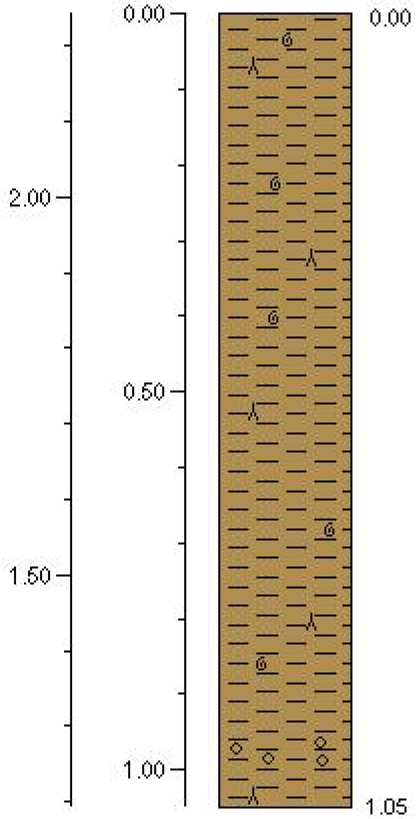


(Brown) Mud. Compact. More plastic towards the base. With roots and charcoal. With Gastropod shells.

(Brown) Mud. Plastic. With roots and charcoal. With many Gastropod shells.

Reference: BDR-SAJ			Date: 06-11-2007
Coordinates	UTM (ED50) 29S	M: 0517259.23 P: 4103090.55	Location: Boca do Rio

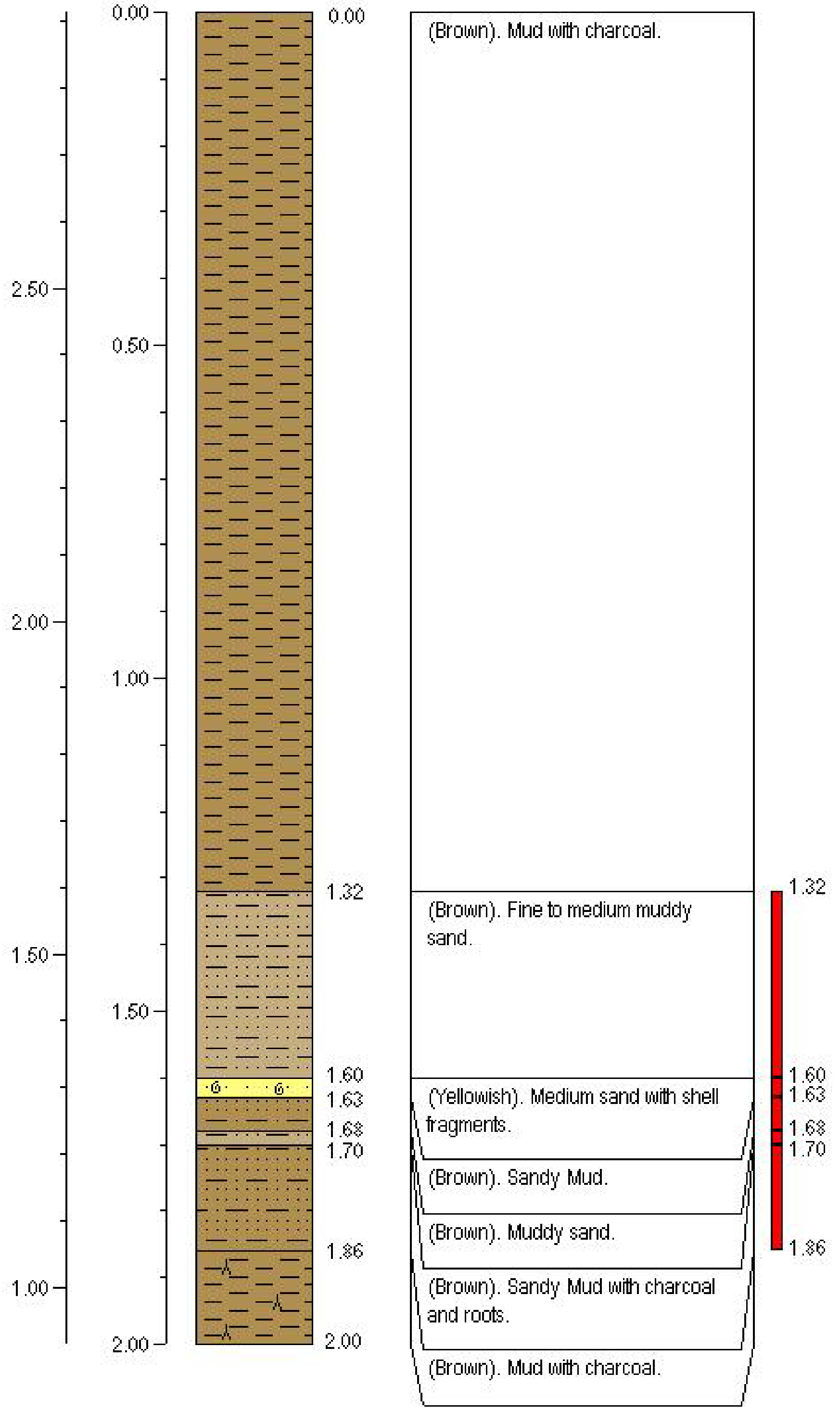
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



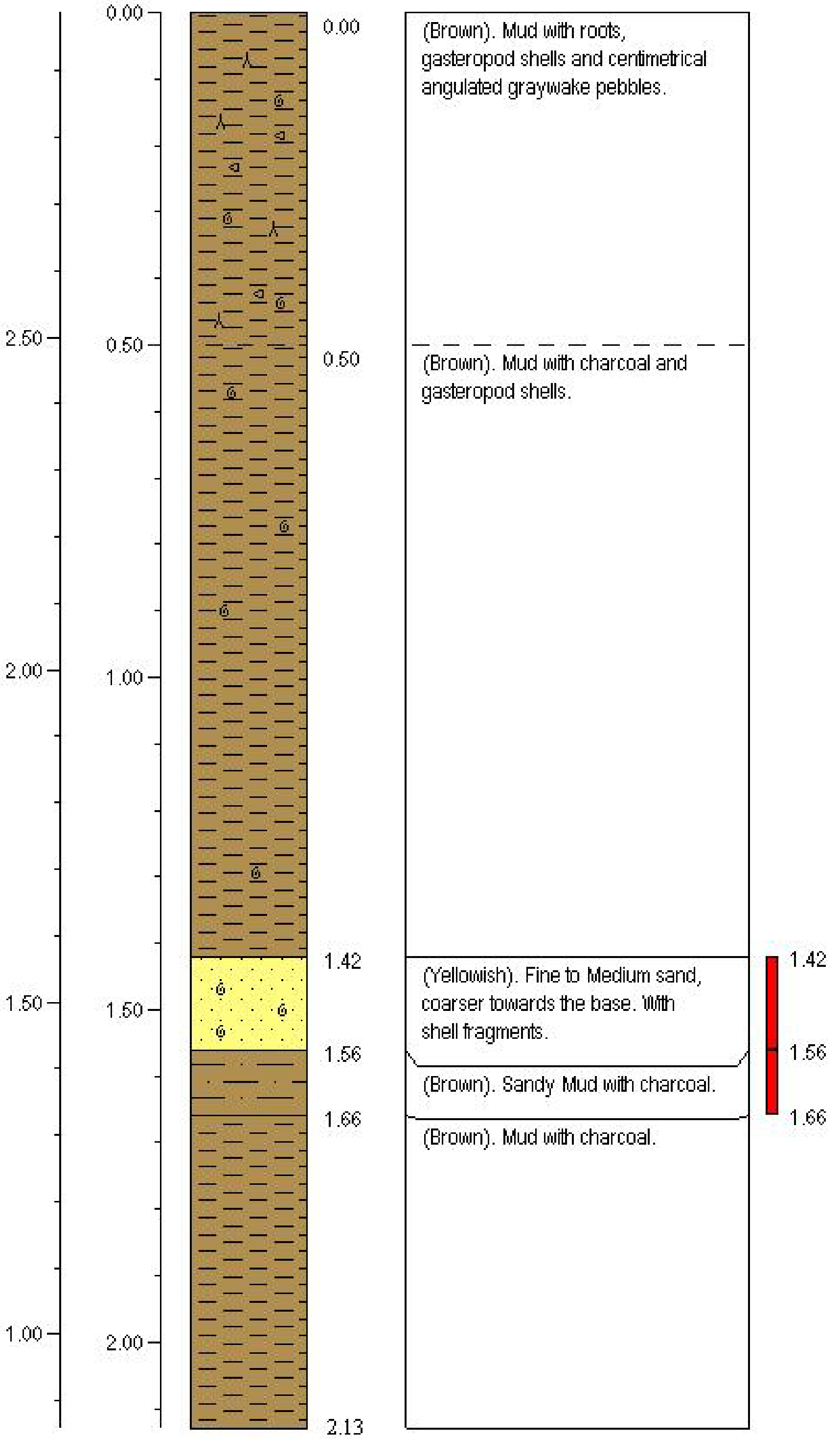
(Brown) Mud. More plastic towards the base. With roots and charcoal. With Gastropod shells. With Millimetric layer of pebbles at depth of 0.98m.

Reference: BDR-SAK			Date: 16-12-2008
Coordinates	UTM (ED50) 29S	M: 0516844 P: 4103369	Location: Boca do Rio

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

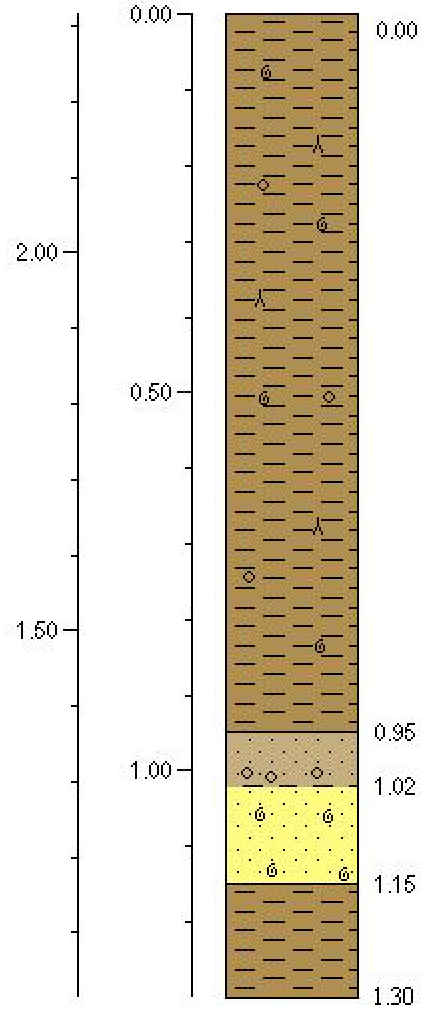


Reference: BDR-SAL			Date: 16-12-2008
Coordinates	UTM (ED50) 29S	**M:** 0516844 **P:** 4103314	**Location:** Boca do Rio
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: **BDR-SAM**			**Date:** 16-12-2008
Coordinates	UTM (ED50) 29S	**M:** 0516862 **P:** 4103116	**Location:** Boca do Rio

Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



(Brown). Mud, sandier towards the base. With gasteropod shells, roots and milimetric greywake pebbles. Charcoal appears at 0.5m depth.

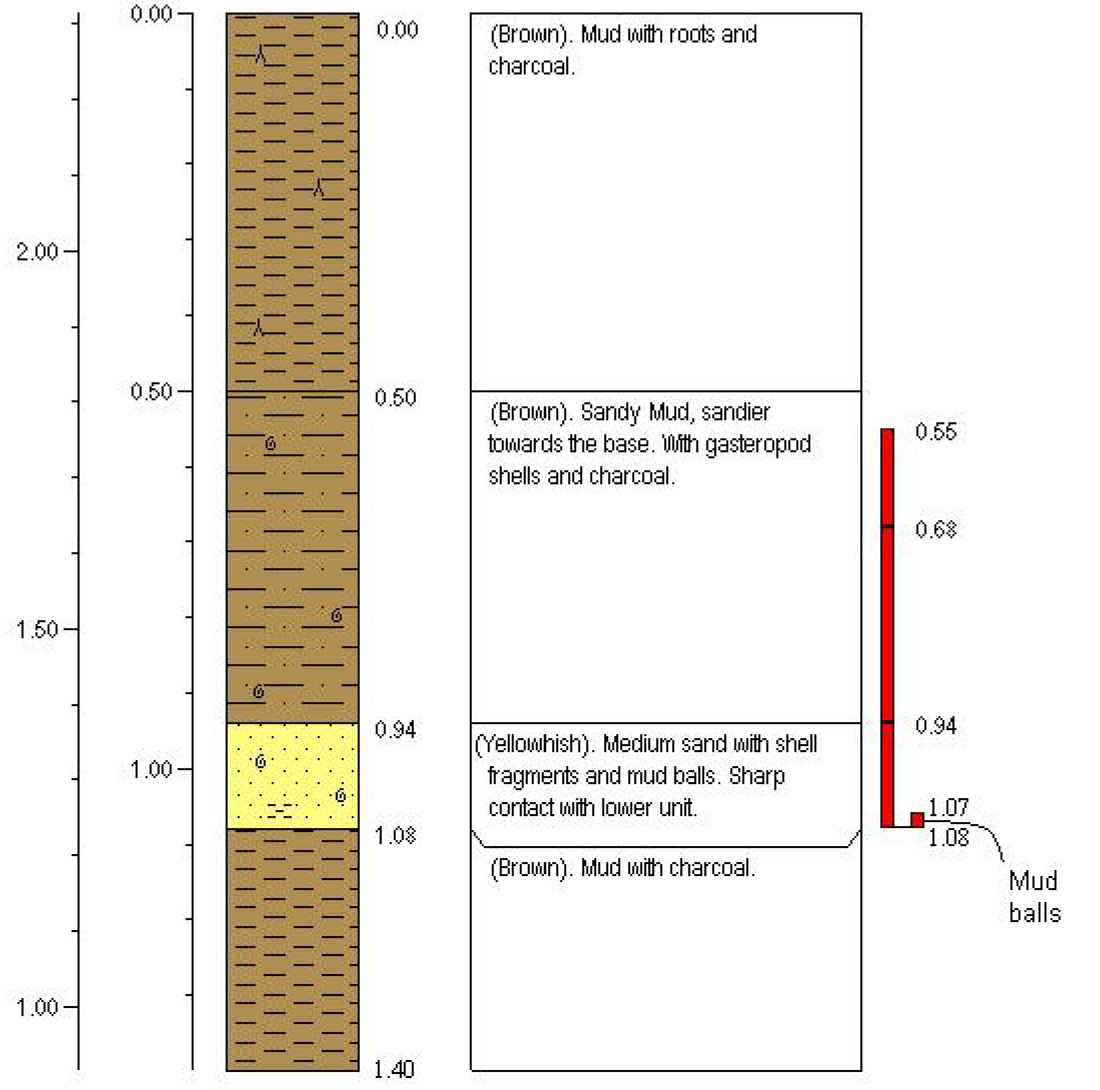
(Brown). Coarse sand (Fluvial?). With rounded milimetric pebbles in the base.

(Yellowish). Medium sand with shell fragments. Sharp contact with lower unit.

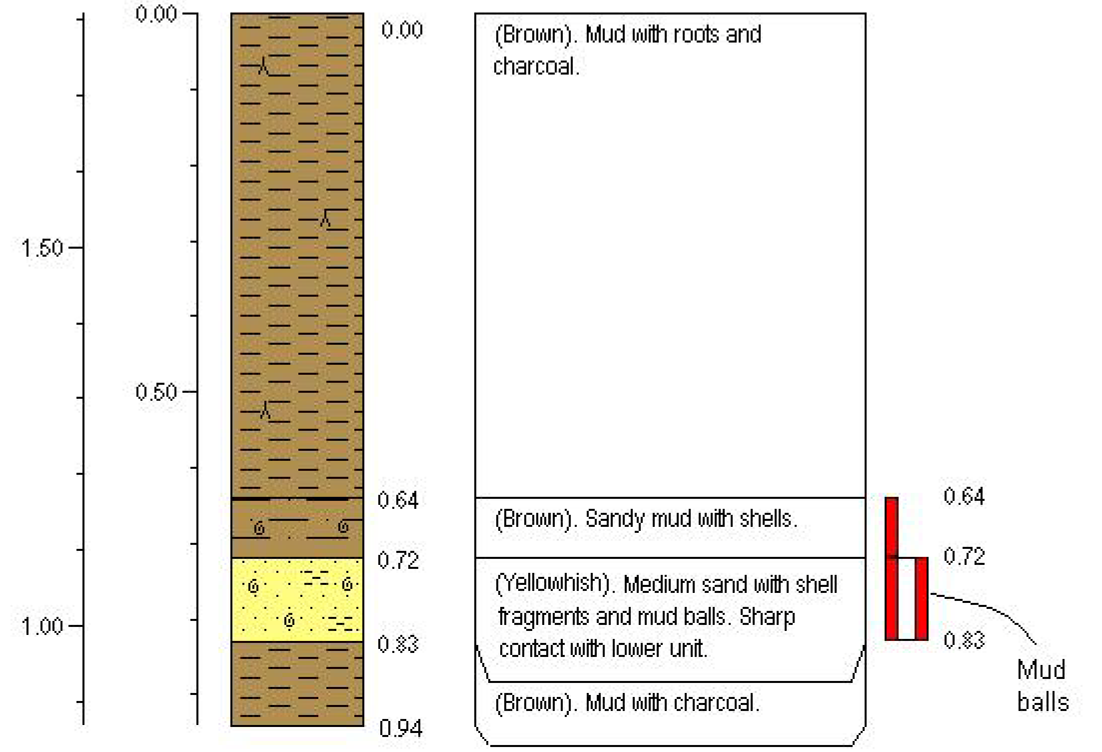
(Brown). Mud with charcoal.

Sampling depth: 0.95 – 1.02 – 1.15

Reference: BDR-SAN			Date: 16-12-2008
Coordinates	UTM (ED50) 29S	M: 0516884 P: 4102993	Location: Boca do Rio
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

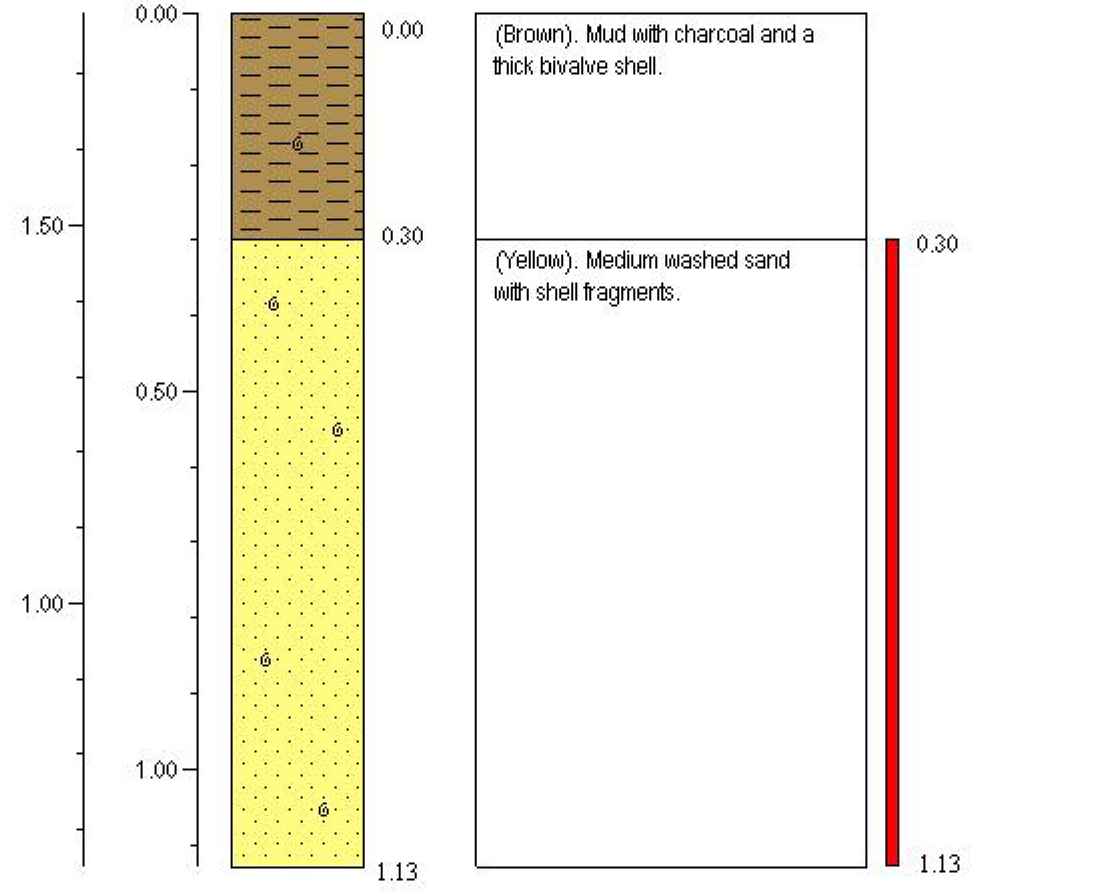


Reference: BDR-SAO			Date: 16-12-2008
Coordinates	UTM (ED50) 29S	M: 0516929 P: 4102752	Location: Boca do Rio
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



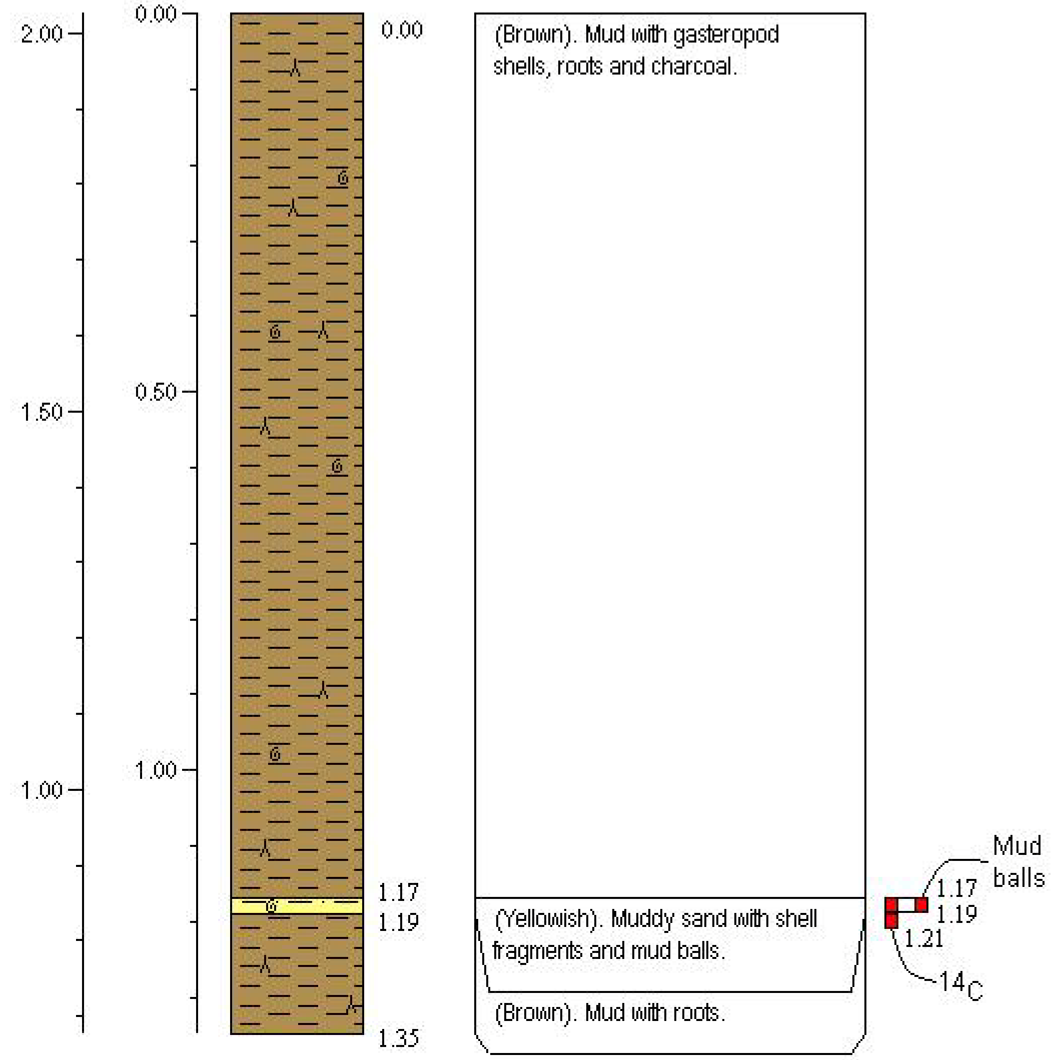
Reference: BDR-SAP			Date: 16-12-2008
Coordinates	UTM (ED50) 29S	M: 0517006 P: 4102631	Location: Boca do Rio

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



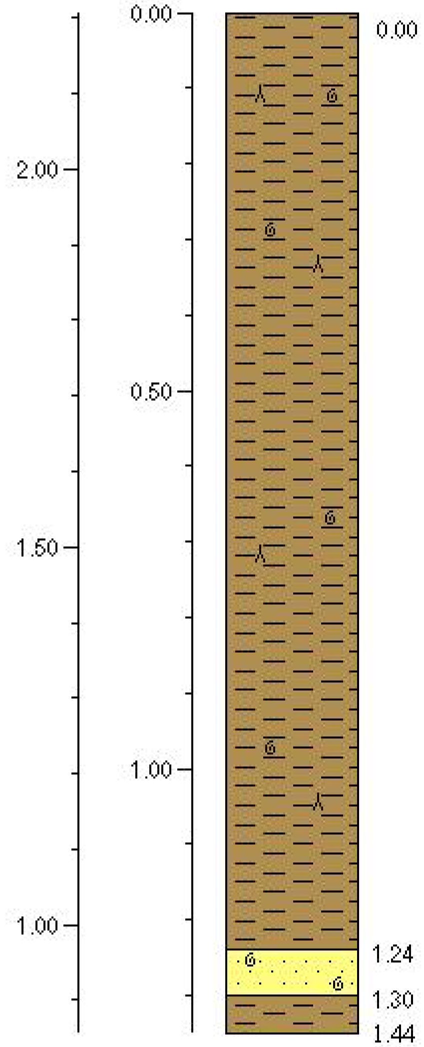
Reference: BDR-SAQ			Date: 17-12-2008
Coordinates	UTM (ED50) 29S	M: 0517175 P: 4103116	Location: Boca do Rio

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: **BDR-SAR**			**Date:** 17-12-2008
Coordinates	UTM (ED50) 29S	**M:** 0517078 **P:** 4103056	**Location:** Boca do Rio

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

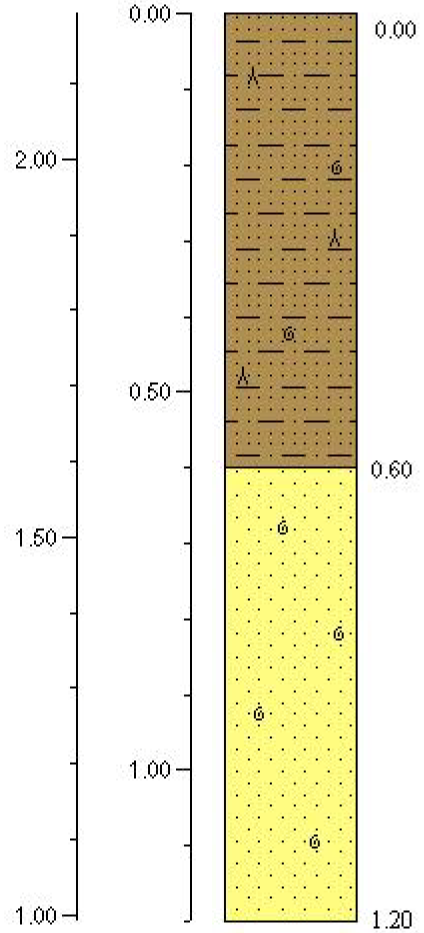


Depth (m)	Description
0.00 – 1.24	(Brown). Mud with roots, charcoal and gasteropod shells.
1.24 – 1.30	(Yellowish). Fine to Medium sand with shell fragments.
1.30 – 1.44	(Brown). Mud with charcoal.

Sampling Depth (m): 1.24 – 1.30

Reference: **BDR-SAS**			Date: 17-12-2008
Coordinates	UTM (ED50) 29S	**M:** 0516843 **P:** 4102630	**Location:** Boca do Rio

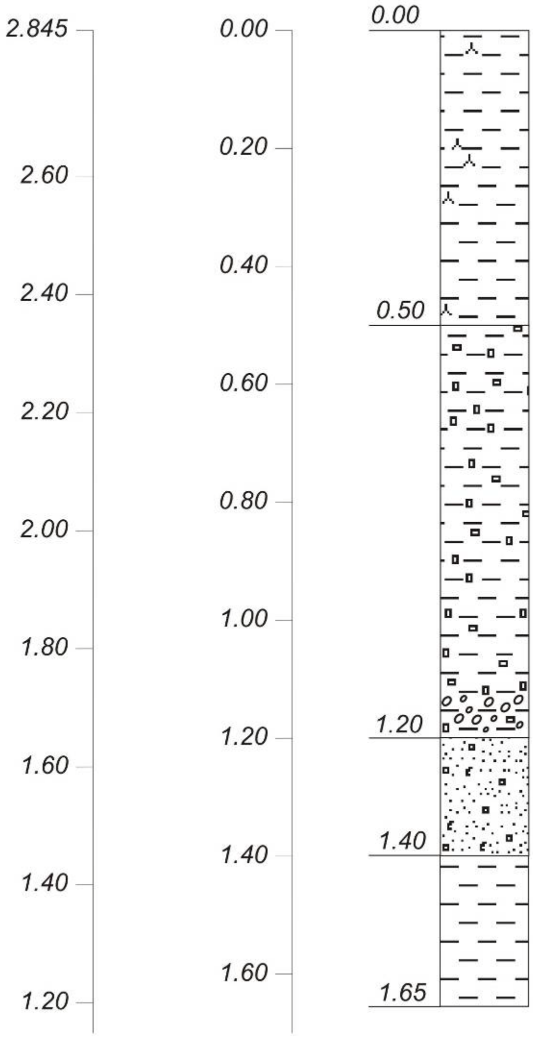
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Depth (m)	Description
0.00 – 0.60	(Brown). Medium muddy sand, sandier towards the base. With roots and shell fragments.
0.60 – 1.20	(Yellow). Medium sand with shell fragments.

Sampling Depth (m): 0.00 – 0.15 – 0.30; 0.60 – 0.90; 1.05 – 1.20

Elevation (m) Relative do MSL	Depth (m)	LOG	Description	Sampling Technique



Depth (m)	Description	Sampling Technique
0.00 – 0.50	Brown mud; spark rootlets.	
0.50 – 1.20	Brown mud with shale, graywacke, quartzite pebbles and brick fragments; to the base changes into gravel with clay matrix containing brick fragments.	1.05 – 1.10 Sampled to a Bag
1.20 – 1.40	Brown poorly sorted fluviatile (?) sand wtih small pebbles and shell fragments.	
1.40 – 1.65	Brown mud.	

BDRSB Coordinates

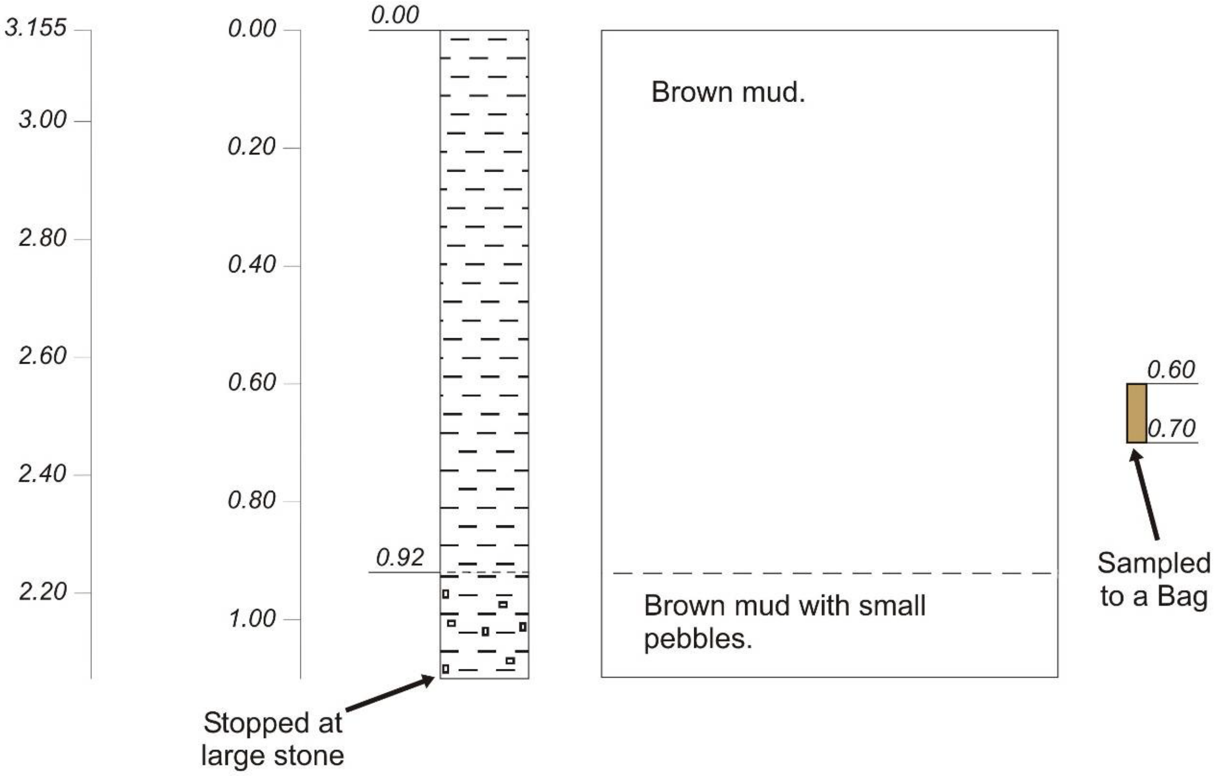
UTM (ED 50) 29S M: 0516760
P: 4103241

29SNB1676003241

LEGEND

Gauge auger

Elevation (m) Relative to MSL	Depth (m)	LOG	Description	Sampling Technique



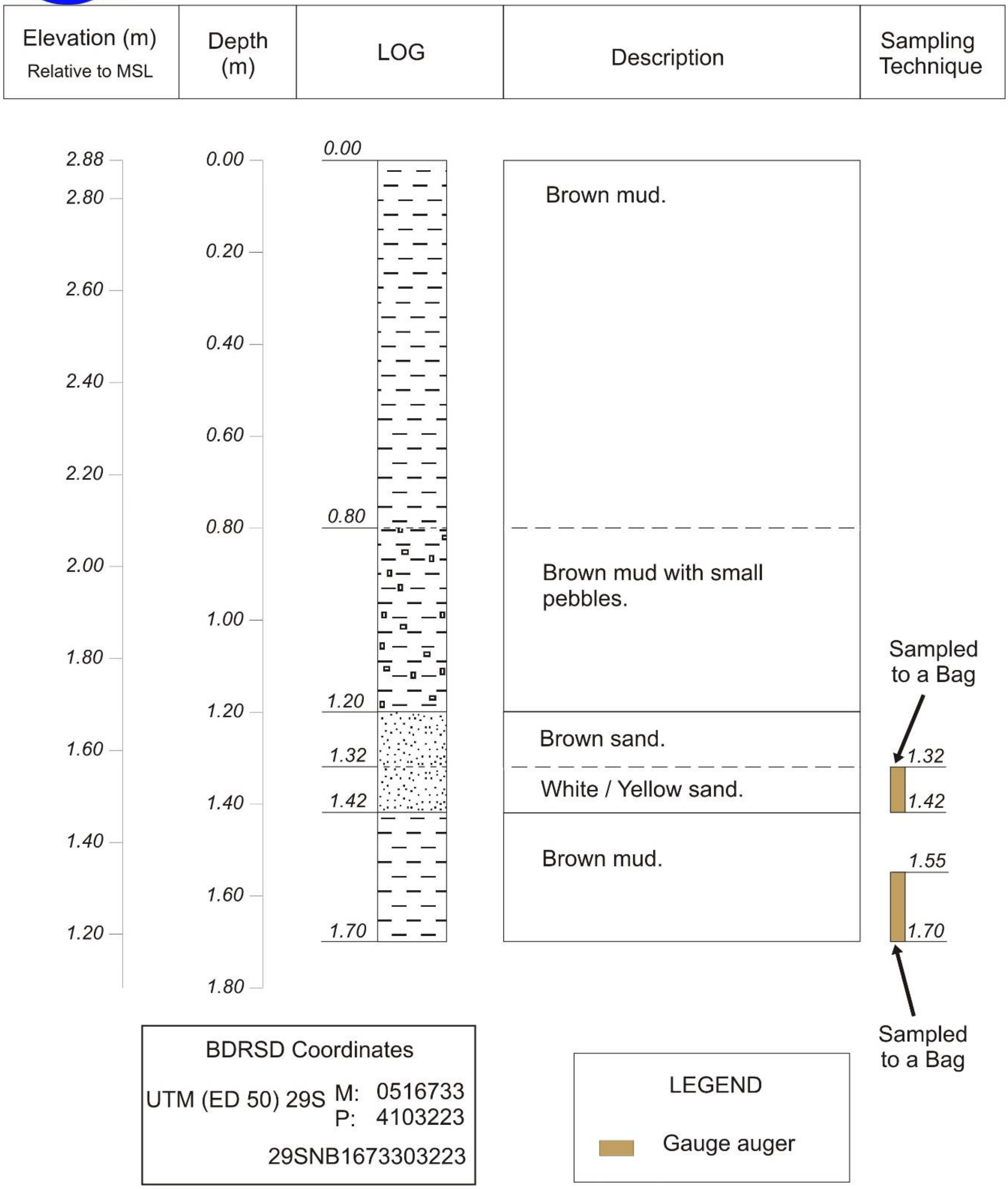
BDRSC Coordinates

UTM (ED 50) 29S M: 0516730
P: 4103275

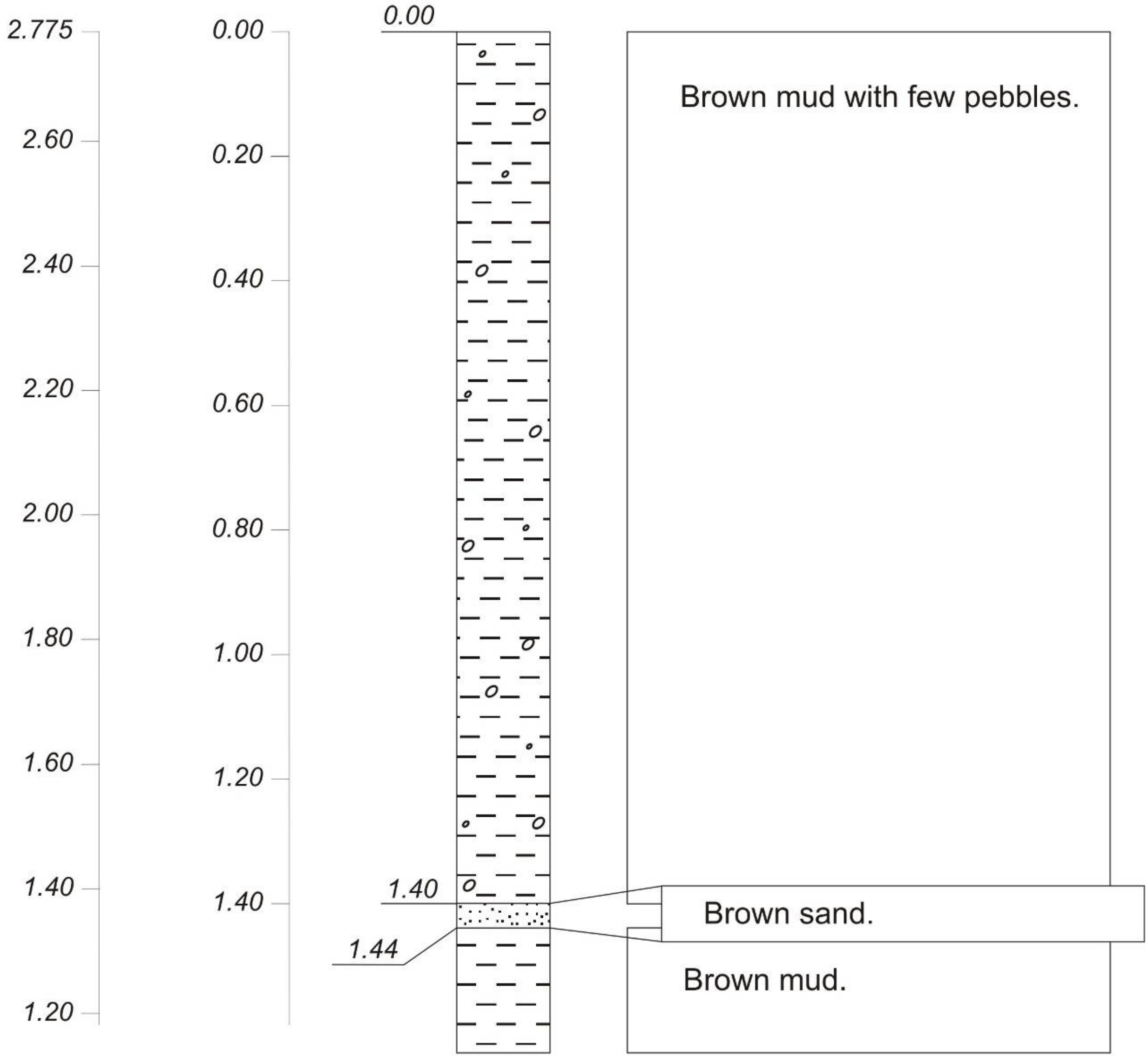
29SNB1673003275

LEGEND

Gauge auger


Elevation (m)
Relative to MSL
Depth
(m)
LOG
Description
Sampling
Technique
2.88
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
0.00
0.80
1.20
1.32
1.42
1.70
Brown mud.
Brown mud with small pebbles.
Brown sand.
White / Yellow sand.
Brown mud.
Sampled to a Bag
1.32
1.42
1.55
1.70
Sampled to a Bag
BDRSD Coordinates
UTM (ED 50) 29S M: 0516733
P: 4103223
29SNB1673303223
LEGEND
Gauge auger

Elevation (m) Relative to MSL	Depth (m)	LOG	Description

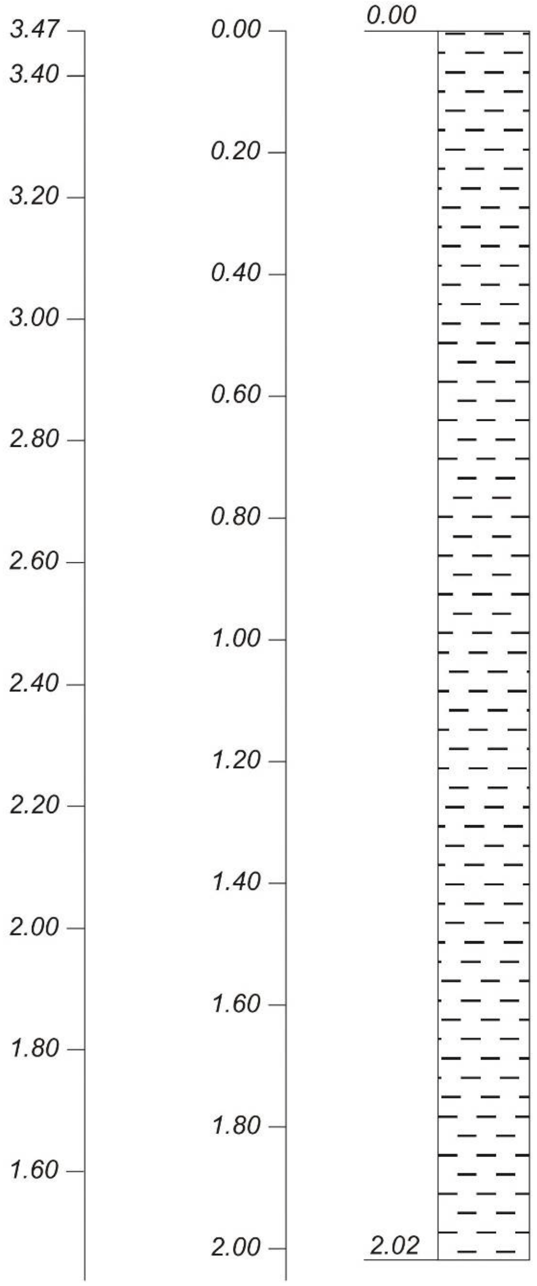


BDRSE Coordinates

UTM (ED 50) 29S M: 0516832
P: 4103238

29SNB1683203238

Elevation (m) Relative to MSL	Depth (m)	LOG	Description



Brown mud with rock fragments

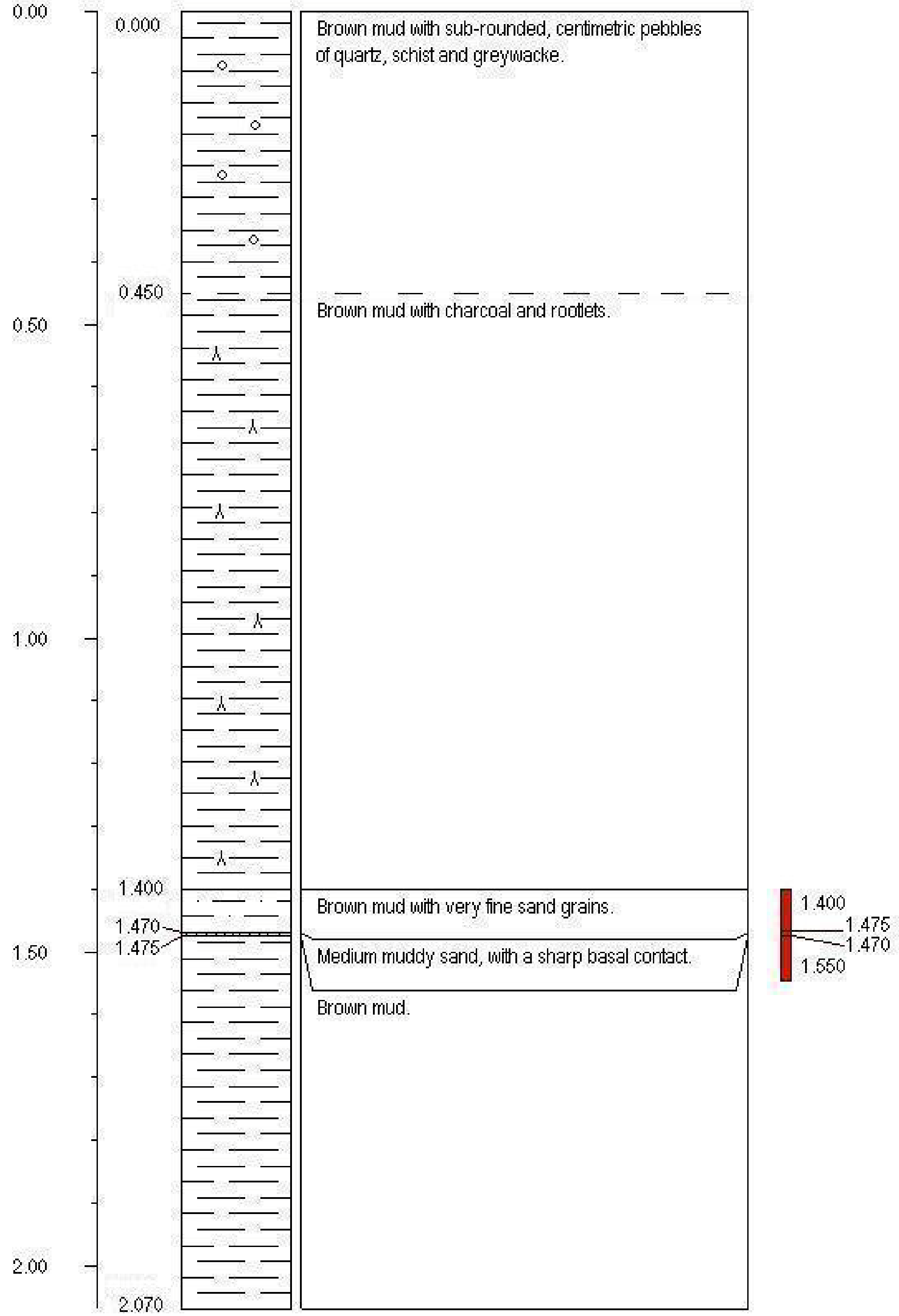
BDRSF Coordinates

UTM (ED 50) 29S M: 0516804
P: 4103246

29SNB1680403246

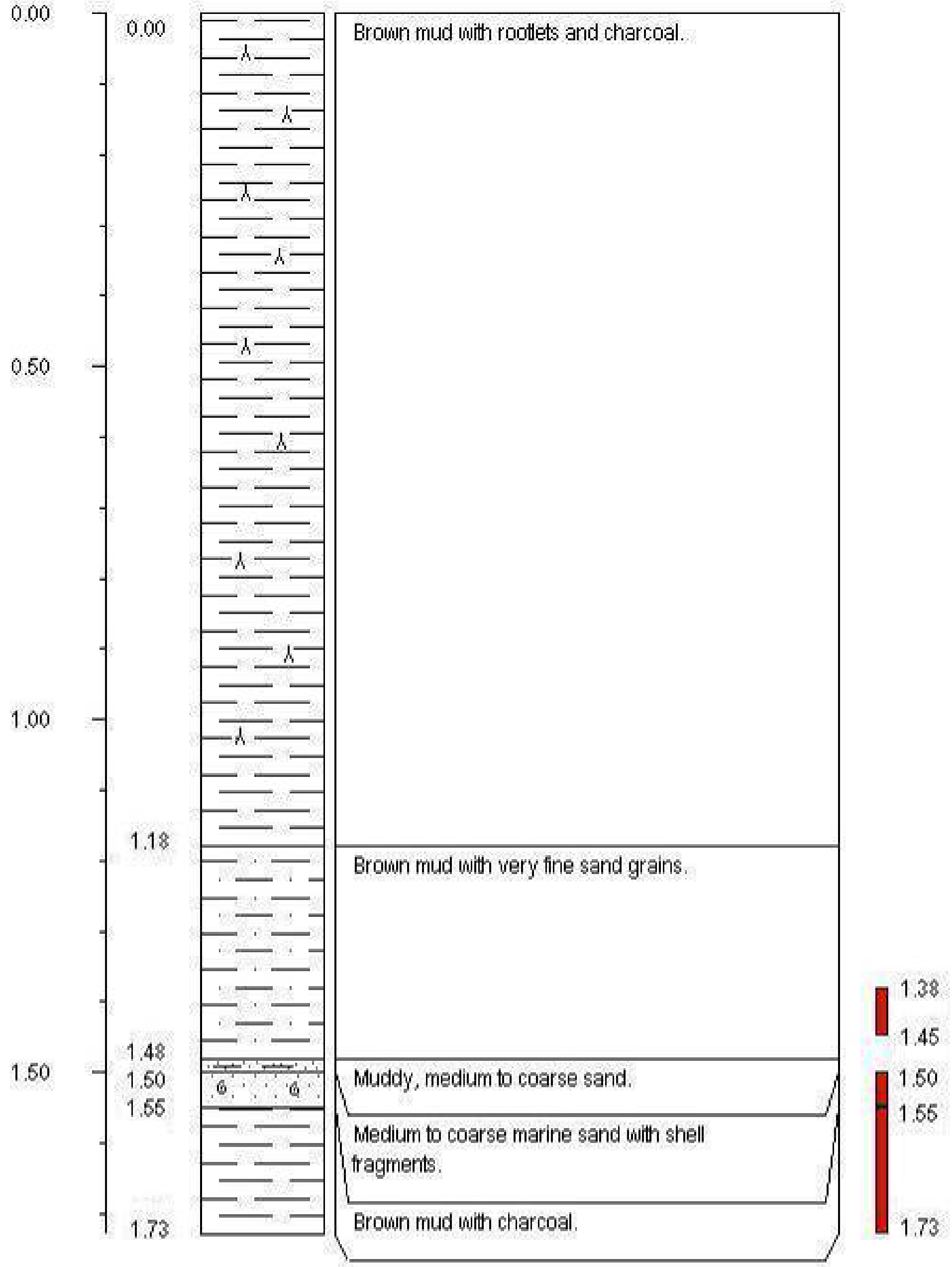
Reference: **BDR-SG**			**Date:** 16-07-2007
Coordinates EPE: 3m	UTM (WGS 84) 29S	**M:** 0516732 **P:** 4103092	**Location:** Boca do Rio

Depth (m) -0.208m below benchmark	**LOG**	**Description**	**Sampling**



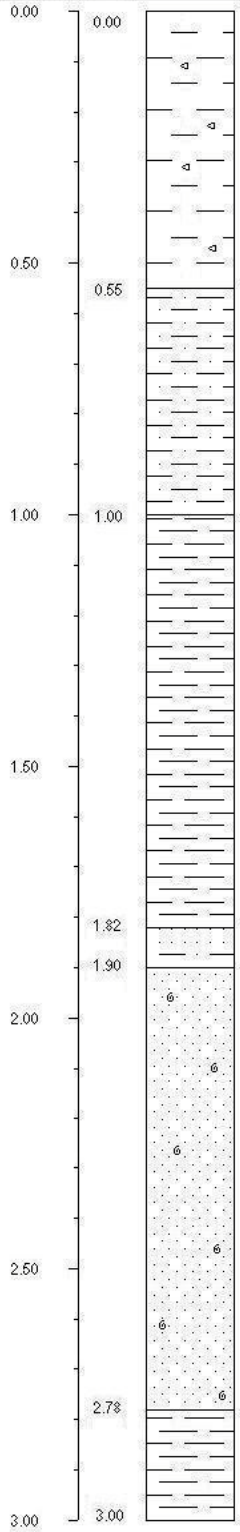
Reference: BDR-SH			Date: 16-07-2007
Coordinates EPE: 3m	UTM (WGS 84) 29S	M: 0516724 P: 4103143	Location: Boca do Rio

Depth (m) -0.2984m below benchmark	LOG	Description	Sampling



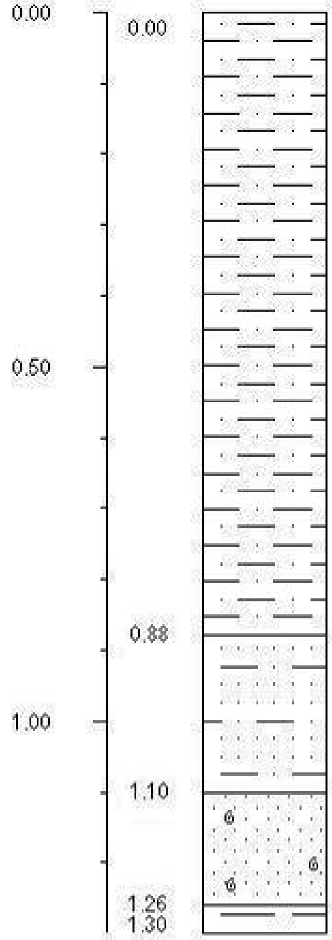
Reference: BDR-SI			Date: 17-07-2007
Coordinates EPE: 5m	UTM (WGS 84) 29S	M: 0516689 P: 4102930	Location: Boca do Rio

Depth (m) +0.5581m above benchmark	LOG	Description	Sampling
0.00 – 0.55		Brown mud with angular centimetric pebbles.	
0.55 – 1.00		Brown mud with charcoal, sand grains and milimetric sub-rounded pebbles.	
1.00 – 1.82		Brown mud.	
1.82 – 1.90		Sandy mud.	
1.90 – 2.78		Medium marine sand with shell fragments.	
2.78 – 3.00		Grey mud.	



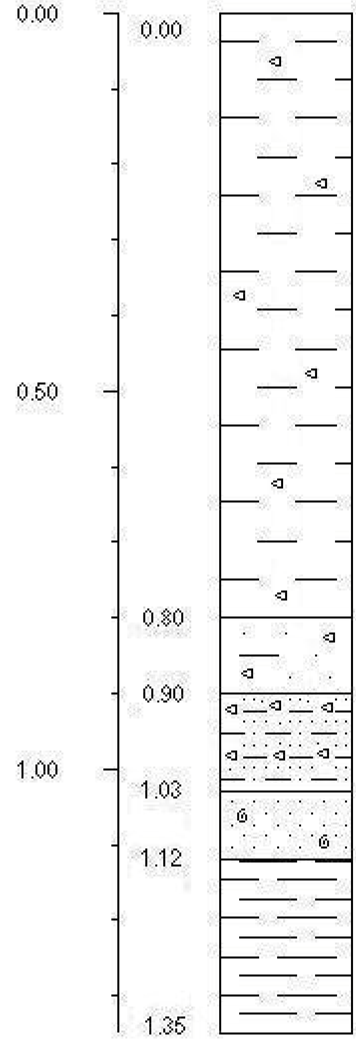
Reference: BDR-SJ			Date: 17-07-2007
Coordinates EPE: 5m	UTM (WGS 84) 29S	**M:** 0516763 **P:** 4102939	**Location:** Boca do Rio

Depth (m) -0.7204m below benchmark	**LOG**	**Description**	**Sampling**
0.00 – 0.88		Brown mud with charcoal and sandy leyers.	
0.88 – 1.10		Muddy sand.	
1.10 – 1.26		Marine medium sand with shell fragments and mud balls near the basal contact.	
1.26 – 1.30		Brown mud with charcoal.	



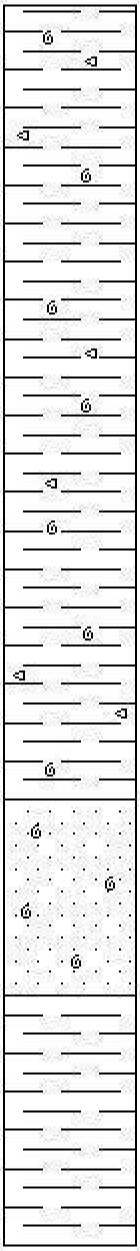
Reference: **BDR-SK**			Date: 17-07-2007
Coordinates EPE: 3m	UTM (WGS 84) 29S	**M:** 0516762 **P:** 4102850	**Location:** Boca do Rio

Depth (m) -0.8422m below benchmark	**LOG**	**Description**	**Sampling**



Depth (m)	Description
0.00 – 0.80	Brown mud with angular centimetric schist pebbles.
0.80 – 0.90	Brown mud with angular centimetric schist pebbles and sand grains.
0.90 – 1.03	Muddy sand with milimetric pebbles.
1.03 – 1.12	Yellow marine sand with shell fragments.
1.12 – 1.35	Brown mud with charcoal.

Reference: **BDR-SL**			**Date:** 17-07-2007
Coordinates EPE: 4m	UTM (WGS 84) 29S	**M:** 0516835 **P:** 4102815	**Location:** Boca do Rio

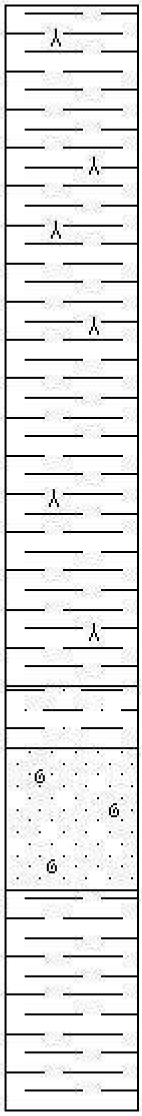
Depth (m) -0.8195m below benchmark	**LOG**	**Description**	**Sampling**
0.00 – 1.05		Brown mud with charcoal and gasteropods shells (helix) and milimetric pebbles.	
1.05 – 1.31		Yellow marine sand with shell fragments and mud balls near the basal contact.	
1.31 – 1.64		Brown mud with charcoal.	

Depth scale: 0.00, 0.50, 1.00, 1.50

Reference: BDR-SM			Date: 17-07-2007
Coordinates	UTM (WGS 84)	M: 0516850	Location:
EPE: 4m	29S	P: 4102740	Boca do Rio

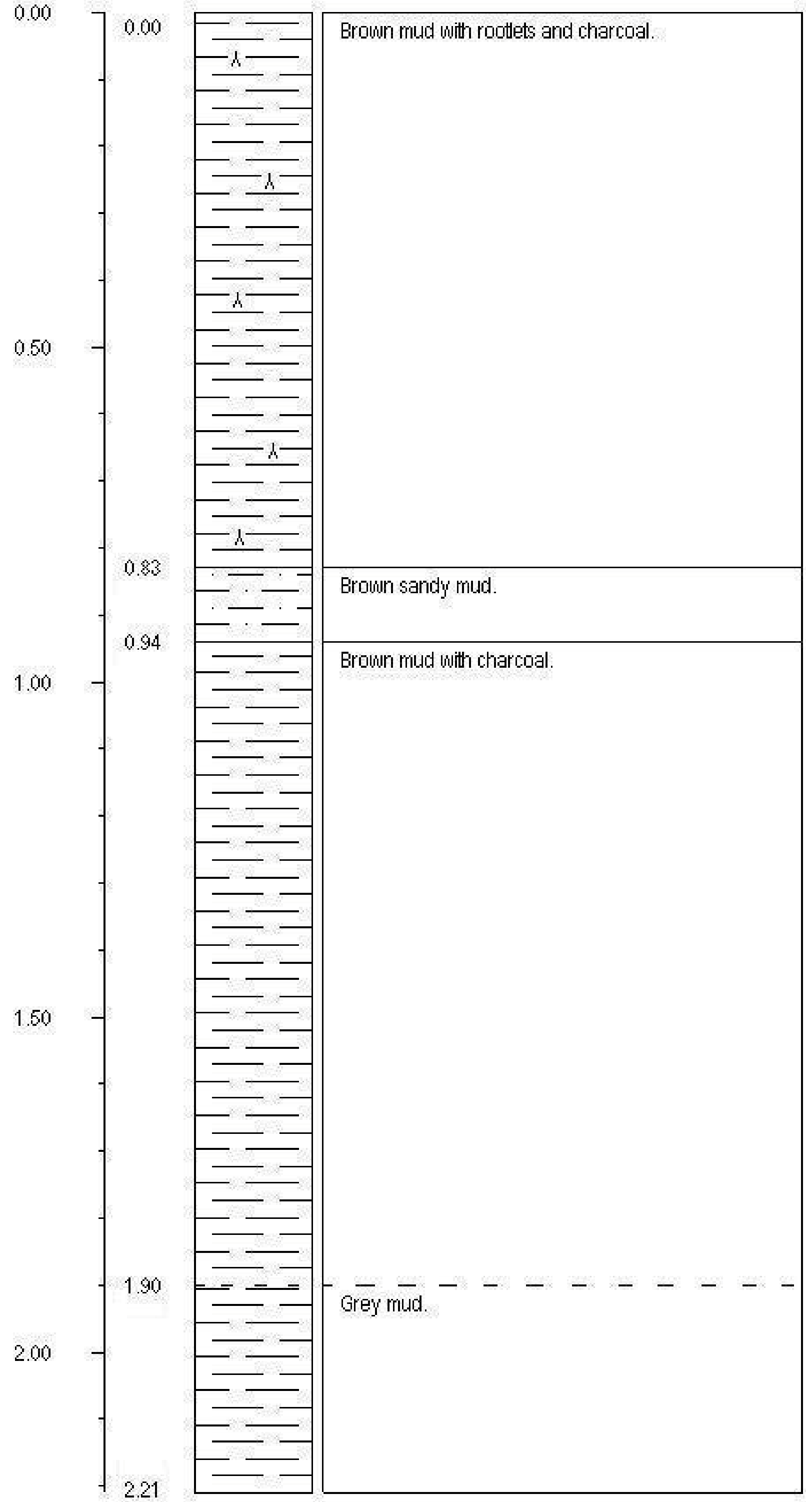
Depth (m) -0.9722m below benchmark	LOG	Description	Sampling
0.00 – 0.90		Brown mud with charcoal and rootlets.	
0.90 – 0.98		Brown mud with very fine sand grains.	
0.98 – 1.17		Yellow marine sand with shell fragments and mud balls.	
1.17 – 1.46		Brown mud with charcoal.	

Depth scale: 0.00, 0.50, 1.00

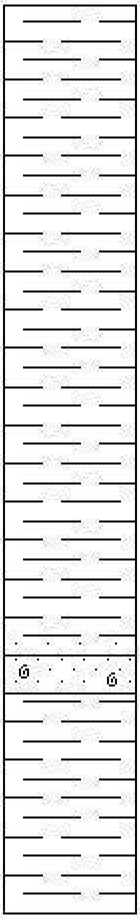


Reference: **BDR-SN**			Date: 17-07-2007
Coordinates EPE: 4m	UTM (WGS 84) 29S	**M:** 0516718 **P:** 4102718	**Location:** Boca do Rio

Depth (m) -0.9938m below benchmark	**LOG**	**Description**	**Sampling**



Reference: **BDR-SO**			Date: 17-07-2007
Coordinates EPE: 4m	UTM (WGS 84) 29S	**M:** 0516701 **P:** 4102800	**Location:** Boca do Rio

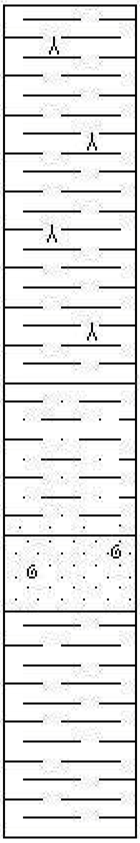
Depth (m) -0.856m below benchmark	**LOG**	**Description**	**Sampling**
0.00 – 0.86		Brown mud with charcoal (sandy near the basal contact)	
0.86 – 0.91		Yellow clean sand with shell fragments.	
0.91 – 1.20		Brown mud.	

Depth scale: 0.00, 0.50, 1.00

Reference: **BDR-SP**			Date: 17-07-2007
Coordinates EPE: 3m	UTM (WGS 84) 29S	**M:** 0516775 **P:** 4102465	**Location:** Boca do Rio

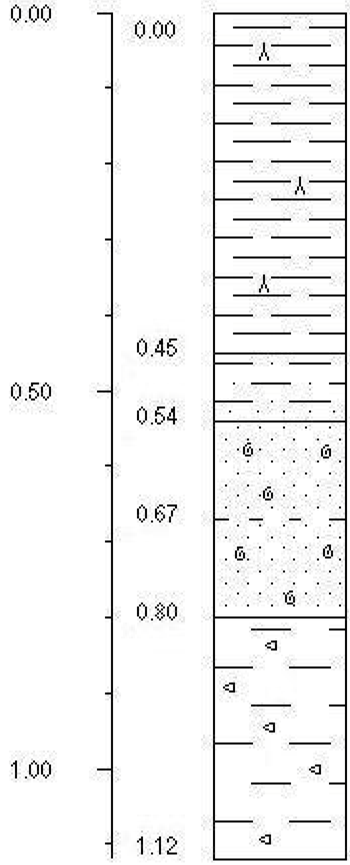
Depth (m) -1.2631m below benchmark	**LOG**	**Description**	**Sampling**
0.00 – 0.50		Brown mud with charcoal and rootlets	
0.50 – 0.70		Brown mud with sand grains more frequent towards the base.	
0.70 – 0.80		Medium yellow clean sand with shell fragments and mud balls (sharp basal contact).	
0.80 – 1.10		Brown mud.	

Depth scale: 0.00, 0.50, 1.00

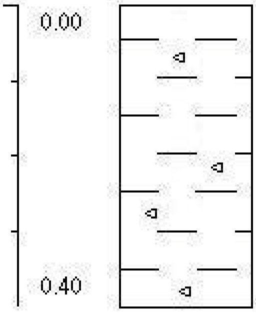


Reference: BDR-SQ			Date: 17-07-2007
Coordinates	UTM (WGS 84)	**M:** 0516848	**Location:**
EPE: 3m	29S	**P:** 4102423	Boca do Rio

Depth (m) -1.3857m below benchmark	LOG	Description	Sampling
0.00 – 0.45		Brown mud with charcoal and rootlets.	
0.45 – 0.54		Brown mud with sand grains more frequent towards the base.	
0.54 – 0.67		Medium yellow sand with shell fragments.	
0.67 – 0.80		The same as above, with mud balls.	
0.80 – 1.12		Brown mud with pebbles and ceramic fragments.	1.00 – 1.07

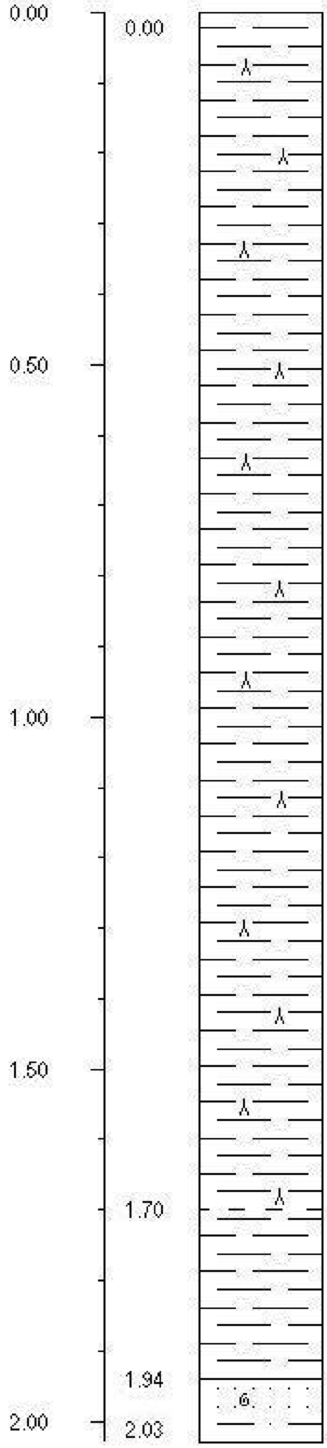


Reference: **BDR-SR**			Date: 18-07-2007
Coordinates EPE: 3m	UTM (WGS 84) 29S	**M:** 0516879 **P:** 4102390	**Location:** Boca do Rio

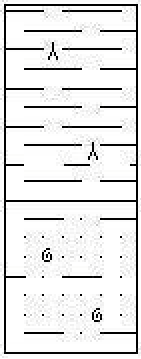
Depth (m) -1.1229m below benchmark	**LOG**	**Description**	**Sampling**
0.00		Brown mud with decimentric angular pebbles.	

Reference: **BDR-SS**			**Date:** 18-07-2007
Coordinates EPE: 4m	UTM (WGS 84) 29S	**M:** 0516910 **P:** 4102526	**Location:** Boca do Rio

Depth (m) -1.2975m below benchmark	**LOG**	**Description**	**Sampling**
0.00 – 1.70		Brown mud with rootlets and charcoal, greyish and more plastic towards the base.	
1.70 – 1.94		Grey plastic mud.	
1.94 – 2.03		Muddy sand with shell fragments.	



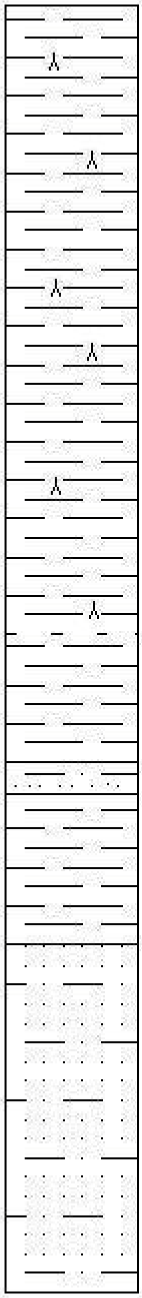
Reference: **BDR-ST**			**Date:** 18-07-2007
Coordinates EPE: 5m	UTM (WGS 84) 29S	**M:** 0516669 **P:** 4102522	**Location:** Boca do Rio

Depth (m) -2.1201m below benchmark	**LOG**	**Description**	**Sampling**
0.00 / 0.00 – 0.21		Brown mud with rootlets and charcoal, greyish towards the base.	
0.21 – 0.26		Grey mud.	
0.26 – 0.46		Muddy sand with shell fragments.	

Reference: **BDR-SU**			**Date:** 18-07-2007
Coordinates	UTM (WGS 84)	**M:** 0517225	**Location:**
EPE: 5m	29S	**P:** 4103049	Boca do Rio

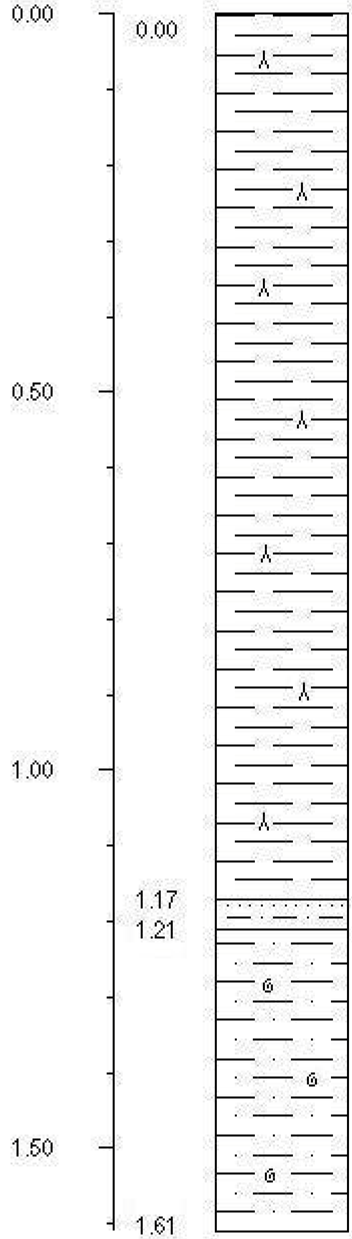
Depth (m) -1.6192m below benchmark	**LOG**	**Description**	**Sampling**
0.00 – 0.83		Brwon mud with rootlets and charcoal.	
0.83 – 1.00		Brown mud greyish towards the base.	
1.00 – 1.04		Medium sand with muddy levels.	
1.04 – 1.24		Grey mud.	
1.24 – 1.70		Medium sand with grey muddy levels.	

Depth scale: 0.00, 0.50, 1.00, 1.50



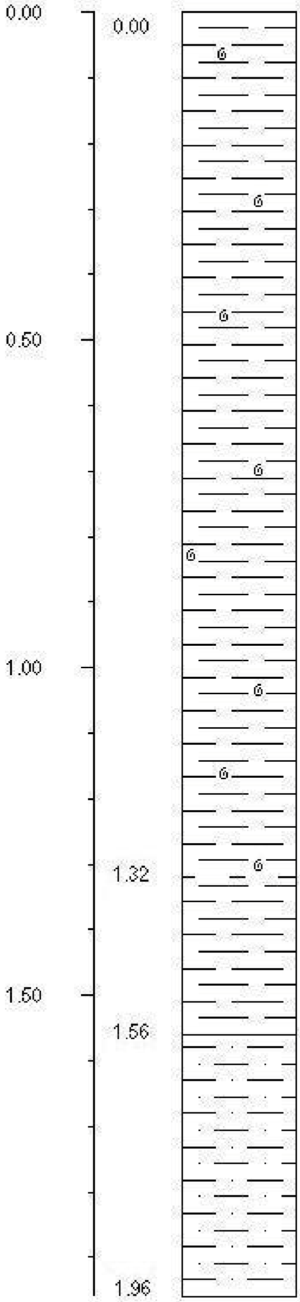
Reference: BDR-SV			Date: 18-07-2007
Coordinates EPE: 3m	UTM (WGS 84) 29S	**M:** 0517152 **P:** 4102967	**Location:** Boca do Rio

Depth (m) -1.5613m below benchmark	**LOG**	**Description**	**Sampling**
0.00 – 1.17		Brown mud with charcoal and rootlets, greyish towards the base.	
1.17 – 1.21		Medium and fine sand with grey mud levels.	
1.21 – 1.61		Grey mud with sandy levels and shell fragments.	



Reference: **BDR-SW**			**Date:** 18-07-2007
Coordinates EPE: 4m	UTM (WGS 84) 29S	**M:** 0517057 **P:** 4102959	**Location:** Boca do Rio

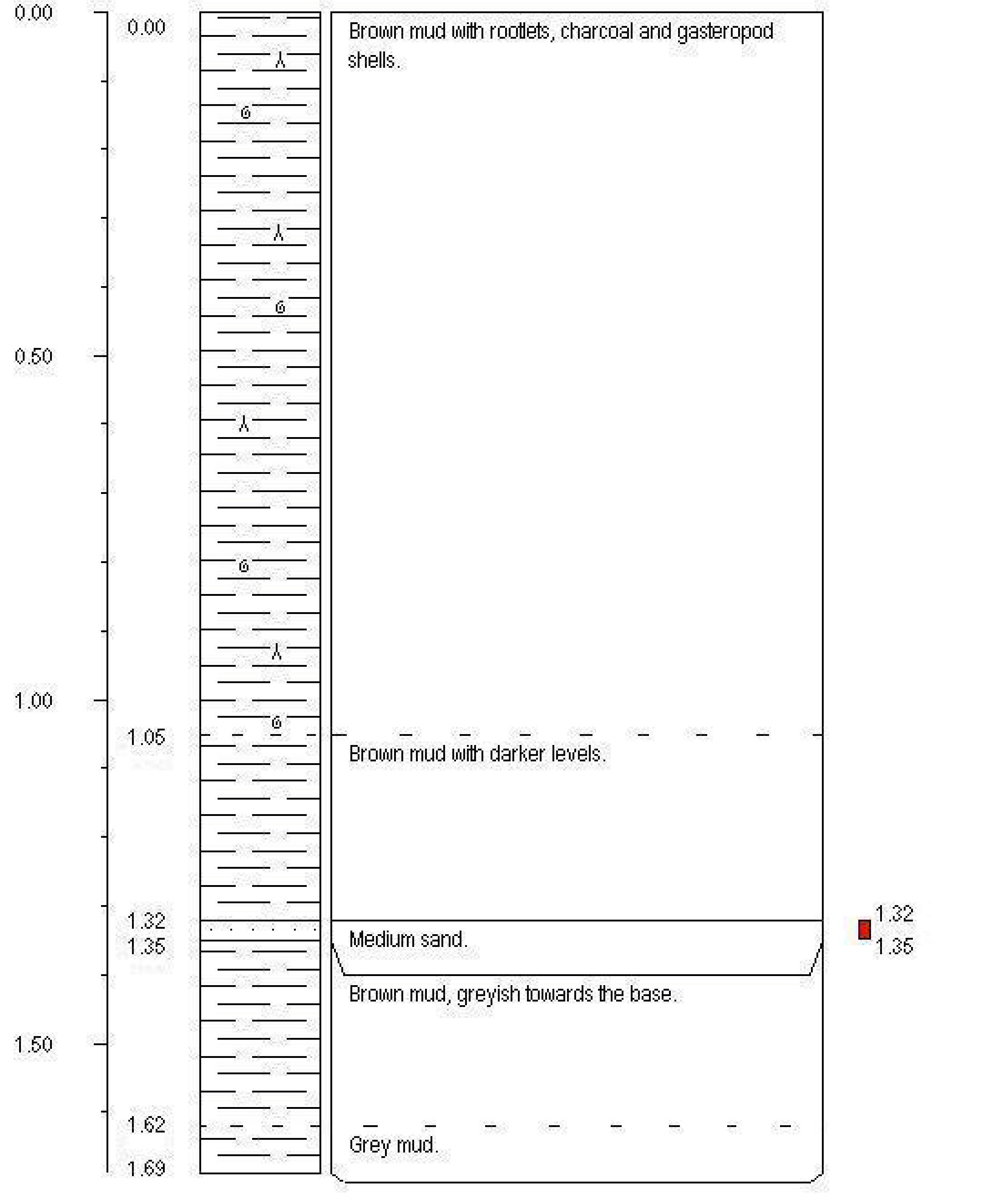
Depth (m) -1.3846m below benchmark	**LOG**	**Description**	**Sampling**



Depth (m)	Description
0.00 – 1.32	Very plastic brown mud with gasteropod shells and charcoal.
1.32 – 1.56	Brown mud, greyish towards the base.
1.56 – 1.96	Grey mud with sandy levels.

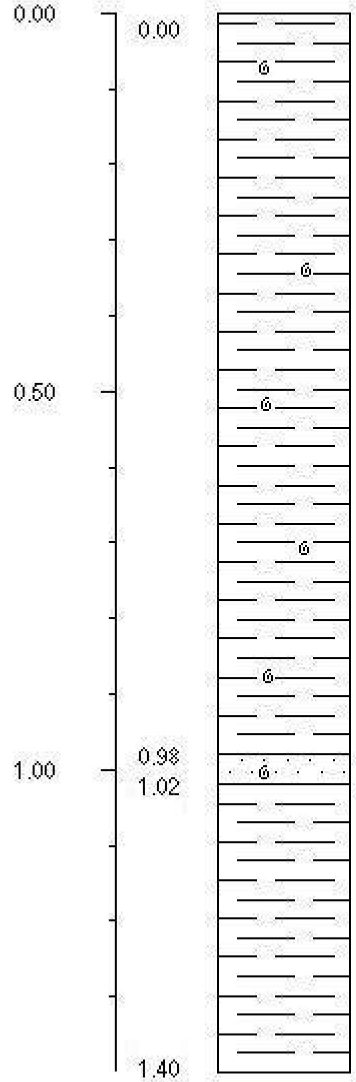
Reference: **BDR-SX**			Date: 18-07-2007
Coordinates EPE: 3m	UTM (WGS 84) 29S	**M:** 0517018 **P:** 4102939	**Location:** Boca do Rio

Depth (m) -1.3293m below benchmark	**LOG**	**Description**	**Sampling**



Reference: **BDR-SY**			Date: 18-07-2007
Coordinates EPE: 3m	UTM (WGS 84) 29S	**M:** 0517041 **P:** 4102850	**Location:** Boca do Rio

Depth (m) -1.4788m below benchmark	**LOG**	**Description**	**Sampling**



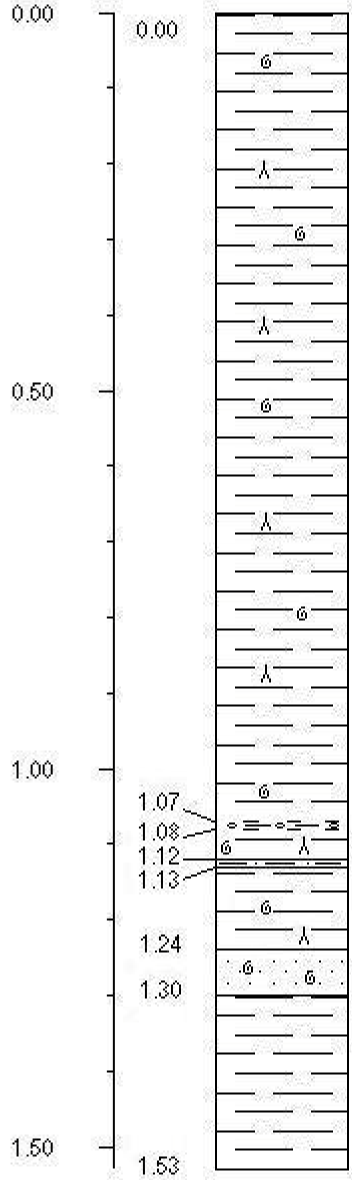
Brown mud with gasteropod shells and charcoal.

Medium light brown sand with shell fragments.

Brown mud, greyish towards the base.

Reference: BDR-SZ			Date: 18-07-2007
Coordinates	UTM (WGS 84)	M: 0516959	Location:
EPE: 4m	29S	P: 4102945	Boca do Rio

Depth (m) -1.2263m below benchmark	LOG	Description	Sampling



Brown mud with rootlets, charcoal and gasteropod shells.

Pastic brown mud with frequent sub-rounded schist pebbles.

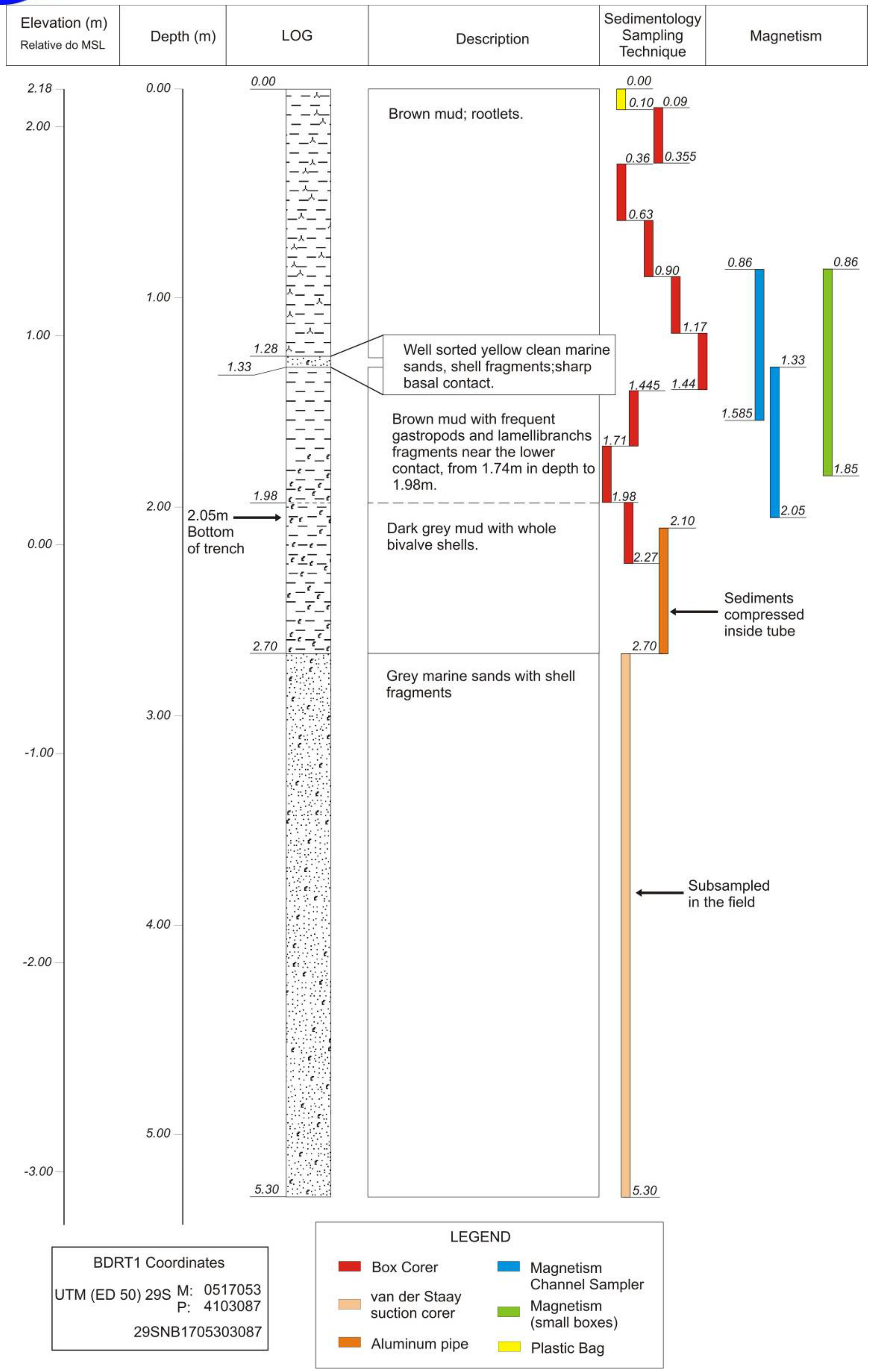
Brown mud with rootlets, charcoal and gasteropod shell.

Pastic brown mud with very fine sand grains.

Brown mud with rootlets, charcoal and gasteropod shell.

Yellow sand with shell fragments and mud balls towards the base (sharp upper and basal contacts).

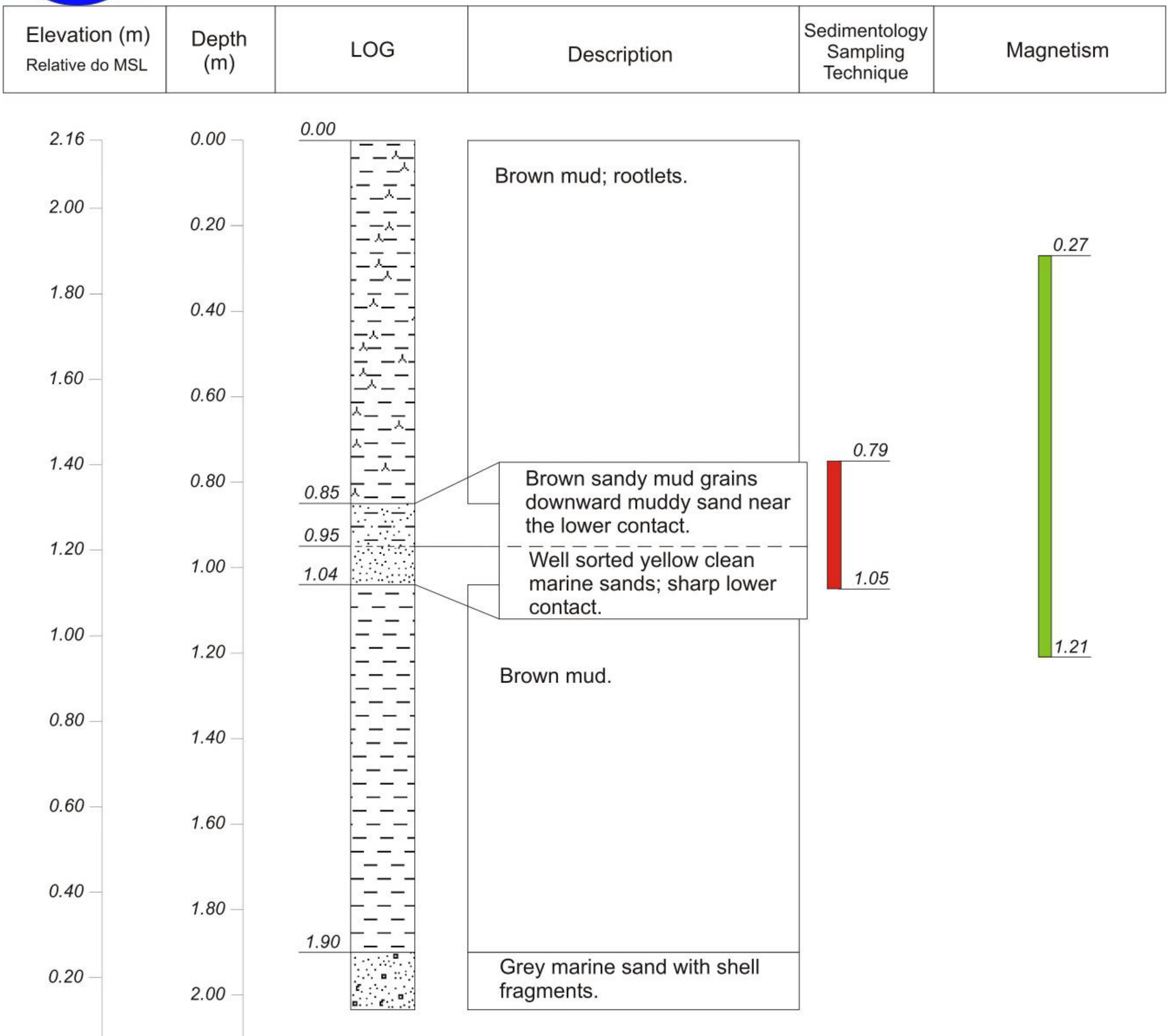
Plastic brown mud.



BDRT1 Coordinates

UTM (ED 50) 29S M: 0517053
P: 4103087

29SNB1705303087



BDRT2 Coordinates

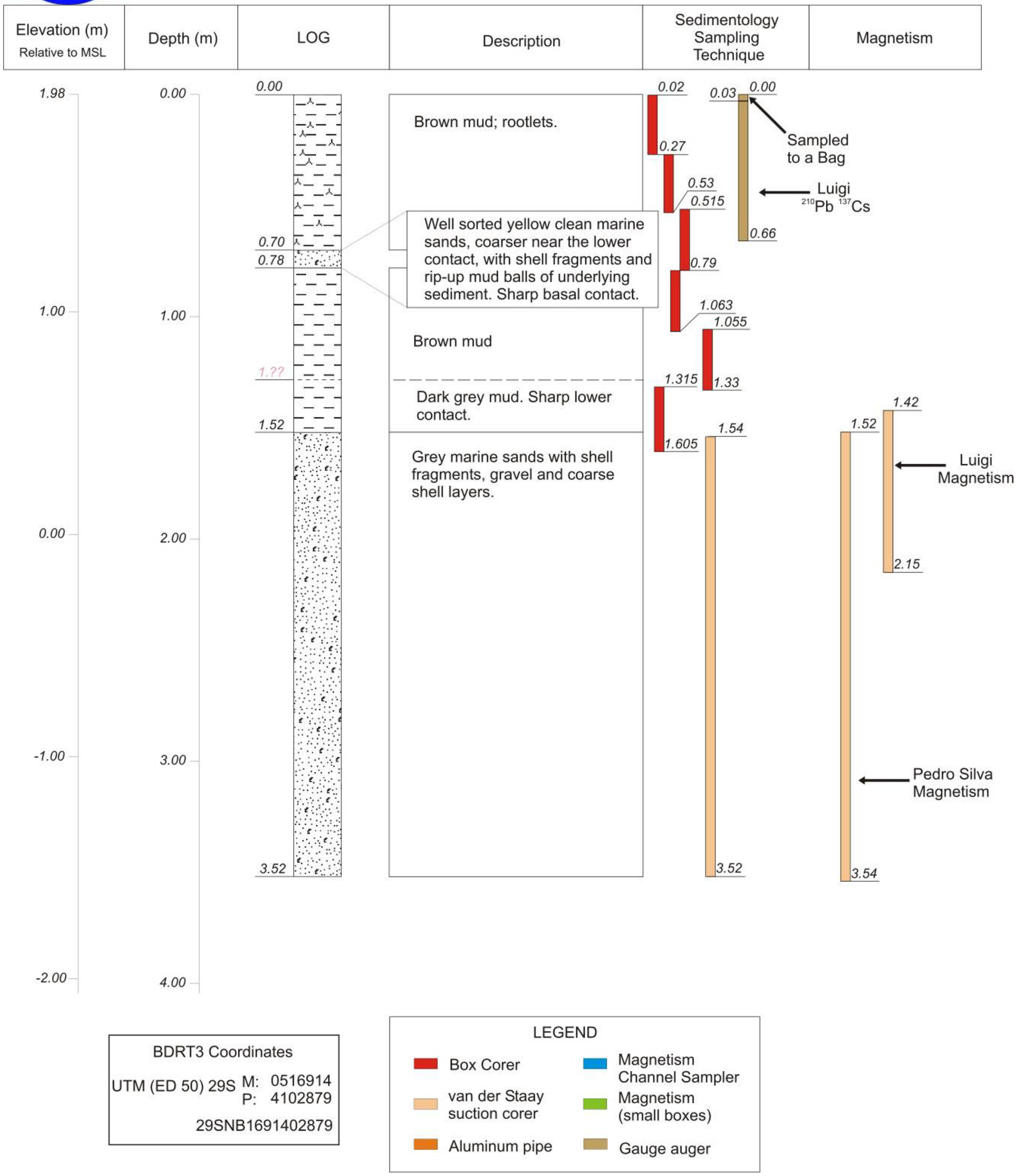
UTM (ED 50) 29S M: 0516903
P: 4102994

29SNB1690302994

LEGEND

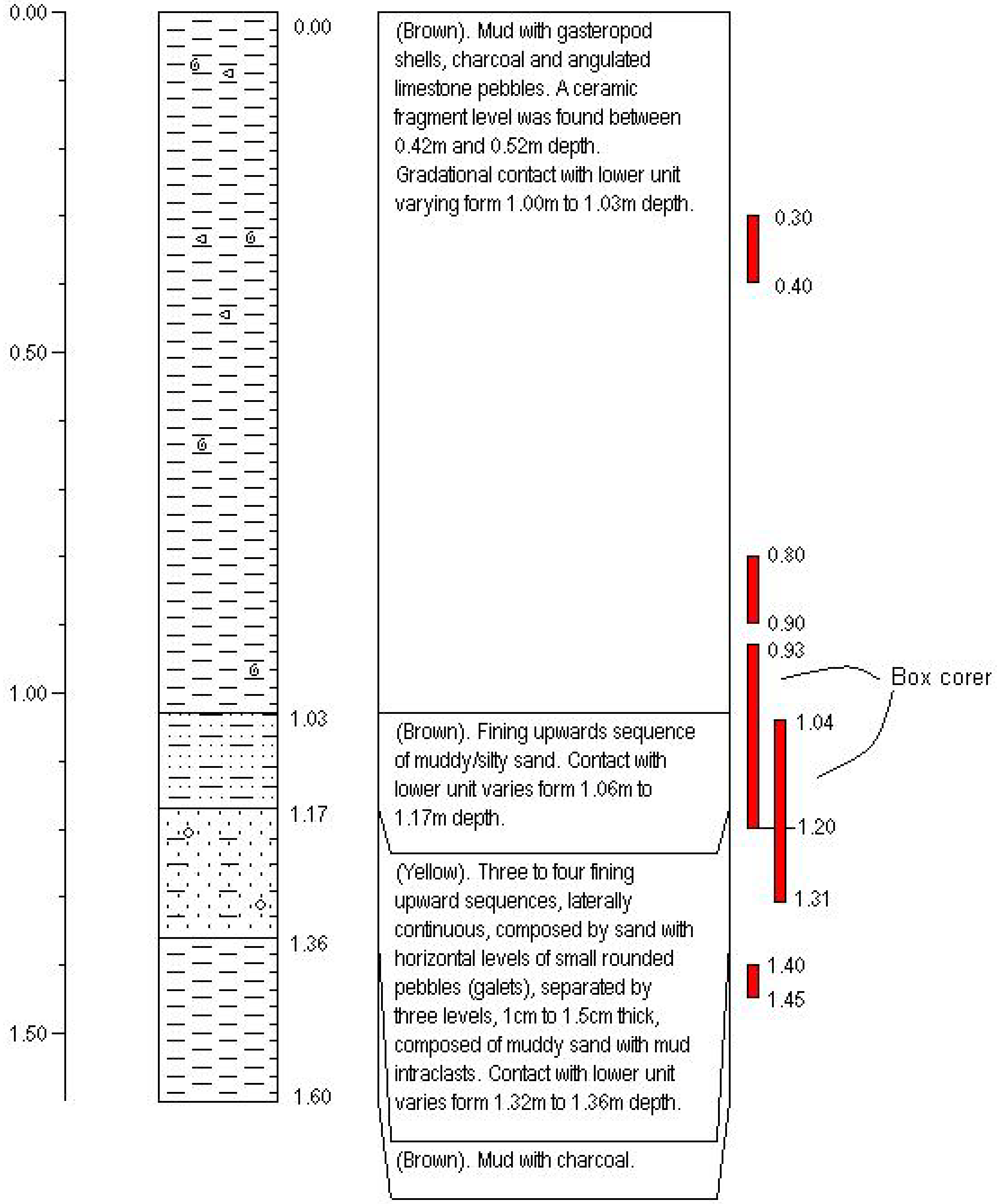
Box Corer

Magnetism (small boxes)



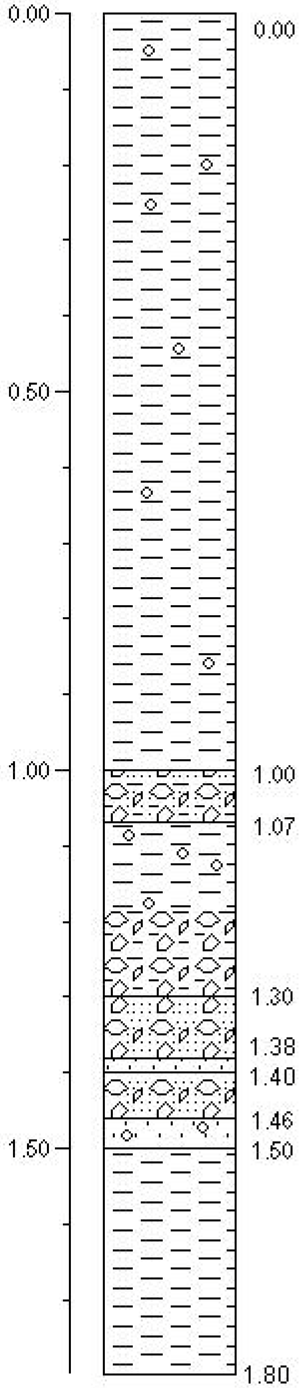
Elevation (m) Relative to MSL
Depth (m)
LOG
Description
Sedimentology Sampling Technique
Magnetism
Brown mud; rootlets.
Well sorted yellow clean marine sands, coarser near the lower contact, with shell fragments and rip-up mud balls of underlying sediment. Sharp basal contact.
Brown mud
Dark grey mud. Sharp lower contact.
Grey marine sands with shell fragments, gravel and coarse shell layers.
Sampled to a Bag
Luigi ^{210}Pb ^{137}Cs
Luigi Magnetism
Pedro Silva Magnetism
1.98
1.00
0.00
-1.00
-2.00
0.00
1.00
2.00
3.00
4.00
0.00
0.70
0.78
1.??
1.52
3.52
0.02
0.27
0.53
0.515
0.79
1.063
1.055
1.315
1.33
1.605
1.54
3.52
0.03
0.00
0.66
1.42
1.52
2.15
3.54
BDRT3 Coordinates
UTM (ED 50) 29S M: 0516914
P: 4102879
29SNB1691402879
LEGEND
Box Corer
van der Staay suction corer
Aluminum pipe
Magnetism Channel Sampler
Magnetism (small boxes)
Gauge auger

Reference: BDR 09 A			Date: 10-07-2009
Coordinates	UTM (ED50) 29S	M: 0516863 P: 4103176	Location: Boca do Rio
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: BDR 09 C			Date: 10-07-2009
Coordinates	UTM (ED50) 29S	M: 0516736 P: 4103238	Location: Boca do Rio

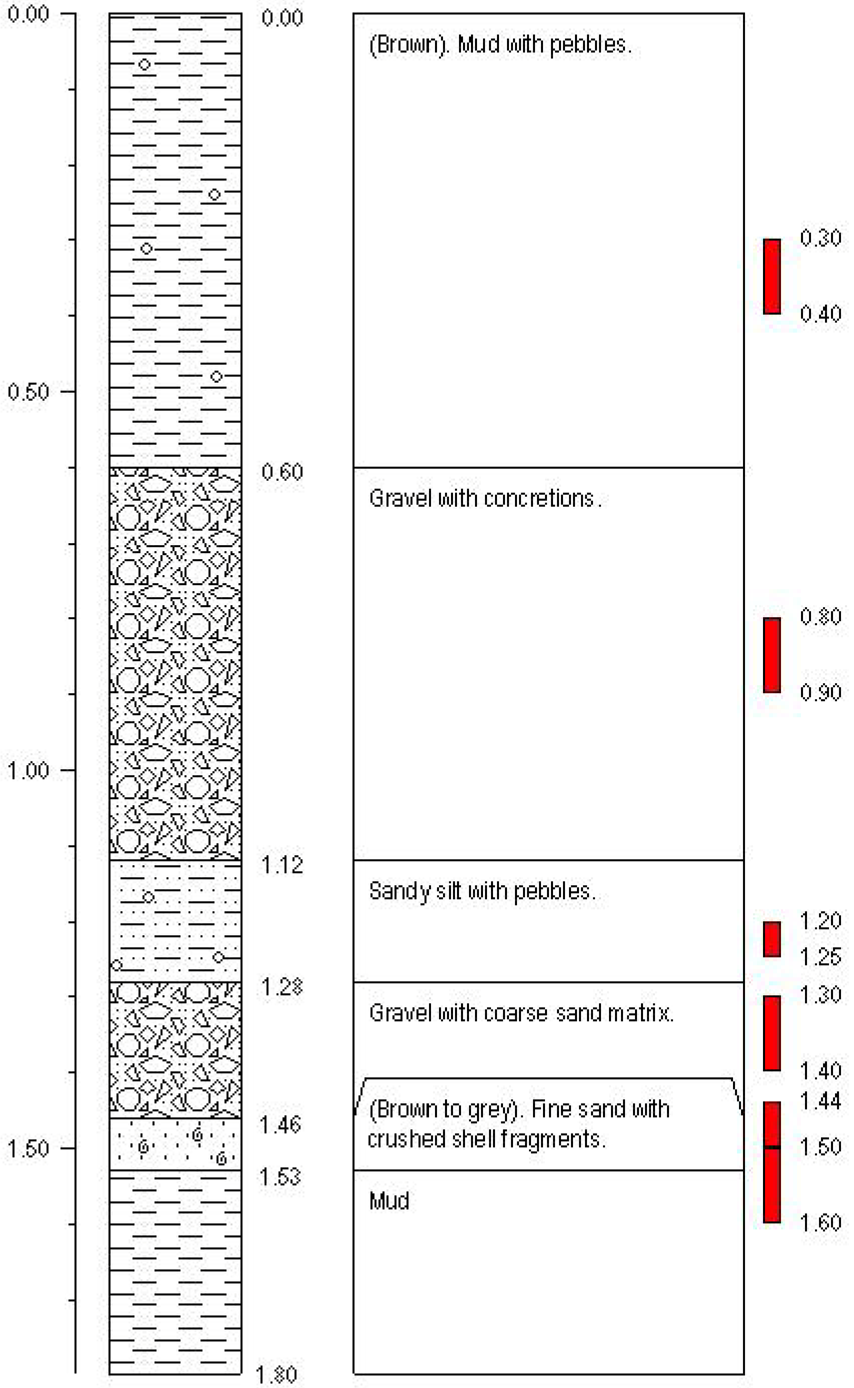
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



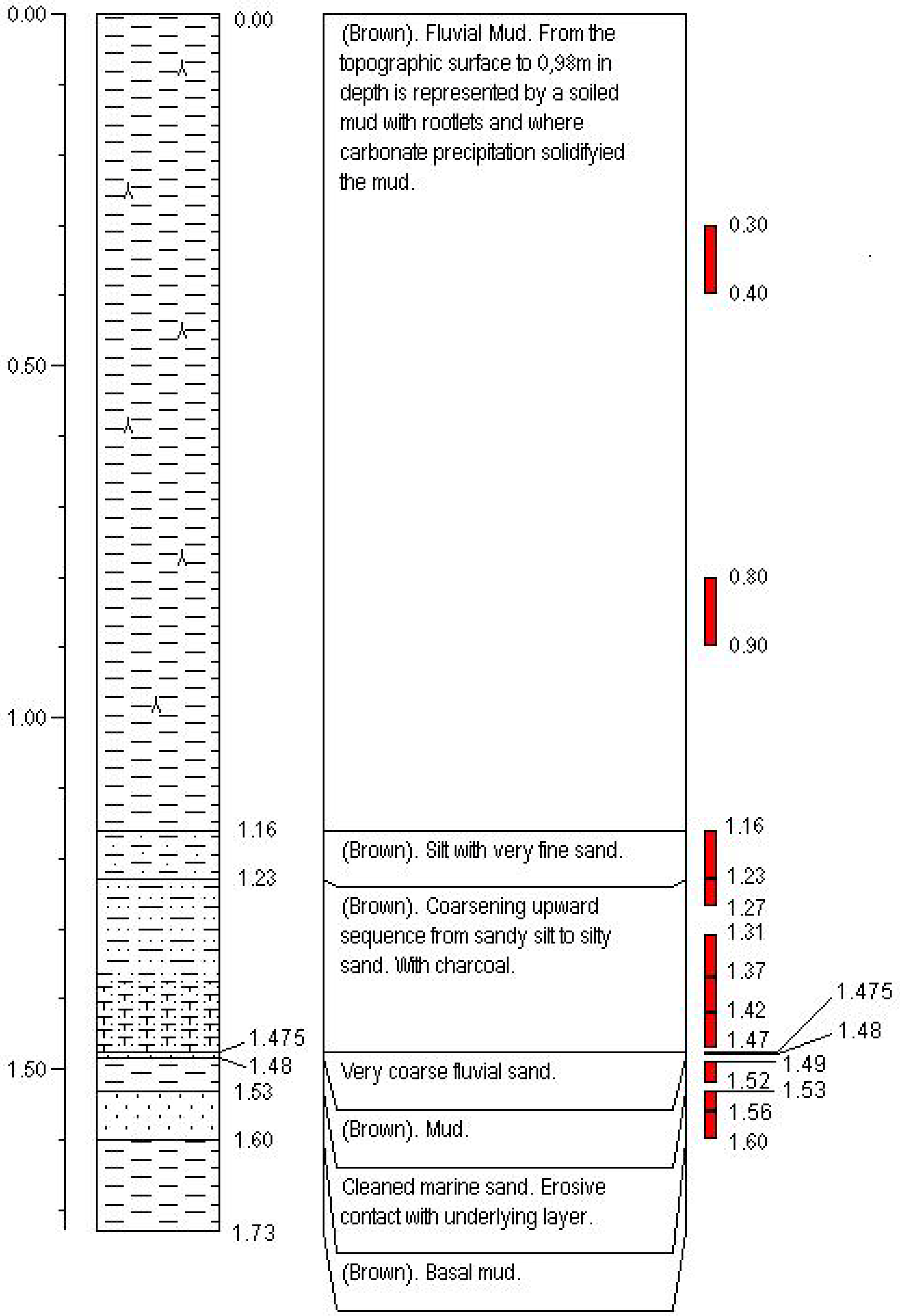
Depth (m)	Description
0.00 – 1.00	(Brown). Mud with milimetric disks of schist. Carbonate precipitation solidifyied the mud.
1.00 – 1.07	Gravel with muddy matrix.
1.07 – 1.30	Fining upward sequence composed of mud with schist and graywake pebbles (Carboniferous) becoming a gravel with muddy matrix towards the base.
1.30 – 1.38	Fluvial gravel with sandy matrix.
1.38 – 1.46	Sand
1.46 – 1.50	Fluvial gravel with sandy matrix
1.50 – 1.80	(White to yellow). Medium to coarse sand with frequent schist and graywake carboniferous pebbles.
	Basal mud.

Sampling Depth (m): 0.30 – 0.40; 0.80 – 0.90; 1.00 – 1.07 – 1.15; 1.30 – 1.38 – 1.40 – 1.46 – 1.50 – 1.60

Reference: BDR 09 D			Date: 10-07-2009
Coordinates	UTM (ED50) 29S	M: 516772 P: 4103208	Location: Boca do Rio
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

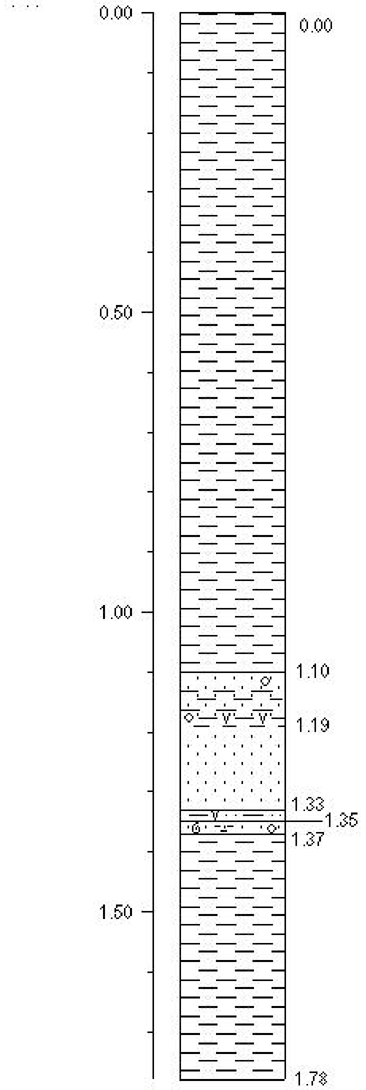


Reference: BDR 09 E			Date: 10-07-2009
Coordinates	UTM (ED50) 29S	M: 0516858 P: 4103372	Location: Boca do Rio
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: BDR 09 F			Date: 10-07-2009
Coordinates	UTM (ED50) 29S	M: 516908 P: 4103450	Location: Boca do Rio

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Brown). Pedogenized mud. Contact with lower unit varies form 1.05m to 1.10m

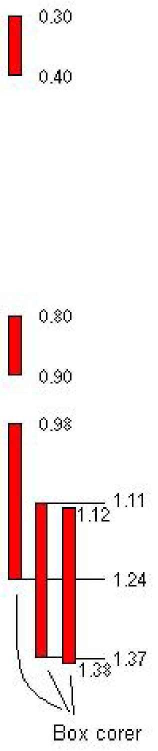
(Brown). The top section is composed of poorly sorted medium to fine sand with small quartz pebbles and inconspicuous horizontal planar lamination as a result of the alignment of charcoal fragments. The bottom section of the layer is composed of a muddy sand with sandy levels containing small (5 to 6mm) schist pebbles and centimetric silt balls with charcoal and plant debris, forming sigmoid patterns (sigmoidal cross-bedding?) alternating from light to dark brown pending 12° to 20° south. Contact with underlying layer varies form 1.18m to 1.19m depth.

(Brown). It can be divided in two horizons: the upper horizon is composed of fine to medium sand, poorly sorted (3cm thickness); the lower horizon is composed of very fine to fine sand, well sorted with heavy minerals and no shell fragments. This layer presents sub-horizontal planar lamination pending south, decreases in thickness towards south and the lower contact varies from 1.28m to 1.33m in depth.

(Brown). Sandy to silty mud with fine sand grains, frequent fermented plant remains and charcoal. Without shell fragments. The contact with the underlying layer varies between 1.32 and 1.35m in depth.

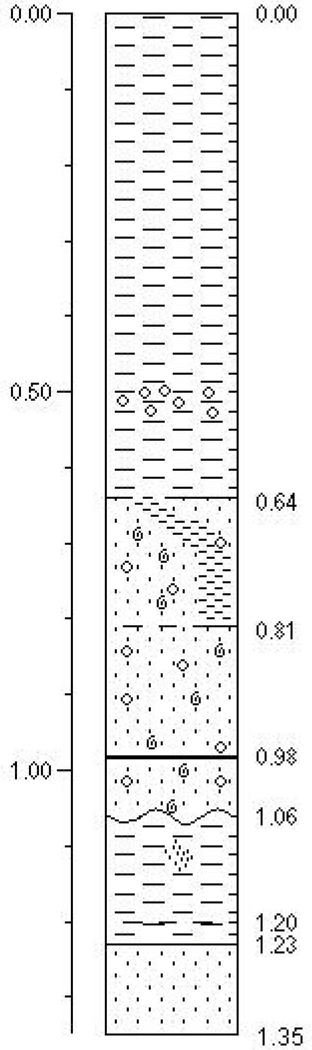
(White). Discontinuous layer, presenting a milimetric to centimetric thickness, composed of marine sand with mud balls and limestone pebbles in the base (when the layer 6cm). This layer decreases in thickness towards west and the contact with the underlying layer varies between 1.27m and 1.48m in depth.

(Brown). Mud.



Reference: BDR 09 G			Date: 11-07-2009
Coordinates	UTM (ED50) 29S	M: 516981 P: 4102623	Location: Boca do Rio

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Compact mud with few decimetric pebbles arround 0.50m depth. Contact with underlying layer varies from 0.45m to 0.64m, pending 10° south.

(Brown to orange). Cemented (due to carbonate precipitation) sand with small limestone pebbles (1cm), rich in bioclasts. The sandy layer is interdigitated with dark brown mud (1mm to 2cm levels of mud witch incorporate the sand).

(Reddish brown to orange). Sand with few shells, limestone and quartz pebbles.

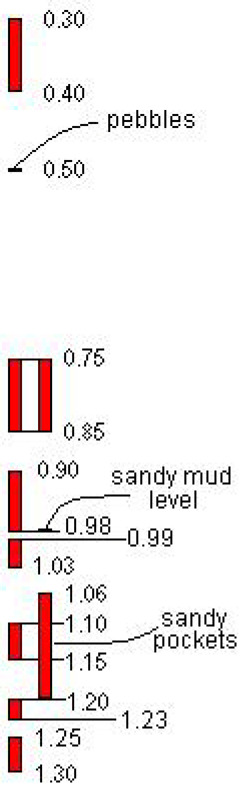
Darker milimetric level composed of sandy mud / muddy sand, pending 2° north.

Clean well sorted sand with shell fragments and limestone pebbles. Contact with underlying layer is erosive, varying from 1.06m to 1.08m depth, pending south, and presents load casts.

(Brown). Mud with sandy pockets.

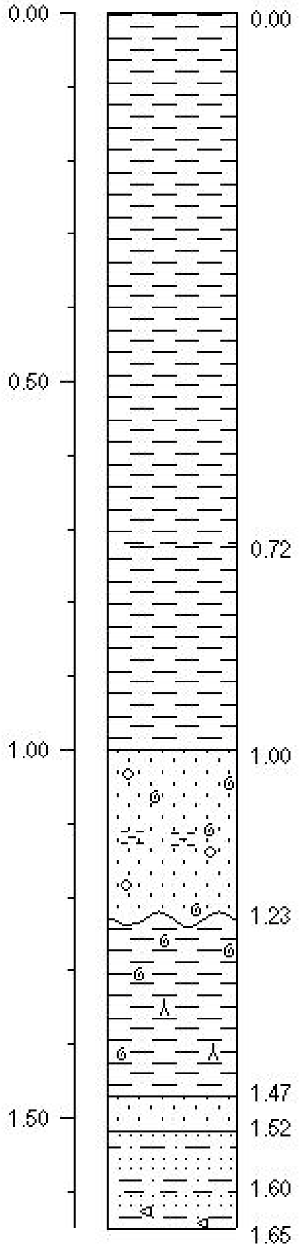
(Grey). Mud with plant remains.

(Grey). Basal sand with shell fragments.



Reference: BDR 09 H			Date: 11-07-2009
Coordinates	UTM (ED50) 29S	M: 517008 P: 4102657	Location: Boca do Rio

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Compact pedogenized mud.

(Brown). Mud with reddish and black spots composed of plastic mud. Lower contact is gradual.

(Light). Medium sand with pebbles and bioclasts alternated with brown fine sandy mud layers with reddish and black spots composed of plastic mud, rounded quartz grains and angulated bioclasts (1.11-1.15m). Contact with lower unit is erosive and presents load casts.

Brown mud, that towards the base becomes a dark grey oily and plastic mud. It contains sand grains similar to the lower sandy unit, vertical rootlets, some of which are burned. The bioclastic content increases in the top of the unit.

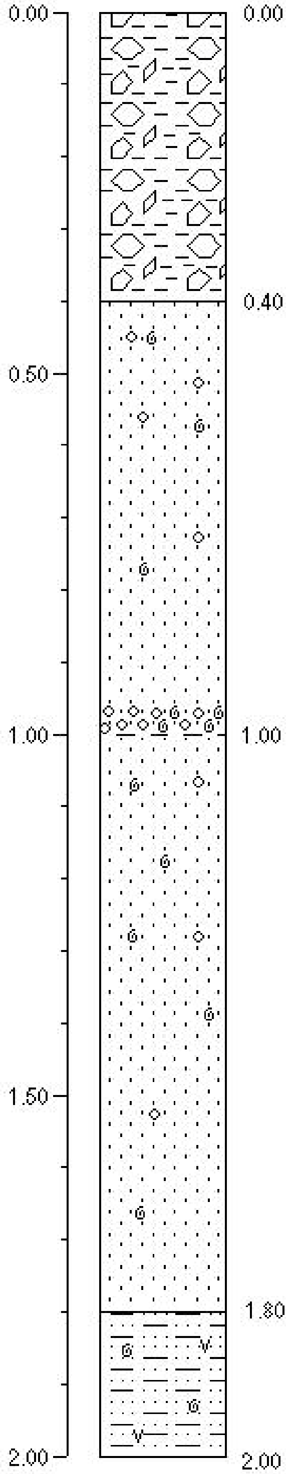
(Grey). Sand.

(Greyish orange). Coarse muddy sand.

(Dark grey). Medium to coarse, well sorted quartzic muddy sand, with dark minerals and angulated bioclasts.

Reference: BDR 09 I			Date: 11-07-2009
Coordinates	UTM (ED50) 29S	M: 0517035 P: 4102573	Location: Boca do Rio

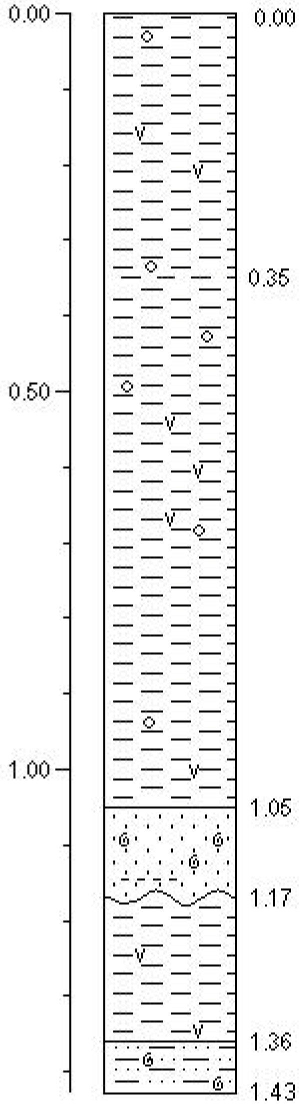
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Depth (m)	Description	Sampling Depth (m)
0.00–0.40	Limestone pebbles and cobbles in a brown muddy matrix.	
0.40–1.00	Sand with rounded pebbles and small and large bioclasts. At the base there is a level of well rounded perforated pebbles with endolithic bivalve shells.	0.75–0.85
1.00–1.80	(Yellow). Clean, well sorted sand with rounded grains and few heavy minerals, bioclasts and litoclasts.	1.07 cobble with endolithic bivalve shells; 1.20–1.30
1.80–2.00	(Grey to black). Muddy sand to sandy mud, with helix (gasteropods) and frequent fermented and burned plant remains.	1.80–2.00 ^{14}C

Reference: BDR 09 J			Date: 11-07-2009
Coordinates	UTM (ED50) 29S	M: 0516934 P: 4102697	Location: Boca do Rio

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Brown). Soiled mud with pebbles, oxidation spots and vegetable matter.

(Brown). Mud with pebbles, oxidation spots and vegetable matter more frequent at the top.

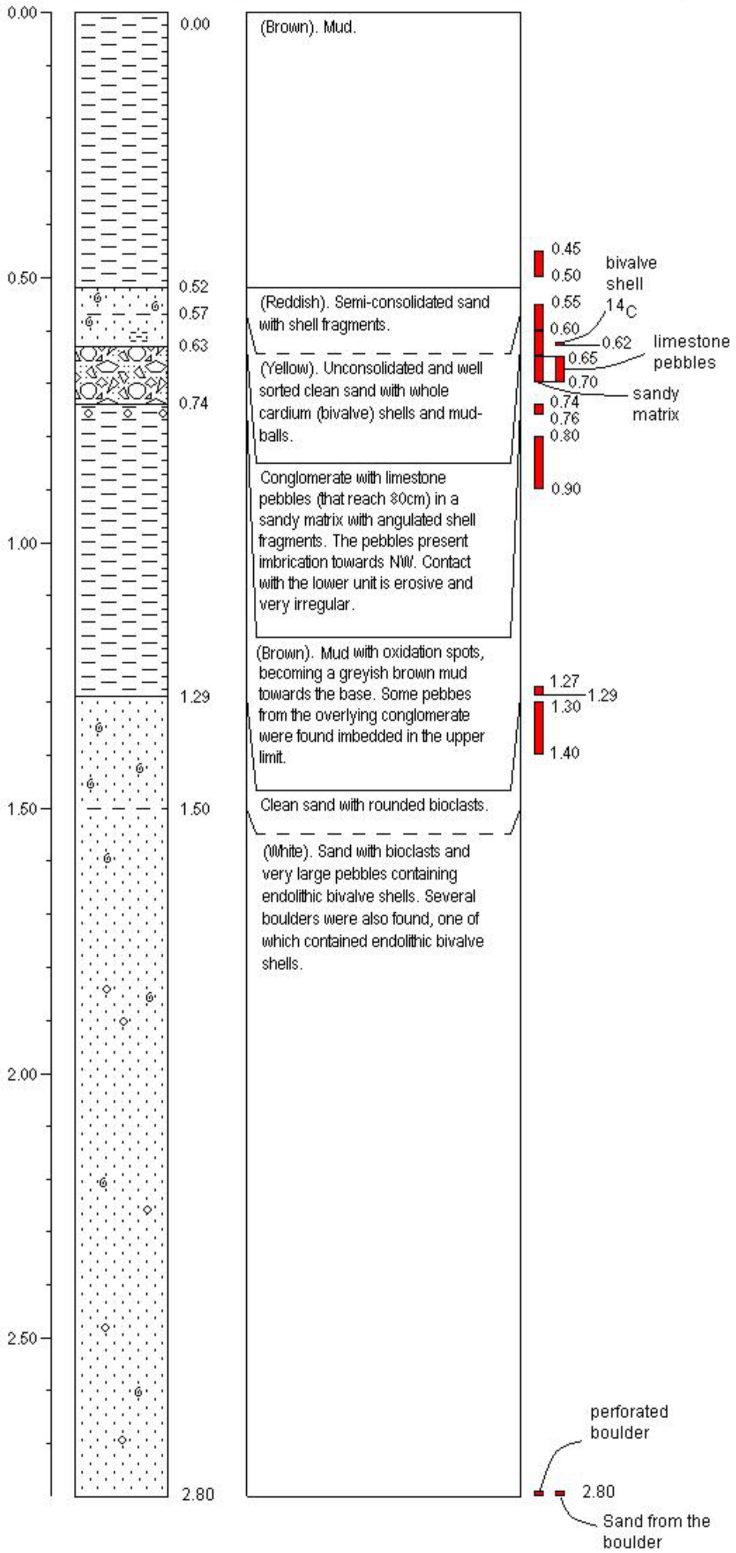
Fining upward sequence composed of fine to medium sand with with many bioclasts and with darker muddy layers in the base. Erosive contact with underlying layer with load casts.

Plastic mud, brown at the top and greyish towards the base, with plant debris.

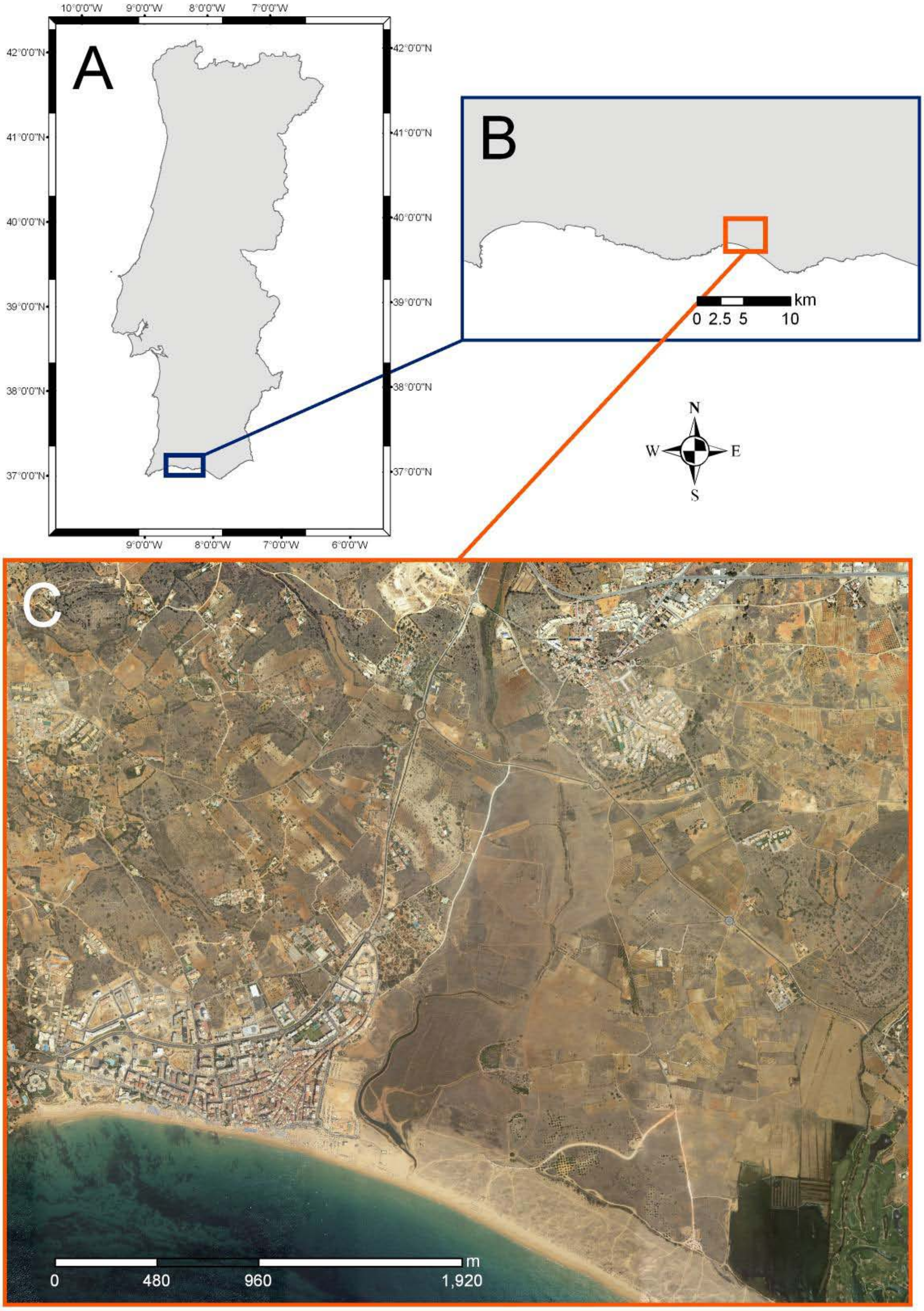
(Grey). Medium muddy sand with bioclasts.

0.96
Box-corer
1.22

Reference: BDR 09 K			Date: 11-07-2009
Coordinates	UTM (ED50) 29S	M: 0516841 P: 4102738	Location: Boca do Rio
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

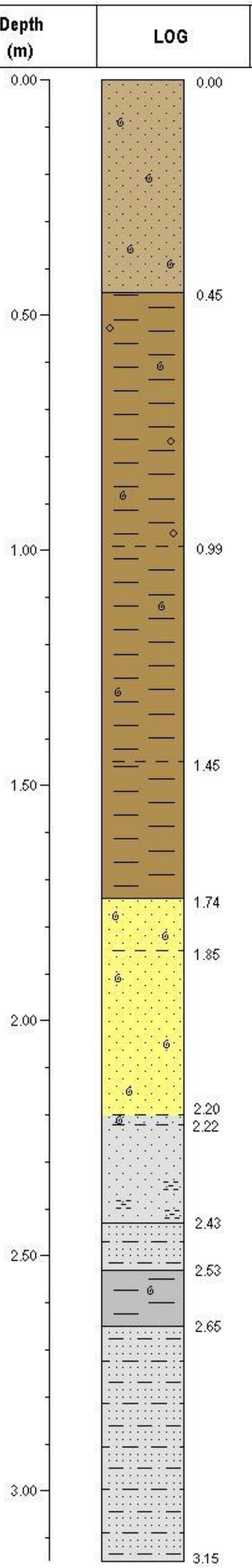


ALCANTARILHA




Alluvial Plain
Land Fill
Backbarrier
Dune
Beach
Scarp
River Channel
0
220
440
880
m
N
S
E
W
ARMAÇÃO DE PERA
Praia
Canelas
Torre
Caliços
S. Sebastião
ALCANTARI
PERA
Mo gado das Relvas

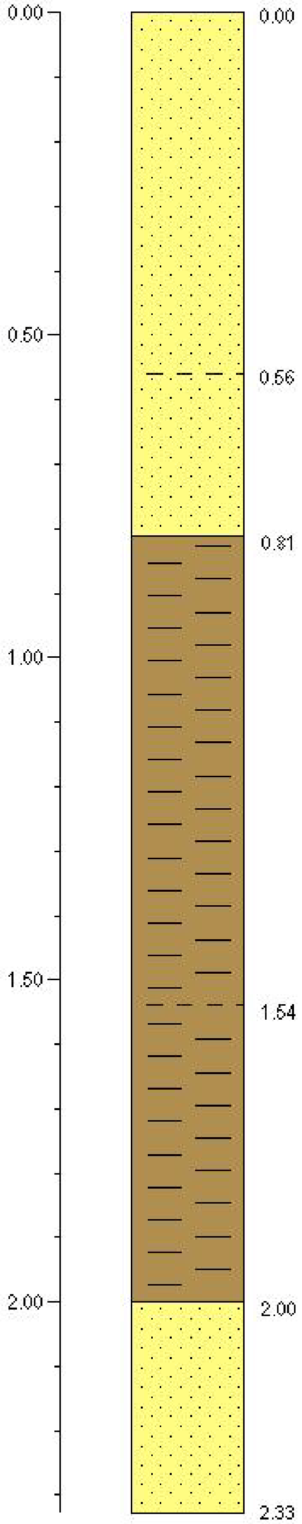
Reference: Alc1		Date: 17-06-2008
Coordinates UTM (ED50) 29S	M: 0557990 P: 4106601	Location: Alcantarilha Stream Lowland



Depth (m)	Description
0.00 – 0.45	(Brown). Medium Sand. Well sorted with rounded grains. Marine shell fragments and terrestrial gastropod shell fragments present.
0.45 – 0.99	(Brown). Compact Mud. With scarse limestone pebbles. One terrestrial gasteropod shell present.
0.99 – 1.45	(Brown). Compact Mud. With charcoal, terrestrial gasteropod and marine shells.
1.45 – 1.74	Plastic Mud.
1.74 – 1.85	Medium to Coarse Sand with whole gasteropod bioclasts.
1.85 – 2.20	(Yellow). Medium to Coarse Sand with whole gasteropod bioclasts and a bivalve shell fragment.
2.20 – 2.22	(Grey). Medium to Coarse Sand with whole gasteropod bioclasts and a bivalve shell fragment.
2.22 – 2.43	(Grey). Sand with mud balls.
2.43 – 2.53	(Grey). Muddy Sand.
2.53 – 2.65	(Grey). Mud. With some shell fragments.
2.65 – 3.15	(Grey). Muddy Sand.

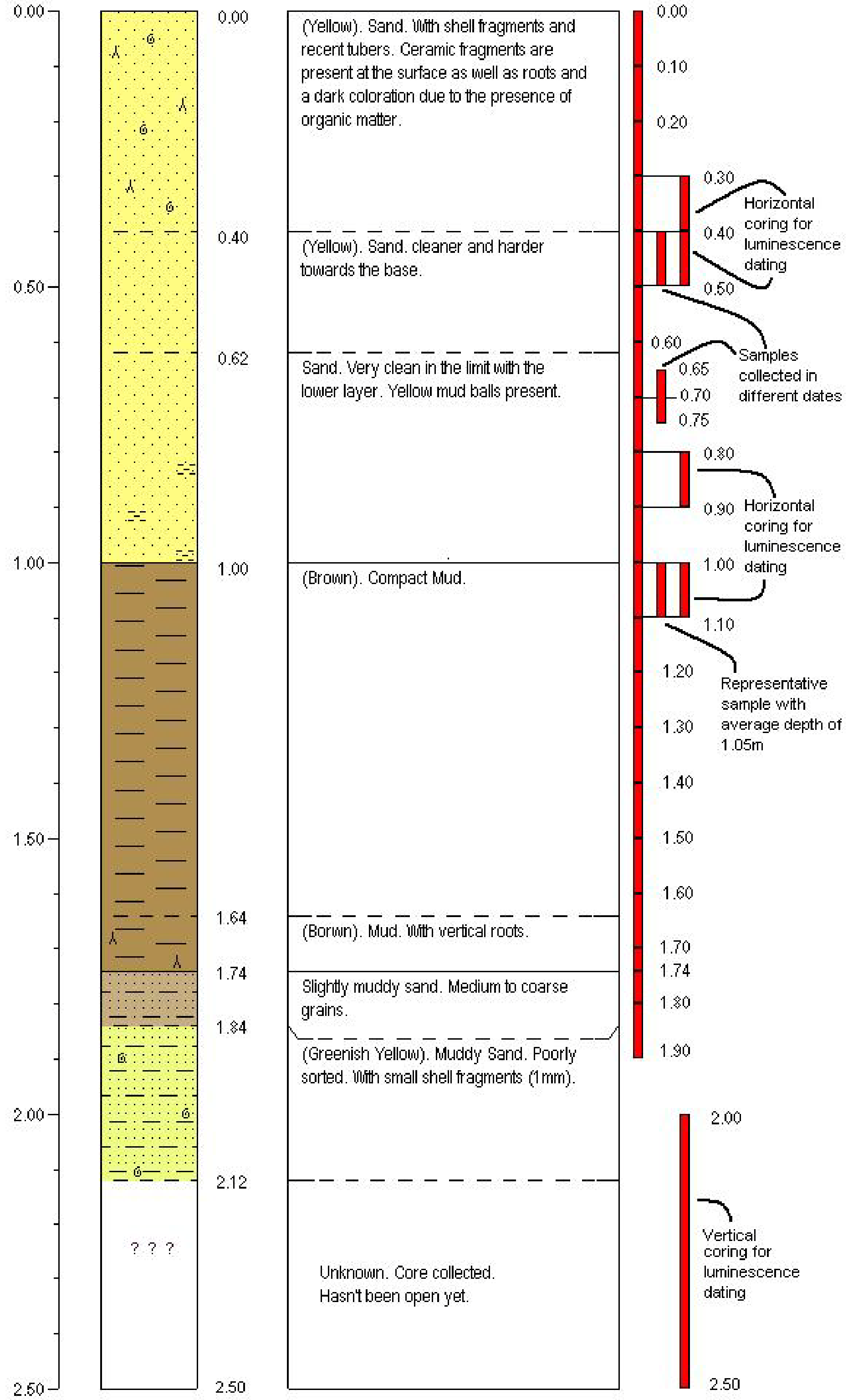
Reference: **Alc2**	Date: 17-06-2008
Coordinates UTM (ED50) 29S — **M:** 0557986 **P:** 4106539	**Location:** Alcantarilha Stream Lowland

Depth (m)	LOG	Description
0.00	0.00	Medium Sand with bioclasts and with terrestrial gasteropods at the surface. Harder sand with ceramic fragments towards the base.
	0.56	(Yellow). Soft beach medium sand. Weel sorted. With well-rounded shell fragments.
	0.81	(Brown). Compact Mud. With charcoal, some roots and scarce gasteropod and bivalve (cardium) shells
	1.54	(Brown). Very Plastic Mud. With charcoal.
2.00	2.00	Medium Sand. Rounded Grains. With some shell fragments.
	2.33	



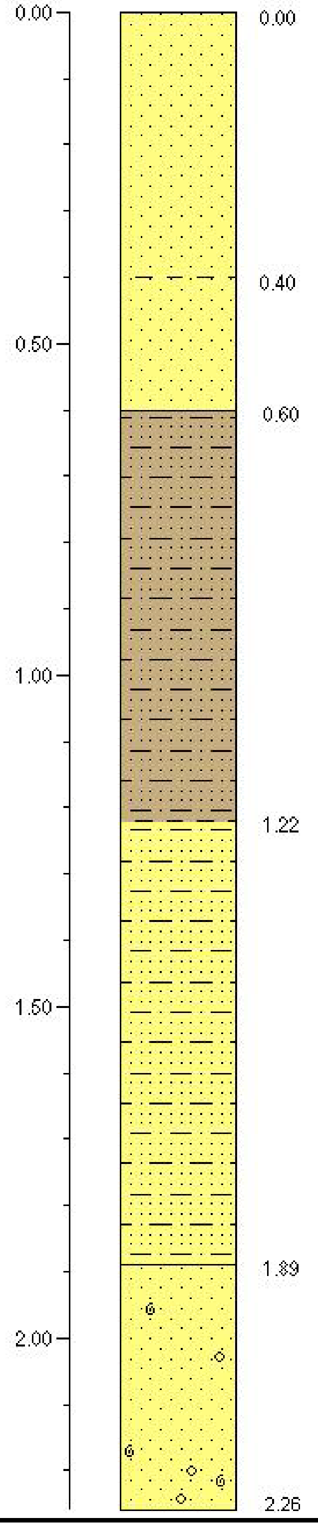
Reference: Alc3			Date: 17-06-2008
Coordinates	UTM (ED50) 29S	M: 0557980 P: 4106474	Location: Alcantarilha Stream Lowland

Depth (m)	LOG	Description	Sampling Depth (m)



Reference: Alc4			Date: 17-06-2008
Coordinates	UTM (ED50) 29S	M: 0557963 P: 4106426	Location: Alcantarilha Stream Lowland

Depth (m)	LOG	Description	Sampling Depth (m)

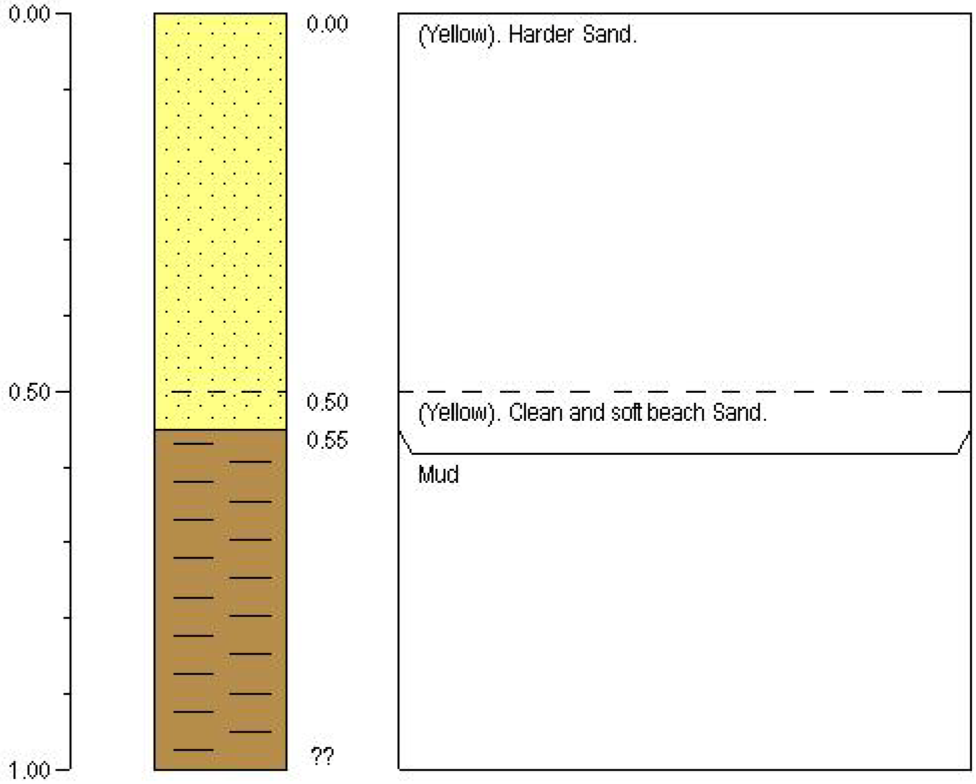


Depth (m)	Description
0.00	(Yellow). Medium pedogenised Sand. Partially consolidated.
0.40	(Yellow). Sand. Soft and unconsolidated.
0.60	(Brown). Unconsolidated Muddy Sand.
1.22	(Yellowish). Muddy Sand. Less muddy towrads the base.
1.89 – 2.26	(Yellow). Coarse to very coarse Sand. Slightly muddy. With small shell fragments. With well-rounded quartz pebbles, bigger bioclasts and lithified sand dune pebbles.

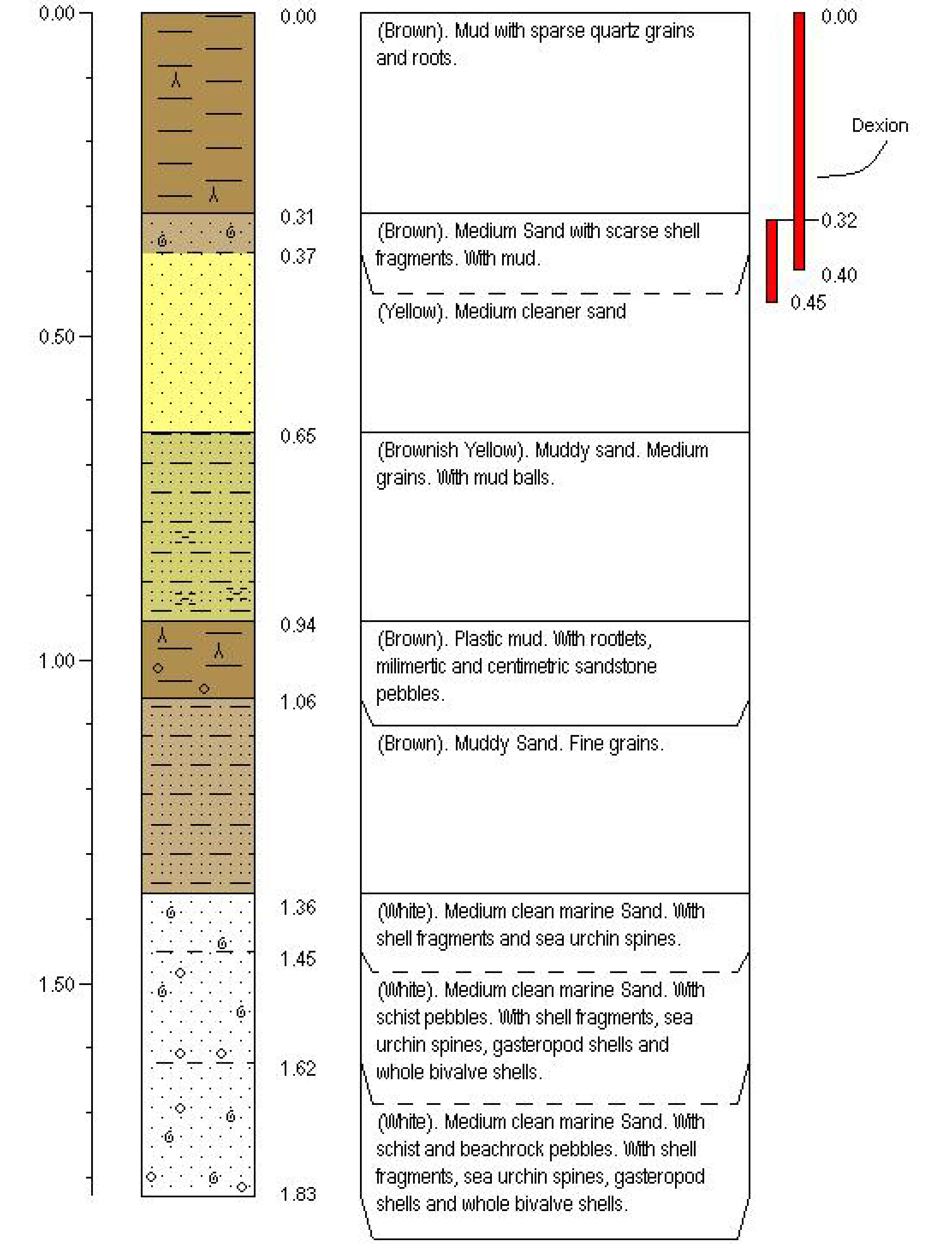
Sampling Depth (m): 0.00, 0.40, 0.60, 0.80, 1.50; 2.00, 2.25

Reference: **Alc5**	**Date:** 17-06-2008
Coordinates UTM (ED50) 29S **M:** 0557991 **P:** 4106569	**Location:** Alcantarilha Stream Lowland

Depth (m)	LOG	Description

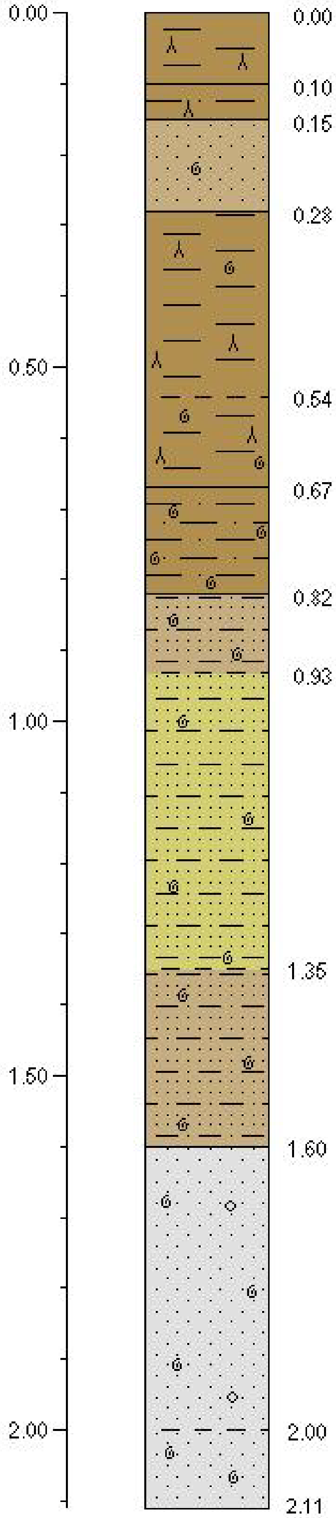


Reference: Alc6			Date: 18-06-2008
Coordinates	UTM (ED50) 29S	M: 0557707 P: 4106517	Location: Alcantarilha Stream High Marsh
Depth (m)	LOG	Description	Sampling Depth (m)



Reference: **Alc7**	**Date:** 18-06-2008
Coordinates UTM (ED50) 29S — **M:** 0557705 **P:** 4106611	**Location:** Alcantarilha Stream High Marsh

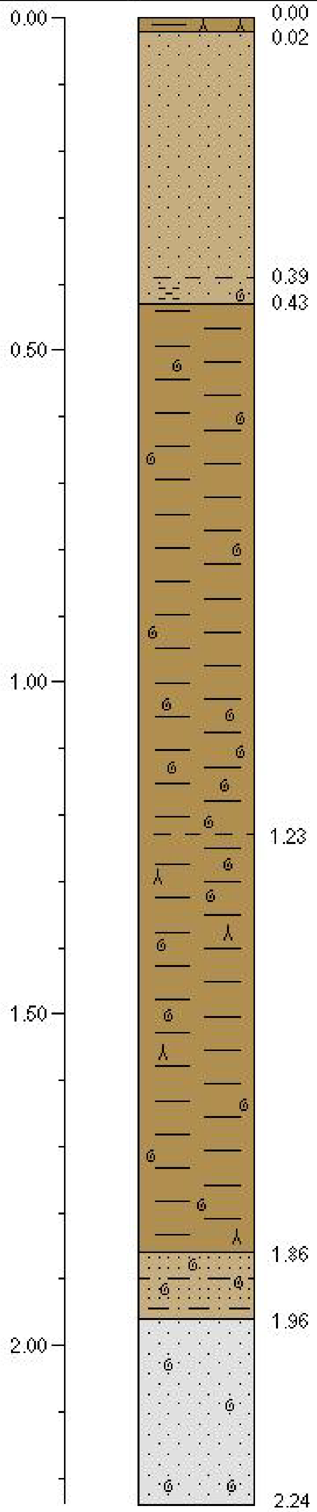
Depth (m)	LOG	Description



Depth (m)	Description
0.00	(Brown). Mud. With roots.
0.10	(Brown). Sandy mud. With roots.
0.15	(Brown). Medium Sand. With scrase shell fragments.
0.28	(Brown). Compact Mud. With roots and scarse terrestrial gasteropod shells.
0.54	(Brown). Compact Mud. With roots, charcoal and shell fragments (Cardium).
0.67	(Brown). Sandy Mud. With many whole small gasteropod shells and charcoal.
0.82	(Brown). Muddy Sand. With shell fragments.
0.93	(Yellowish Brown). Muddy Sand. Less muddier when compared with upper layer. With bioclasts.
1.35	(Brown). Muddy Sand. With bioclasts.
1.60	(Grey). Medium Sand. With small pebbles and bioclasts.
2.00	(Grey). Coarser Sand. With big bioclasts (Cardium shell) and many Cerithium shells.
2.11	

Reference: Alc8		Date: 18-06-2008
Coordinates UTM (ED50) 29S	M: 0557723 P: 4106653	Location: Alcantarilha Stream High Marsh

Depth (m)	LOG	Description



(Brown). Mud with roots.

(Brown). Unwashed Medium Sand. Muscovite present.

(Brown). Sand. With mud balls and scarse small shell fragments.

(Brown). Mud. With terrestrial gasteropod shells. With lamellibranchs shell fragments and whole bivalve (Cardium) shells from 1m depth. Towards the base, many gasteropod shells appear (terrestrial?).

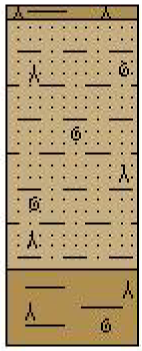
(Brown). Mud. With roots, charcoal, many gasteropod shells, whole bivalve shells, and lamelibranch shell fragments.

Muddy bioclastic Sand. Medium to coarse grains. With big bivalve shells and charcoal.

(Grey). Bioclastic Sand. Well sorted. With well-rounded grains. With bivalve shell fragments and some Cerithium shells.

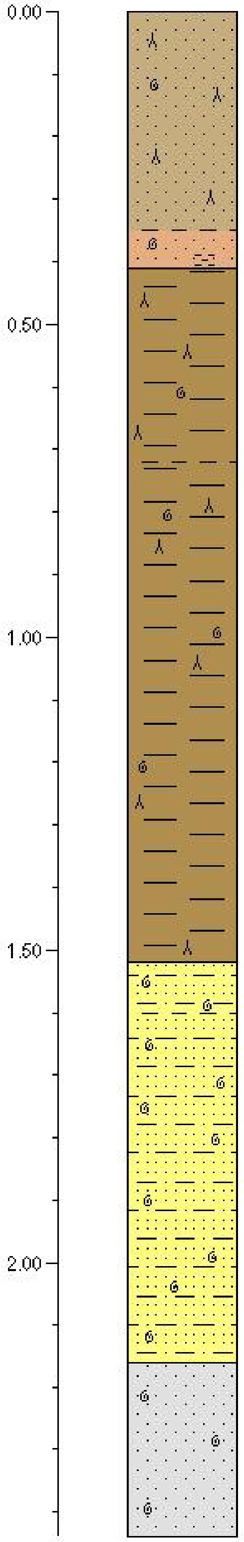
Reference: **Alc9**	**Date:** 18-06-2008
Coordinates UTM (ED50) 29S — **M:** 0557790 **P:** 4106750	**Location:** Alcantarilha Stream High Marsh

Depth (m)	LOG	Description
0.00 – 0.02		(Brown). Mud with roots.
0.02 – 0.35		(Brown). Muddy unwashed sand. With roots, charcoal and small shell fragments.
0.35 – 0.45		(Brown). Compact Mud. With roots and scarse shell fragments.



Reference: Alc10		Date: 18-06-2008
Coordinates UTM (ED50) 29S	M: 0557830 P: 4106848	Location: Alcantarilha Stream High Marsh

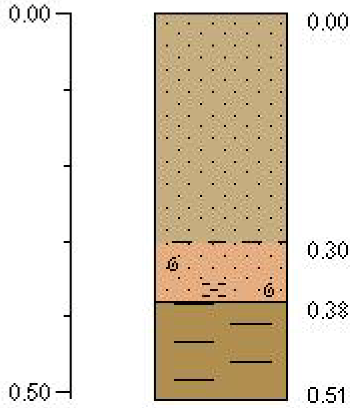
Depth (m)	LOG	Description



Depth (m)	Description
0.00	(Brown). Pedogenic Sand. With roots and scarse small shell fragments.
0.35	(Reddish Brown). Cleaner Sand. With scarse small shell fragments and mud balls towards the base.
0.41	(Borwn). Compact Mud. With charcoal, rootlets and scarse shell fragments.
0.72	(Borwn). Compact Mud. With charcoal, rootlets and scarse shell fragments. With bivalve shell fragments and gasteropod shells.
1.52	(Yellow). Muddy bioclastic fine Sand.
1.60	(Yellow). Muddy fine Sand. With bioclasts, big bivalve shell and Cerithium shell frgaments.
2.16	(Grey). Medium Sand. With bioclasts, Cerithium and bivalve shells.
2.44	

Reference: **Alc11**	Date: 18-06-2008
Coordinates UTM (ED50) 29S — **M:** 0557903 **P:** 4106952	**Location:** Alcantarilha Stream High Marsh

Depth (m)	LOG	Description



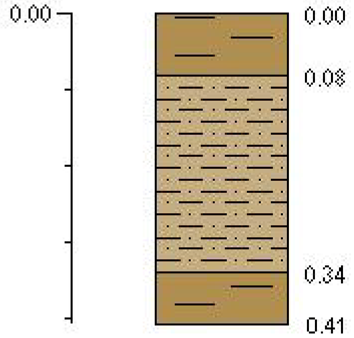
(Brown). Pedogenic Sand.

(Reddish Brown). Cleaner Sand. With scarse shell fragments and mud balls.

(Brown). Mud.

Reference: **Alc12**	Date: 18-06-2008
Coordinates UTM (ED50) 29S — **M:** 0557946 **P:** 4107046	**Location:** Alcantarilha Stream Lowland

Depth (m)	LOG	Description

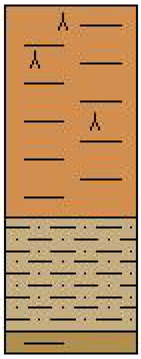


(Brown). Compact Pedogenic Mud.

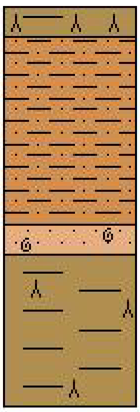
(Brown). Silt with fine sand. Sandier towards the base.

Mud

Reference: **Alc13**		Date: 18-06-2008
Coordinates UTM (ED50) 29S	**M:** 0557952 **P:** 4107066	**Location:** Alcantarilha Stream High Marsh

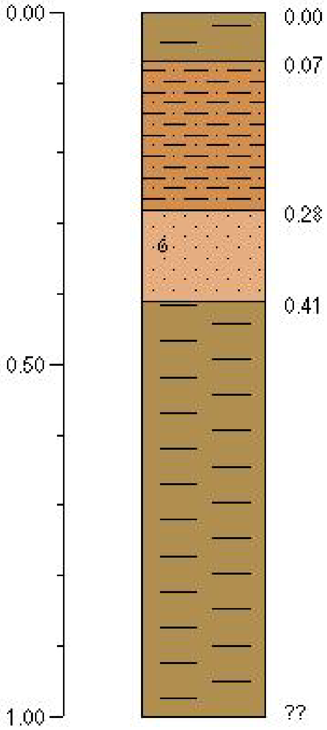
Depth (m)	LOG	Description
0.00 – 0.28		(Reddish Brown). Compact Mud. With roots and sparse sand grains.
0.28 – 0.43		(Brown). Silt to very fine muddy sand.
0.43 – 0.46		(Brown). Compact Mud.

Reference: **Alc14**		Date: 18-06-2008
Coordinates UTM (ED50) 29S	**M:** 0557928 **P:** 4107009	**Location:** Alcantarilha Stream High Marsh

Depth (m)	LOG	Description
0.00 – 0.04		(Brown). Compact Mud. With many roots.
0.04 – 0.29		(Reddish). Silty Mud.
0.29 – 0.33		(Reddish Brown). Unwashed fine to medium Sand. With scarse shells (Alluvial?).
0.33 – 0.53		(Brown). Mud. With roots.

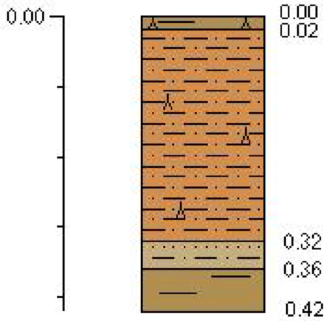
Reference: **Alc15**	**Date:** 18-06-2008
Coordinates UTM (ED50) 29S — **M:** 0557939 **P:** 4107030	**Location:** Alcantarilha Stream High Marsh

Depth (m)	LOG	Description
0.00	0.00 – 0.07	Compact Mud.
	0.07 – 0.28	(Reddish Brown). Silty Mud.
	0.28 – 0.41	(Reddish Brown). Fine to Medium unwashed Sand. With scarse small bioclasts (Alluvial?).
0.50	0.41 – ??	(Brown). Compact Mud.
1.00		



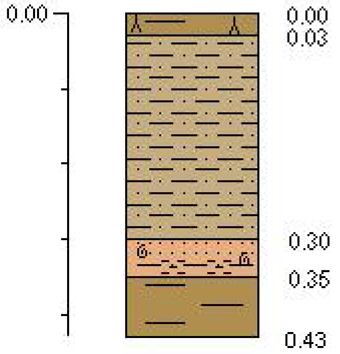
Reference: **Alc16**	**Date:** 18-06-2008
Coordinates UTM (ED50) 29S — **M:** 0558015 **P:** 4106971	**Location:** Alcantarilha Stream Lowland

Depth (m)	LOG	Description
0.00	0.00 – 0.02	(Brown). Mud with roots.
	0.02 – 0.32	(Reddish Brown). Silt. Towards the base becames a fine muddy sand, unwashed, with roots.
	0.32 – 0.36	(Brown).Fine muddy Sand (Alluvial?).
	0.36 – 0.42	(Brown). Compact Mud.



Reference: Alc17	Date: 18-06-2008
Coordinates UTM (ED50) 29S M: 0557966 P: 4106883	Location: Alcantarilha Stream Lowland

Depth (m)	LOG	Description	Sampling Depth (m)



(Brown). Mud with roots.

(Brown). Pedogenic mud that becomes a reddish brown very fine muddy sand, towards the base.

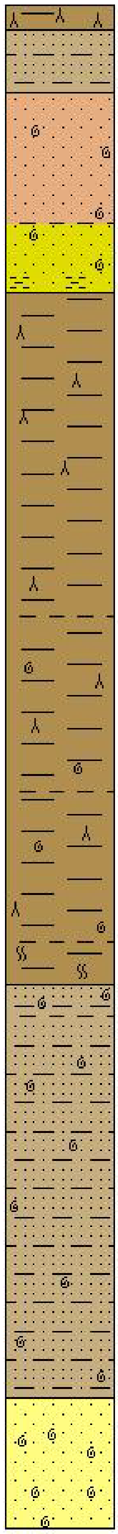
(Reddish). Cleaner fine sand. With scarse shells that increase in frequency towards the base and mud balls near the lower limit.

(Brown). Compact Mud.

Sampling Depth: 0.33 – 0.35

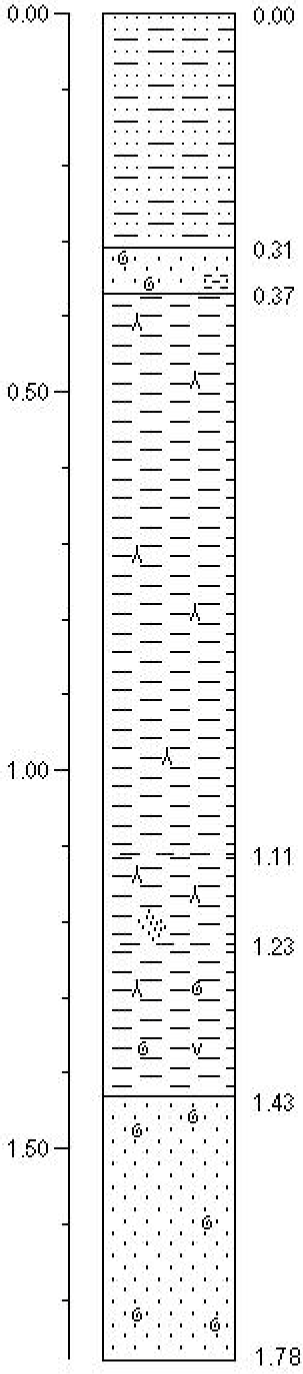
Reference: Alc18			Date: 18-06-2008
Coordinates	UTM (ED50) 29S	M: 0557921 P: 4106780	Location: Alcantarilha Stream Lowland

Depth (m)	LOG	Description	Sampling Depth (m)
0.00 – 0.04		(Brown). Mud with roots.	0.00, 0.04
0.04 – 0.14		(Brown). Pedogenic fine to medium silty Sand.	0.14
0.14 – 0.35		(Reddish). Cleaner medium Sand. With shell fragments.	
0.35 – 0.46		(Dark Yellow). Washed beach Sand. With some shell fragments. With mud balls near the lower contact.	0.35, 0.44, 0.46, 0.48, 0.50
0.46 – 0.98		(Brown). Compact Mud. With rootlets. Without shells.	
0.98 – 1.26		(Brown). Compact Mud. With rootlets. With fresh water gasteropod shells.	1.04, 1.14
1.26 – 1.50		(Brown). Compact Mud. With rootlets. With fresh water gasteropod shells. With some bivalve fragments (Cardium).	1.26, 1.41
1.50 – 1.57		(Brown). Plastic Mud. With bioturbation marks filled with sand.	1.50
1.57 – 1.62		(Brown). Very fine muddy Sand. With shell fragments.	1.57
1.62 – 2.23		Very fine muddy Sand. With gasteropod shells and big bivalve shell fragments.	1.62, 1.88
2.23 – 2.44		(Yellowish). Washed medium Sand. With many bioclasts and Cerithium shells.	2.23, 2.44



Reference: **ALC 19**			**Date:** 08-07-2009
Coordinates	UTM (ED50) 29S	**M:** 0558098 **P:** 4106608	**Location:** Alcantarilha stream lowland

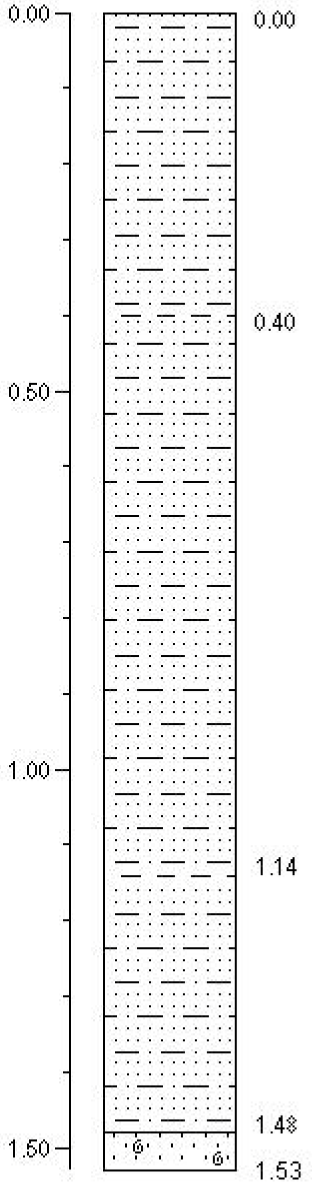
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



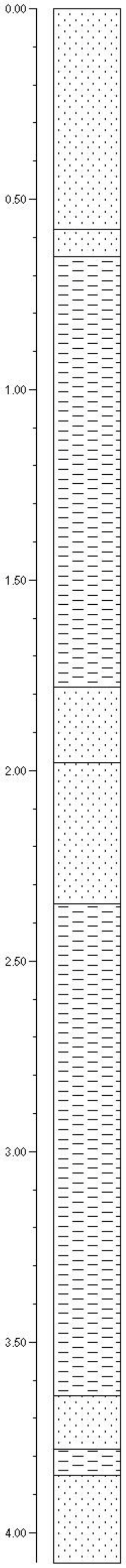
Depth (m)	Description
0.00 – 0.31	(Brown). Slightly muddy sand
0.31 – 0.37	(Brown). Clean sand with frequent shell fragments and with mud balls
0.37 – 1.11	(Brown). Mud with scarce sand grains, fermented plant remains, millimetric miocenic limestone grains, charcoal and rootlets.
1.11 – 1.23	(Brown). Mud with scarce sand grains, fermented plant remains, millimetric miocenic limestone grains, charcoal, rootlets and sand pockets
1.23 – 1.43	(Brown). Mud with scarce sand grains, gasteropod shells, fermented plant remains, millimetric miocenic limestone grains, charcoal and rootlets.
1.43 – 1.78	Marine medium sand with shell fragments and whole gastropod shells.

Reference: ALC 20			Date: 08-07-2009
Coordinates	UTM (ED50) 29S	M: 0558174 P: 4106586	Location: Alcantarilha stream lowland

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)
0.00 – 0.40		(Brown). Sandy mud, less sandy towards the base.	
0.40 – 1.14		(Brown). Sandy mud, less sandy towards the base, with sand pockets.	
1.14 – 1.48		(Brown). Sandy mud, less sandy towards the base.	
1.48 – 1.53		Marine medium sand with shell fragments and whole gastropod shells.	



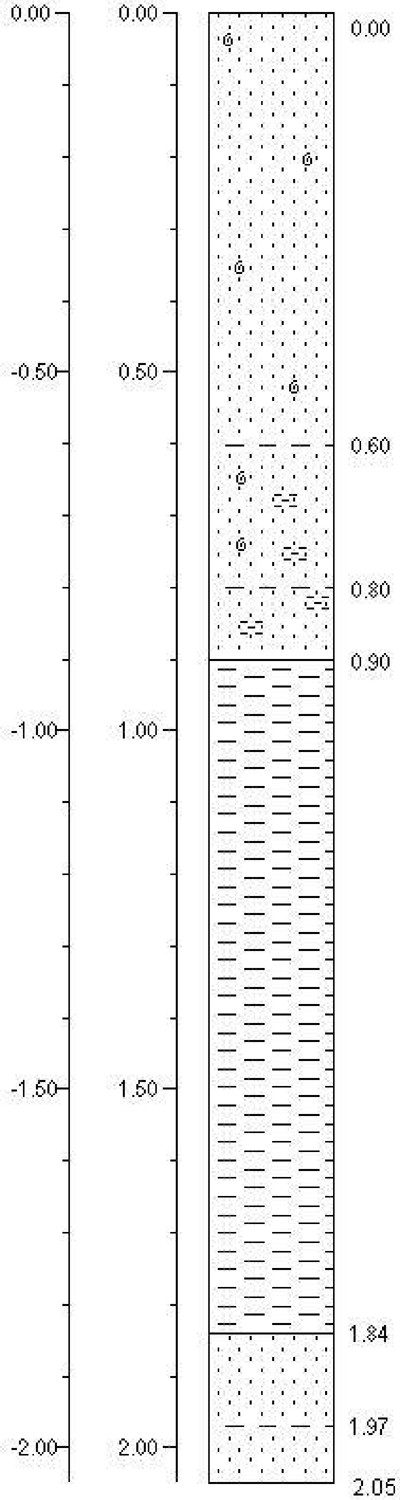
Reference: ALC 21			Date: 08-07-2009
Coordinates	UTM (ED50) 29S	M: 0558131 P: 4106528	Location: Alcantarilha stream lowland



Elevation / Depth (m)	Description	Sampling Depth (m)
0.00	(Red). Medium unconsolidated sand with shell fragments more frequent towards the top and scarse charcoal.	
0.58	Clean marine sand with shell shell frafments and equinoderm spicules.	
0.65	(Brown). Compact mud.	
1.78	Medium clean sand without shells	
1.98	Clean sand with shell fragments.	
2.35	(Gray). Plastic mud with plants remains, without shells.	
3.64	(Gray). Fine sand with shell fragments.	3.64 3.70 ^{14}C 3.78
3.78	(Gray). Mud	3.80
3.85	(Gray). Fine sand with shell fragments.	3.85 3.90 3.95 4.00 4.05
4.08		

Reference: **ALC 22**			**Date:** 08-07-2009
Coordinates	UTM (ED50) 29S	**M:** 0558124 **P:** 4106456	**Location:** Alcantarilha stream lowland

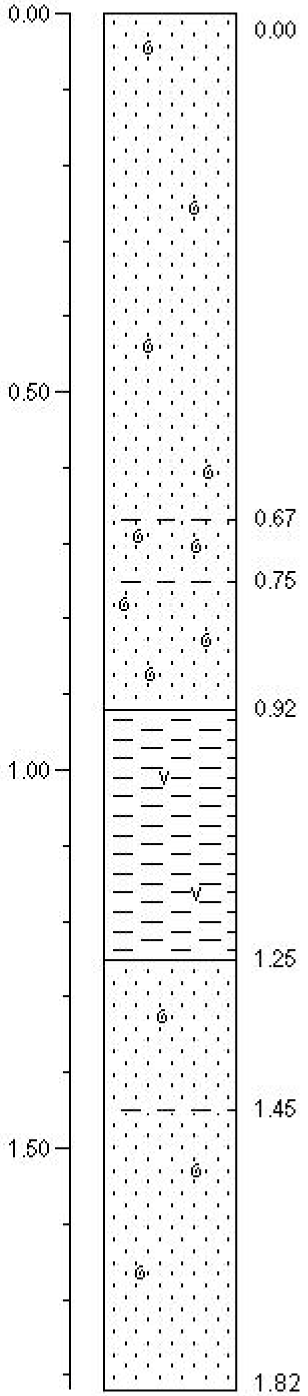
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Depth (m)	Description
0.00 – 0.60	(Red). Unconsolidated medium to fine sand with shell fragments.
0.60 – 0.80	(Red). Unconsolidated medium to fine sand with shell fragments and mud balls.
0.80 – 0.90	Sand, coarser then the above, with mud balls.
0.90 – 1.84	(Brown). Compact mud.
1.84 – 1.97	(Brown). Medium sand.
1.97 – 2.05	(Gray). Medium sand.

Reference: **ALC 23**			**Date:** 08-07-2009
Coordinates	UTM (ED50) 29S	**M:** 0558109 **P:** 4106387	**Location:** Alcantarilha stream lowland

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Reddish). Medium to fine sand with gasteropod shell fragments.

(Yellowish). Medium well sorted sand with shell fragments some of which are rounded lamellibranch fragments.

(Yellow). Medium to fine poorly sorted sand with shells fragments. Contact with underlying layer is abrupt.

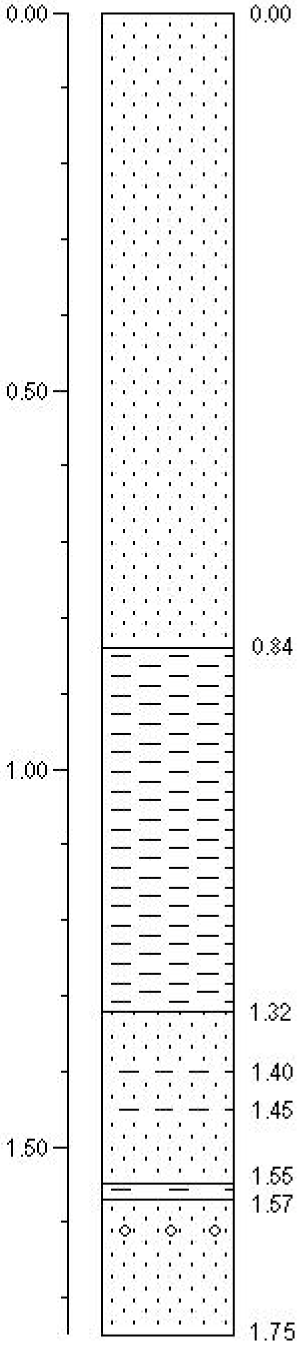
(Brown). Compact mud with burned plant remains and scarce sand grains.

(Yellow to orange). Medium sand. If present, shell fragments present the same size as the sand grains and are rounded.

(White). Clean medium sand. If present, shell fragments present the same size as the sand grains and are rounded.

Reference: **ALC 24**			Date: 08-07-2009
Coordinates	UTM (ED50) 29S	**M:** 0558117 **P:** 4106415	**Location:** Alcantarilha stream lowland

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Reddish). Medium to fine sand.

(Brown). Compact mud.

(Orange). Medium sand.

(Yellow). Medium sand.

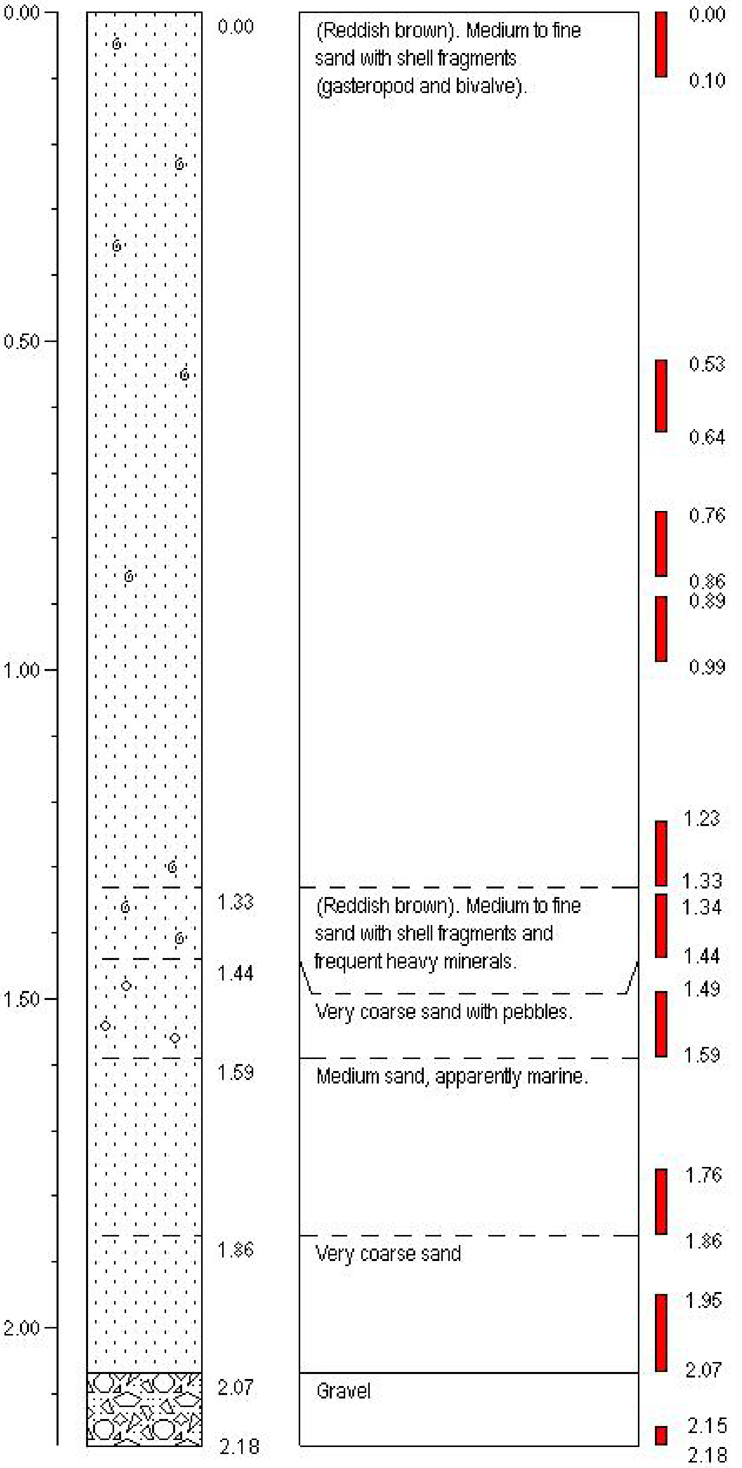
(Gray). Medium clean sand.

(Gray). Plastic mud.

(Gray). Clean sand with pebbles at 1.60m depth.

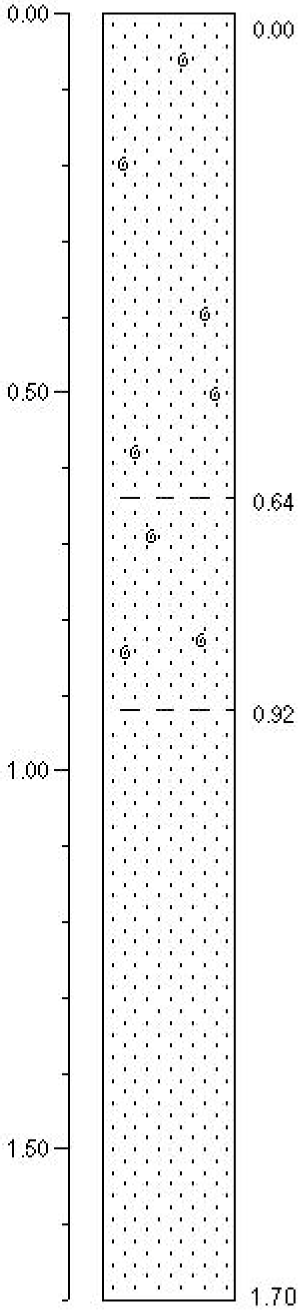
Reference: ALC 25			Date: 08-07-2009
Coordinates	UTM (ED50) 29S	M: 0557872 P: 4106465	Location: Alcantarilha stream lowland

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



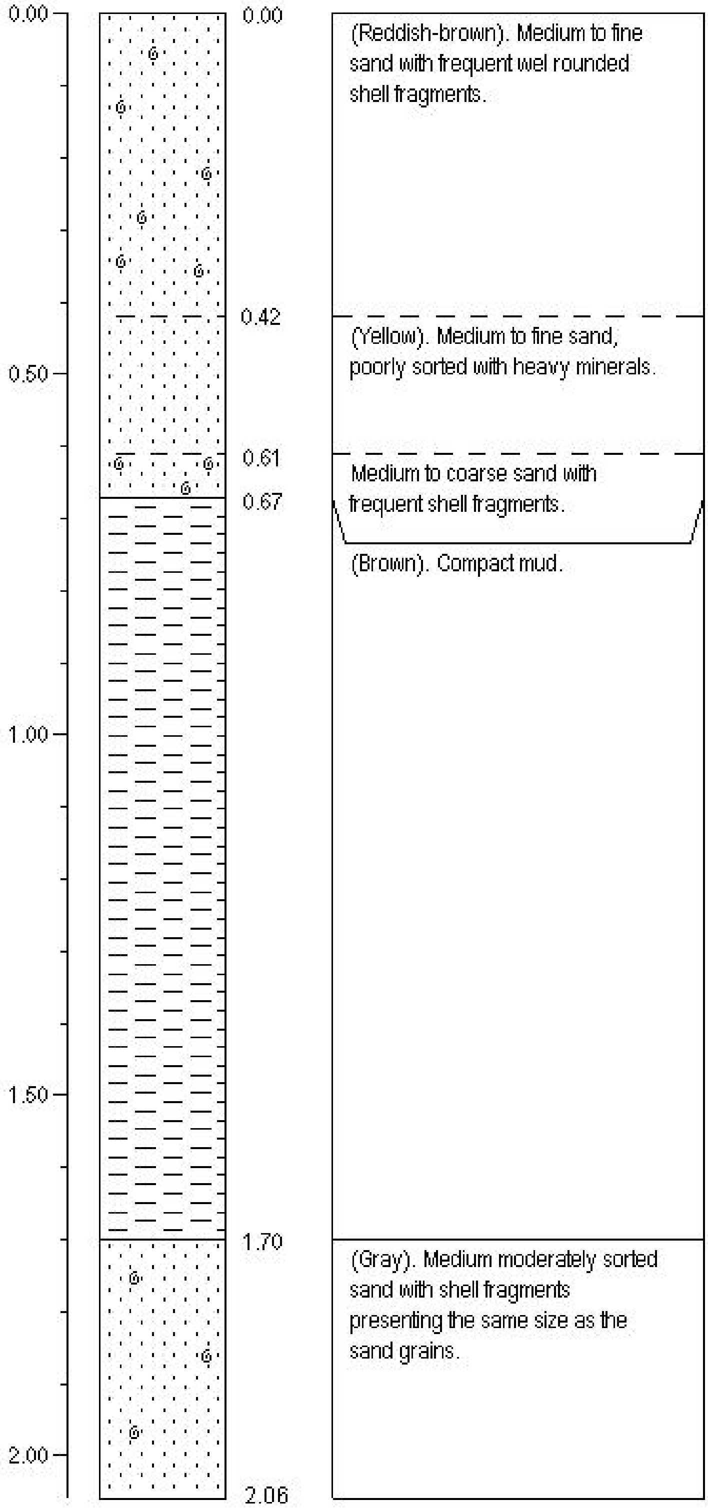
Reference: ALC 27			Date: 08-07-2009
Coordinates	UTM (ED50) 29S	M: 0557870? P: 4106490	Location: Alcantarilha stream lowland

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



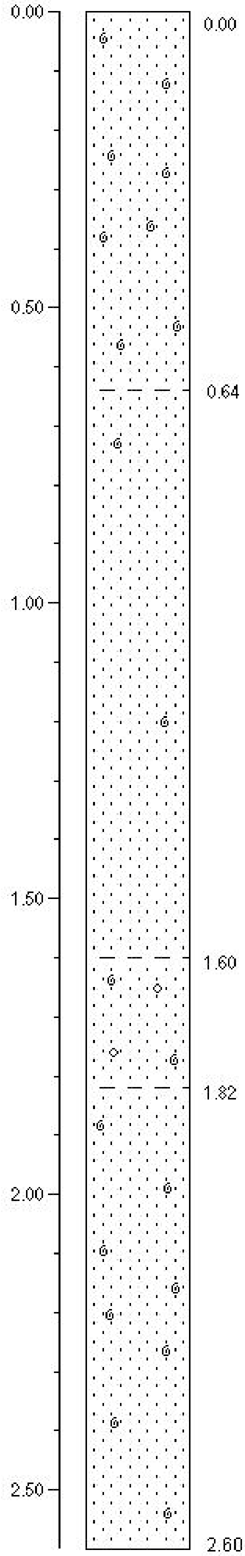
Depth (m)	Description
0.00 – 0.64	(Reddish brown). Medium to fine sand with frequent well rounded shell fragments.
0.64 – 0.92	(Reddish brown). Medium to fine sand with frequent well rounded shell fragments and frequent heavy minerals.
0.92 – 1.70	Medium poorly sorted medium sand.

Reference: ALC 28			**Date:** 08-07-2009
Coordinates	UTM (ED50) 29S	**M:** 0557931 **P:** 4106554	**Location:** Alcantarilha stream lowland
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: **ALC 29**			**Date:** 09-07-2009
Coordinates	UTM (ED50) 29S	**M:** 0557920 **P:** 4106408	**Location:** Alcantarilha stream lowland

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

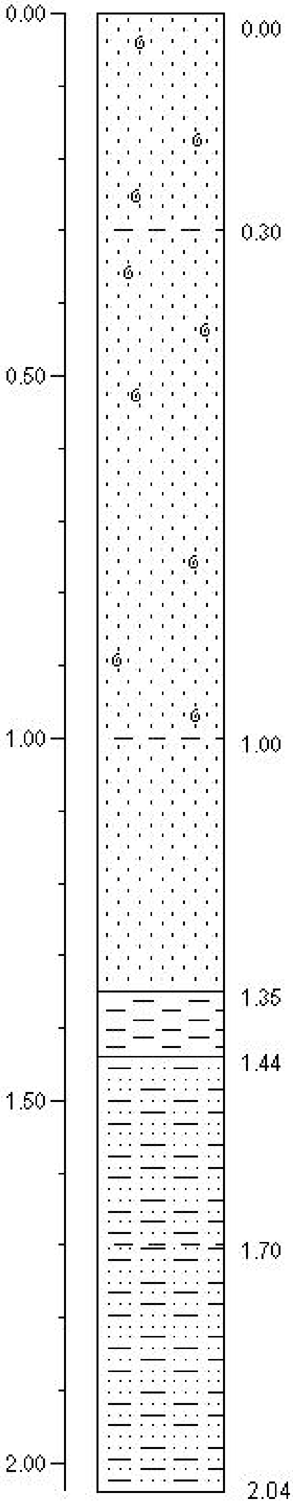


Depth (m)	Description
0.00 – 0.64	(Yellow). Unconsolidated medium to fine clean sand with frequent shell fragments, some gasteropod. Towards the base the sand becomes brownish with nodules containing iron (palaeosoil?).
0.64 – 1.60	(Yellow). Unconsolidated medium to fine clean sand with scarce shell fragments and with heavy minerals (magnetite?).
1.60 – 1.82	(Orange). Medium to coarse sand with shell fragments bigger then the sand grains and with small rounded pebbles.
1.82 – 2.60	Medium to coarse marine sand, rounded grains with frequent bioclasts.

Sampling Depth (m): 0.10 – 0.20; 0.40 – 0.50; 0.60 – 0.70 – 0.80 – 0.90 – 1.00 – 1.10 – 1.20 – 1.30 – 1.35 – 1.40 – 1.45 – 1.50; 1.55 – 1.60 – 1.67; 1.68 – 1.82; 1.85 – 1.90 – 2.00; 2.05 – 2.10 – 2.20; 2.30 – 2.39; 2.45 – 2.60

Reference: **ALC 31**			**Date:** 09-07-2009
Coordinates	UTM (ED50) 29S	**M:** 0558040 **P:** 4106384	**Location:** Alcantarilha stream lowland

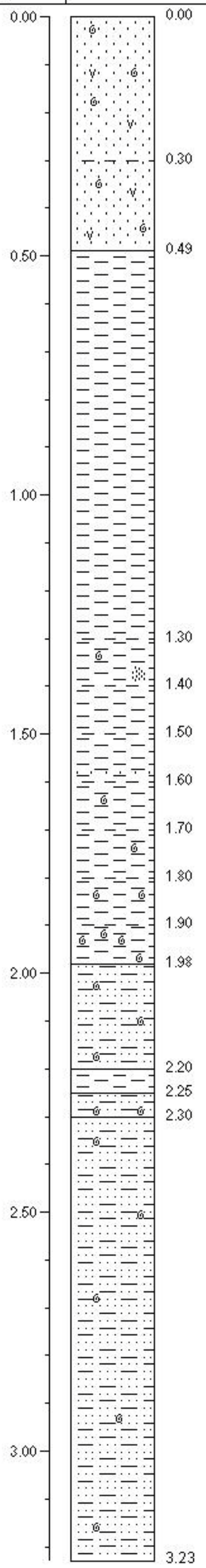
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Depth (m)	Description
0.00	(Reddish). Medium to fine sand with frequent shell fragments (helix) (aeolian sand?).
0.30	(Yellow). Medium to fine sand with rounded shell fragments (aeolian sand?).
1.00	(Dark brown). Medium to fine sand.
1.35	(Brown). Compact mud.
1.44	(Red). Medium muddy sand.
1.70	(Brown to light brown towards the base). Medium muddy sand.
2.04	

Reference: ALC 32			Date: 09-07-2009
Coordinates	UTM (ED50) 29S	M: 0558001 P: 4106640	Location: Alcantarilha stream lowland

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Brown). Unconsolidated unclean sand with helix and plant remains.

(Reddish). Unconsolidated unclean sand with helix and plant remains.

(Brown).Compact mud

(Brown). Mud with sand pockets and scarce shell fragments.

Mud with intercalated sand layers towards the base.

(Brown). Mud.

(Brown). Mud with scarce shell fragments.

(Brown). Slightly wet mud with scarce shell fragments.

(Brown). Mud with few shell fragments.

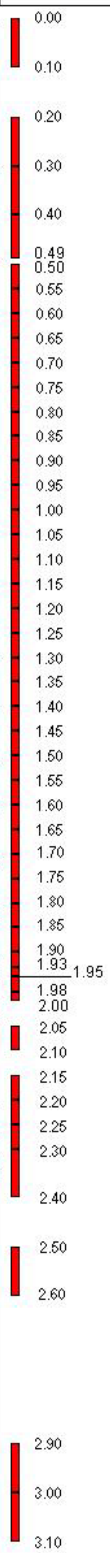
(Brown). Mud with frequent shell fragments.

Muddy sand with shell fragments.

(Gray). Plastic mud.

(Gray). Sandy mud with large shells.

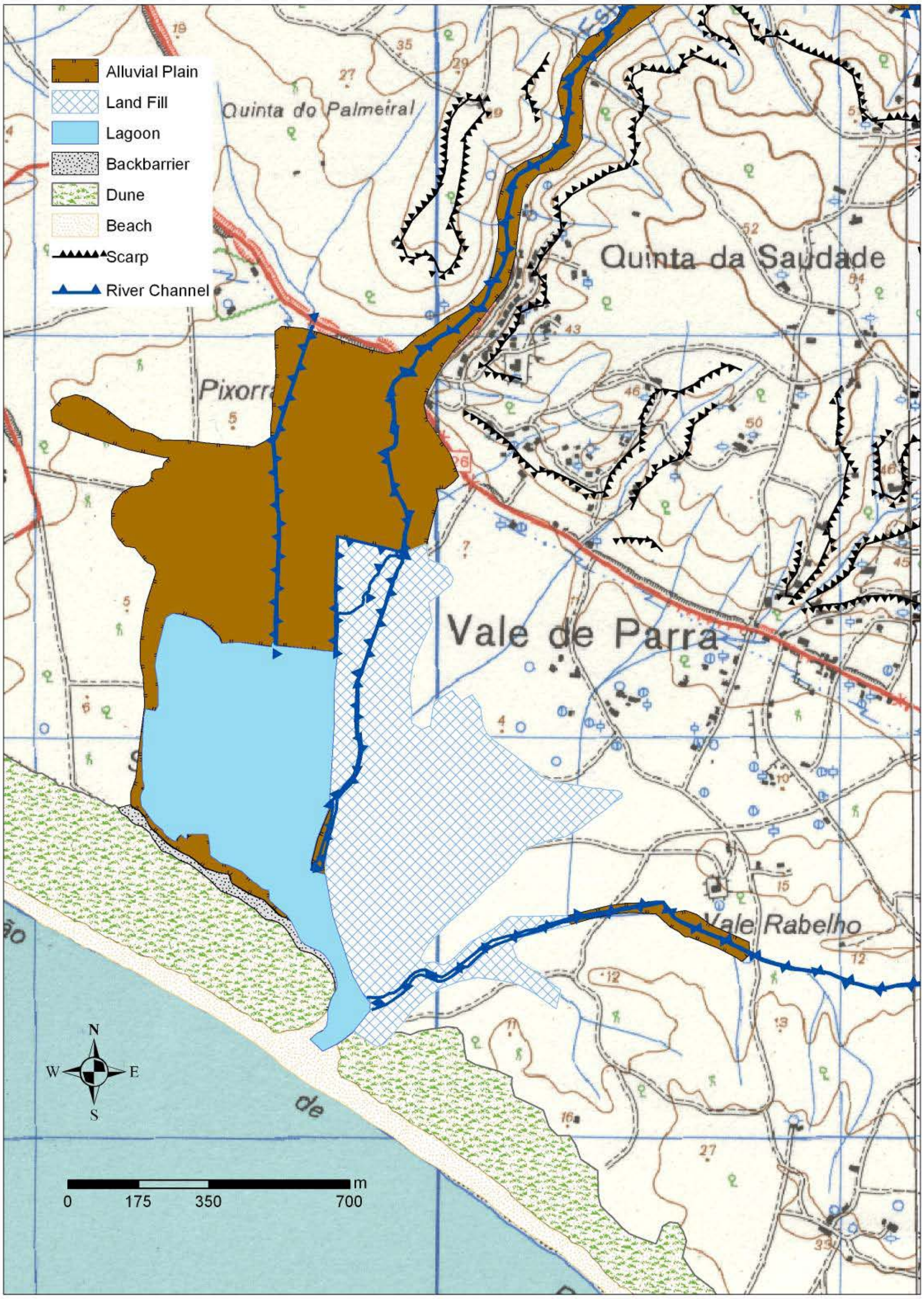
(Gray). Muddy sand with small gasteropod shells.



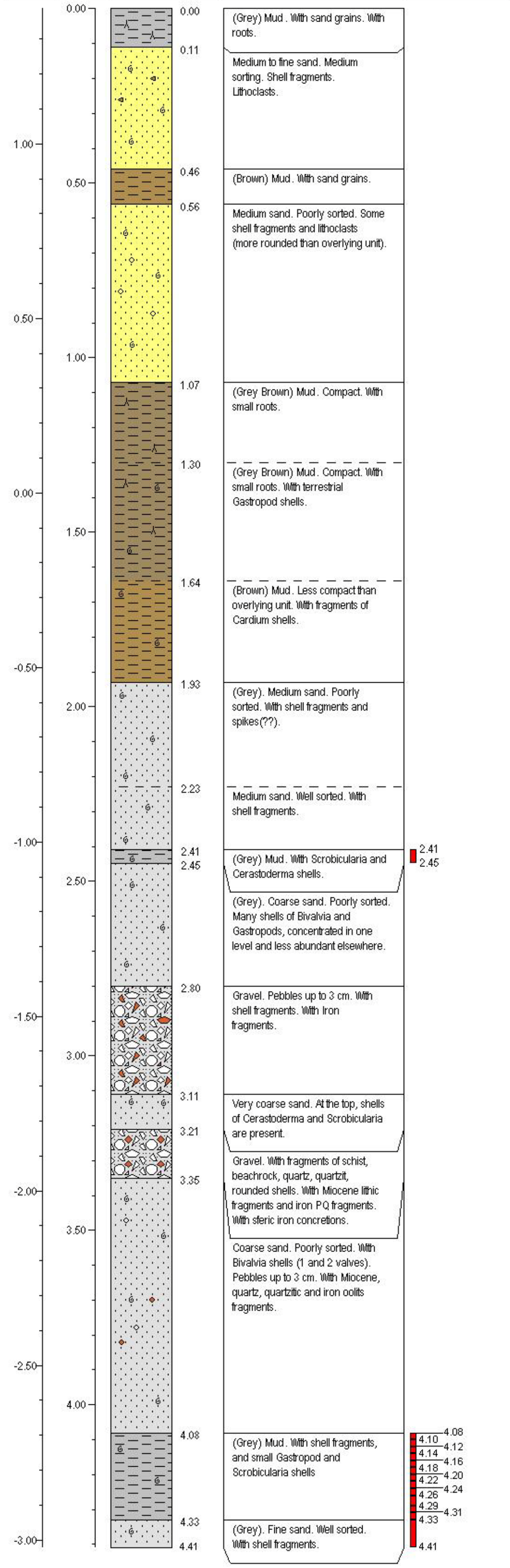
Reference: ALC 33			Date: 09-07-2009
Coordinates	UTM (ED50) 29S	M: 0557922 P: 4106599	Location: Alcantarilha stream lowland

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)
0.00	0.00 – 0.30	(Light brown). Unconsolidated medium sand with helix shells.	0.00, 0.10, 0.20, 0.30
0.50	0.30 – 0.56	(Reddish brown). Unconsolodated medium sand with few bioclasts.	0.40, 0.50, 0.56 (^{14}C)
1.00	0.56 – 1.25	(Brown). Mud	0.58, 0.64, 0.69, 0.74, 1.15, 1.20
1.50	1.25 – 1.95	(Brown). Slightly wet mud.	1.80, 1.90
2.00	1.95 – 2.15	(Gray). Slightly muddy sand with frequente shell fragments.	2.05, 2.15

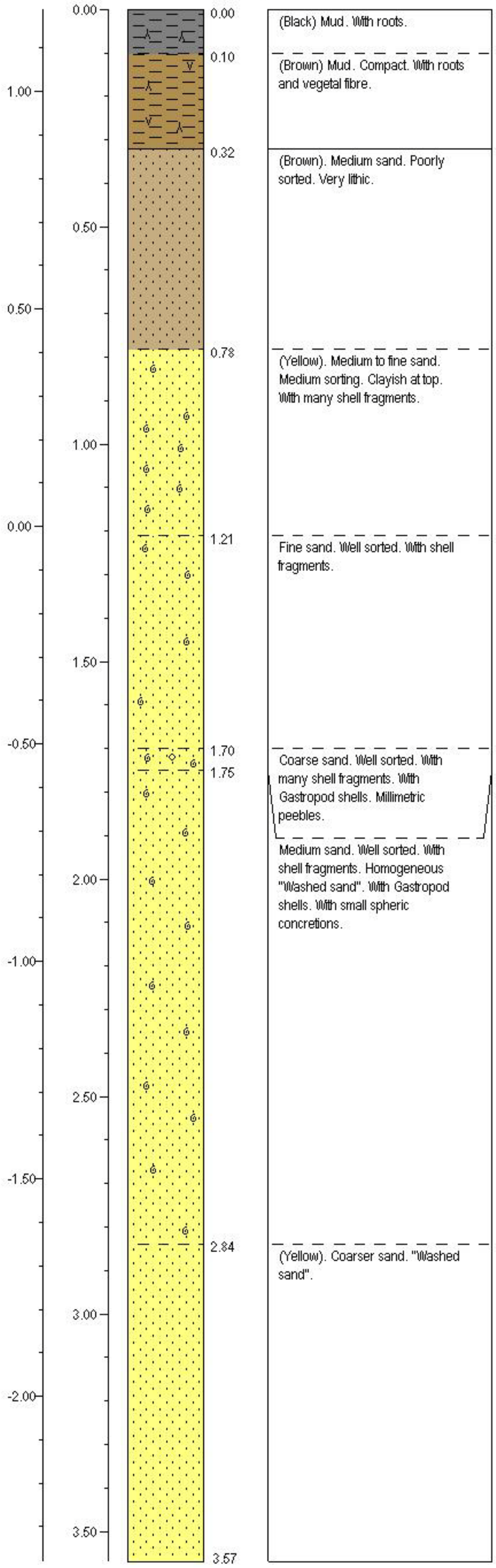
SALGADOS


Alluvial Plain
Land Fill
Lagoon
Backbarrier
Dune
Beach
Scarp
River Channel
Quinta do Palmeiral
Quinta da Saudade
Pixorr
Vale de Parra
Vale Rabelho
N
W
E
S
0
175
350
700
m

Reference: SG1			Date: 04-11-2007
Coordinates	UTM (ED50) 29S	M: 0559593 P: 4105559	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

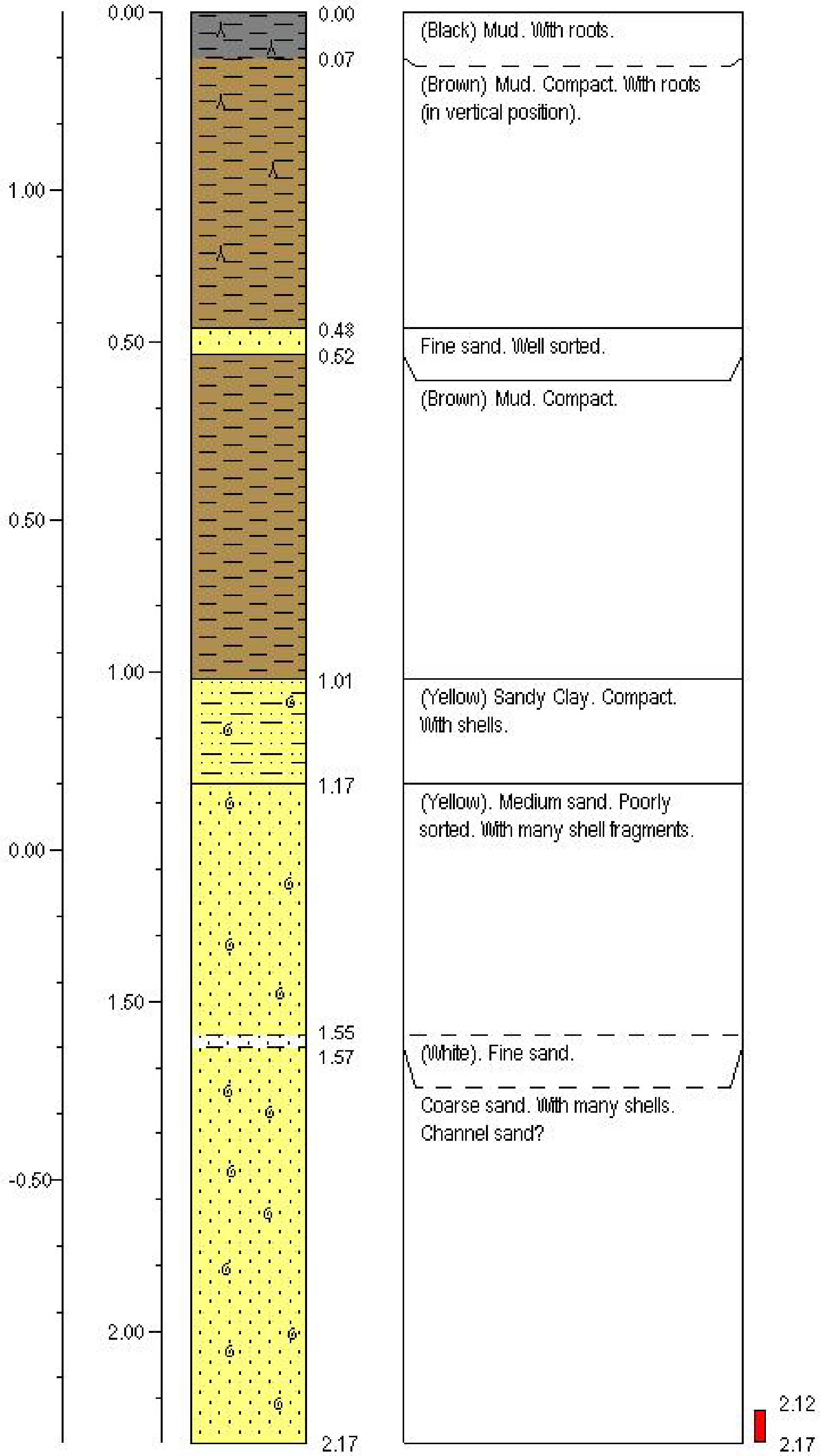


Reference: SG2			Date: 04-11-2007
Coordinates	UTM (ED50) 29S	M: 0559574 P: 4105643	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



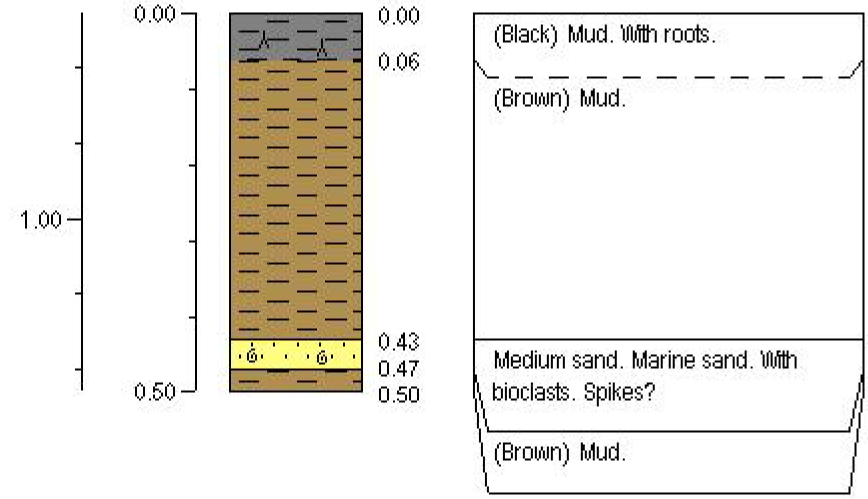
Reference: SG3			Date: 04-11-2007
Coordinates	UTM (ED50) 29S	M: 0559581 P: 4105850	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

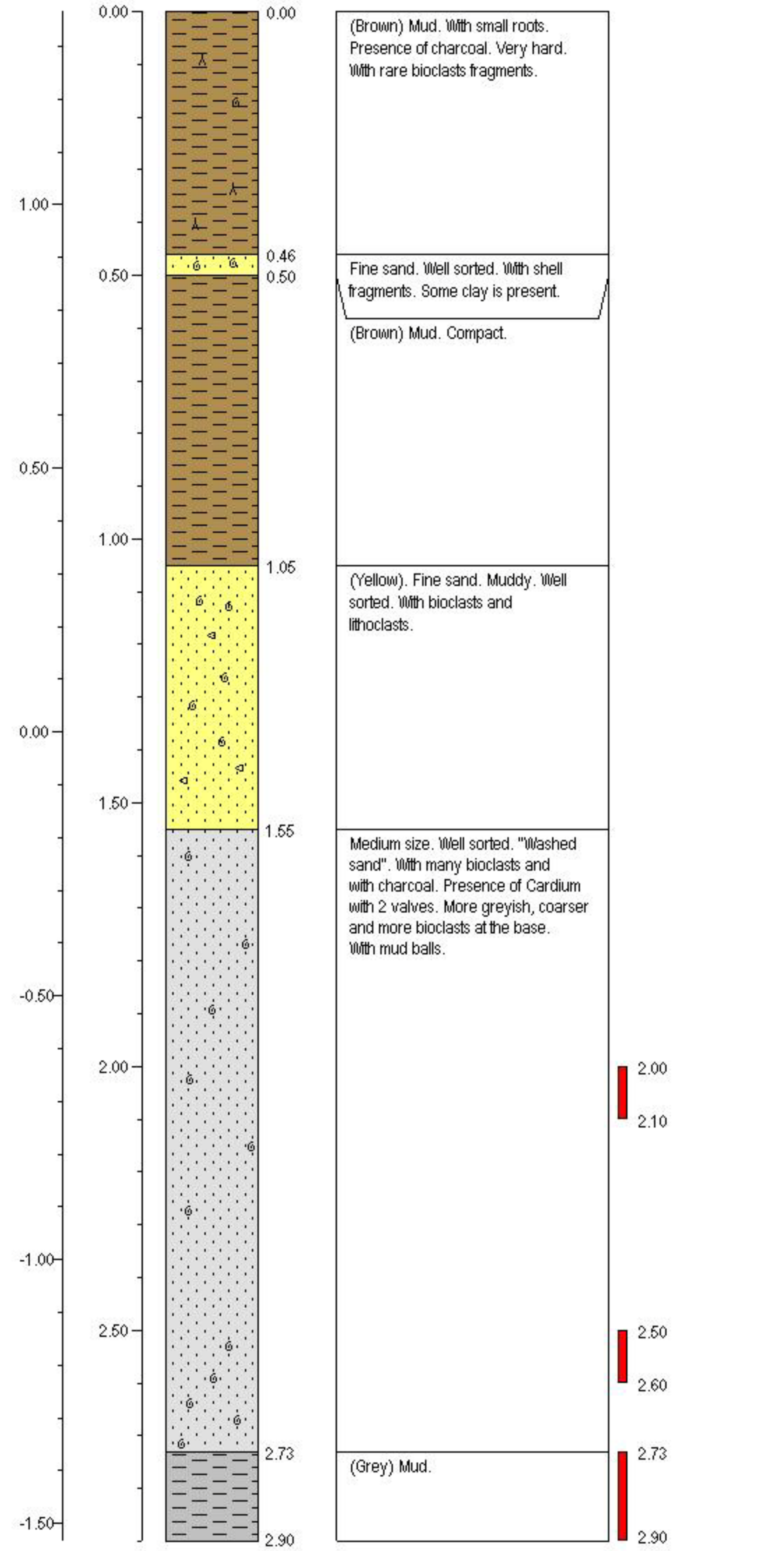


Reference: **SG4**			**Date:** 04-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559589 **P:** 4105828	**Location:** Salgados Lagoon

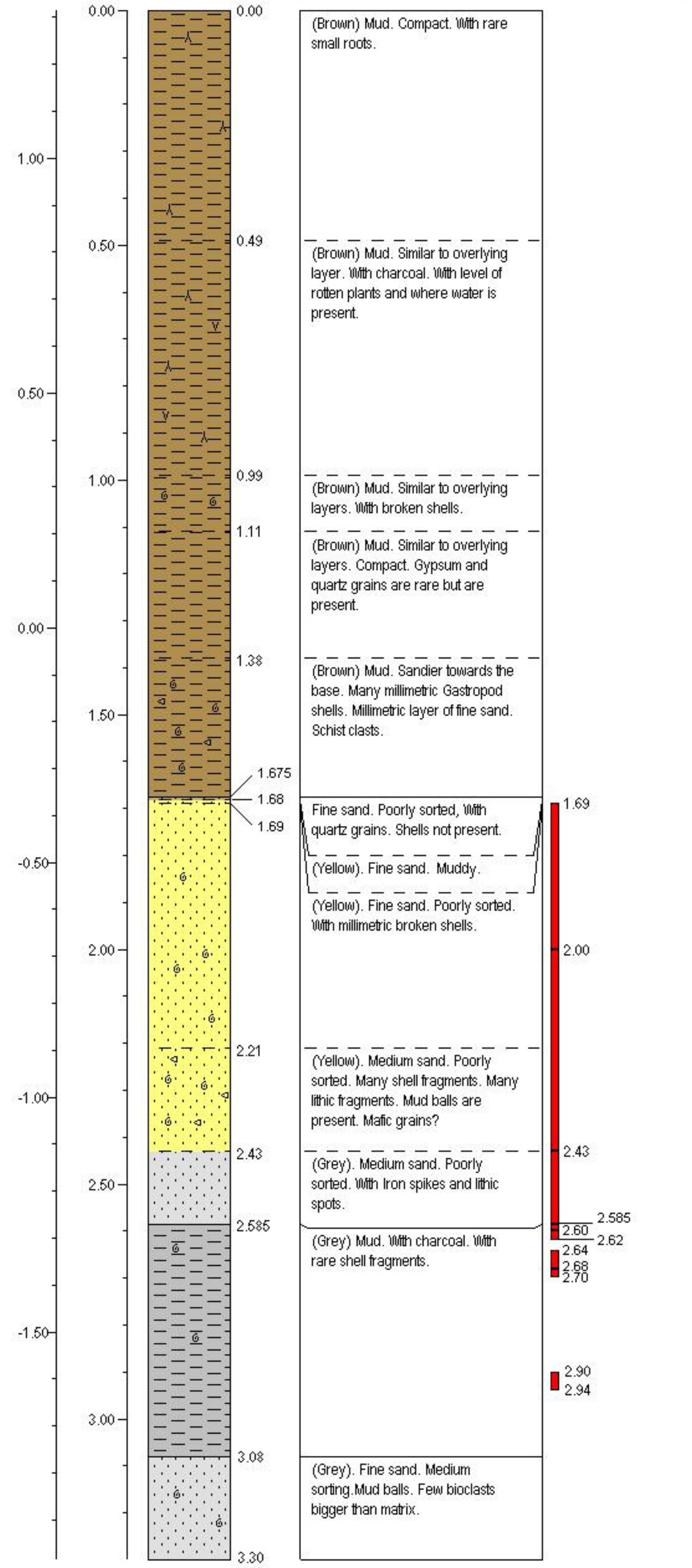
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: SG5			Date: 04-11-2007
Coordinates	UTM (ED50) 29S	M: 0559590 P: 4106018	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

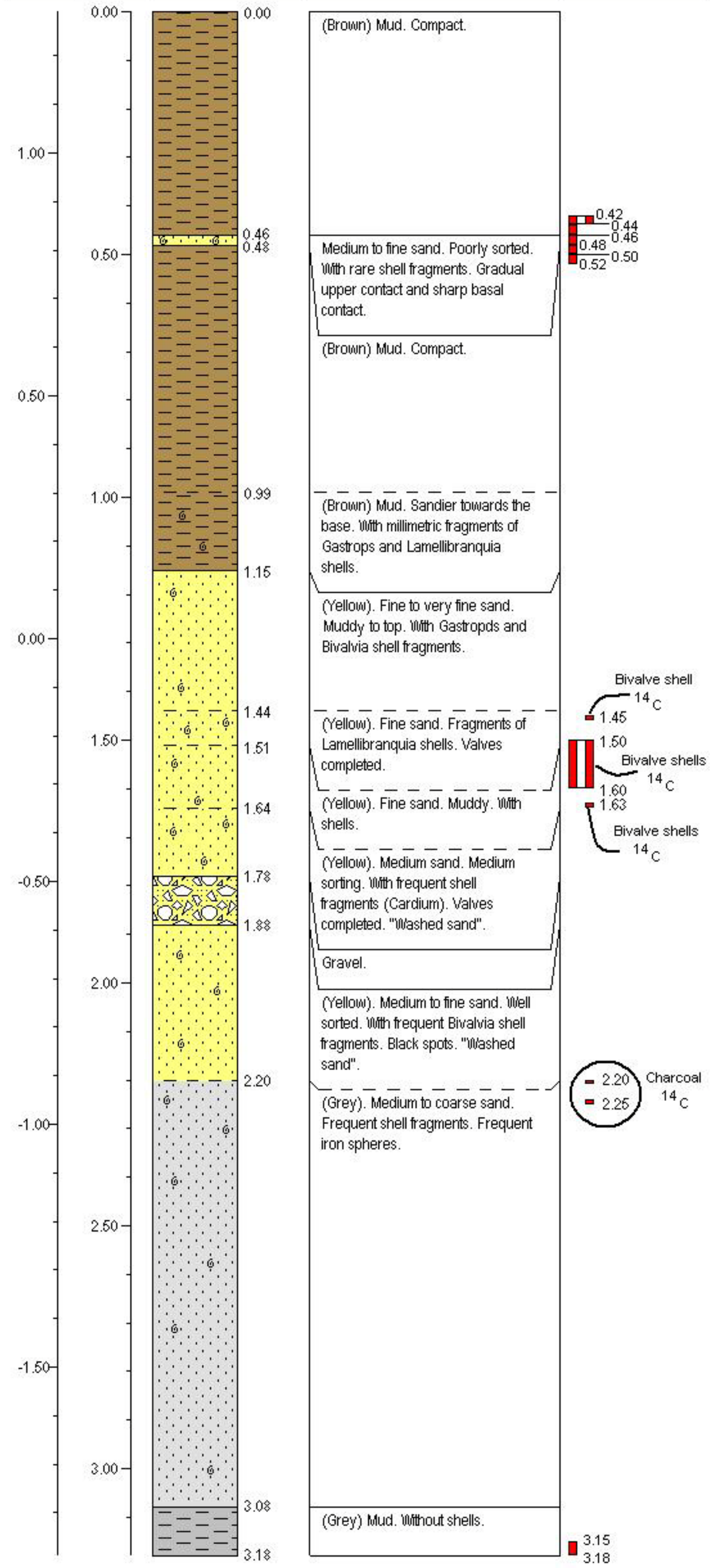


Reference: SG6			Date: 04-11-2007
Coordinates	UTM (ED50) 29S	M: 0559499 P: 4106031	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



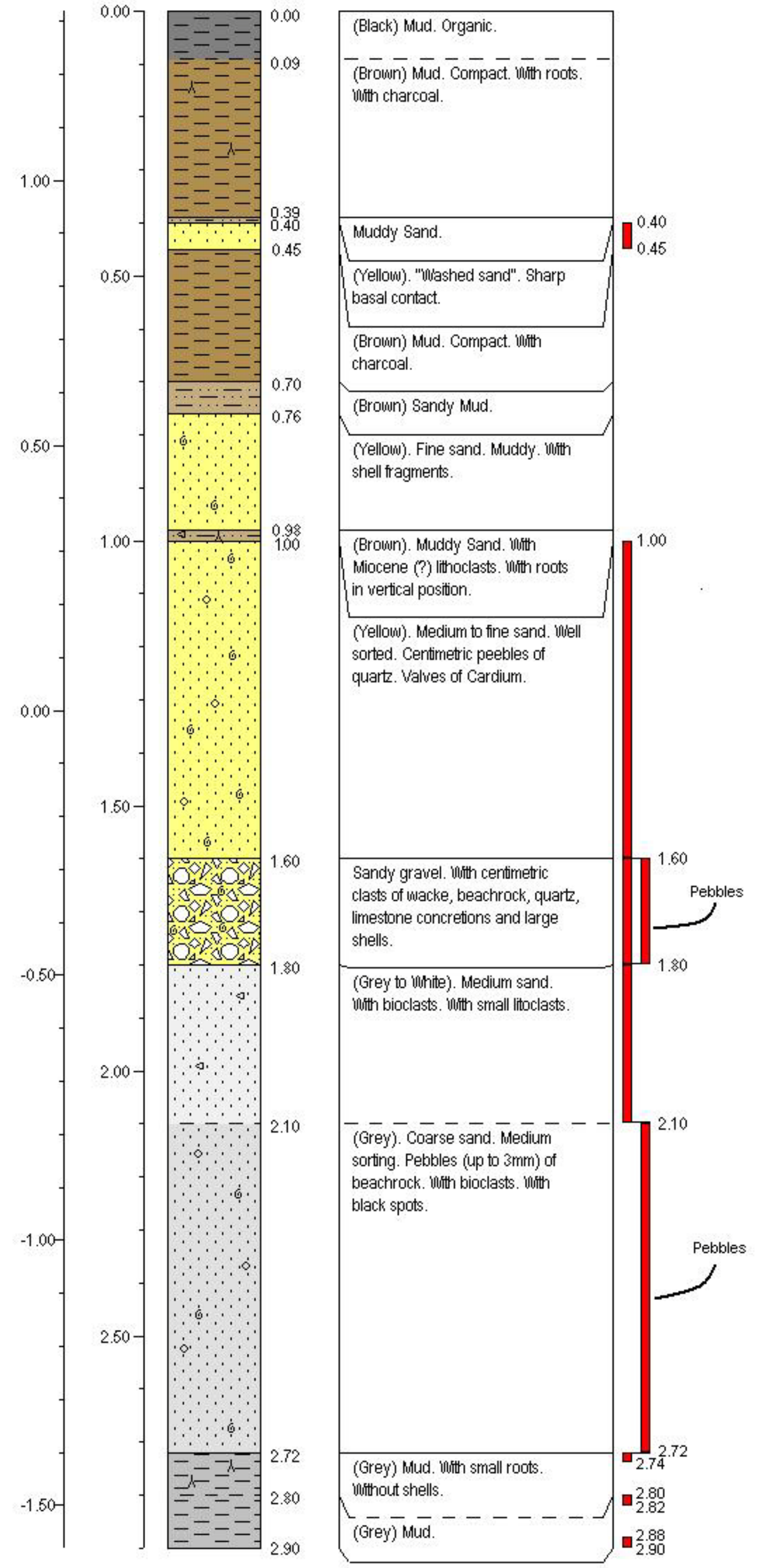
Reference: SG7			Date: 04-11-2007
Coordinates	UTM (ED50) 29S	M: 0559481 P: 4105870	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

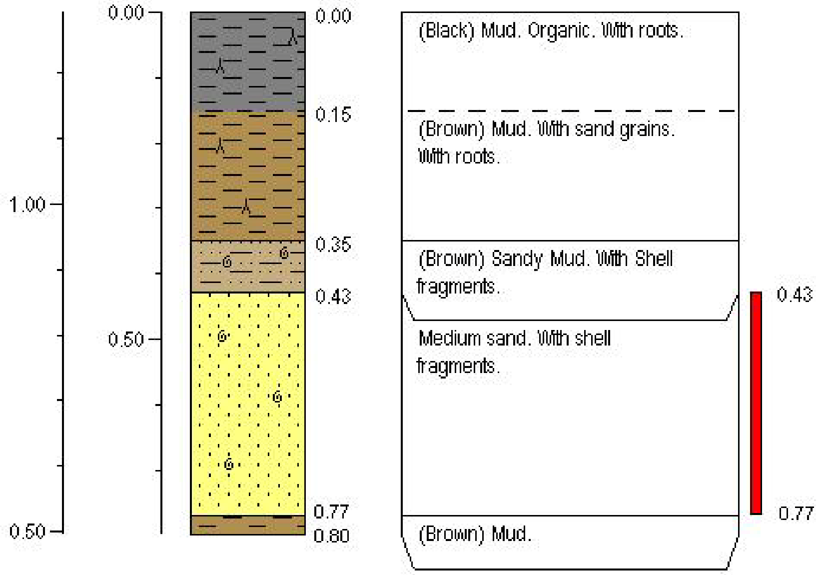


Reference: SG8			Date: 04-11-2007
Coordinates	UTM (ED50) 29S	M: 0559482 P: 4105751	Location: Salgados Lagoon

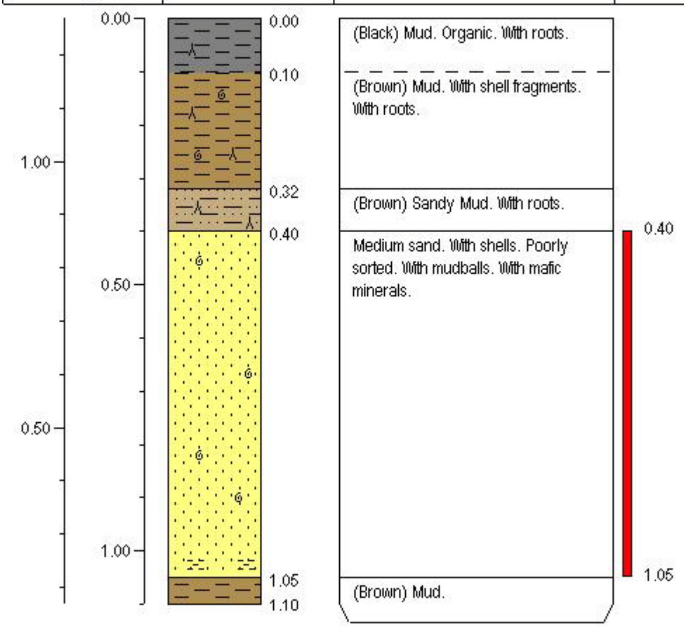
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



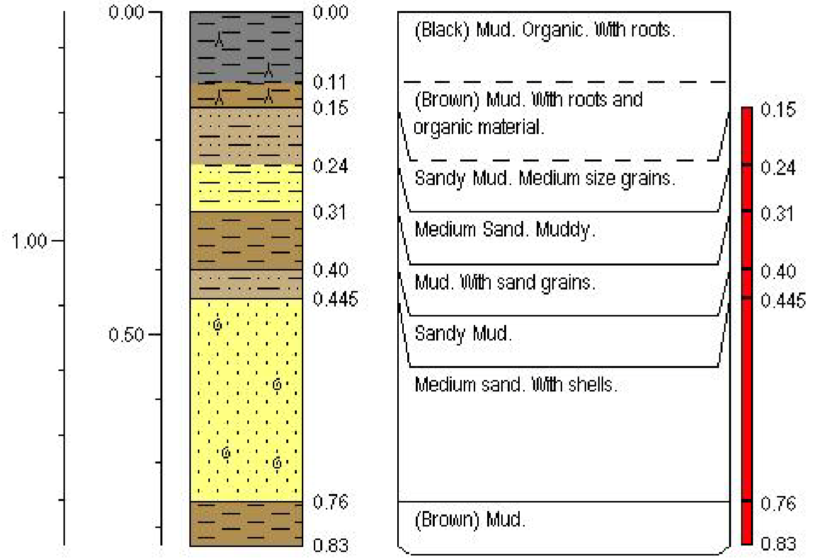
Reference: **SG9**			Date: 05-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559616 **P:** 4105572	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



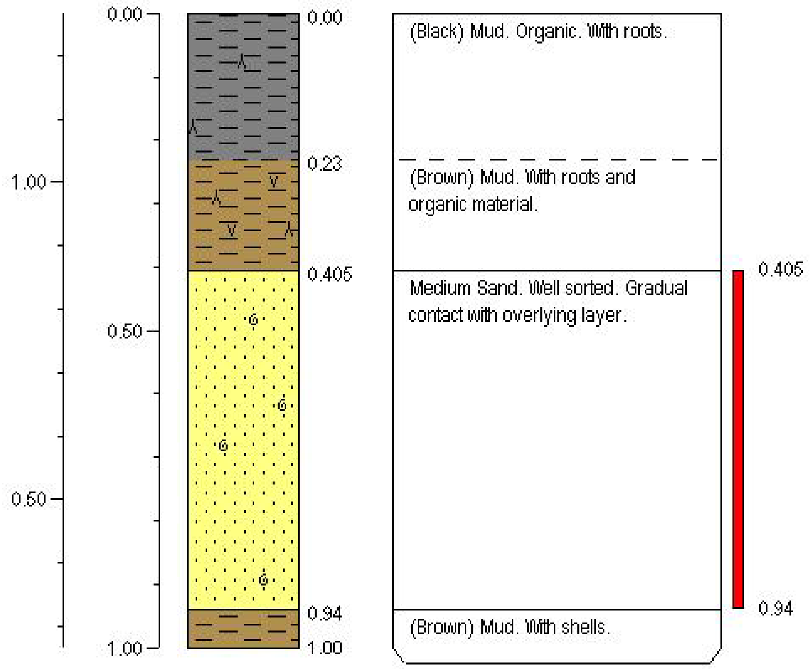
Reference: **SG10**			Date: 05-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559613 **P:** 4105601	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



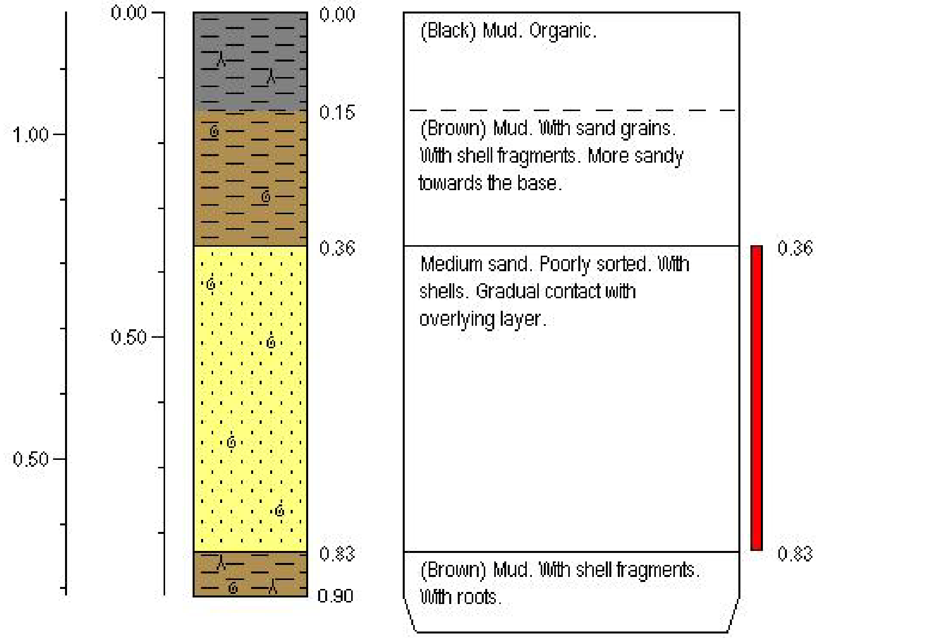
Reference: SG11			Date: 05-11-2007
Coordinates	UTM (ED50) 29S	M: 0559589 P: 4105587	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



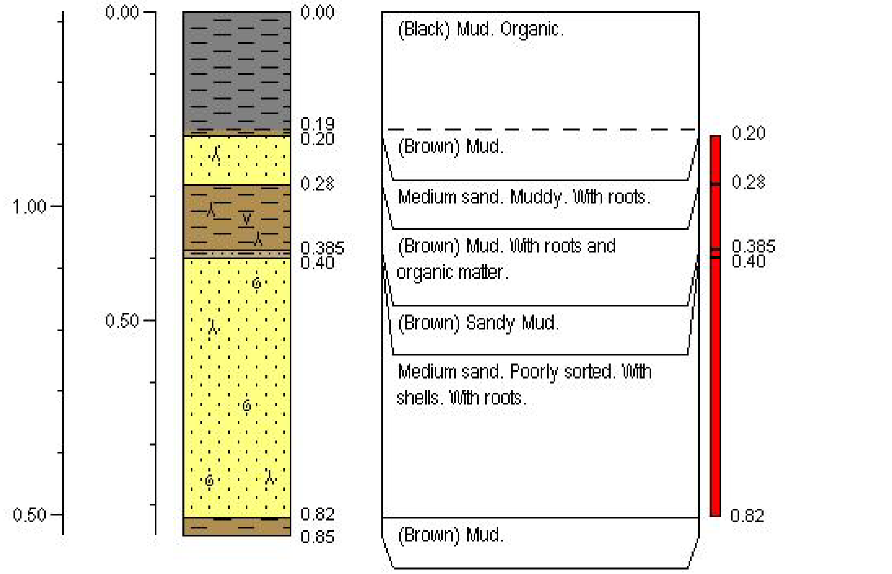
Reference: SG12			Date: 05-11-2007
Coordinates	UTM (ED50) 29S	M: 0559601 P: 4105594	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



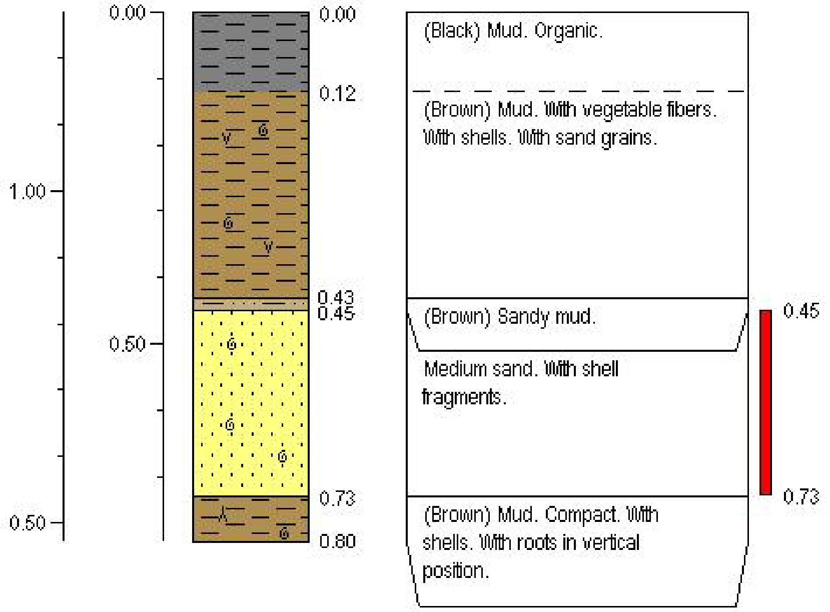
Reference: SG13			Date: 05-11-2007
Coordinates	UTM (ED50) 29S	M: 0559602 P: 4105622	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



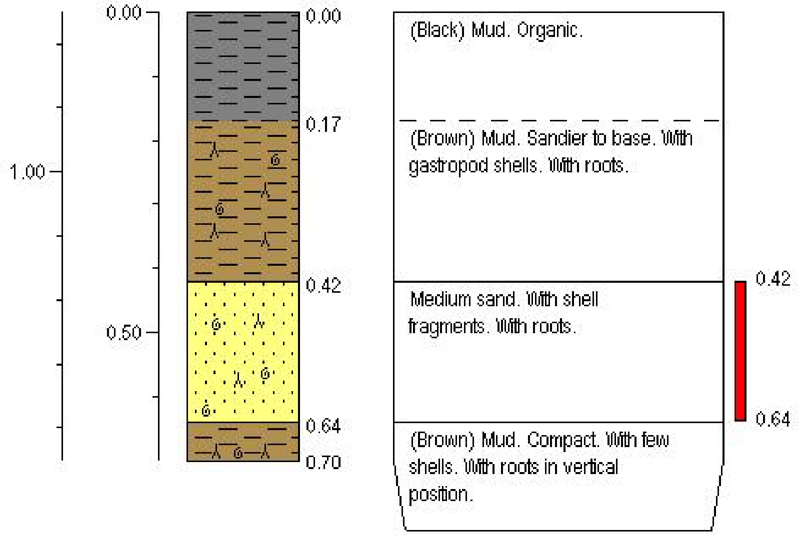
Reference: SG14			Date: 05-11-2007
Coordinates	UTM (ED50) 29S	M: 0559581 P: 4105609	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



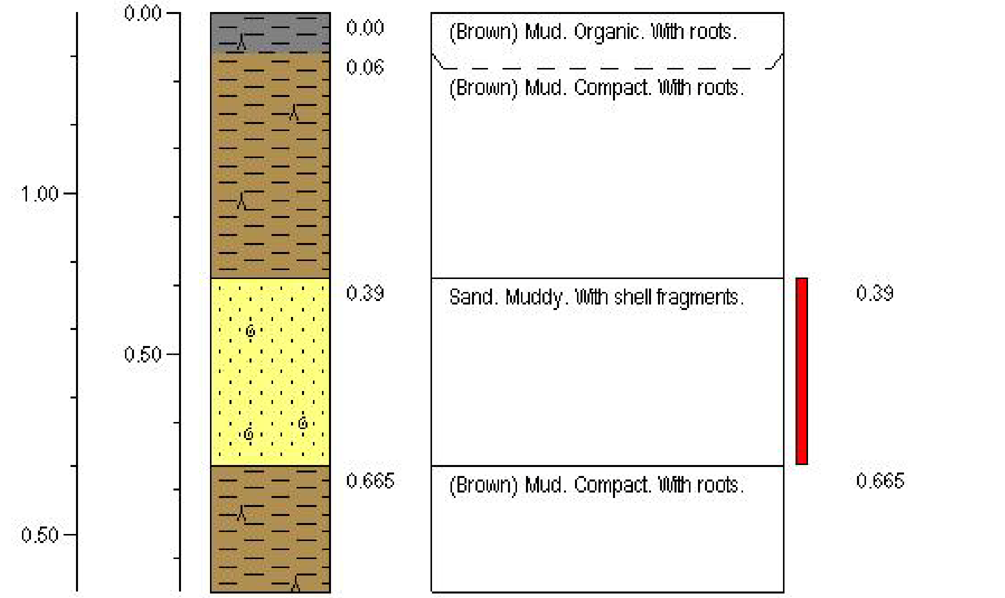
Reference: **SG15**			**Date:** 05-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559585 **P:** 4105648	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



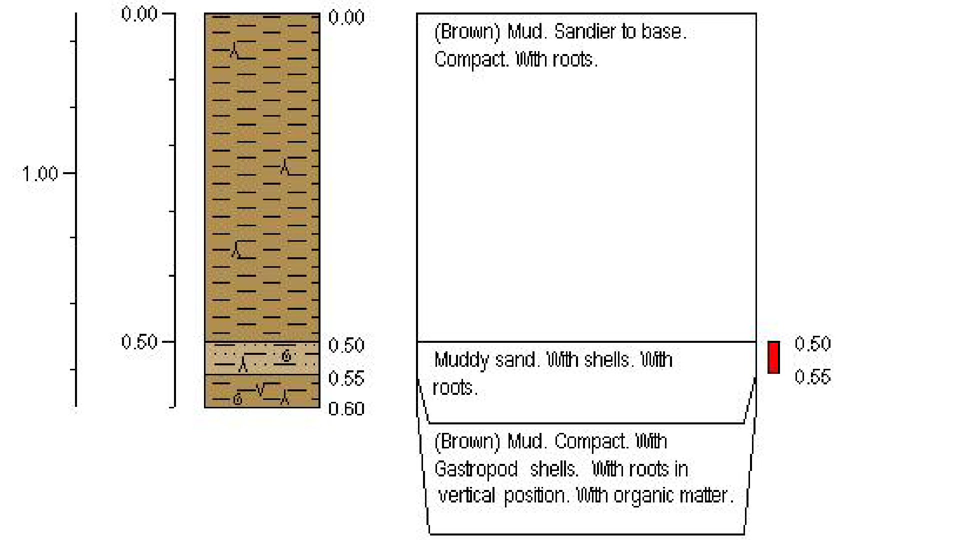
Reference: **SG16**			**Date:** 05-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559570 **P:** 4105676	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



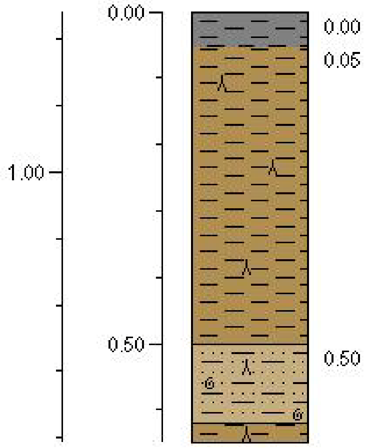
Reference: **SG17**			**Date:** 05-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559572 **P:** 4105704	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: **SG18A**			**Date:** 05-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559571 **P:** 4105734	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: **SG18B**			Date: 05-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559571 **P:** 4105734	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



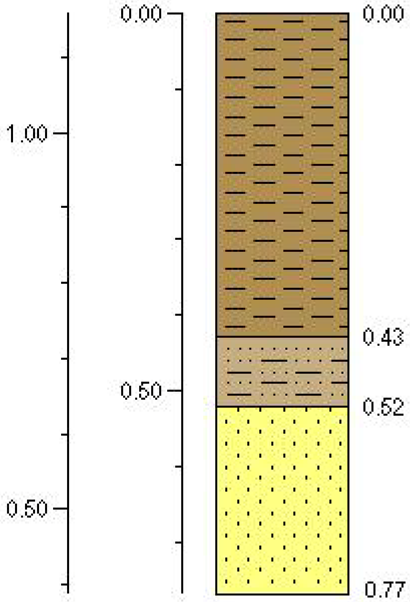
(Dark) Mud. Organic.

(Brown) Mud. Compact with roots.

Muddy sand. Medium size. With shells. With roots.

(Brown) Mud. Compact with roots.

Reference: **SG19**			Date: 05-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559586 **P:** 4105707	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



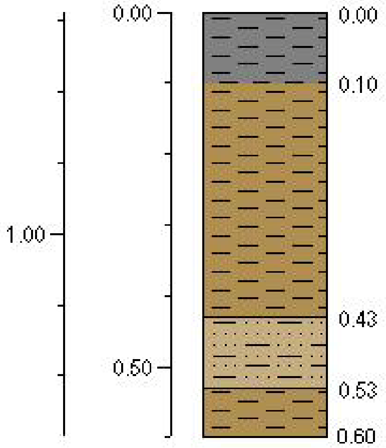
(Brown) Mud. With shells. With roots.

(Brown) Sandy Mud. With shell fragments.

Medium sand. With shell fragments.

Reference: **SG20**			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559590.80 **P:** 4105779.55	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Black) Mud. With organic matter.

(Brown) Mud. Plastic. With centimetric Bivalvia shells. With roots in vertical position. Charcoal present. Grey spots.

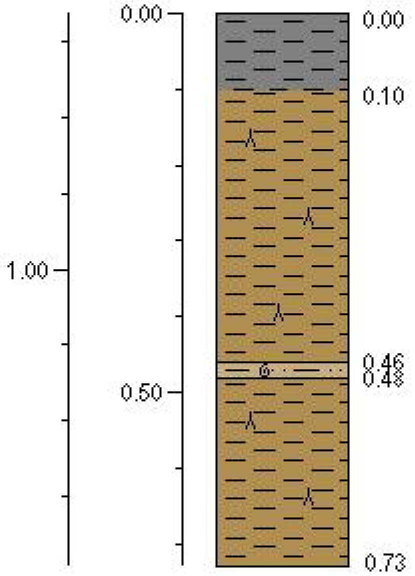
Muddy Sand. Medium size grains. Poorly sorted. With shells.

(Brown) Mud. Plastic. More sandier towards the base. With charcoal.

Sampling depth: 0.43 – 0.53

Reference: **SG21**			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559589.80 **P:** 4105810.55	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Black) Mud. Organic.

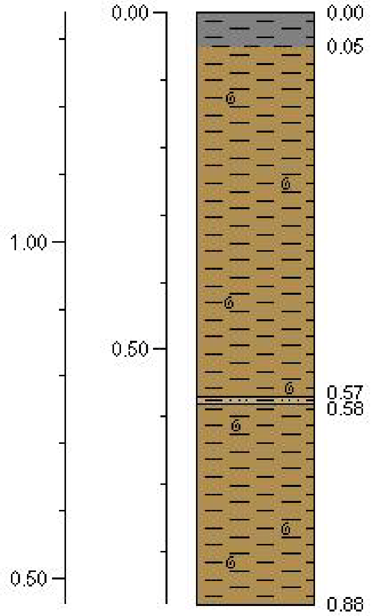
(Brown) Mud. Plastic. With roots. With charcoal. With grey spots.

Muddy Sand. Medium size grains. With shells.

(Brown) Mud. Plastic. With roots. With charcoal. With grey spots.

Sampling depth: 0.46 – 0.48

Reference: SG22			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	M: 0559594.80 P: 4105885.55	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Black) Mud. Organic.

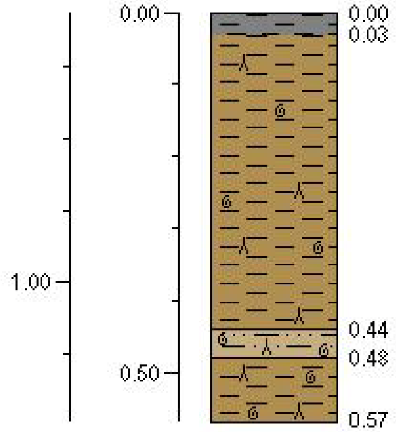
(Brown) Mud. Plastic. With charcoal. With Gastropod shells. With grey spots.

Sandy Mud. With Broken shells.

(Brown) Mud. Plastic. With Gastropod shells. With Bivalvia shell fragments.

Sampling depth: 0.57 – 0.58

Reference: SG23			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	M: 0559597.80 P: 4105948.56	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Black) Mud. Organic.

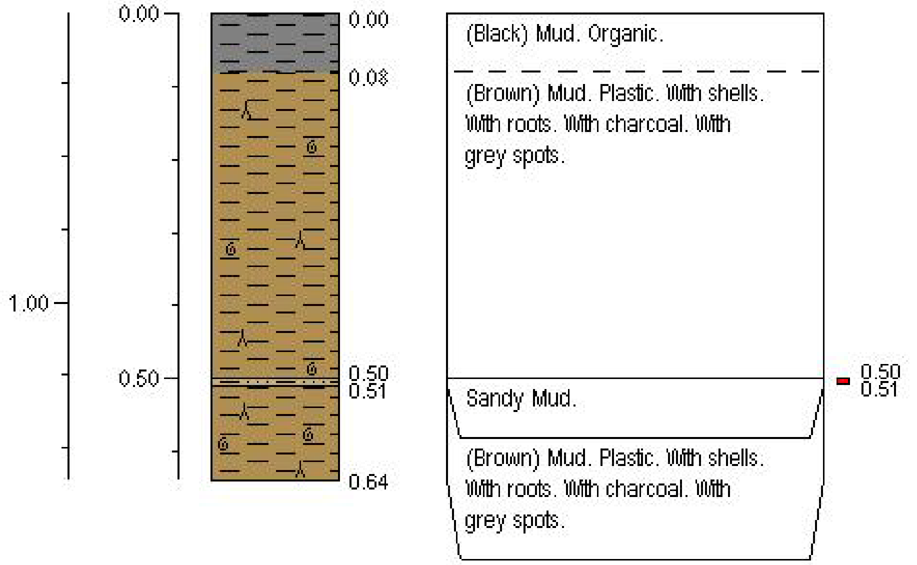
(Brown) Mud. Plastic. With shells. With roots. With charcoal. With grey spots.

Muddy sand. Medium to fine grains. With shells. With roots.

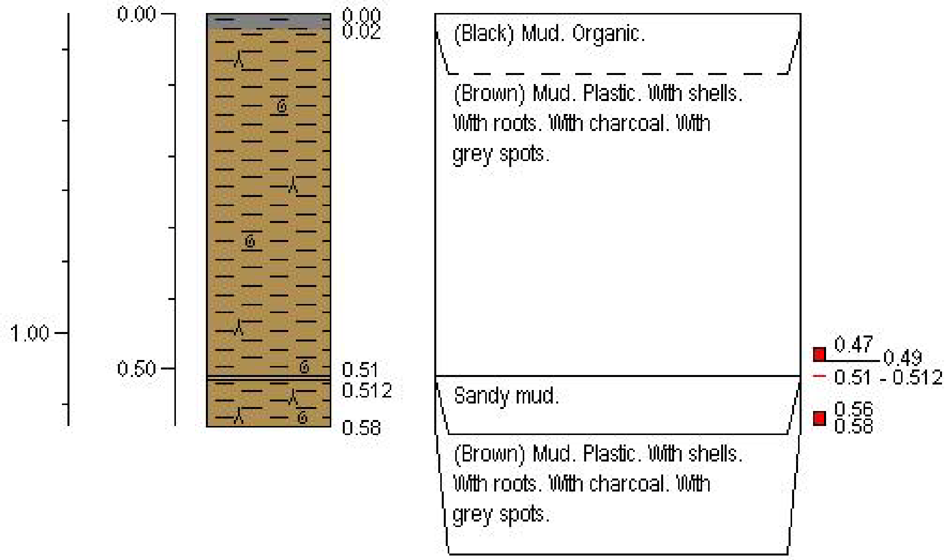
(Brown) Mud. Plastic. With shells. With roots. With charcoal. With grey spots.

Sampling depth: 0.44 – 0.48 – 0.57

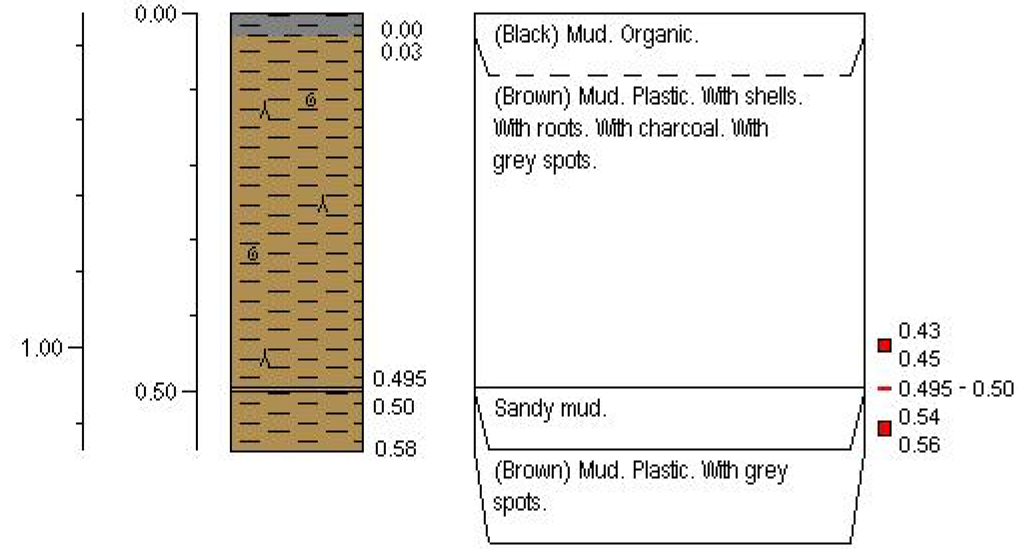
Reference: **SG24**			**Date:** 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559600.80 **P:** 4105984.56	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



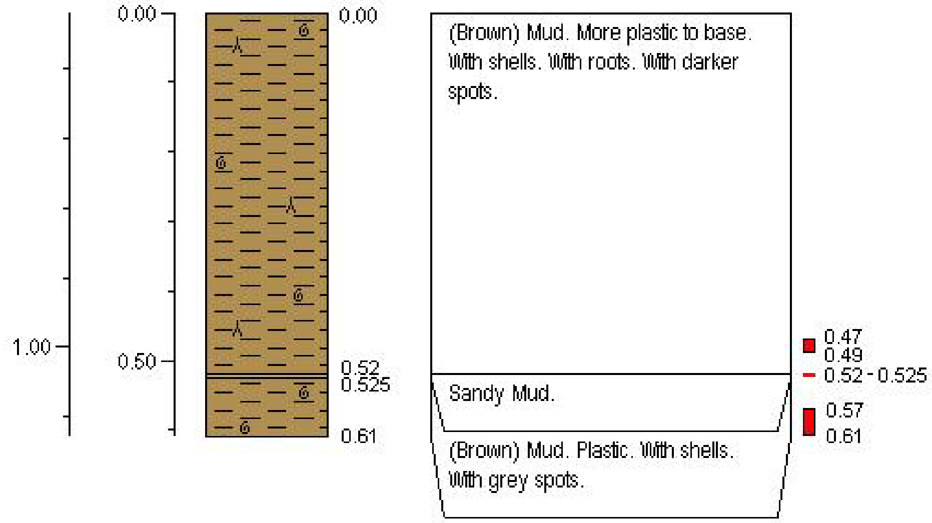
Reference: **SG25**			**Date:** 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559606.80 **P:** 4106049.56	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: **SG26**			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559606.80 **P:** 4106073.56	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**

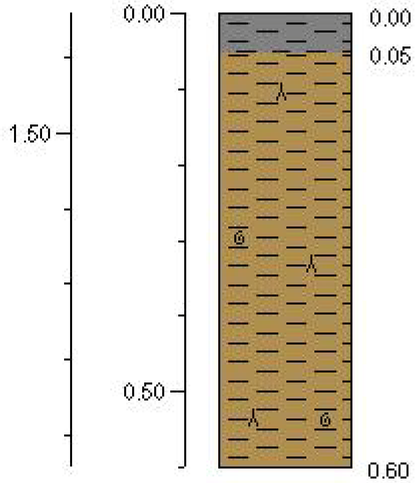


Reference: **SG27**			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559608.80 **P:** 4106094.56	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: **SG28**			**Date:** 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559608.80 **P:** 4106118.56	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

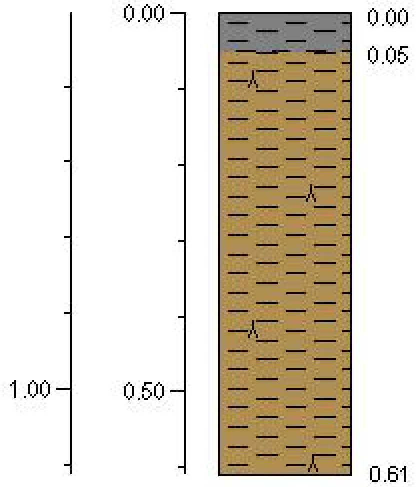


Mud. Organic soil (?)

(Brown) Mud. Plastic. With Gastropods shells. With roots. With darker spots.

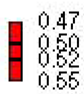
Reference: **SG29**			**Date:** 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559609.80 **P:** 4106101.56	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



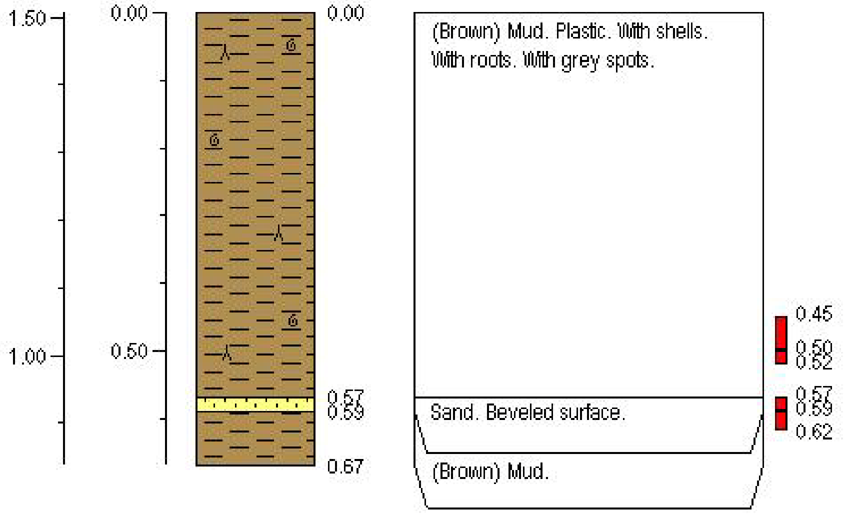
(Dark) Mud. Organic.

(Brown) Mud. Plastic. With roots. With charcoal. With grey spots.



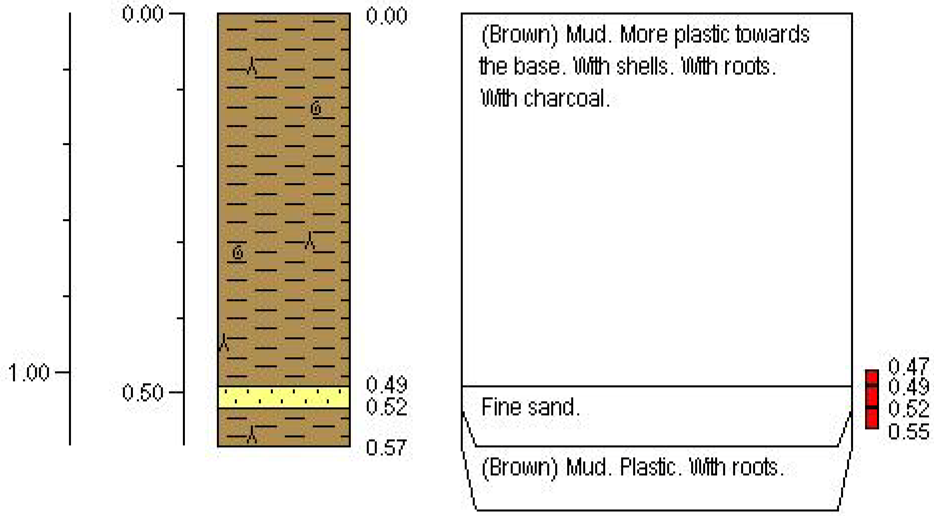
Reference: **SG30**			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559652.80 **P:** 4106071.56	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

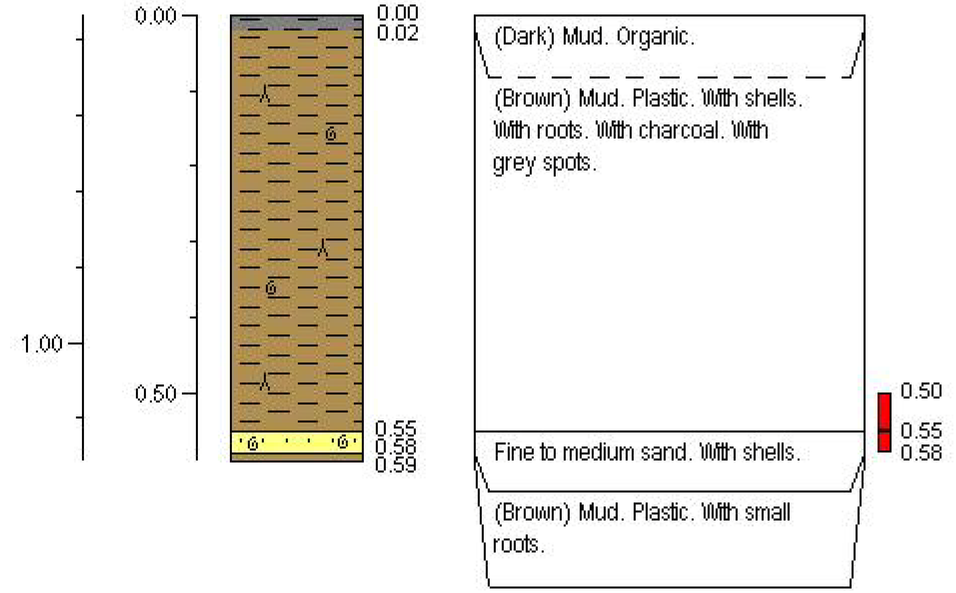


Reference: **SG31**			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559652.80 **P:** 4106043.56	**Location:** Salgados Lagoon

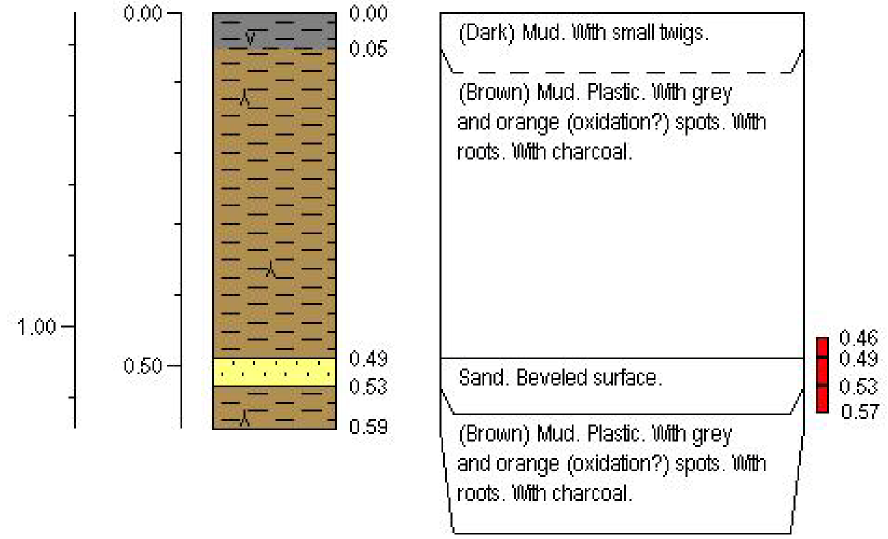
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



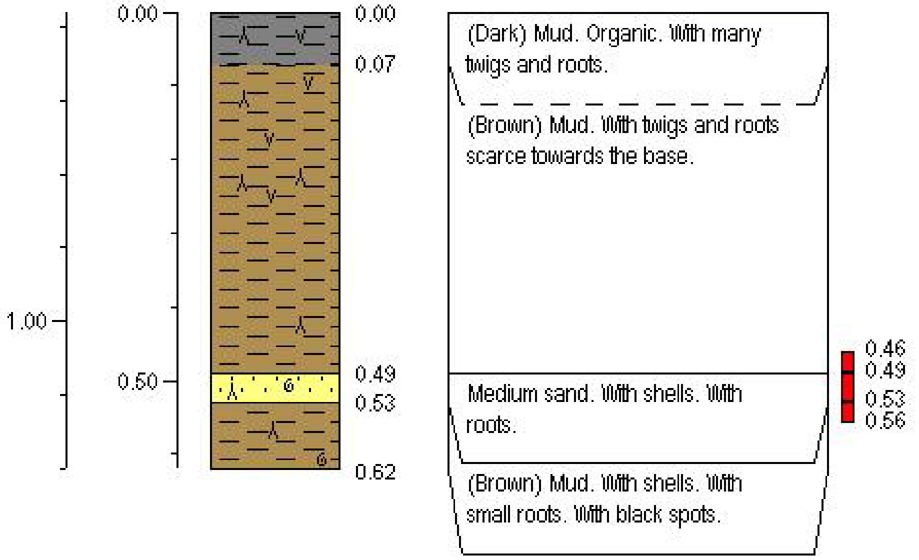
Reference: **SG32**			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559653.80 **P:** 4106012.56	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



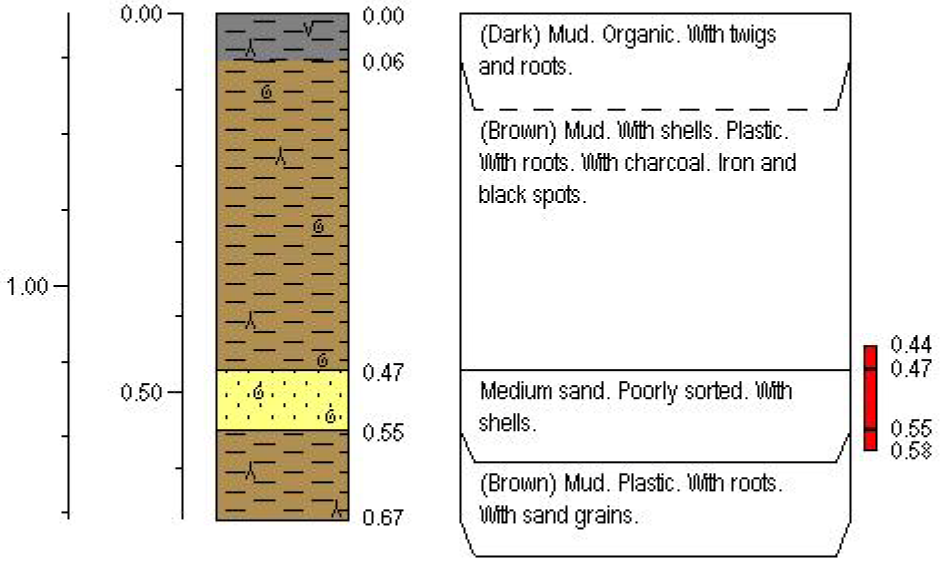
Reference: **SG33**			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559651.80 **P:** 4105983.56	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: SG34			**Date:** 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559654.80 **P:** 4105921.55	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**

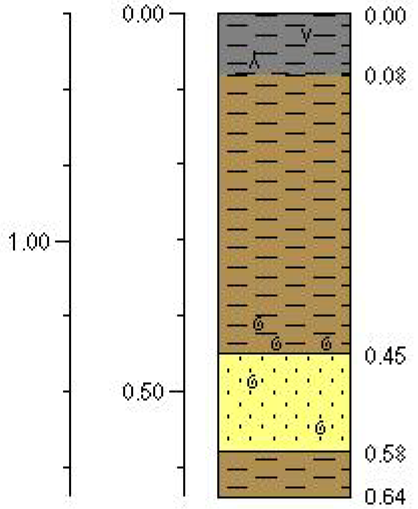


Reference: SG35			**Date:** 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559652.80 **P:** 4105863.55	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: SG36			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	M: 0559654.80 P: 4105797.55	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark) Mud. Organic. With twigs and roots.

(Brown) Mud. More plastic towards the base. With Bivalvia shell fragments at the base. With charcoal. With black spots.

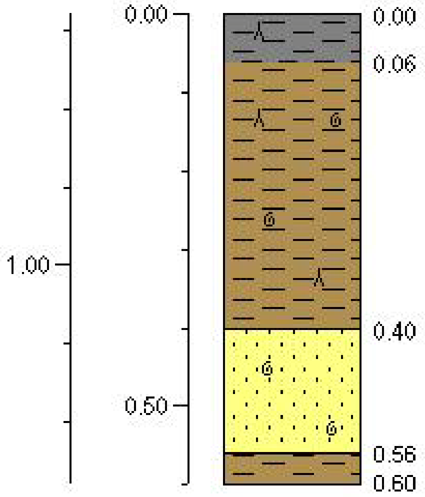
Medium sand. Poorly sorted. With shells.

(Brown) Mud. Plastic.

Sampling depth: 0.42, 0.45, 0.55, 0.58

Reference: SG37			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	M: 0559645.80 P: 4105739.55	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark) Mud. Organic. With roots.

(Brown) Mud. More plastic to base. With shells. With roots. With charcoal. With grey and orange (oxidation?) spots.

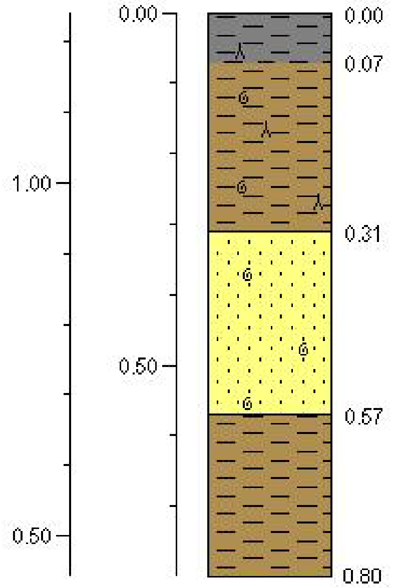
Medium sand. Poorly sorted. With shells.

(Brown) Mud. Plastic.

Sampling depth: 0.37, 0.40, 0.56, 0.59

Reference: **SG38**			**Date:** 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559651.80 **P:** 4105678.55	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

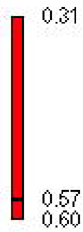


(Dark) Mud. Organic. With roots.

(Brown) Mud. Plastic. With shells. With roots. With charcoal. With grey and orange (oxidation?) spots.

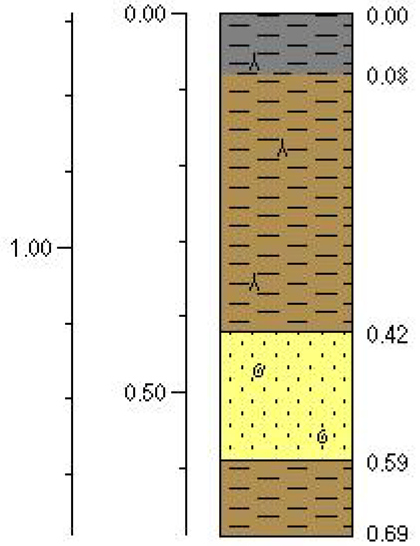
Medium sand. Poorly sorted. With shells.

(Brown) Mud. Plastic.



Reference: **SG39**			**Date:** 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559674.80 **P:** 4105742.55	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

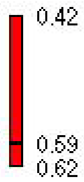


(Dark) Mud. Organic. With roots.

(Brown) Mud. Plastic. With roots in vertical position. With charcoal. With grey spots.

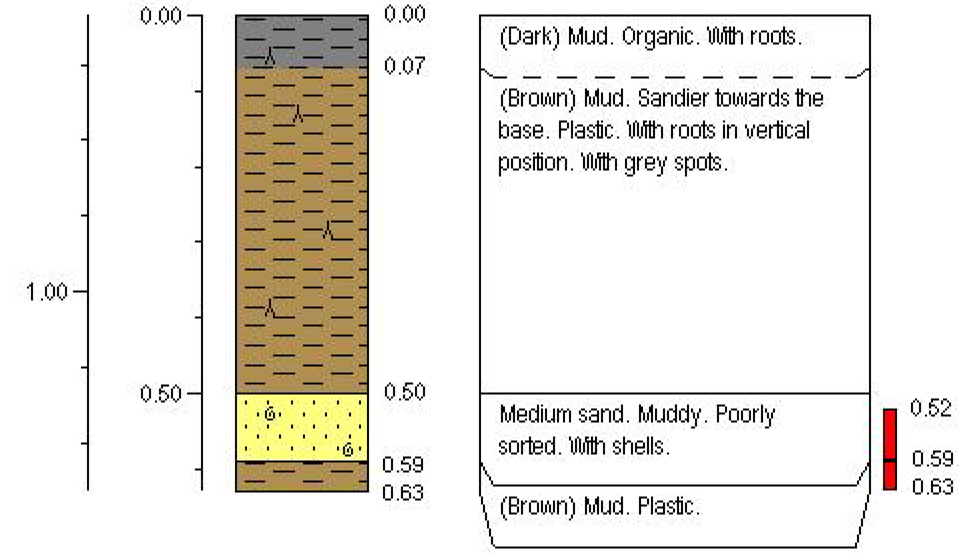
Medium sand. Poorly sorted. With shells.

(Brown) Mud. Plastic.



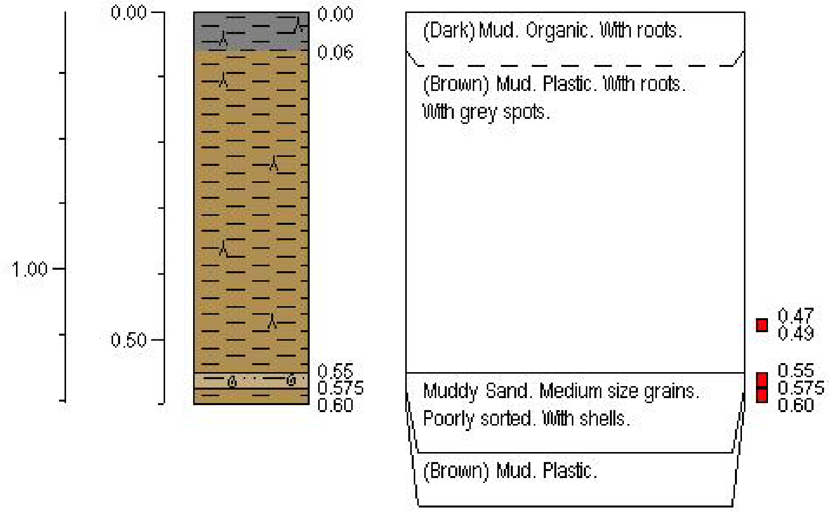
Reference: **SG40**			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559681.80 **P:** 4105797.55	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

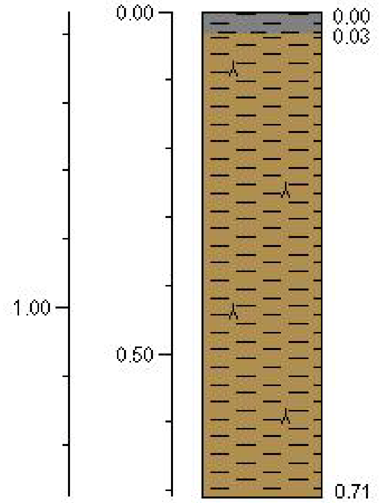


Reference: **SG41**			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559694.80 **P:** 4105862.55	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



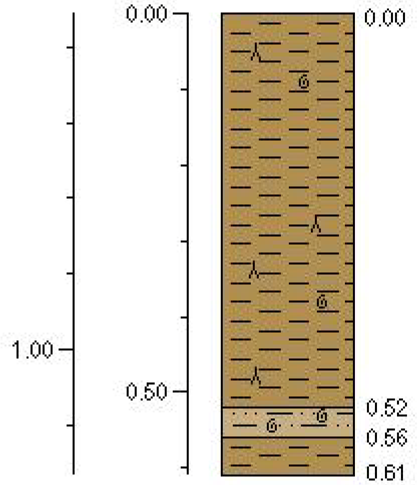
Reference: SG42			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	M: 0559698.80 P: 4105939.55	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark) Mud. Organic.

(Brown) Mud. Compact. With roots. With many charcoal.

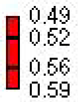
Reference: SG43			Date: 07-11-2007
Coordinates	UTM (ED50) 29S	M: 0559681.80 P: 4105968.56	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Brown) Mud. Compact. With few shells. With roots. With dark spots. With charcoal.

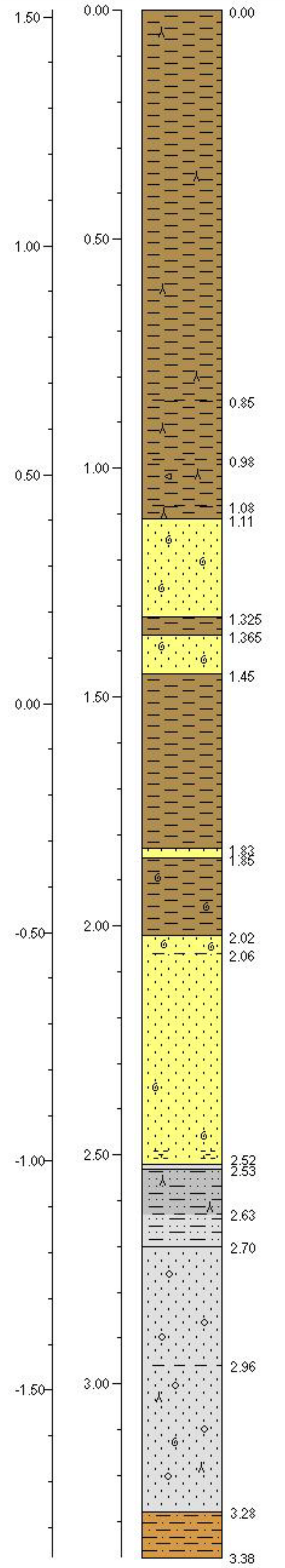
Muddy Sand. Medium size grains. With shells.

(Brown) Mud.



Reference: SG44			Date: 11-11-2007
Coordinates	UTM (ED50) 29S	M: 0559389 P: 4106206	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Brown) Mud. Compact With small roots. Few charcoal. Without shells.

(Brown) Mud. Compact. With small roots. Few charcoal. Without shells. With Gypsum?

(Brown) Mud. Compact. With small roots. Few charcoal. Without shells. With millimetric Miocene clasts.

(Brown) Mud. Sandier that overlying layer. Compact. With small roots. Few charcoal. Without shells.

(Yellow). Fine sand. With Gastropod and Bivalvia shells.

(Brown) Mud. Compact.

Fine sand. Medium sorting. Muddy sand. Many preserved Gastropod shells (up to 2mm) and Bivalvia shells (Cardium). Few valves (up to 1mm). Few millimetric charcoal.

(Brown) Mud. Compact. With millimetric layers of grey sand with shells (Gastropods). Gastropd and Bivalvia shells.

(Yellow). Fine sand. Poorly sorted. Without shells.

(Brown) Mud. Compact. Few Mollusc shells.

Medium sand. Good to medium sorting. "Washed" sand. With many millimetric fragments of Gastropods and Bivalvia shells. Small pieces of charcoal.

(Yellow). Medium to fine sand. "Washed" sand. Mud balls at the base. Few broken shells. Few black spots.

(Grey). Medium to coarse sand. Poorly sorted. Many black spots. Many broken shells.

(Dark Grey) Muddy sand. Soft. With many roots in vertical position. With no shells.

(Grey) Sandy Mud. Soft.

(Grey). Fine sand. Well sorted. Many pebbles of quartz and quartzit. Spheric pieces of Iron. Without shells.

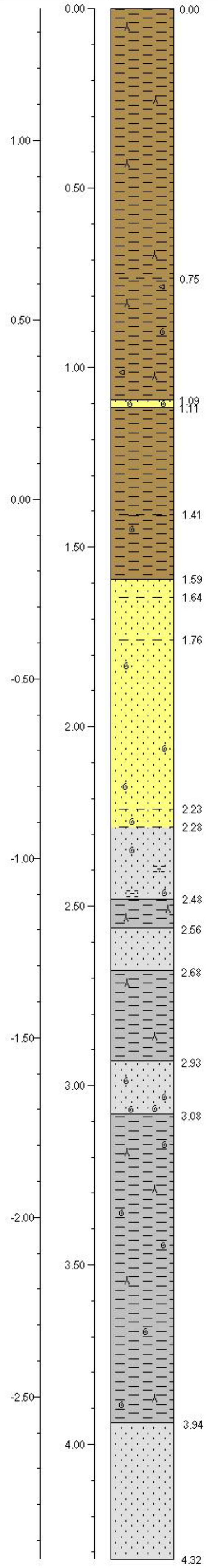
(Grey). Fine to very fine. Well sorted. With pebbles. 1 Fragment of crab shell. Few roots.

(Redish with grey parts). Sandy silt. Very compact. With roots in vertical position. Miocene or PQ?

Sampling depths: 0.90 (Gypsum); 1.08; 1.11; 1.22; 2.20; 2.25; 2.52; 2.57; 2.61; 2.63; 2.91; 2.96; 3.21; 3.26; 3.28; 3.32; 3.38

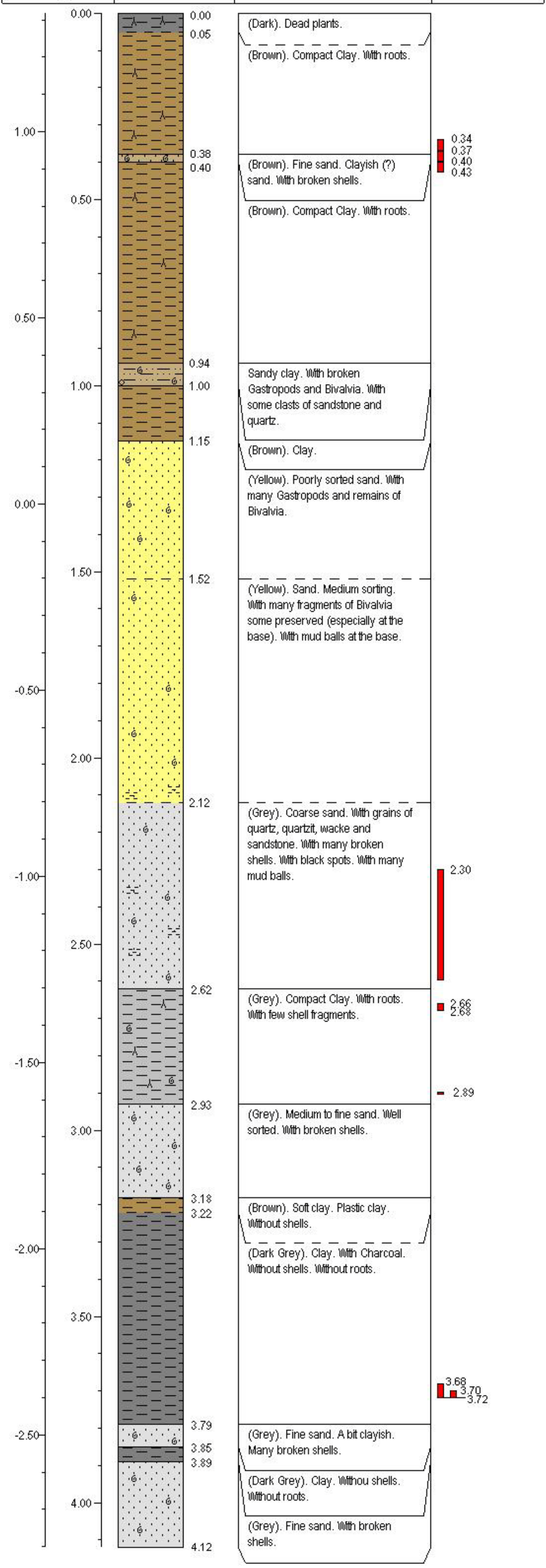
Reference: **SG45**			Date: 11-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559397 **P:** 4106029	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

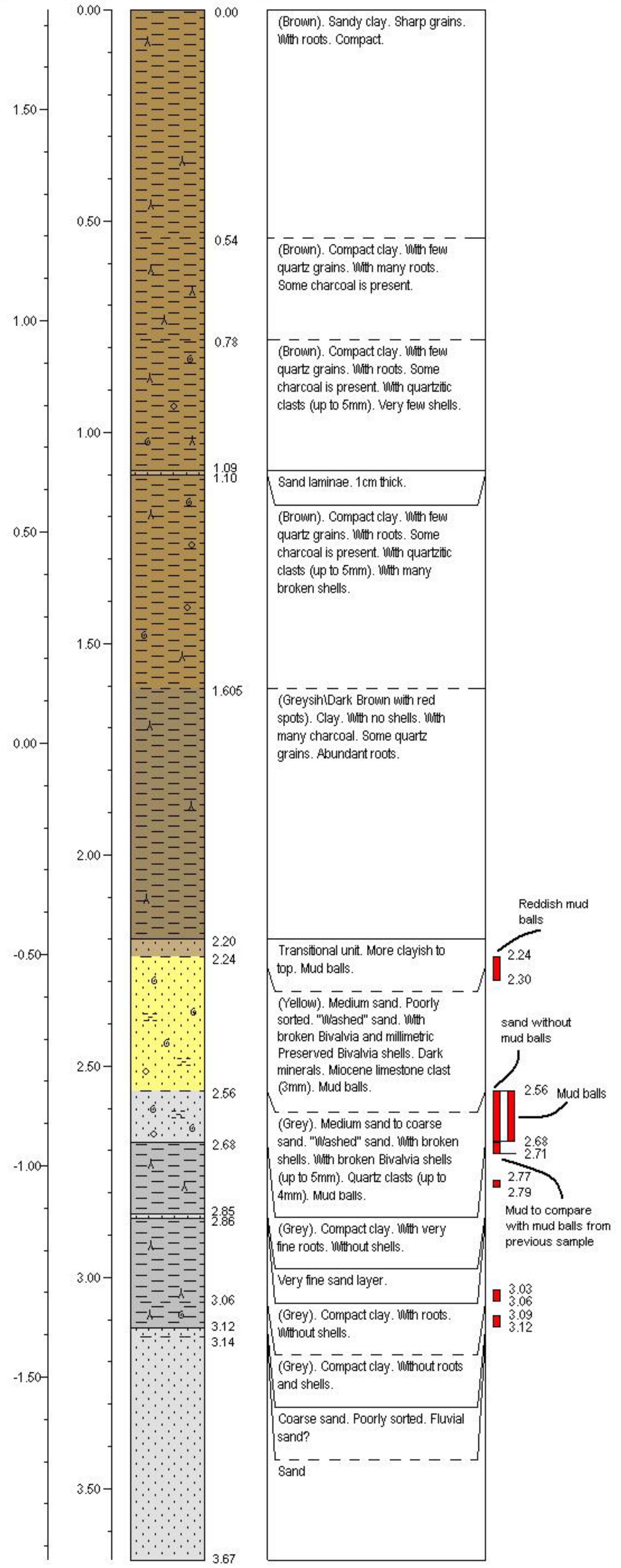


Depth (m)	Description	Sampling Depth (m)
0.00	(Brown) Mud. Compact. With roots and many charcoal.	
0.75	(Brown) Mud. Compact. With roots and many charcoal. With clasts. With rare broken Bivalvia shells.	
1.09	(Yellow). Fine sand. Many broken shells. Many Gastropod shells and charcoal. Few Lamellibranch shells.	
1.11	(Brown) Mud. Compact. With Gypsum crystals.	
1.41	(Brown) Mud. Compact. With Gypsum crystals. Few broken shells.	
1.59	(Yellow). Very fine sand. Muddy sand.	
1.64	Medium sand. Poor to medium sorting. With no shells. With millimetric grains of quartz and jaspe (?).	
1.76	(Yellow). Medium sand. Coarser towards the top. Medium sorting. With spheres of Iron. With broken shells. With heavy minerals.	
2.23	Fine to medium sand. Well sorted. "Washed sand". Few shell fragments.	
2.28	(Grey). Medium sand. Poorly sorted. "Washed" sand. With broken shells. Many mud balls.	2.54 2.56
2.48	(Grey) Mud. With small roots.	
2.56	Sand.	
2.68	(Grey) Mud. With small roots.	2.85 2.88
2.93	(Grey). Medium sand. With broken shells. Coarser bioclasts at the base.	2.98 Bivalve shell ^{14}C
3.08	(Grey) Mud. With many broken Gastropod and Bivalvia shells. Some small roots. Very thin layers of grey sand with broken shells.	
3.94	Sand.	
4.32		

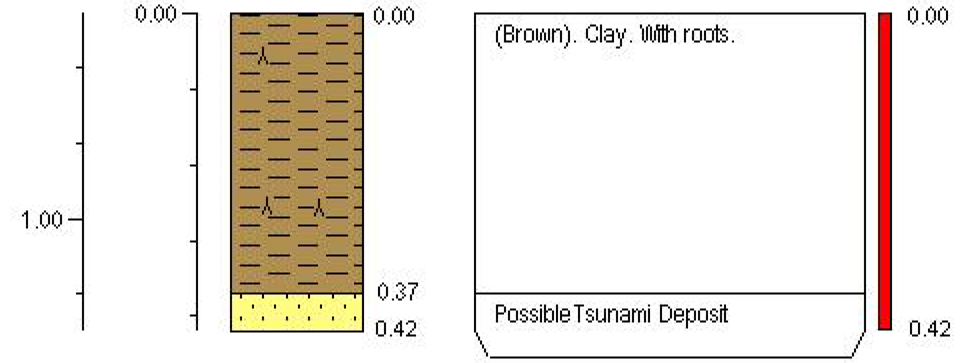
Reference: SG46			Date: 11-11-2007
Coordinates	UTM (ED50) 29S	M: 0559397 P: 4105886	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



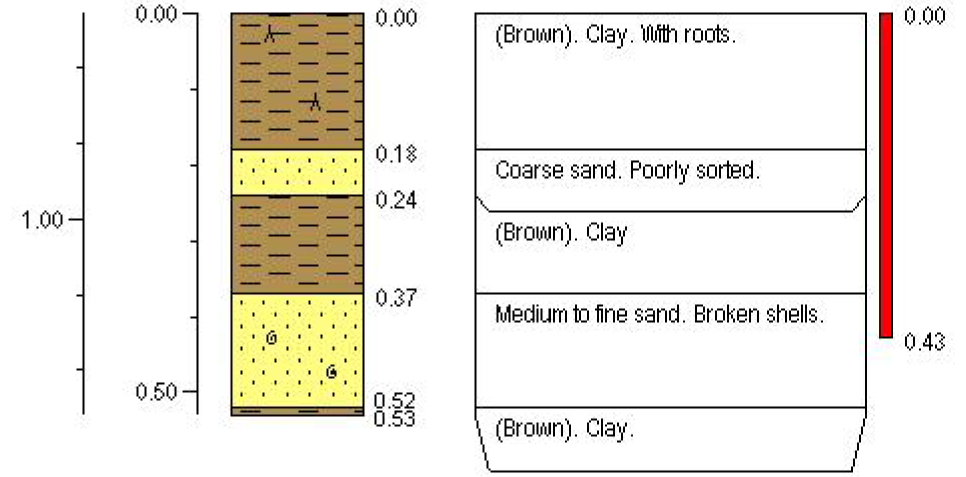
Reference: SG47			Date: 11-11-2007
Coordinates	UTM (ED50) 29S	M: 0559509 P: 4106334	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: **SG48**			Date: 11-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559547 **P:** 4105734	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**

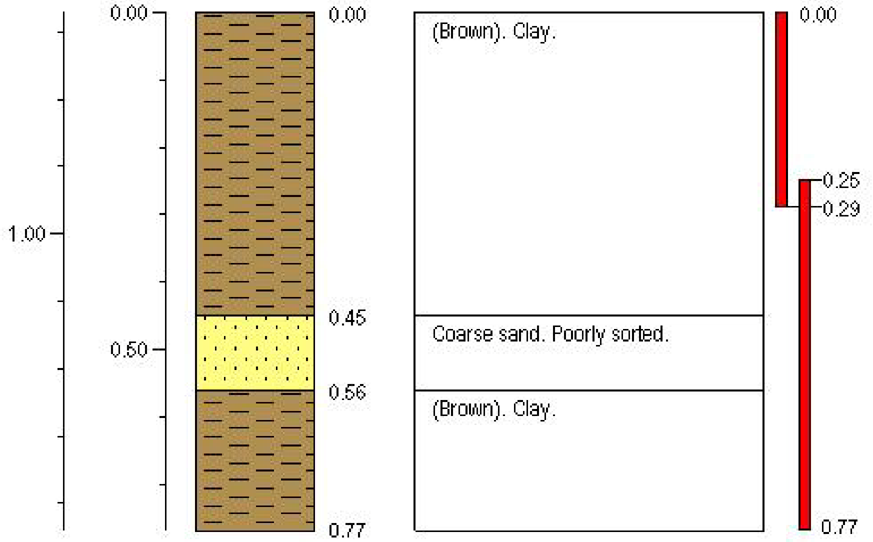


Reference: **SG48A**			Date: 11-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559547 **P:** 4105734	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



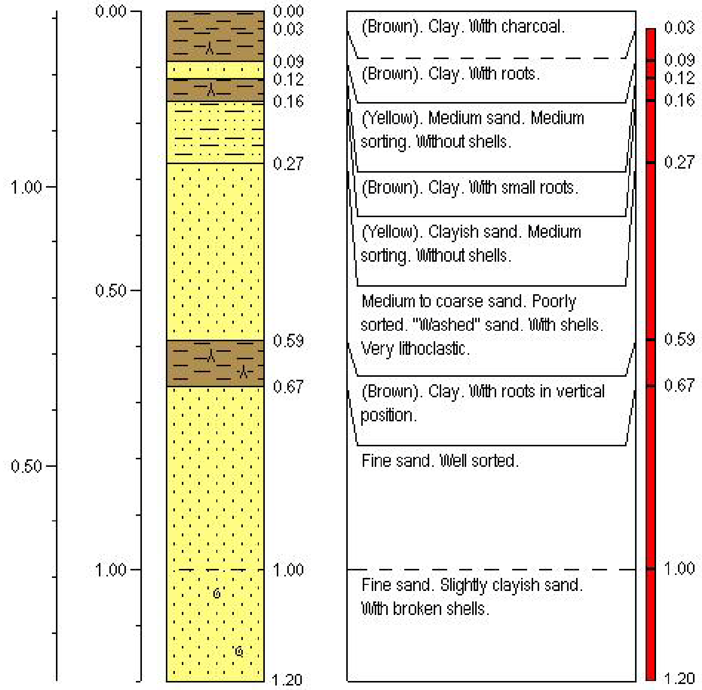
Reference: SG49			Date: 11-11-2007
Coordinates	UTM (ED50) 29S	M: 0559517 P: 4105748	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



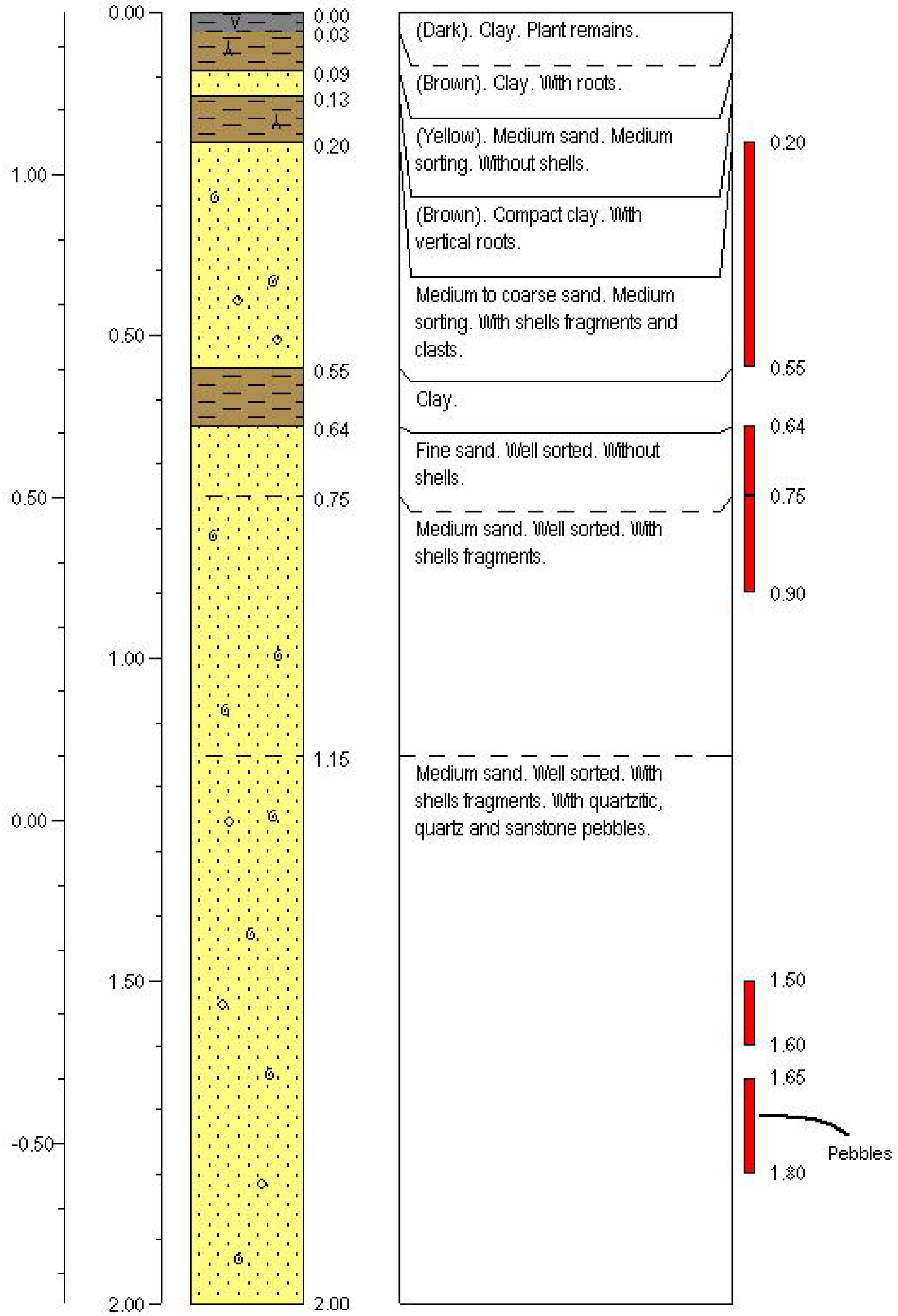
Reference: SG50			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559546 P: 4105629	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

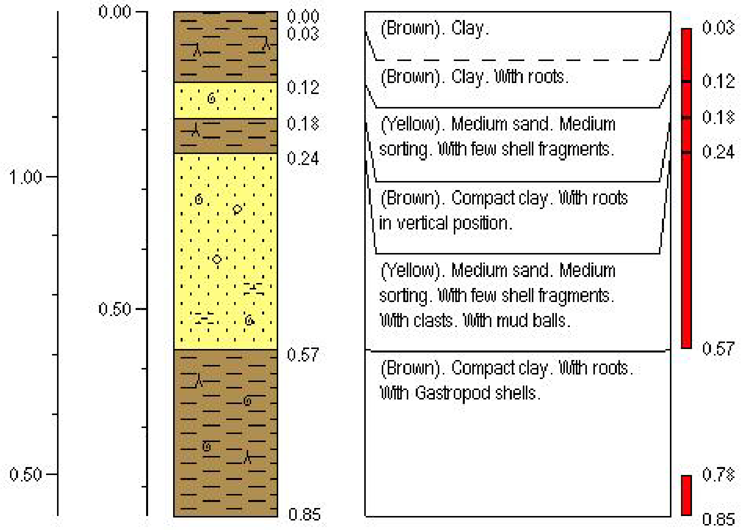


Reference: **SG51**			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559546 **P:** 4105659	**Location:** Salgados Lagoon

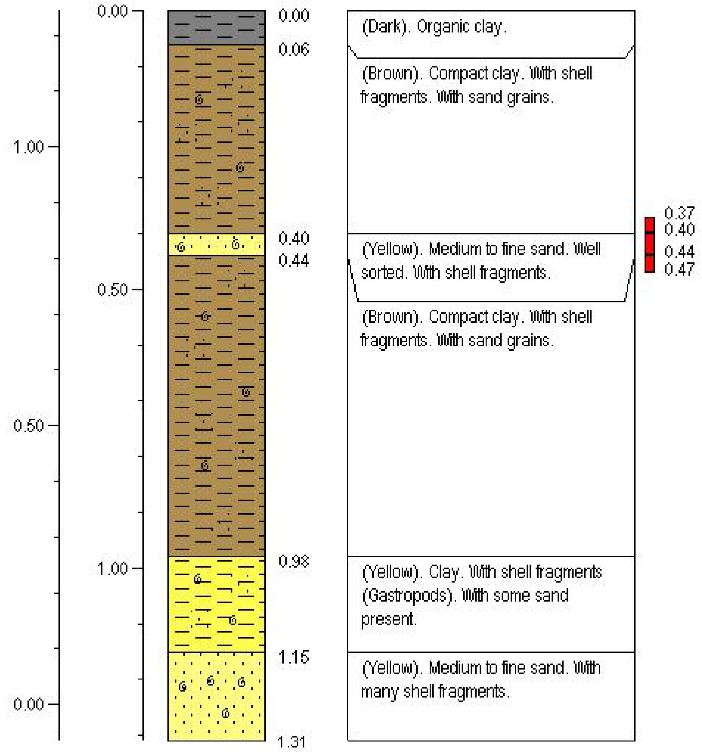
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: SG52			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559536 P: 4105698	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

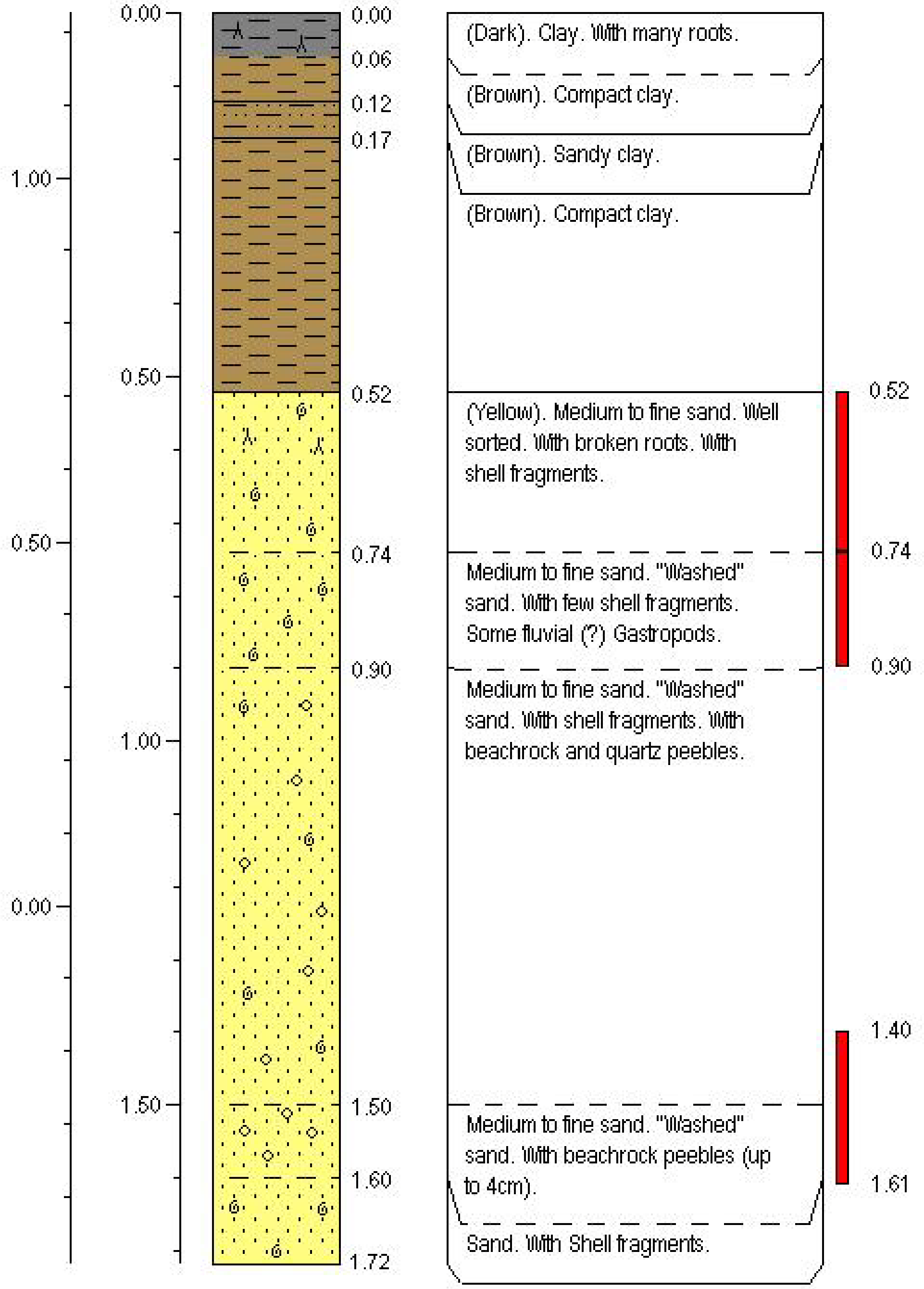


Reference: SG53			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559480 P: 4105772	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

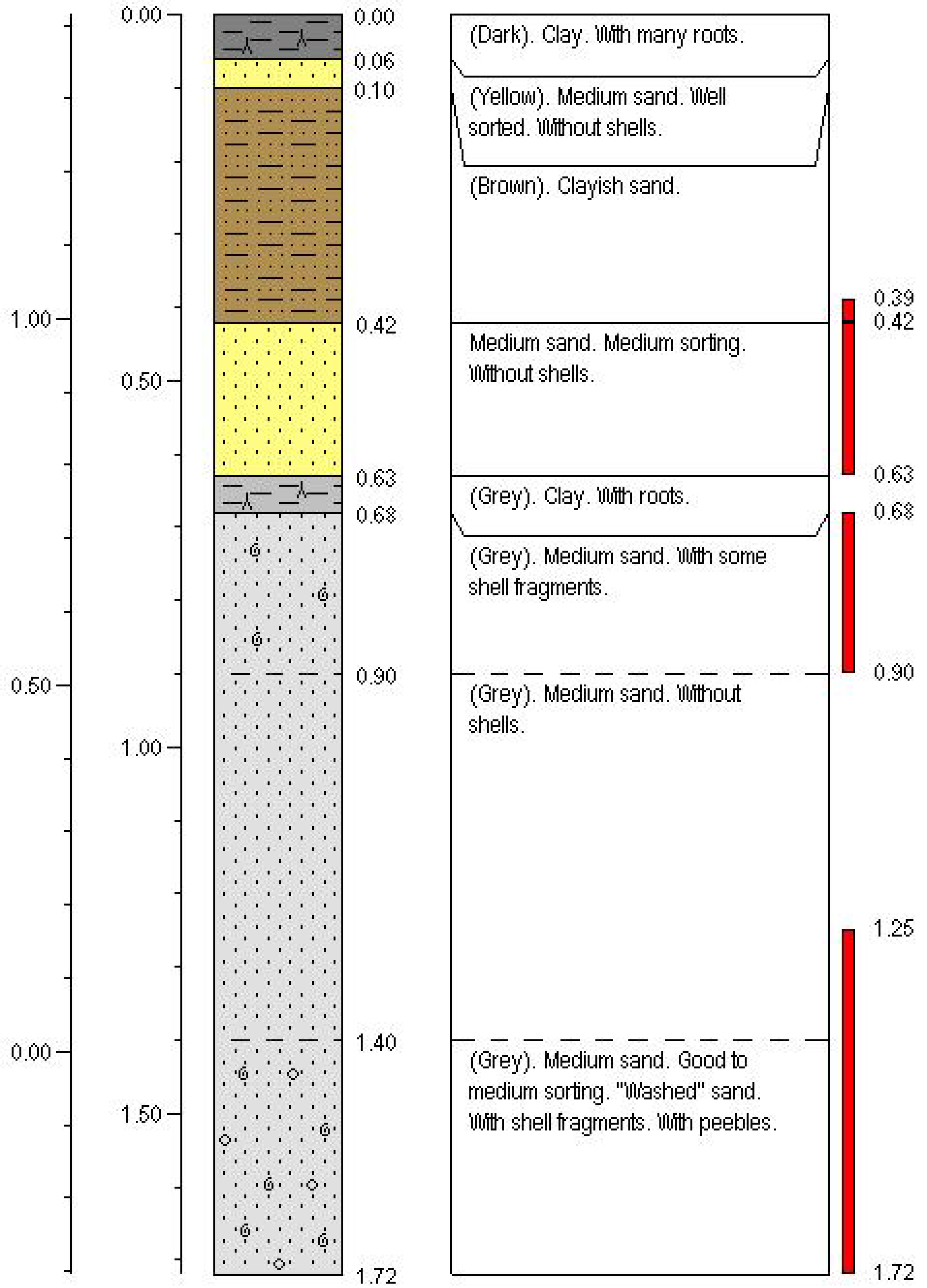


Reference: **SG54**			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559475 **P:** 4105714	**Location:** Salgados Lagoon

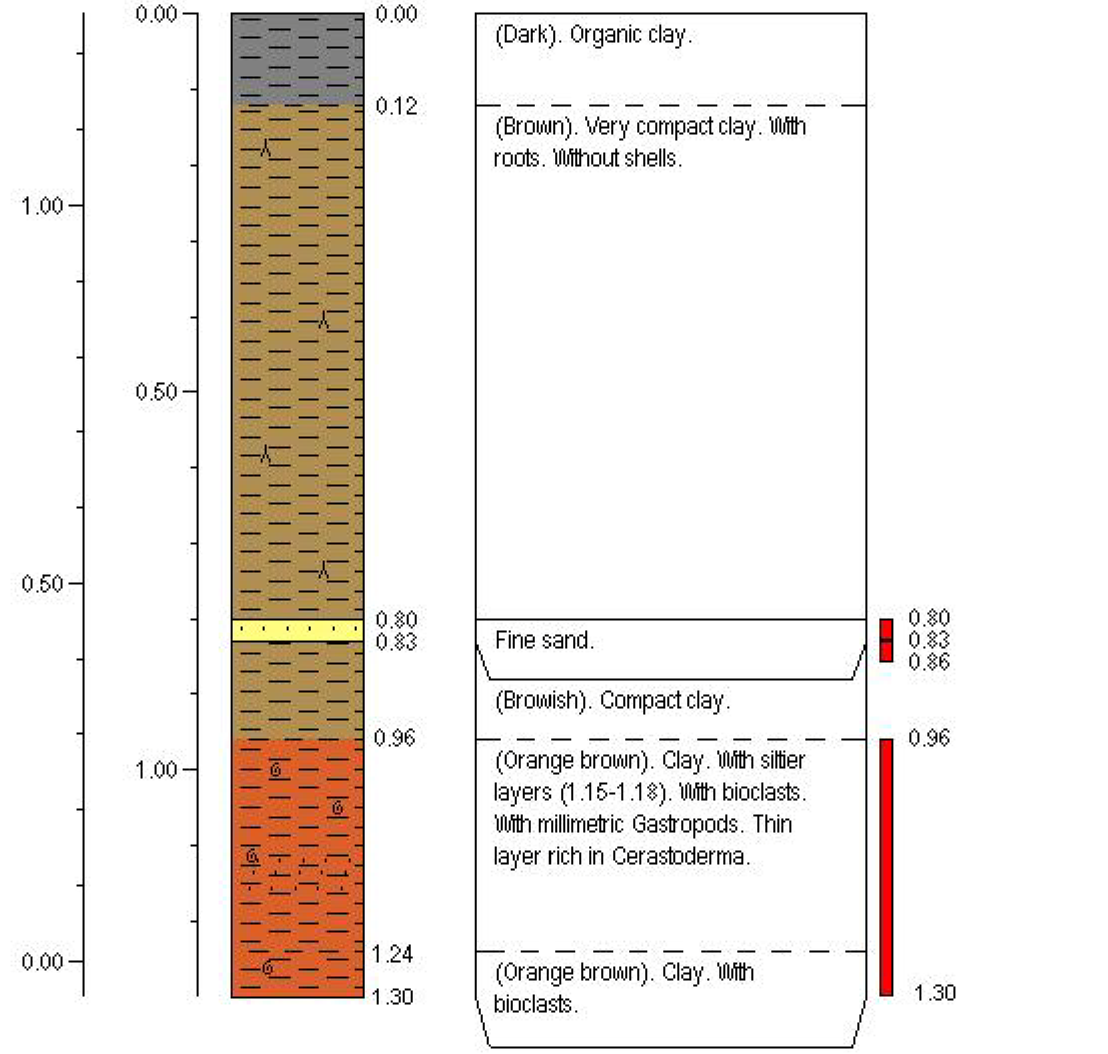
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



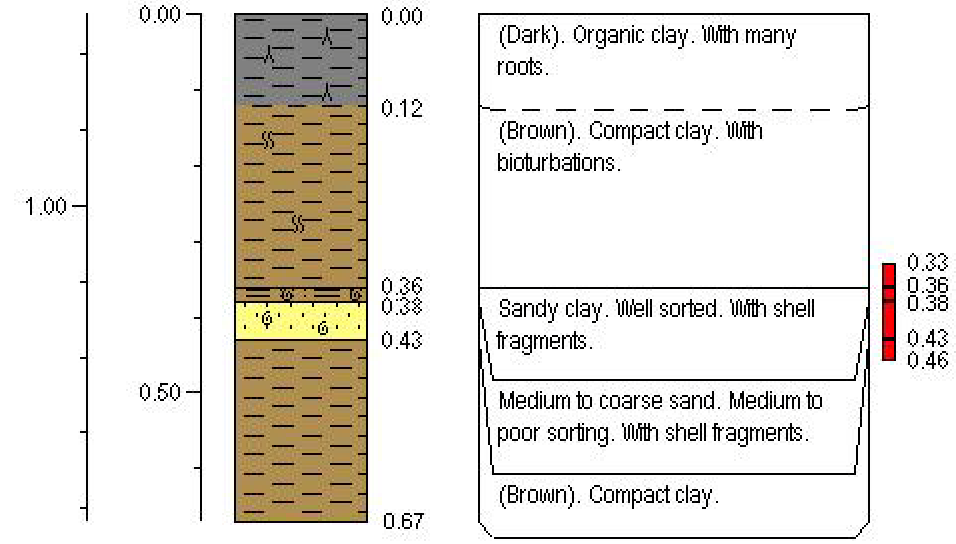
Reference: SG55			**Date:** 17-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559465 **P:** 4105684	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



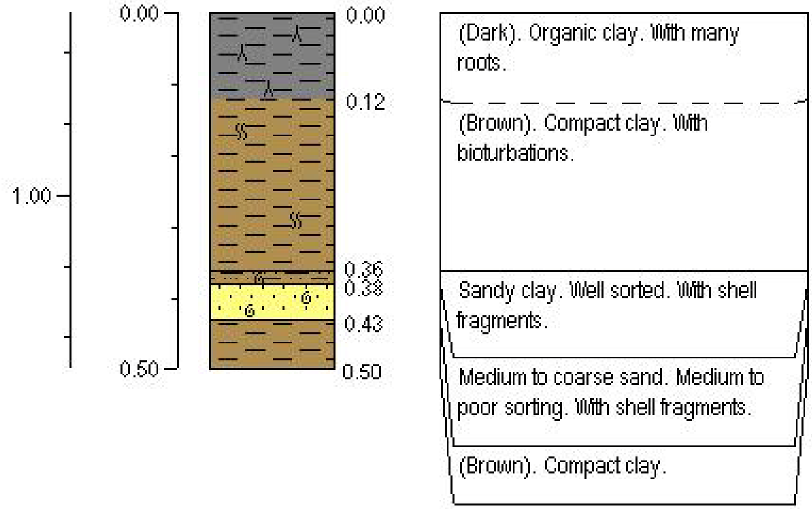
Reference: **SG56**			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559531 **P:** 4105782	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: SG57			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559529 P: 4105813	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

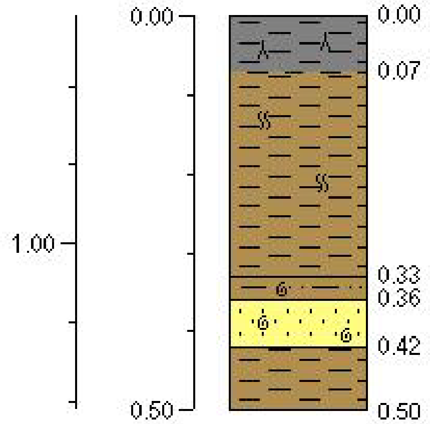


Reference: SG58			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559530 P: 4105802	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: SG59			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559531 P: 4105845	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



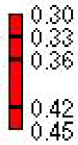
(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Sandy clay. Well sorted. With shell fragments.

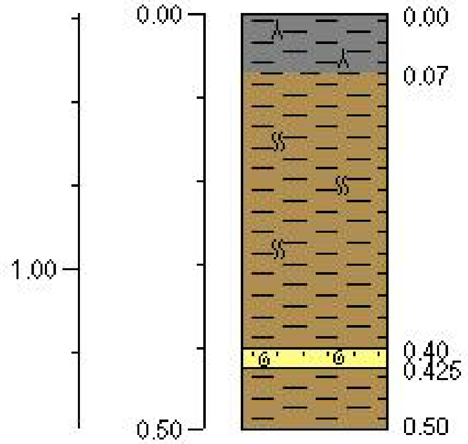
Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.



Reference: SG60			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559533 P: 4105873	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



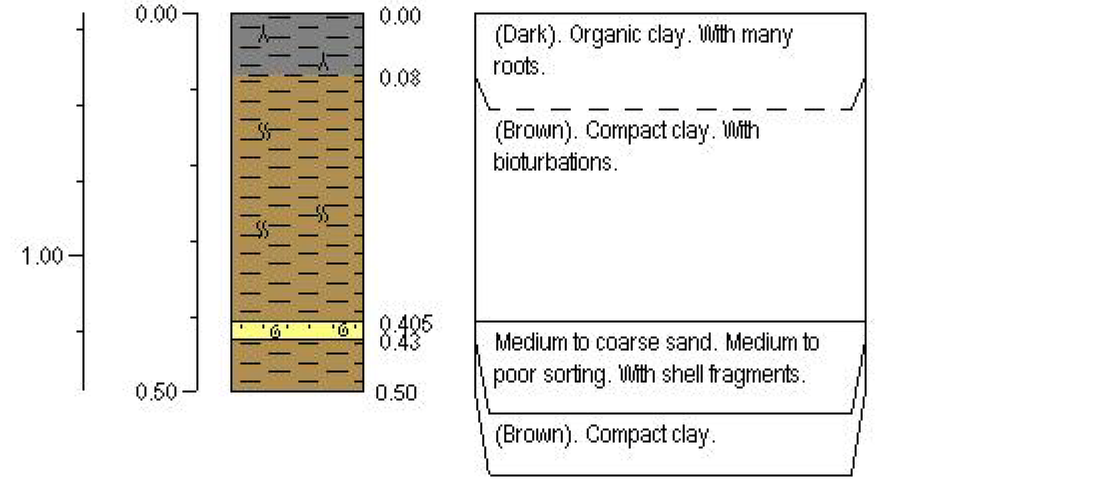
(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

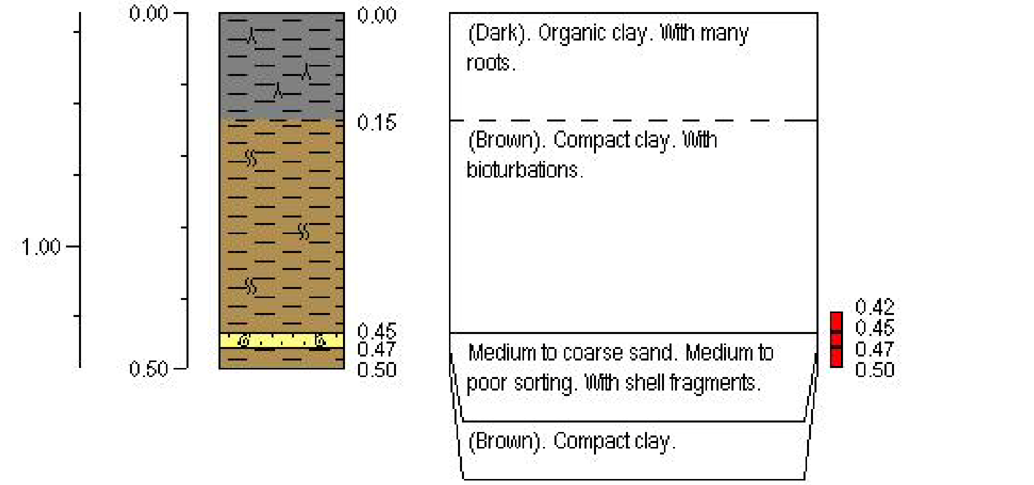
Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: SG61			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559531 P: 4105905	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

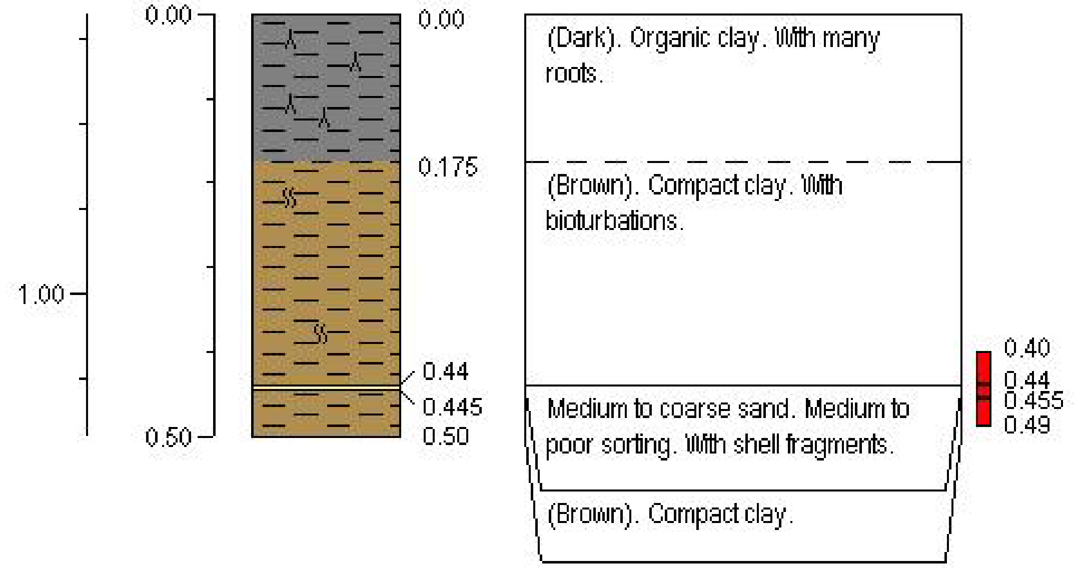


Reference: SG62			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559531 P: 4105935	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



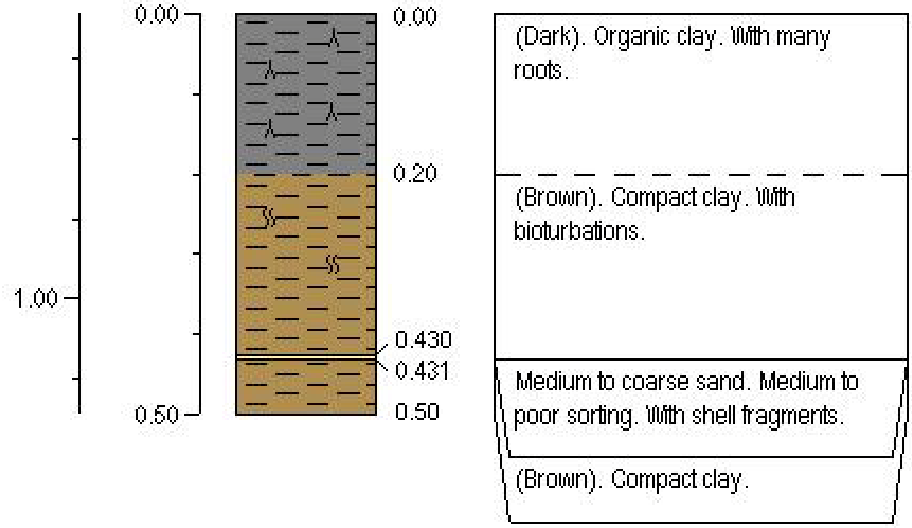
Reference: **SG64**	Date: 17-11-2007
Coordinates UTM (ED50) 29S — **M:** 0559533 **P:** 4105948	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

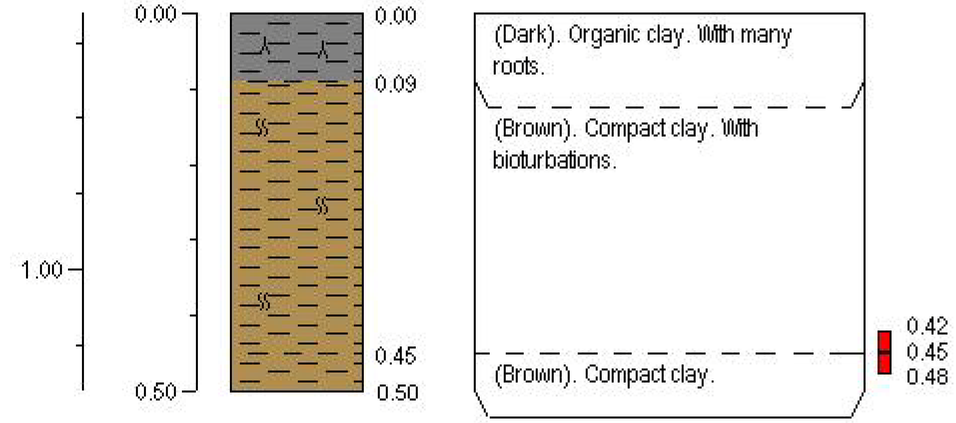


Reference: **SG63**	Date: 17-11-2007
Coordinates UTM (ED50) 29S — **M:** 0559531 **P:** 4105964	**Location:** Salgados Lagoon

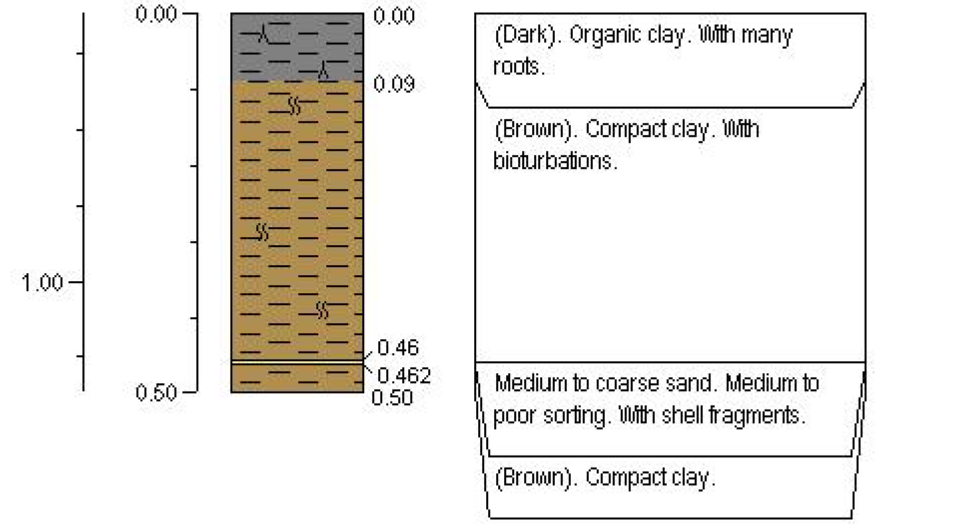
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: **SG65**			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559533 **P:** 4105980	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**

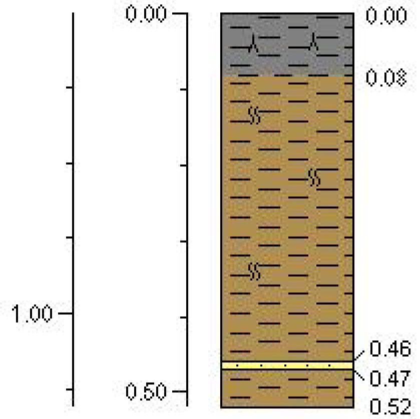


Reference: **SG67**			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559533 **P:** 4106010	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: SG69			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559533 P: 4106041	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

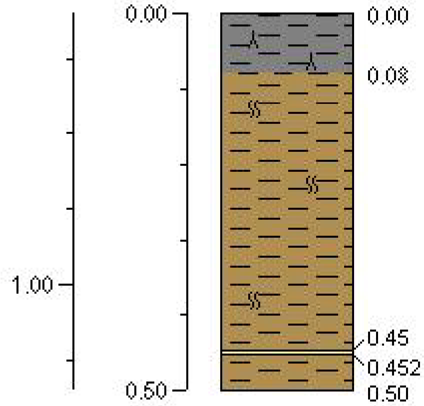
(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: SG68			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559533 P: 4106025	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

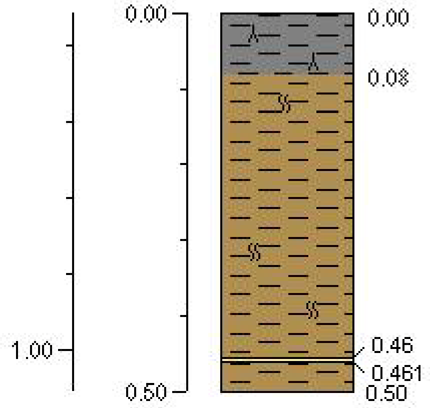
(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: SG71			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559534 P: 4106071	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

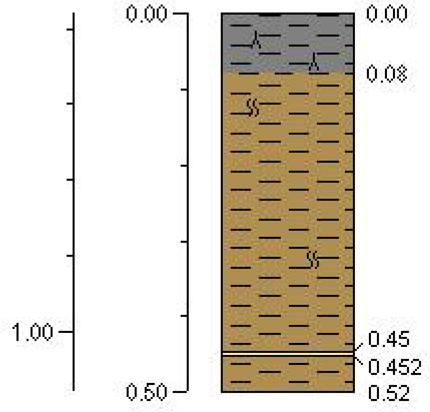
(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: SG70			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559533 P: 4106056	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



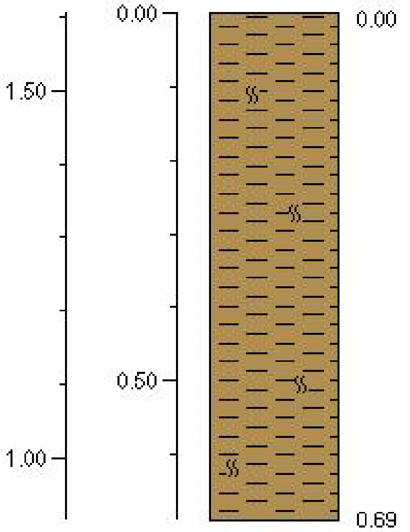
(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

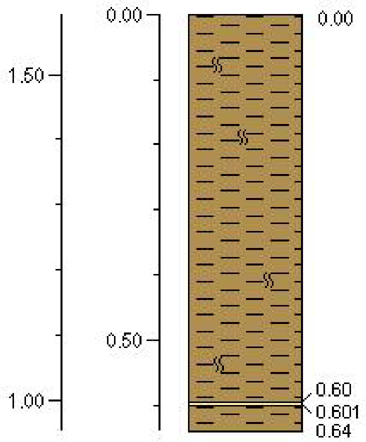
(Brown). Compact clay.

Reference: SG73			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559537 P: 4106106	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Brown). Compact clay. With bioturbations.

Reference: SG72			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559536 P: 4106089	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

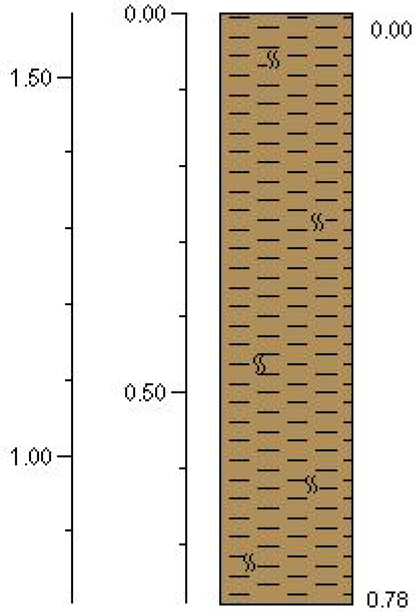


(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

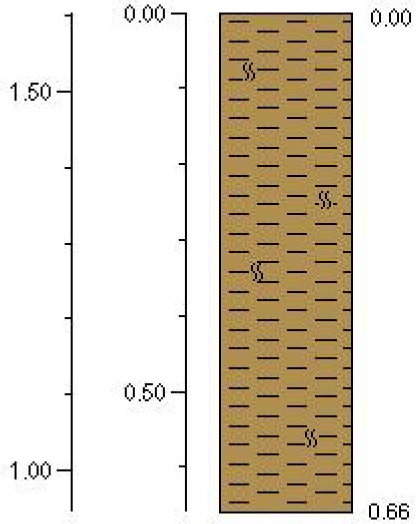
(Brown). Compact clay.

Reference: **SG75**			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559495 **P:** 4106125	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



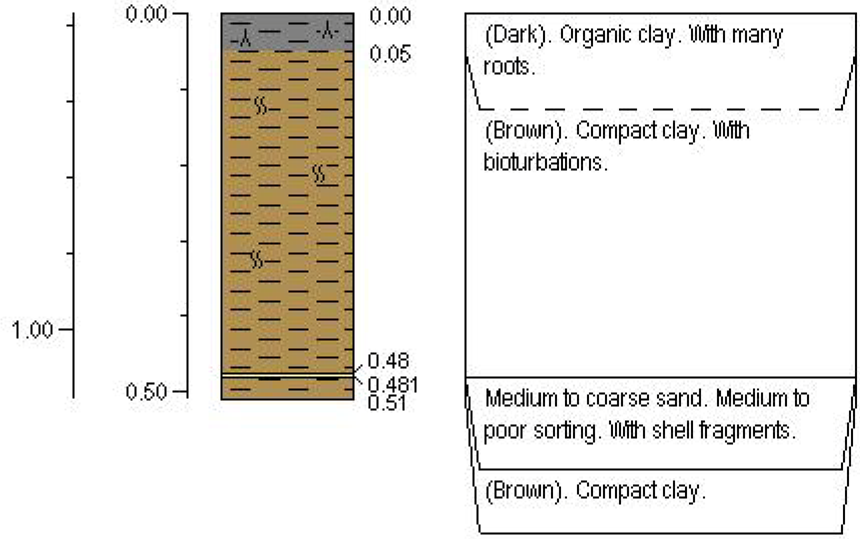
(Brown). Compact clay. With bioturbations.

Reference: **SG74**			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559538 **P:** 4106123	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**

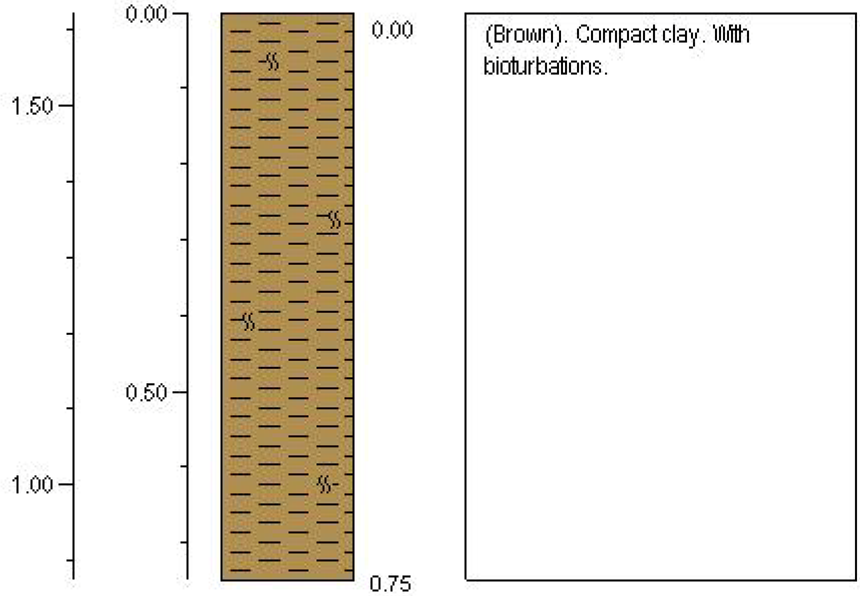


(Brown). Compact clay. With bioturbations.

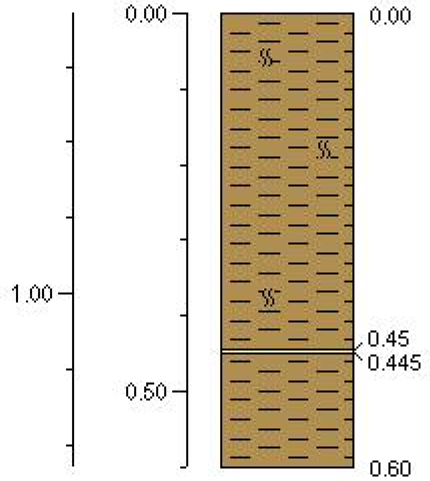
Reference: SG77			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559490 P: 4106073	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: SG76			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559492 P: 4106095	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: SG79			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559464 P: 4106055	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

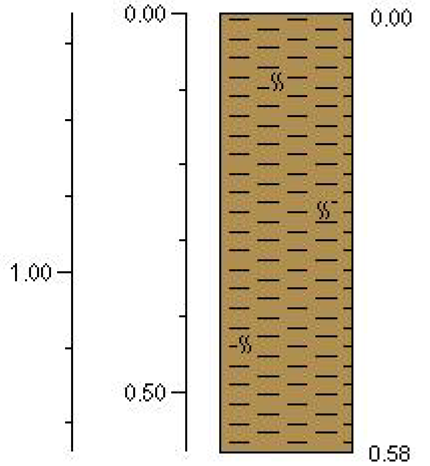


(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

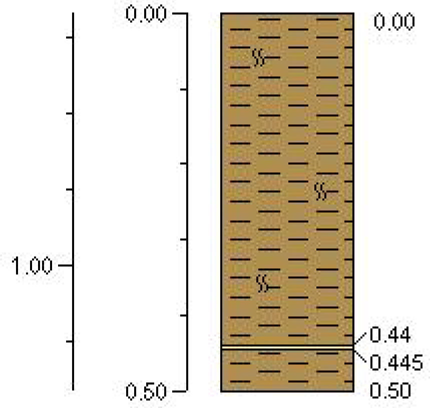
Reference: SG78			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559491 P: 4106058	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Brown). Compact clay. With bioturbations.

Reference: SG81			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559460 P: 4106022	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



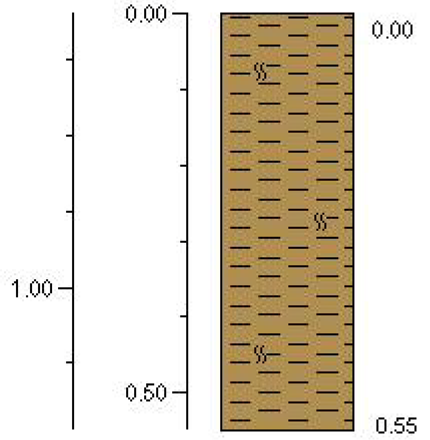
(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: SG80			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559463 P: 4106038	Location: Salgados Lagoon

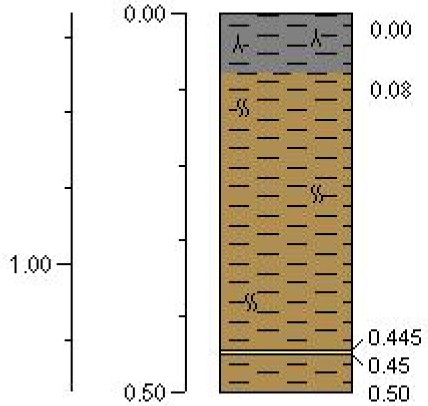
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Brown). Compact clay. With bioturbations.

Reference: SG83			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559494 P: 4105999	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

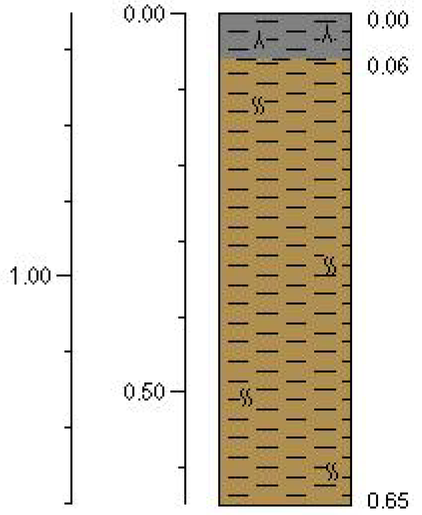
(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: SG82			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559493 P: 4106015	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

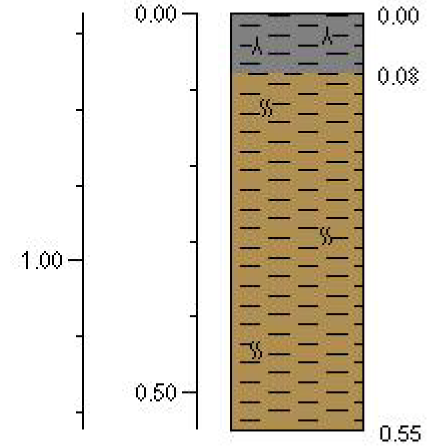


(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: **SG84**			**Date:** 17-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559459 **P:** 4105999	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

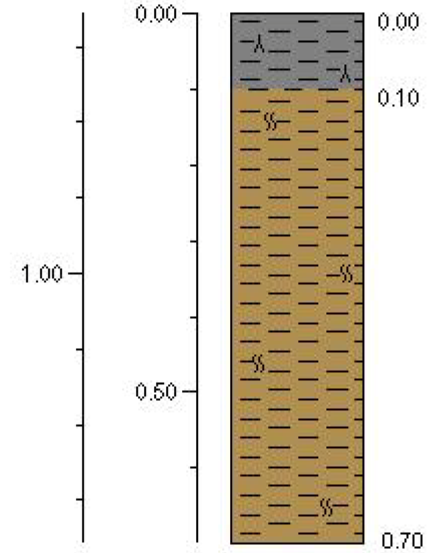


(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: **SG85**			**Date:** 17-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559458 **P:** 4105983	**Location:** Salgados Lagoon

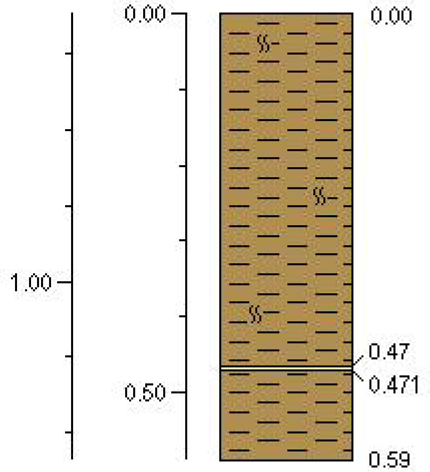
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: SG86			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559458 P: 4105968	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

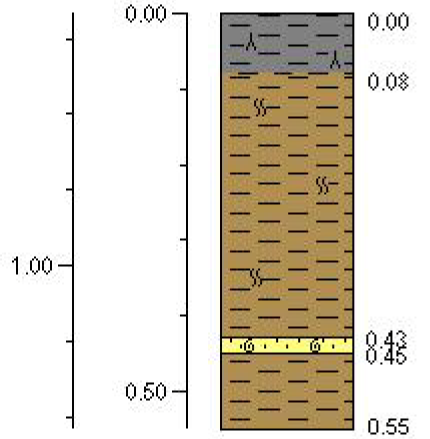


(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: SG87			Date: 17-11-2007
Coordinates	UTM (ED50) 29S	M: 0559457 P: 4105954	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



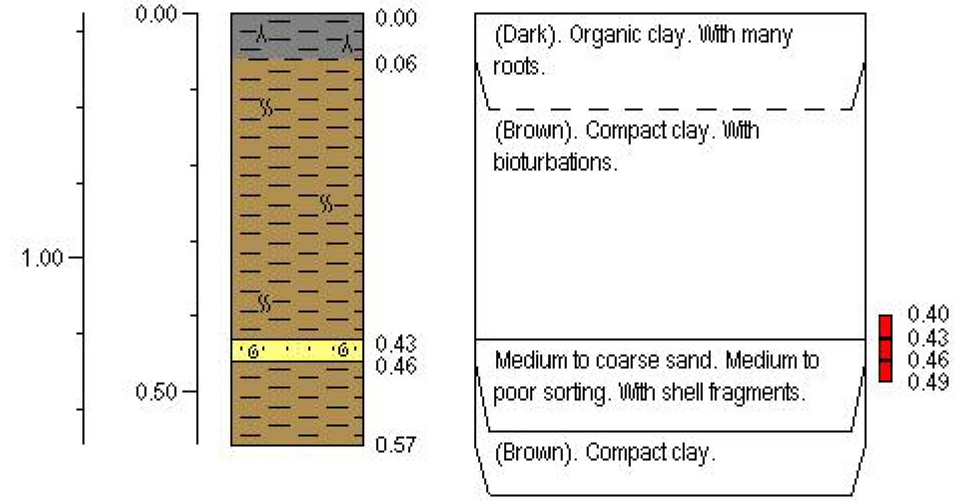
(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

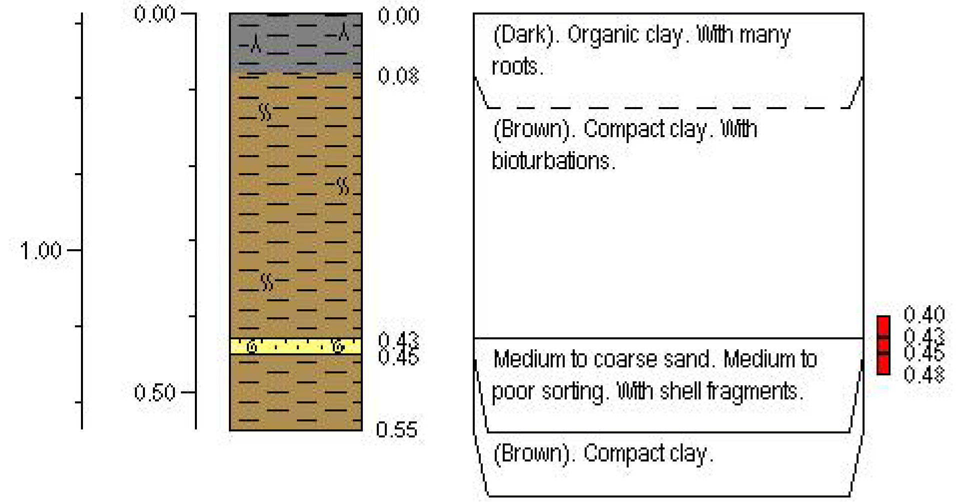
Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: SG88			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559456 P: 4105939	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

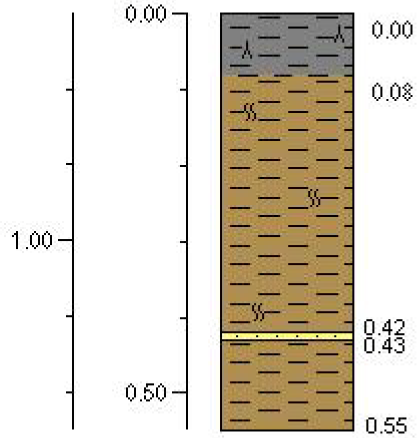


Reference: SG89			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559457 P: 4105920	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: **SG90**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559456 **P:** 4105905	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

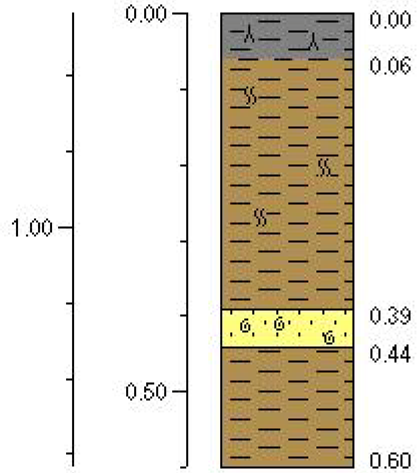
Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Sampling depth: 0.39, 0.42, 0.43, 0.46

Reference: **SG91**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559456 **P:** 4105890	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

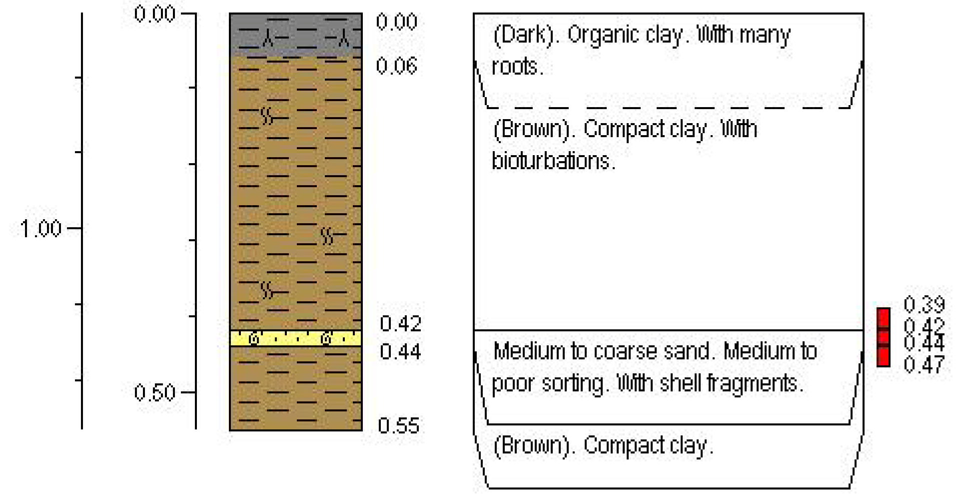
(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

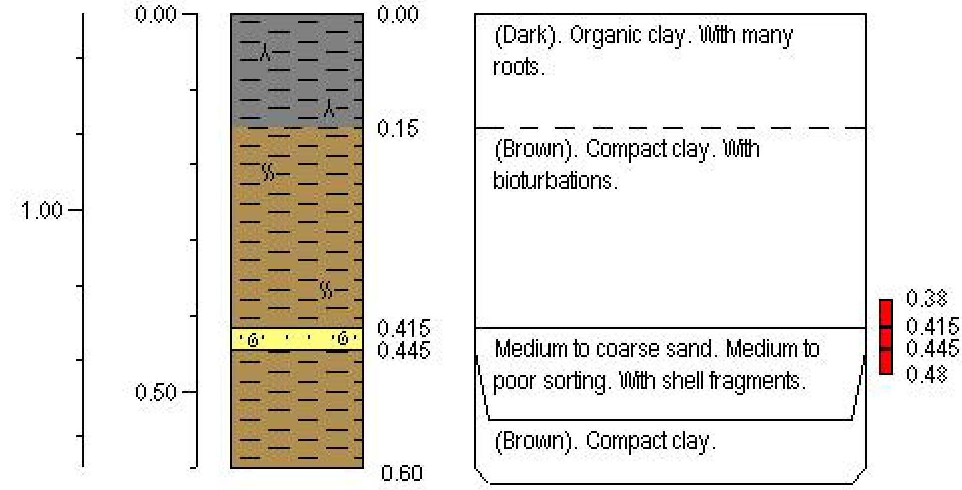
(Brown). Compact clay.

Sampling depth: 0.36, 0.39, 0.44, 0.47

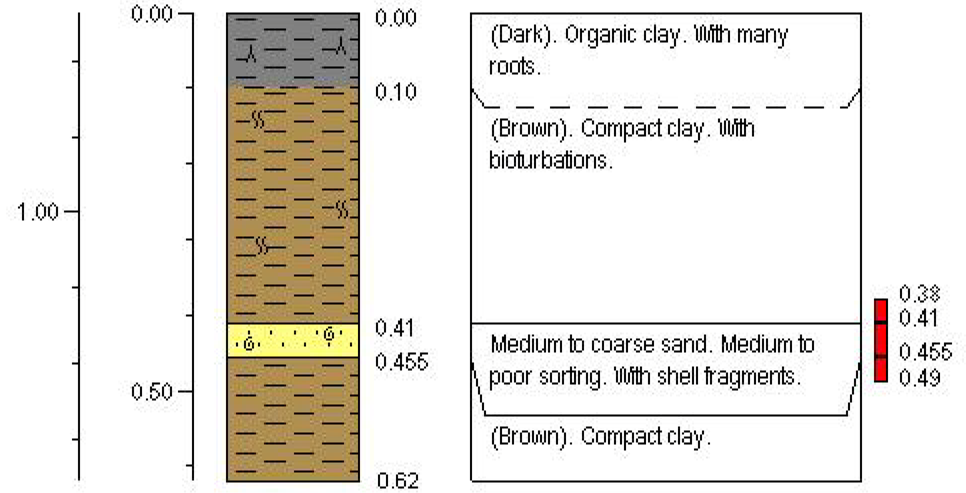
Reference: SG92			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559457 P: 4105859	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



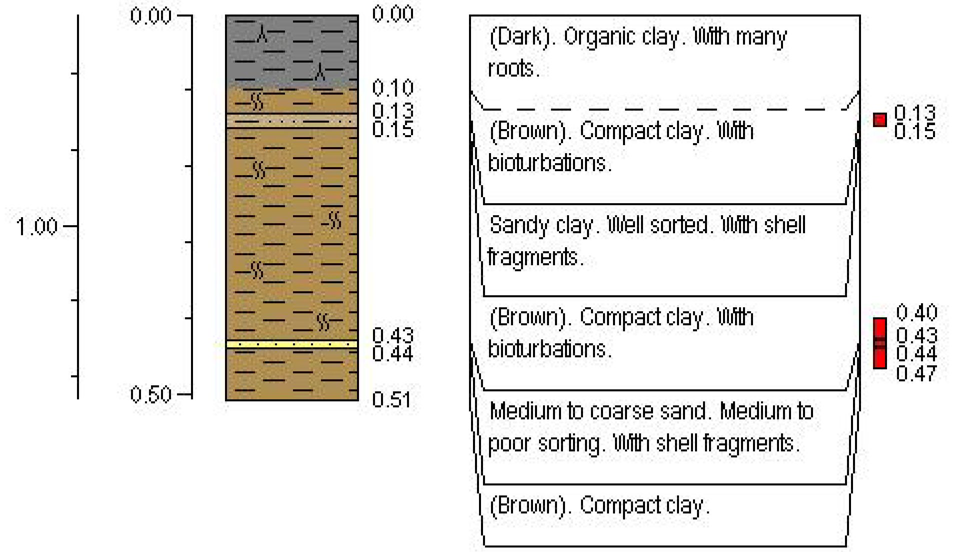
Reference: SG93			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559457 P: 4105830	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



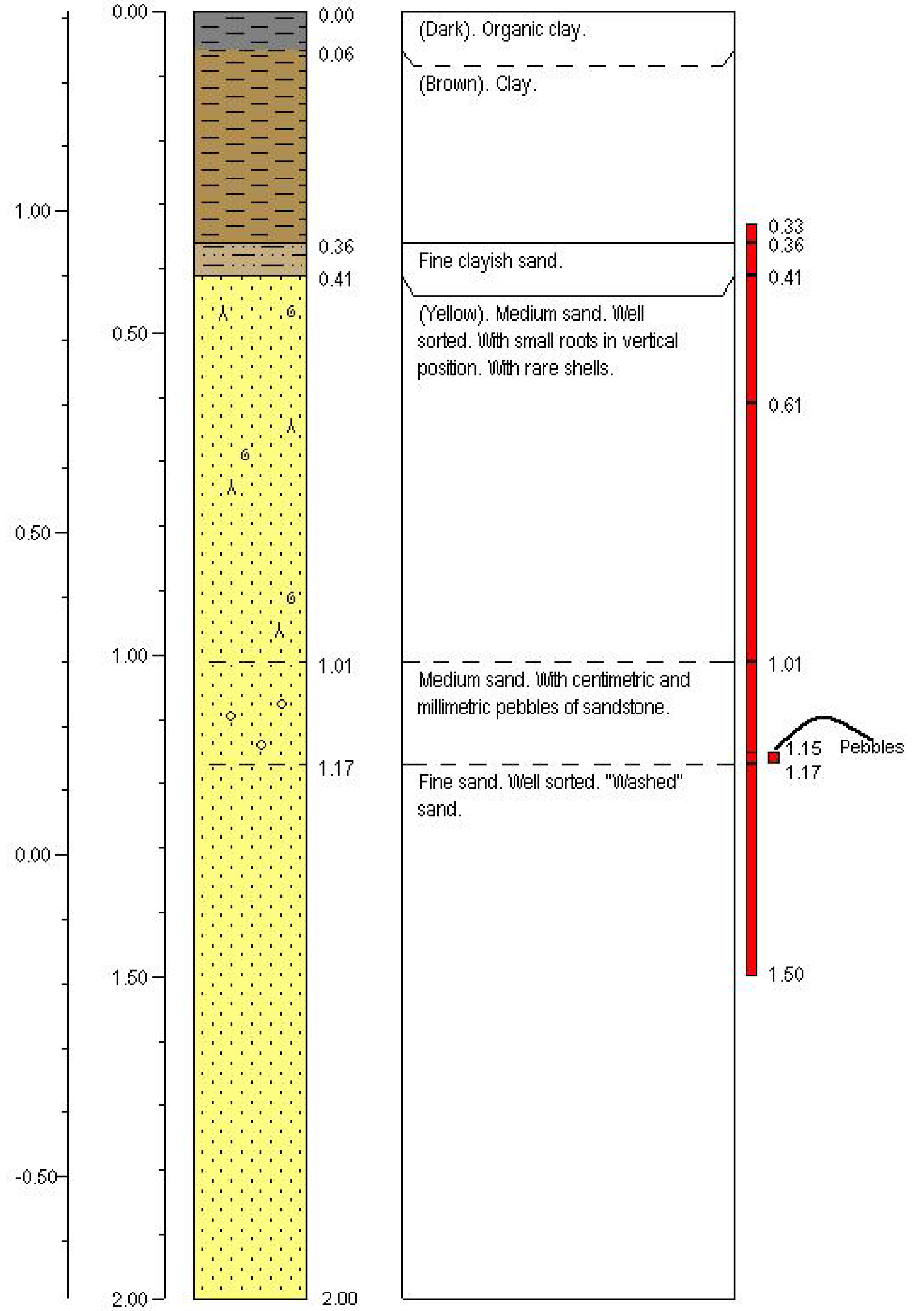
Reference: **SG94**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559458 **P:** 4105800	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: **SG95**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559458 **P:** 4105760	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**

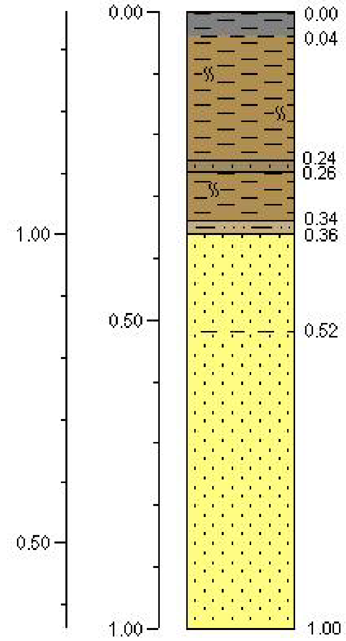


Reference: SG96			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559457 P: 4105730	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: SG97			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559457 P: 4105700	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

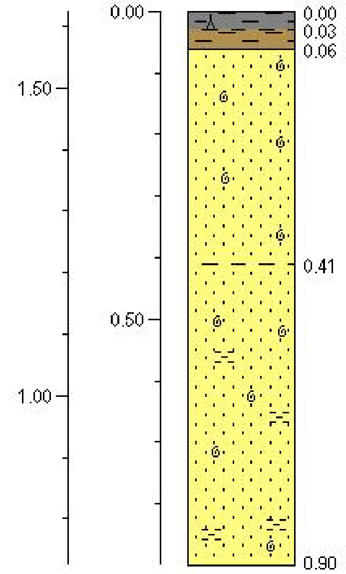


- (Dark). Organic clay.
- (Brown). Compact. With bioturbations.
- (Greyish). Medium sand. Well sorted. Without shells.
- (Brown). Compact clay. With bioturbations
- Clayish sand.
- (Yellow). Medium sand. Well sorted. Without shells.
- (Yellow). Medium sand. Well sorted.

Sampling Depth (m): 0.24 – 0.26; 0.31 – 0.34 – 0.36 – 0.52

Reference: SG98			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559437 P: 4105671	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

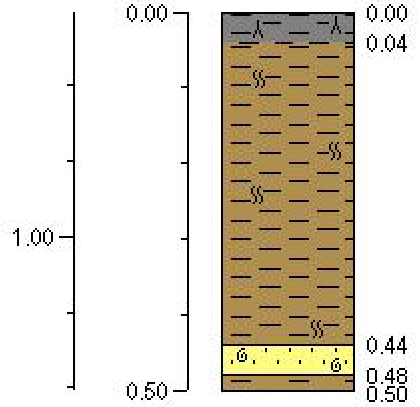


- (Dark). Organic clay. With many roots.
- (Brown). Clay.
- (Yellow). Medium sand. Medium sorting. With shell fragments.
- (Yellow). Medium sand. Medium sorting. With shell fragments. With mud balls.

Sampling Depth (m): 0.20 – 0.23; 0.34 – 0.37

Reference: SG99			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559486 P: 4105800	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

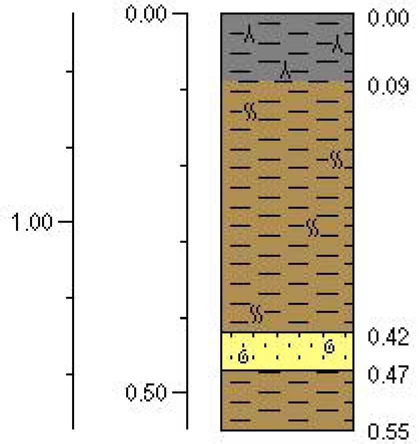
Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Sampling depth: 0.41, 0.44, 0.48, 0.50

Reference: SG100			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559487 P: 4105830	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

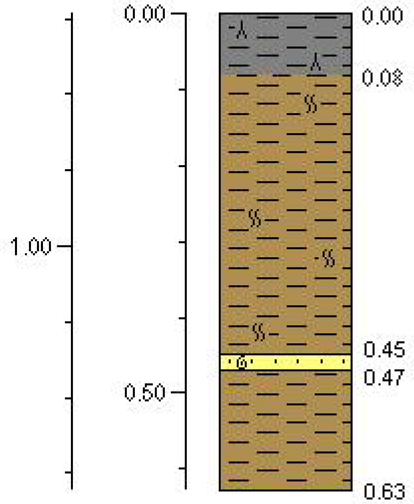
(Brown). Compact clay. With bioturbations.

Sand. Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown) Compact clay.

Sampling depth: 0.39, 0.42, 0.47, 0.50

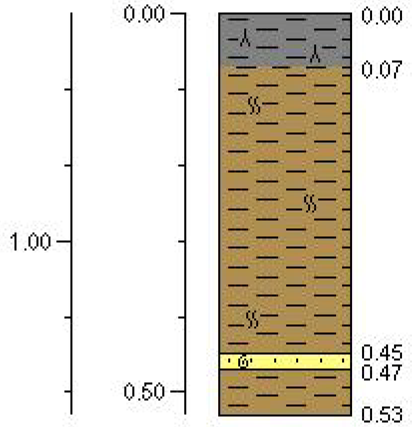
Reference: **SG102**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559487 **P:** 4105892	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Description
(Dark). Organic clay. With many roots.
(Brown). Compact clay. With bioturbations.
Medium to coarse sand. Medium to poor sorting. With shell fragments.
(Brown). Compact clay.

Sampling Depth (m): 0.42, 0.45, 0.47, 0.50

Reference: **SG101**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559486 **P:** 4105860	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**

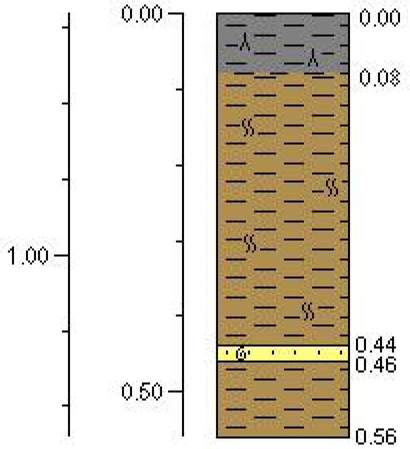


Description
(Dark). Organic clay. With many roots.
(Brown). Compact clay. With bioturbations.
Medium to coarse sand. Medium to poor sorting. With shell fragments.
(Brown). Compact clay.

Sampling Depth (m): 0.42, 0.45, 0.47, 0.50

Reference: **SG104**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559486 **P:** 4105920	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

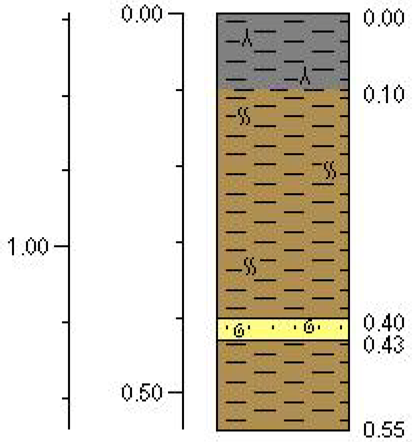
Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Sampling depth: 0.41, 0.44, 0.46, 0.49

Reference: **SG103**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559486 **P:** 4105905	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

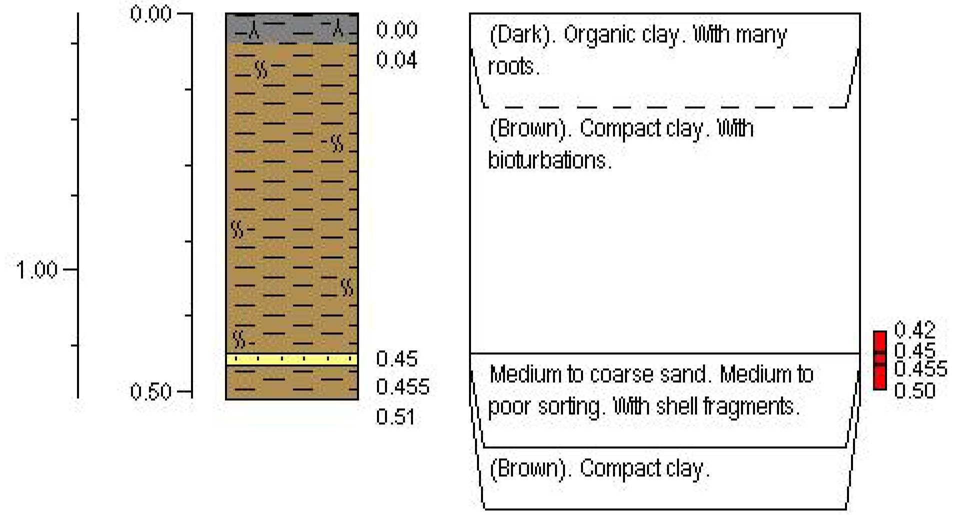
Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Sampling depth: 0.37, 0.40, 0.43, 0.46

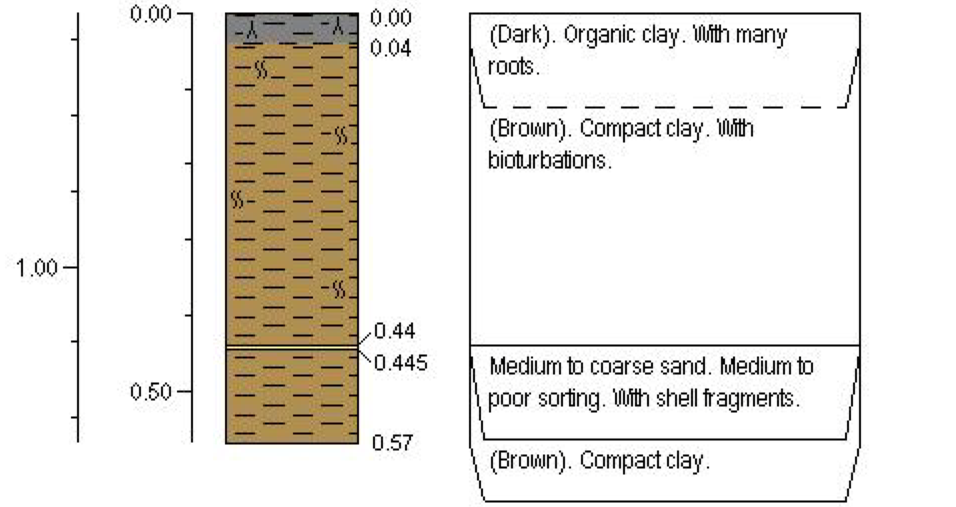
Reference: SG106			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559486 P: 4105950	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



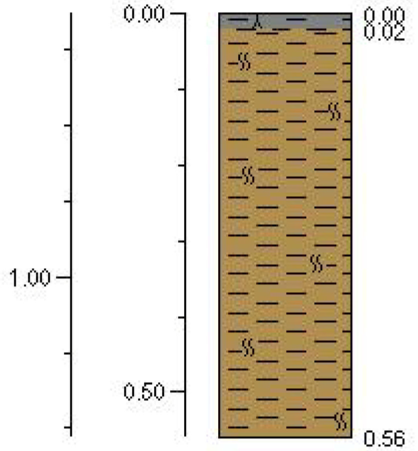
Reference: SG105			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559486 P: 4105935	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: SG107			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559486 P: 4105965	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

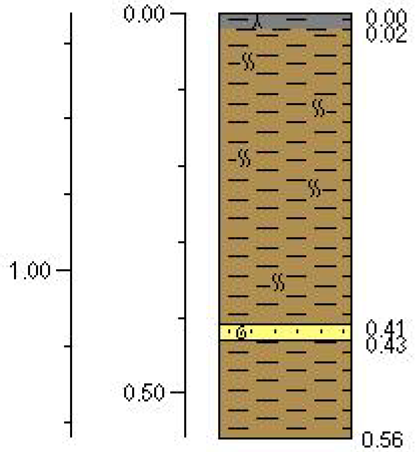


(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: SG108			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559486 P: 4105980	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

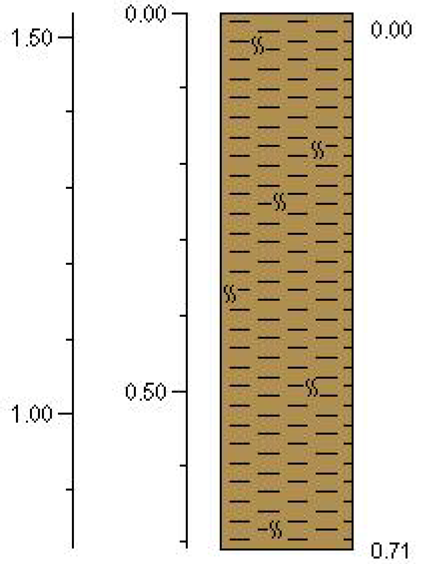
Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Sampling depth: 0.38 0.41 0.43 0.46

Reference: **SG109**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559647 **P:** 4106087	**Location:** Salgados Lagoon

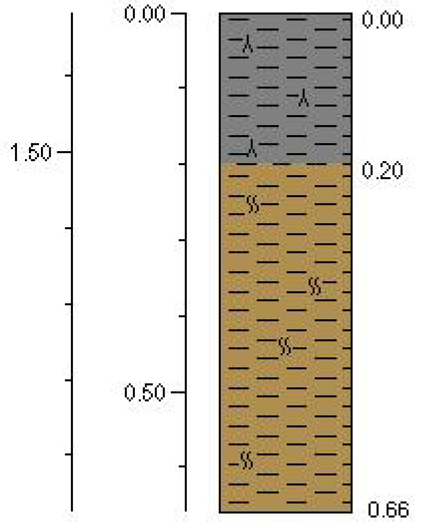
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



(Brown). Compact clay. With bioturbations.

Reference: **SG110**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559653 **P:** 4106110	**Location:** Salgados Lagoon

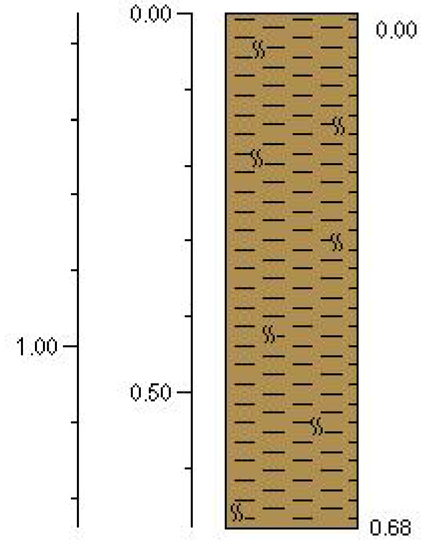
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



(Dark). Organic clay. With many roots.

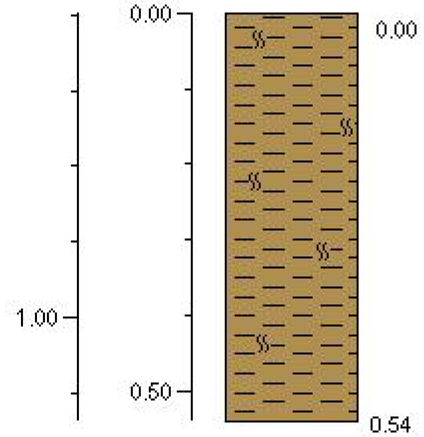
(Brown). Compact clay. With bioturbations.

Reference: **SG111**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559678 **P:** 4105998	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



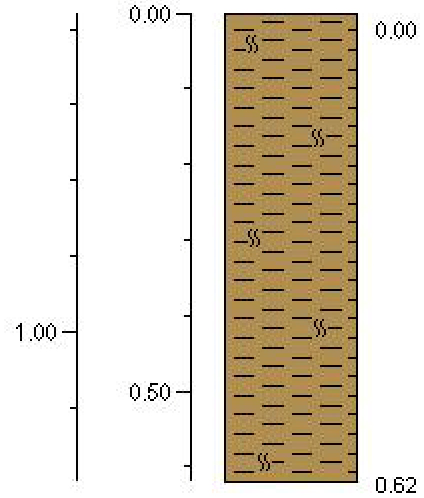
(Brown). Compact clay. With bioturbations.

Reference: **SG112**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559396 **P:** 4106111	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



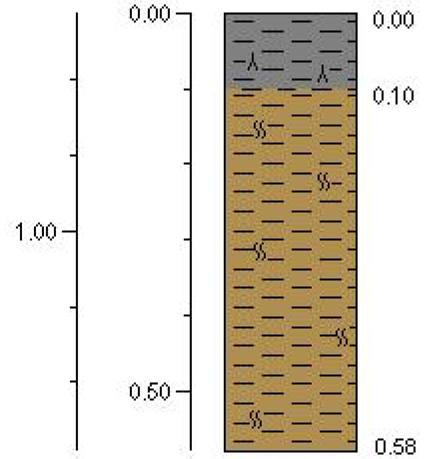
(Brown). Compact clay. With bioturbations.

Reference: **SG113**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559358 **P:** 4106111	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



(Brown). Compact clay. With bioturbations.

Reference: **SG114**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559358 **P:** 4106027	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**

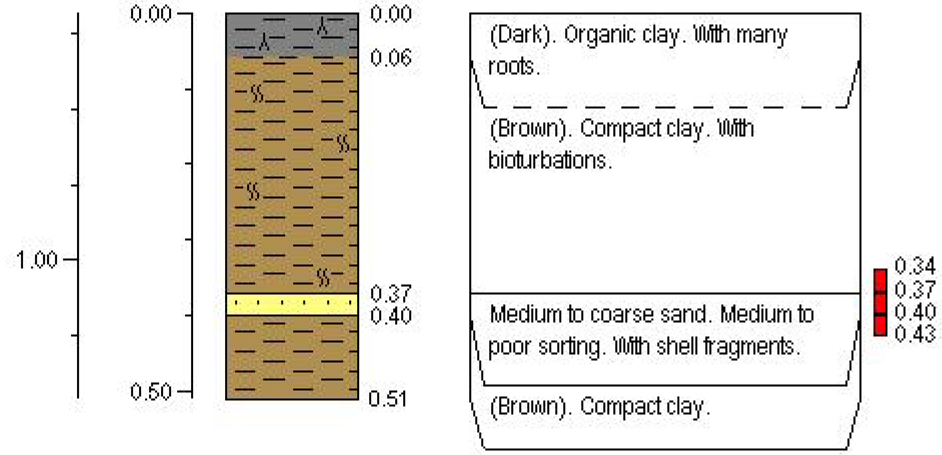


(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

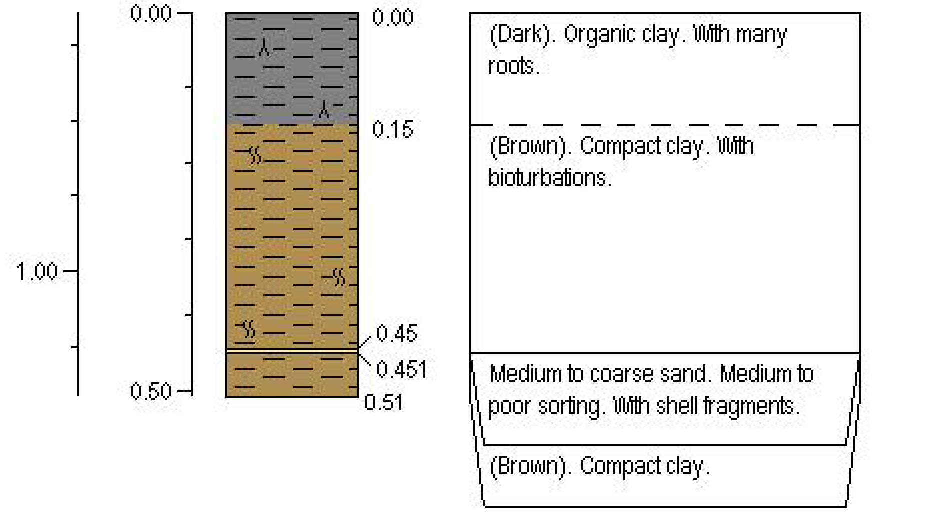
Reference: SG115			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559397 **P:** 4105920	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

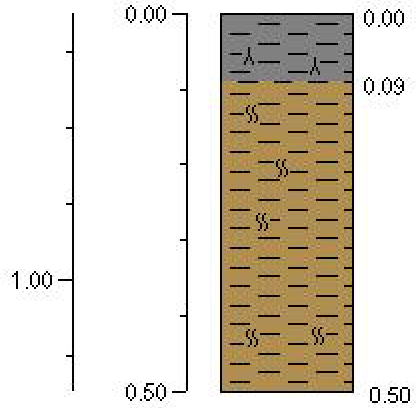


Reference: SG116			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559399 **P:** 4105949	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



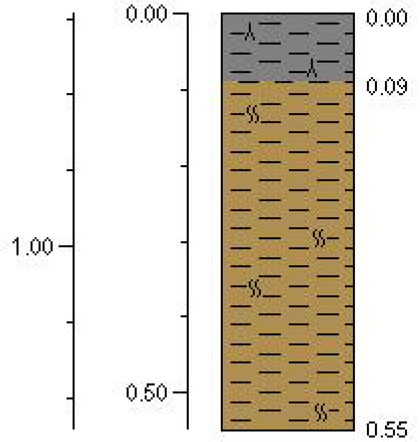
Reference: **SG117**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559397 **P:** 4105965	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: **SG118**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559398 **P:** 4105981	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**

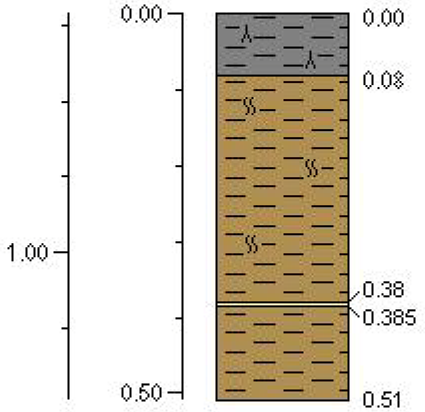


(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: **SG119**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559396 **P:** 4105934	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

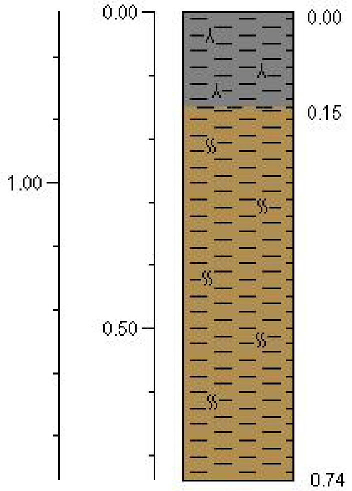
(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: **SG120**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559358 **P:** 4105890	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

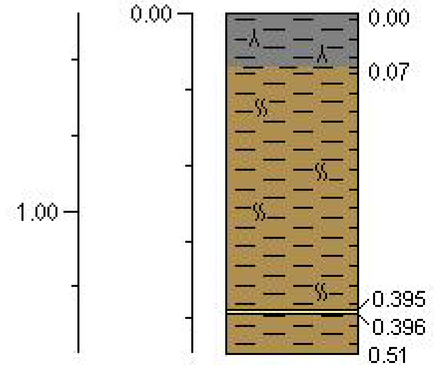


(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: **SG121**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559380 **P:** 4105888	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

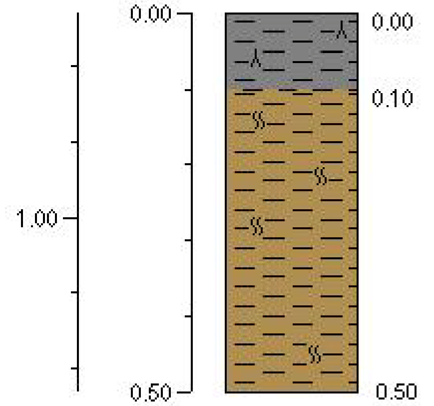
(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: **SG122**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559357 **P:** 4105904	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

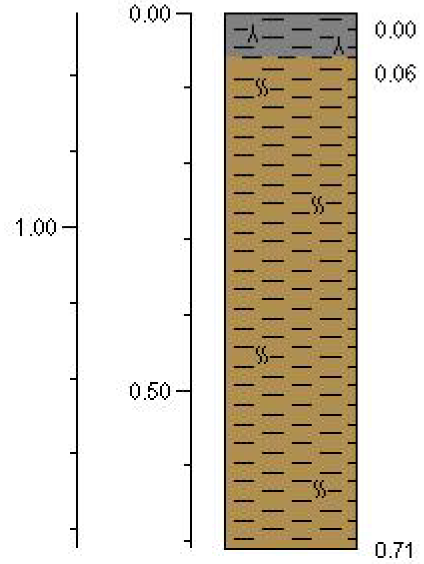


(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: **SG123**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559323 **P:** 4105895	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

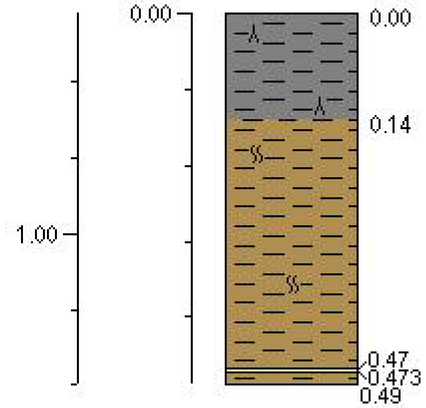


(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: **SG124**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559400 **P:** 4105874	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

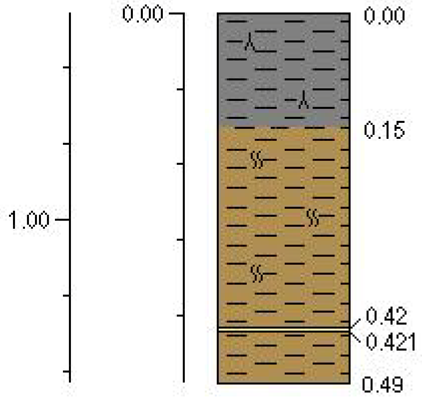
(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: SG125			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559399 P: 4105859	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

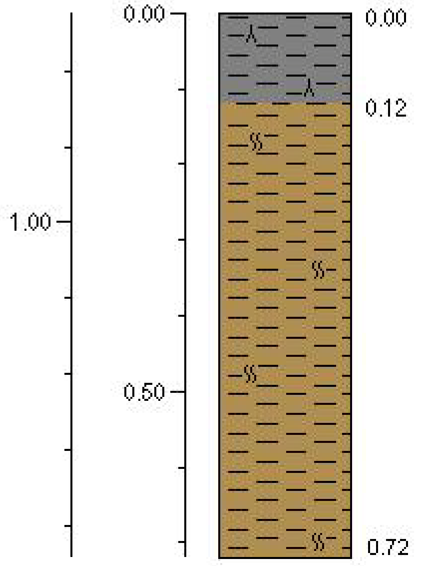
(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

(Brown). Compact clay.

Reference: SG126			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559399 P: 4105845	Location: Salgados Lagoon

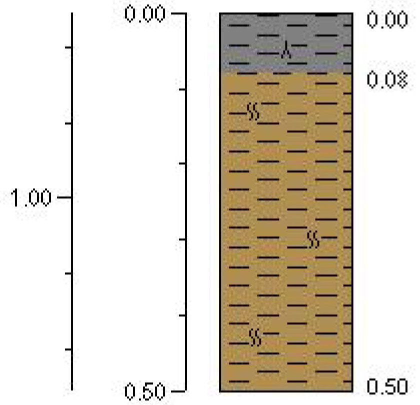
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

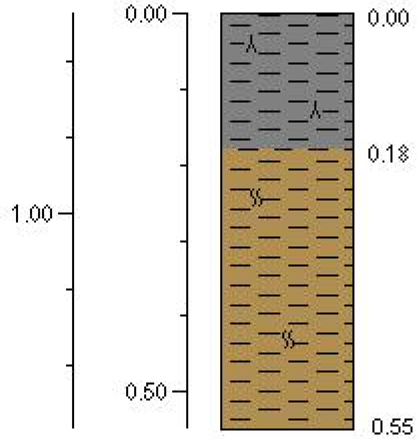
Reference: SG127			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559400 P: 4105829	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

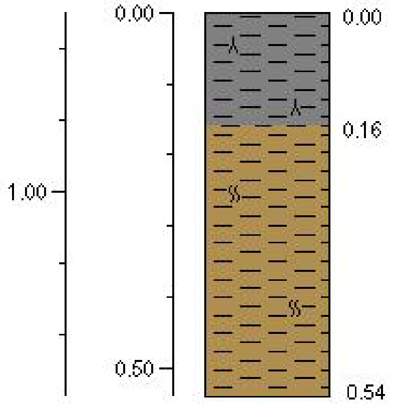
Reference: SG128			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559399 P: 4105816	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

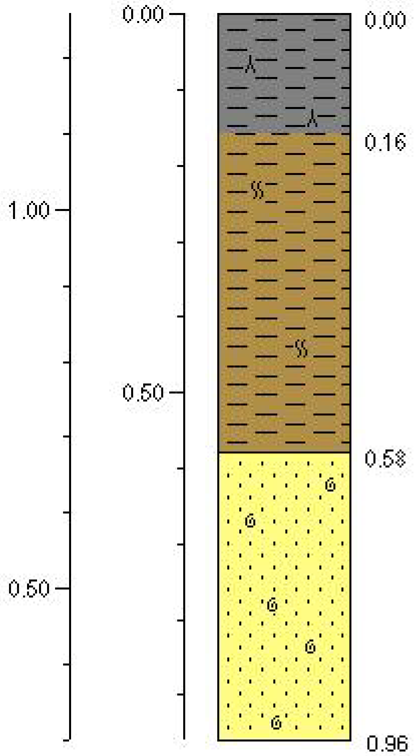
Reference: **SG129**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559400 **P:** 4105802	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: **SG130**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559399 **P:** 4105770	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



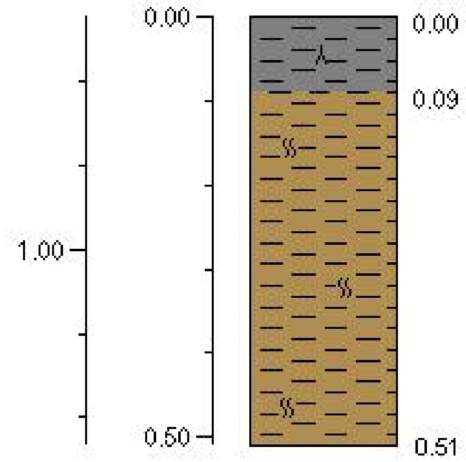
(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

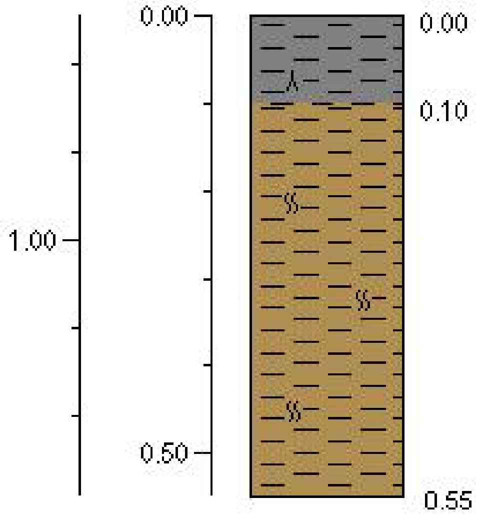
Reference: **SG131**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559357 **P:** 4105874	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)
		(Dark). Organic clay. With many roots.	
		(Brown). Compact clay. With bioturbations.	



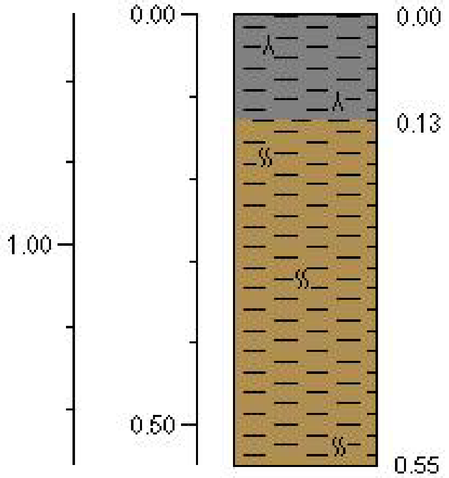
Reference: **SG132**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559358 **P:** 4105845	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)
		(Dark). Organic clay. With many roots.	
		(Brown). Compact clay. With bioturbations.	



Reference: SG133			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559356 P: 4105787	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

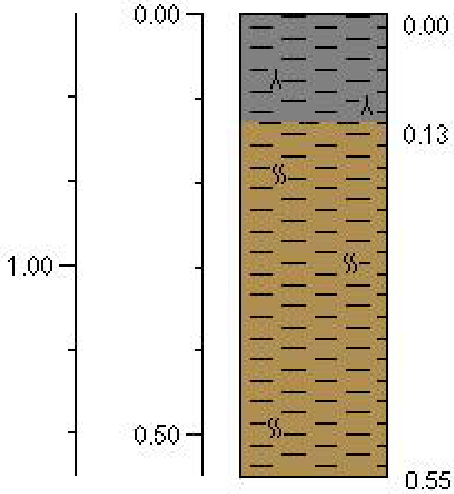


(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: SG134			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559287 P: 4105801	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

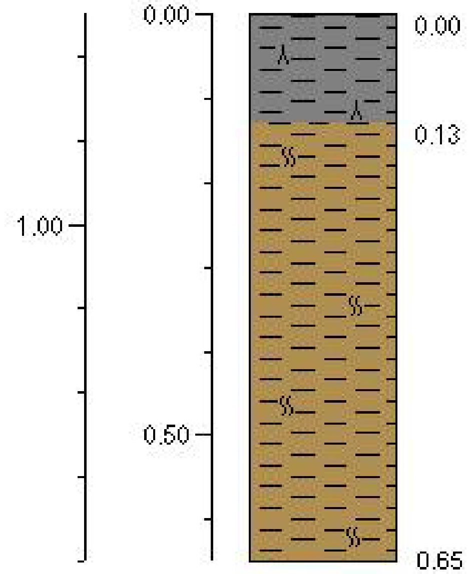


(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: **SG135**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559424 **P:** 4105816	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

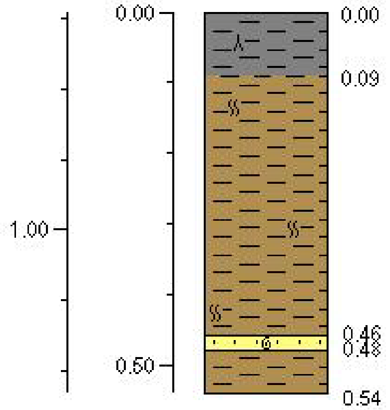


(Dark). Organic clay. With many roots.

(Brown). Compact clay. With bioturbations.

Reference: **SG136**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559427 **P:** 4105879	**Location:** Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Dark). Organic clay. With many roots.

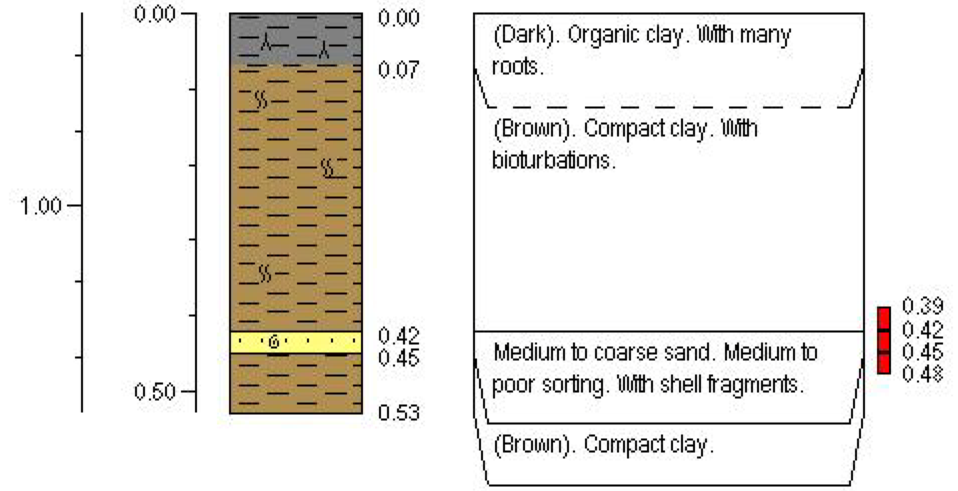
(Brown). Compact clay. With bioturbations.

Medium to coarse sand. Medium to poor sorting. With shell fragments.

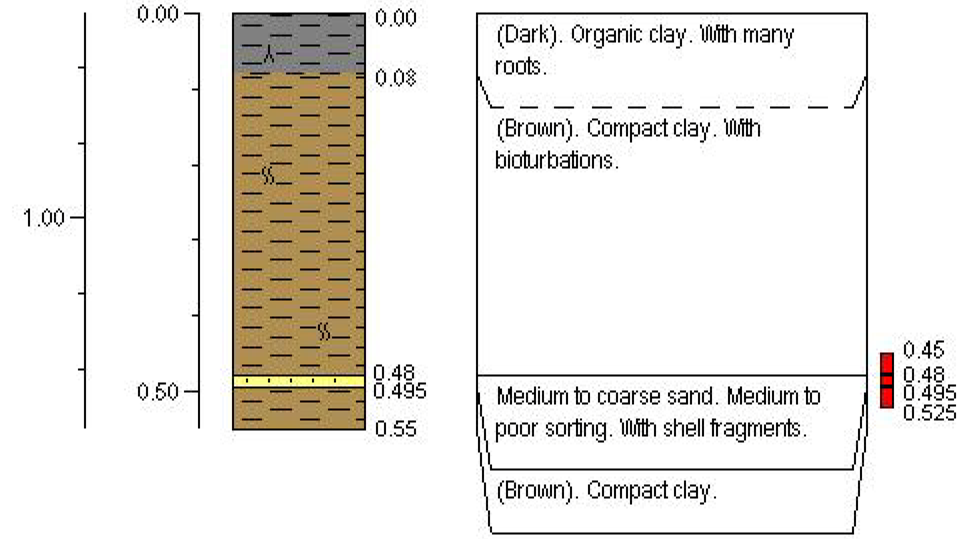
(Brown). Compact clay.

Sampling depth: 0.43, 0.46, 0.48, 0.51

Reference: **SG137**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559426 **P:** 4105864	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**

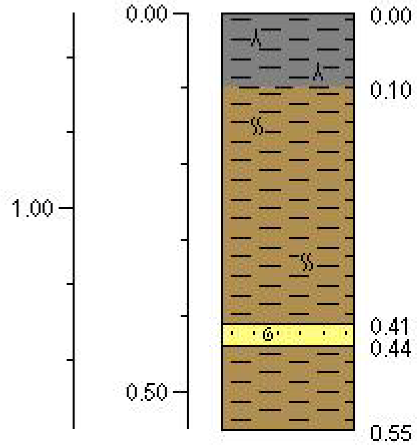


Reference: **SG138**			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	**M:** 0559427 **P:** 4105847	**Location:** Salgados Lagoon
Elevation / Depth (m)	**LOG**	**Description**	**Sampling Depth (m)**



Reference: SG139			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559427 P: 4105829	Location: Salgados Lagoon

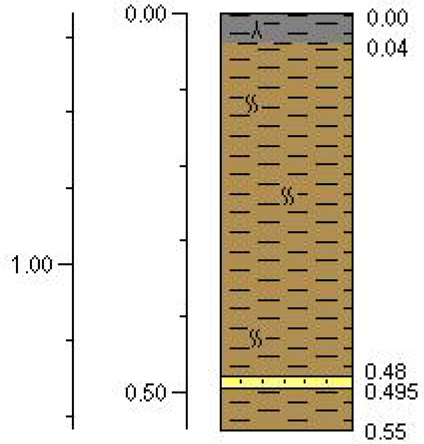
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Description	Sampling Depth (m)
(Dark). Organic clay. With many roots.	
(Brown). Compact clay. With bioturbations.	
Medium to coarse sand. Medium to poor sorting. With shell fragments.	0.38 0.41 0.44 0.47
(Brown). Compact clay.	

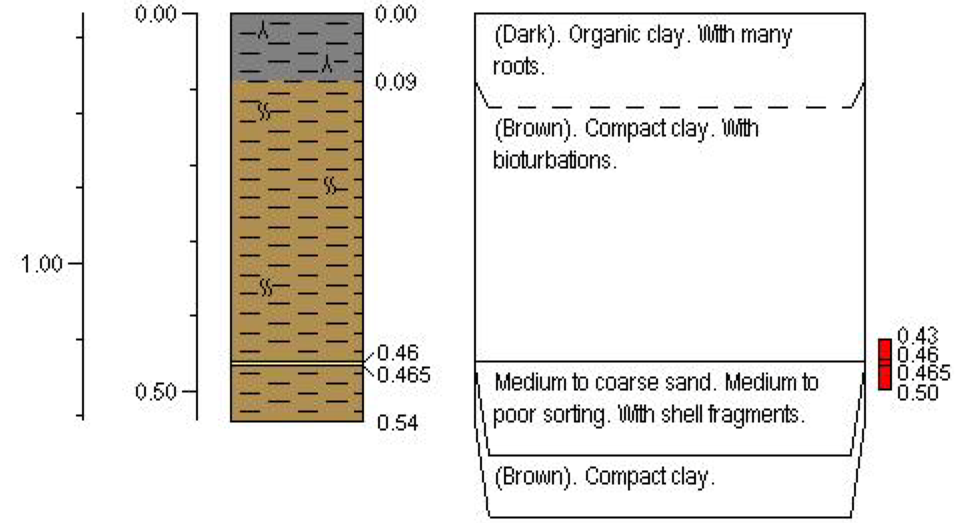
Reference: SG140			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559428 P: 4105917	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

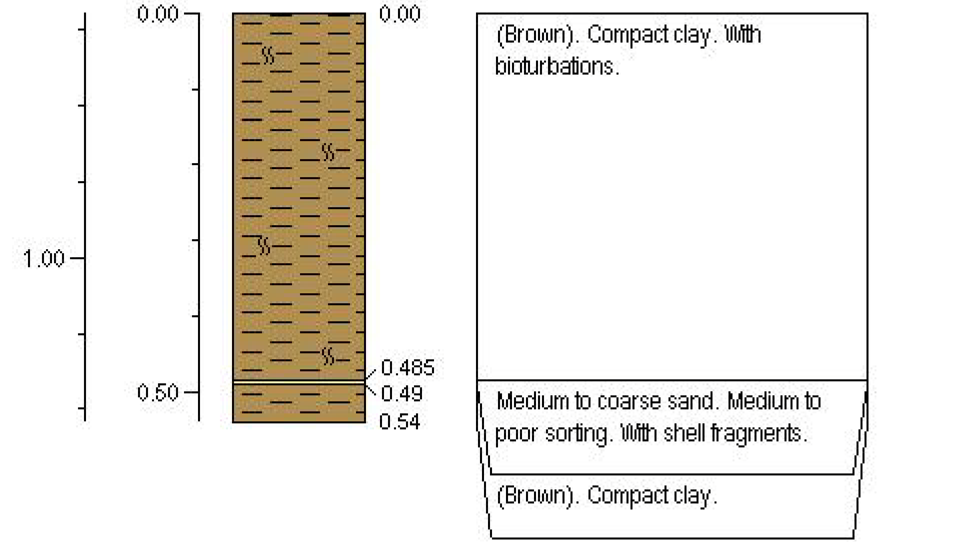


Description	Sampling Depth (m)
(Dark). Organic clay. With many roots.	
(Brown). Compact clay. With bioturbations.	
Medium to coarse sand. Medium to poor sorting. With shell fragments.	0.45 0.48 0.495 0.53
(Brown). Compact clay.	

Reference: SG141			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559427 P: 4105936	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

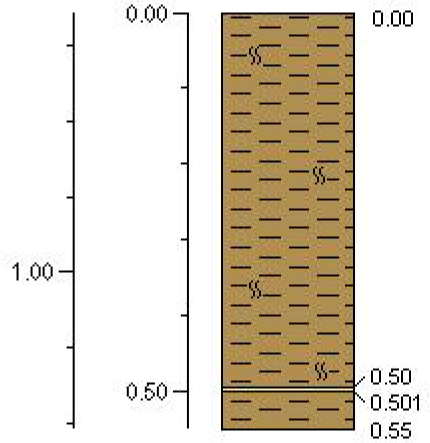


Reference: SG142			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559429 P: 4105950	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: SG143			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559428 P: 4105966	Location: Salgados Lagoon

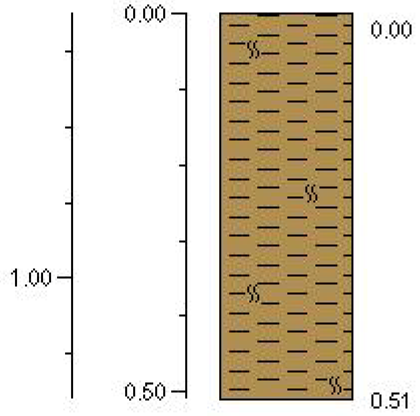
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Description
(Brown). Compact clay. With bioturbations.
Medium to coarse sand. Medium to poor sorting. With shell fragments.
(Brown). Compact clay.

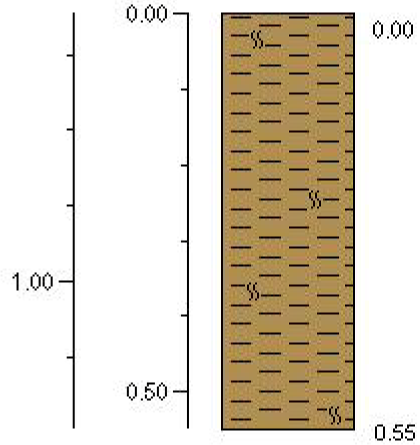
Reference: SG144			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559427 P: 4105981	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



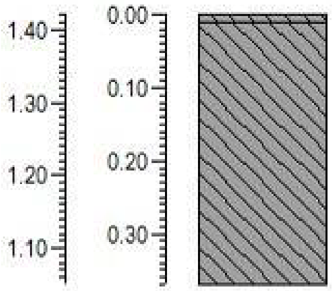
Description
(Brown). Compact clay. With bioturbations.

Reference: SG145			Date: 18-11-2007
Coordinates	UTM (ED50) 29S	M: 0559429 P: 4105996	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



(Brown). Compact clay. With bioturbations.

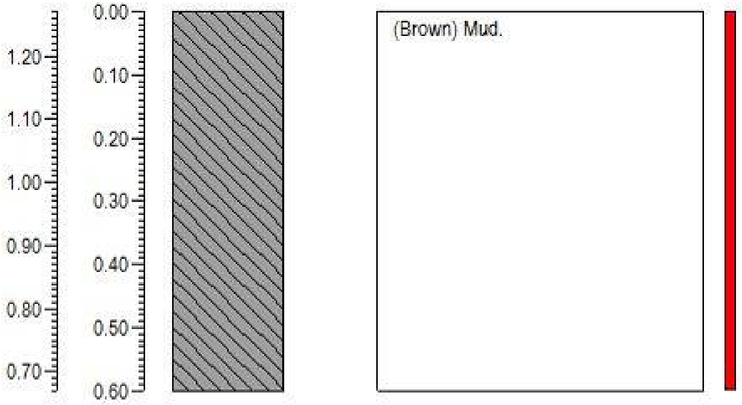
Reference: SG_LV1			Date: 25-05-2009
Coordinates	UTM (ED50) 29S	M: 0559607 P: 4106022	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



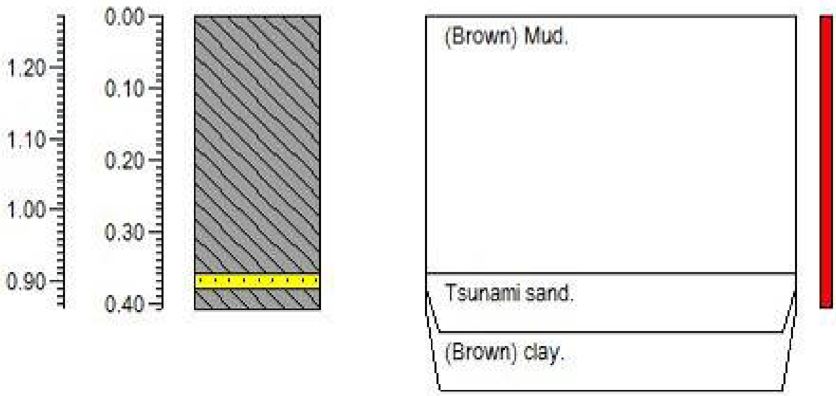
(Black) Mud.

(Brown) Mud.

Reference: SG_LV3			Date: 26-05-2009
Coordinates	UTM (ED50) 29S	M: 0559415 P: 4105830	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

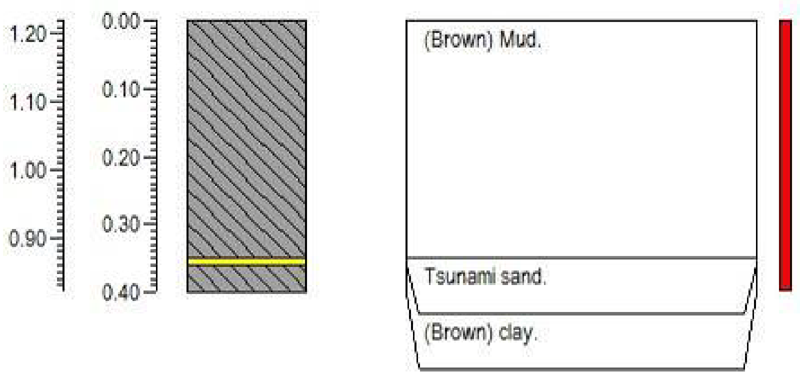


Reference: SG_LV4			Date: 26-05-2009
Coordinates	UTM (ED50) 29S	M: 0559521 P: 4105855	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



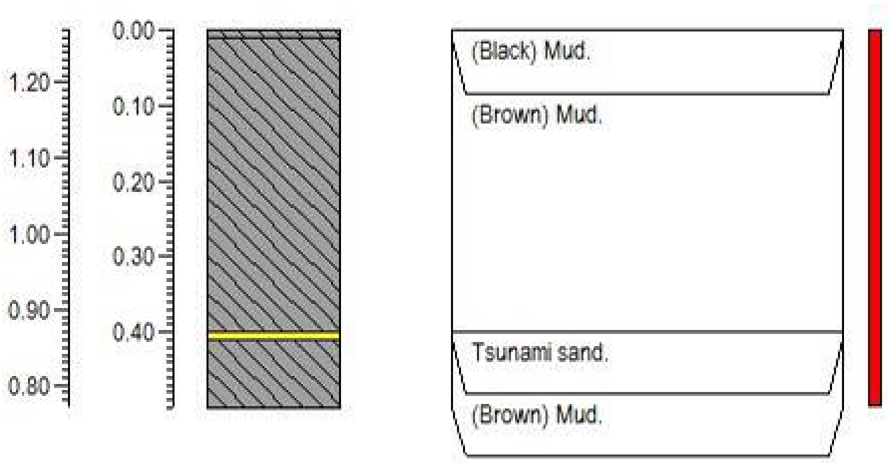
Reference: SG_LV5			Date: 26-05-2009
Coordinates	UTM (ED50) 29S	M: 0559612 P: 4105857	Location: Salgados Lagoon

Elevation / Depth (m)	LOG	Description	Sampling Depth (m)

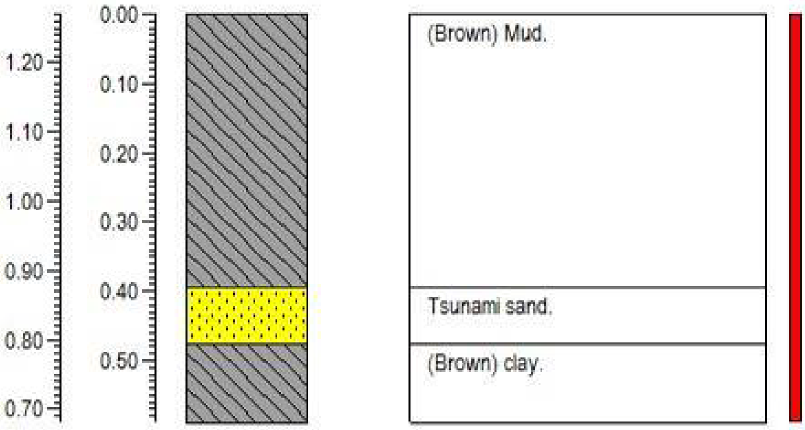


Reference: SG_LV6			Date: 25-05-2009
Coordinates	UTM (ED50) 29S	M: 0559542 P: 4105782	Location: Salgados Lagoon

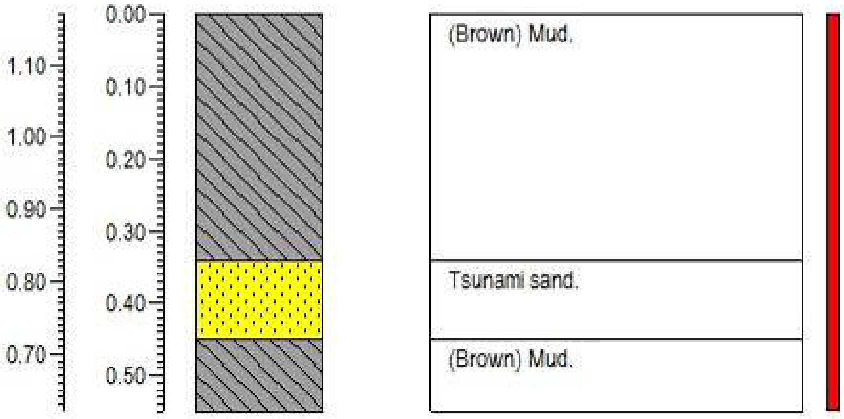
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



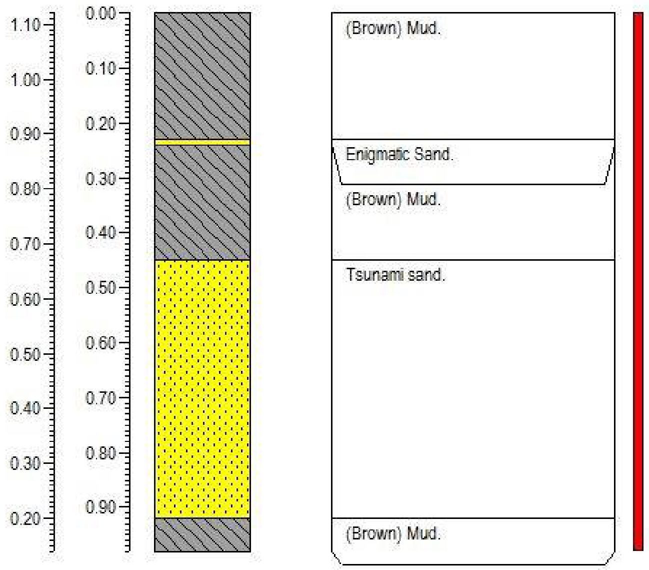
Reference: SG_LV7			Date: 26-05-2009
Coordinates	UTM (ED50) 29S	M: 0559650 P: 4105775	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



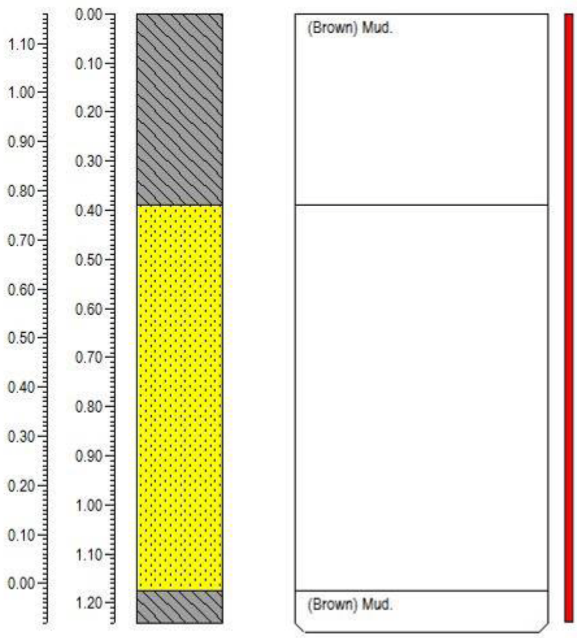
Reference: SG_LV9			Date: 25-05-2009
Coordinates	UTM (ED50) 29S	M: 0559626 P: 4105703	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



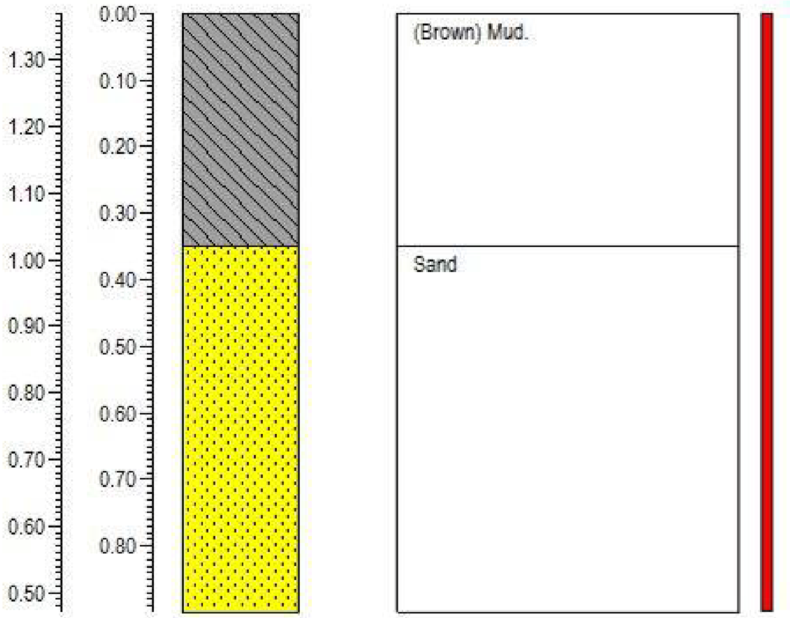
Reference: SG_LV10			Date: 25-05-2009
Coordinates	UTM (ED50) 29S	M: 0559660 P: 4105625	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



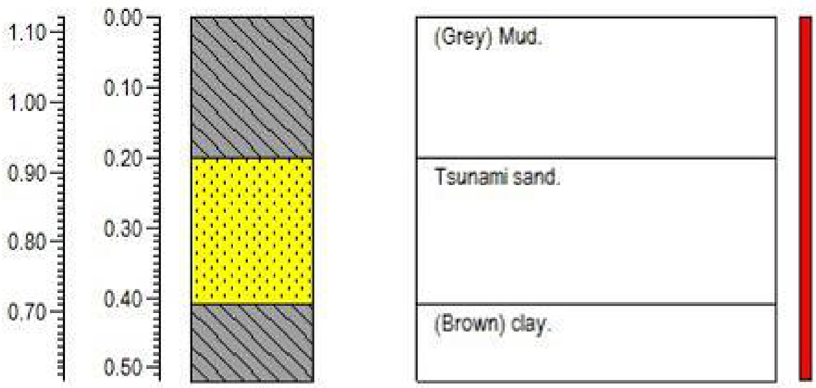
Reference: SG_LV10A			Date: 25-05-2009
Coordinates	UTM (ED50) 29S	M: 0559657 P: 4105582	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



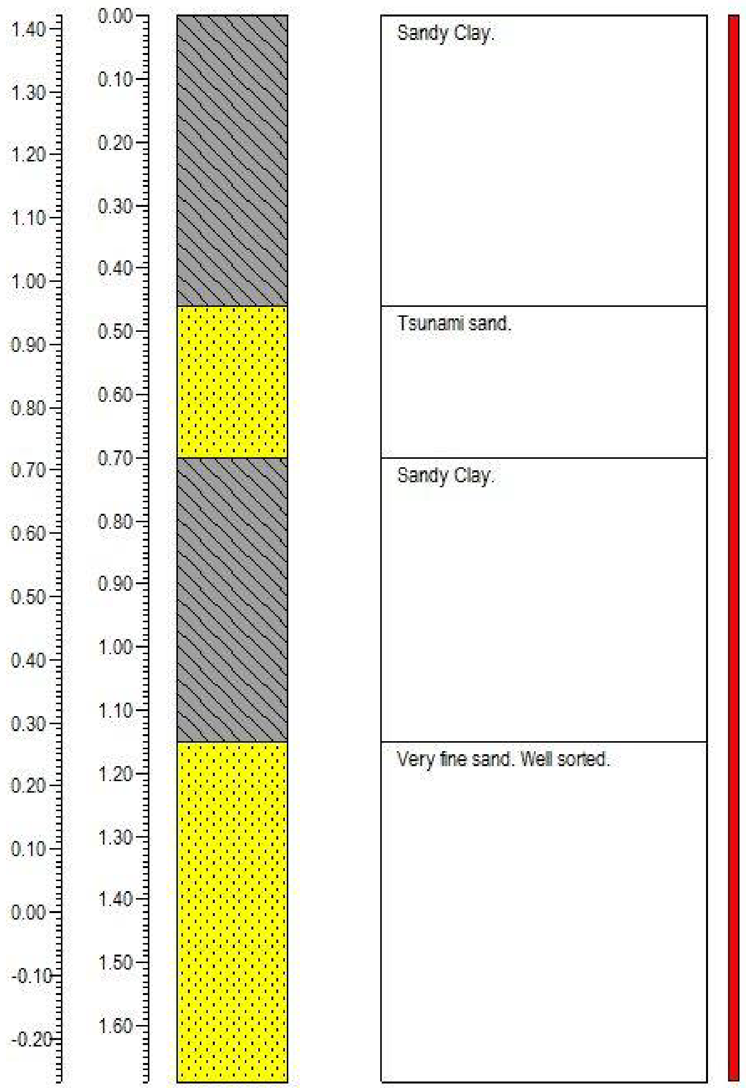
Reference: SG_LV11			Date: 26-05-2009
Coordinates	UTM (ED50) 29S	M: 0559452 P: 4105696	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



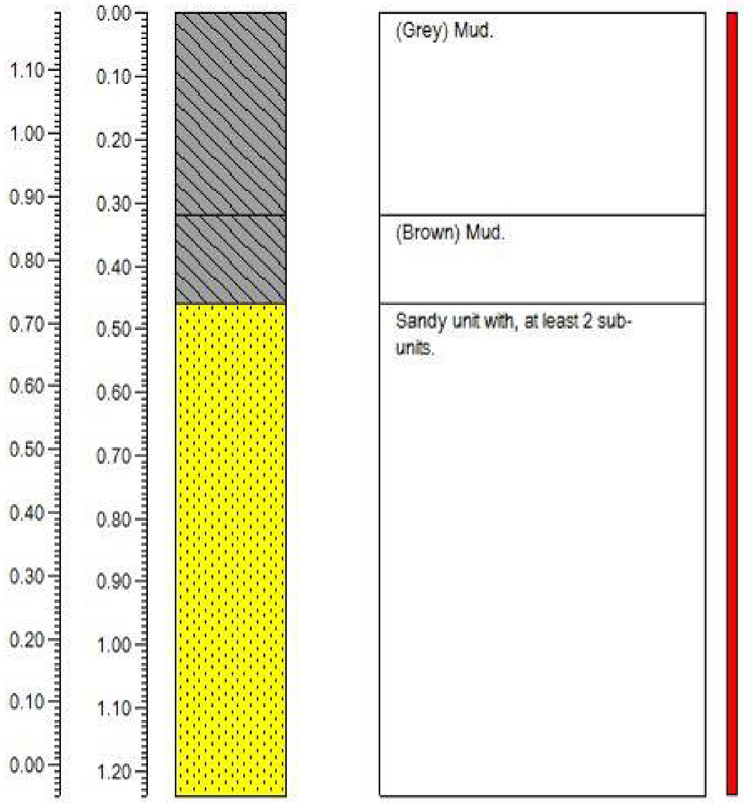
Reference: SG_LV11A			Date: 26-05-2009
Coordinates	UTM (ED50) 29S	M: 0559546 P: 4105686	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



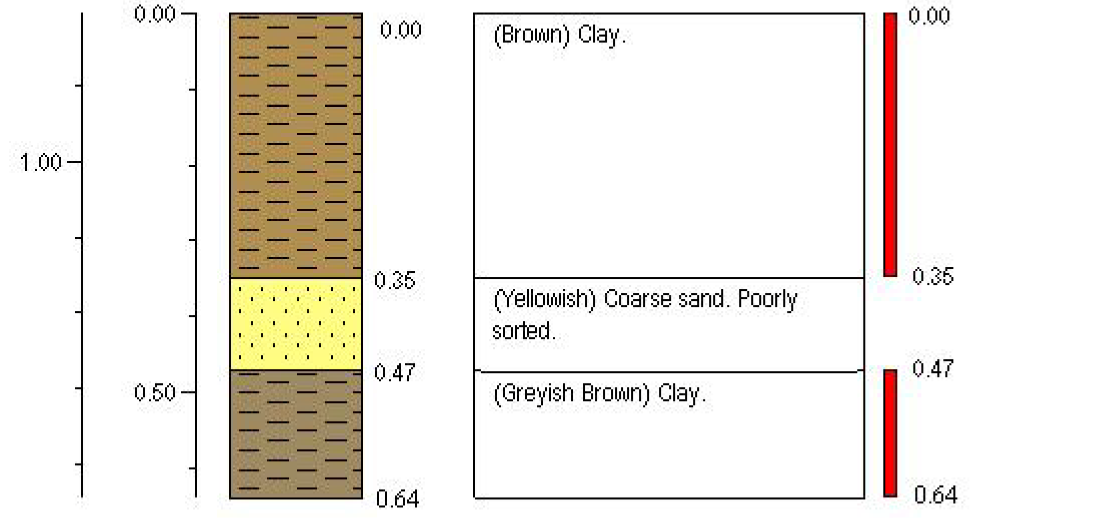
Reference: SG_LV12			Date: 26-05-2009
Coordinates	UTM (ED50) 29S	M: 0559558 P: 4105630	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: SG_LV13			Date: 25-05-2009
Coordinates	UTM (ED50) 29S	M: 0559650 P: 4105519	Location: Salgados Lagoon
Elevation / Depth (m)	LOG	Description	Sampling Depth (m)



Reference: SG-LUIGI			**Date:** 17-12-2008
Coordinates	UTM (ED50) 29S	**M:** 0559522 **P:** 4105737	**Location:** Salgados Lagoon
Elevation / Depth +1.195 (MSL) **(m)**	**LOG**	**Description**	**Sampling Depth (m)**



Project n. 037110

NEAREST

"Integrated observations from NEAR shore sourcES of Tsunamis: towards an early warning system"

Instrument: STREP

Thematic priority: 1.1.6.3 GOCE (GlObal Change and Ecosystems)

D21: REPORT ON ONSHORE TSUNAMI RECORDS ANNEXE 4 – RESULTS ON FORAMINIFERA FROM ALCANTARILHA AND SALGADOS LOWLANDS (SURFACE AND CORED SEDIMENTS)

Due date of deliverable: 30 November 2009 (26 months)

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Duration: 36 + 6 months

Organisation name of lead contractor for this deliverable: **CSIC**

Revision: template

Project Co founded By the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination level		
PU	Public	
PP	Restricted to other programme participants (including Commission Services)	
RE	Restricted to a group specified by the Consortium (including Commission Services)	RE
CO	Confidential, only for members of the Consortium (including Commission Services)	

WP6 - Paleotsunami and Paleoseismic records

D21: REPORT ON *ONSHORE TSUNAMI RECORDS* ANNEXE 4 – RESULTS ON FORAMINIFERA FROM ALCANTARILHA AND SALGADOS LOWLANDS (SURFACE AND CORED SEDIMENTS)

Leader WP 6: CSIC

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Responsable Task 6.1:

Onshore sedimentological evidence of tsunami records

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PART I

Estudo dos Foraminíferos Bênticos das Sondagens SG e ALC (Salgados e Alcantarilha)

João Carlos Jorge Moreno

2008

Índice

RELATÓRIO

O presente relatório descreve o trabalho executado por **João Carlos Jorge Moreno**, no âmbito do projecto de investigação NEAREST, no decurso do período Setembro-Dezembro de 2008. **O estudo dos foraminíferos bênticos em sondagens da lagoa dos Salgados e da lagoa de Alcantarilha,** a que se reporta este relatório, integra-se na caracterização de evidências geológicas de inundação por tsunami de segmentos litorais no Algarve e uma aproximação *multiproxi* das assinaturas deposicionais associadas a tsunamis em sequências sedimentares costeiras, com vista ao estabelecimento de intervalos de recorrência.

1. INTRODUÇÃO

Os microfósseis têm sido comummente utilizados como meio de investigação no reconhecimento e caracterização de sedimentos gerados por paleotsunamis quer globalmente quer na costa portuguesa (Hindson *et al*., 1996; Hindson *et al*., 1999; Kortekaas & Dawson, 2007).

Os registos paleontológicos são reveladores não só da elevada energia associada ao evento (ex: presença de raízes, fragmentos de plantas, conchas partidas, etc.), mas também de condições hidrológicas e geodinâmicas específicas que podem levar a um acréscimo na abundância de fósseis marinhos e salobros. Com efeito, dependendo da hidrodinâmica da linha de costa, da geomorfologia costeira e do comportamento das ondas de tsunami, o registo fóssil vai apresentar características particulares/distintas. As associações dependem, por exemplo, dos habitats atravessados pelas ondas de tsunami no seu percurso em direcção à costa. Mas proceder a generalizações é sempre difícil, razão pela qual se torna importante contextualizar os foraminíferos encontrados com os dados conhecidos dos habitats marinhos costeiros e da plataforma continental e com o registo micropaleontológico das unidades sedimentares imediatamente inferior e superior.

Os critérios paleontológicos *per si* podem ser inconclusivos na sua diferenciação de outros episódios marinhos, daí a reconhecida necessidade de conjugar vários critérios de interpretação e análise (análise histórica, sondagens e descrição estratigráfica, susceptibilidade magnética, raios-X e fotografia digital, fluorescência de raios-X, perda ao rubro, análise geoquímica, análise granulométrica e métodos de datação – Termoluminescência e ^{210}Pb).

2. OBJECTIVOS

Os objectivos gerais da tarefa 3 incluem:

- ✓ Interpretação do conteúdo micropaleontológico (foraminíferos bênticos) de 60 amostras em 22 sondagens curtas, para reconstituição paleoambiental de sequências sedimentares costeiras na lagoa dos Salgados (Algarve);

- ✓ Interpretação do conteúdo micropaleontológico (foraminíferos bênticos) de 43 amostras em 5 sondagens curtas e de 19 amostras superficiais, para reconstituição paleoambiental de sequências sedimentares costeiras na lagoa de Alcantarilha (Algarve).

3. RESULTADOS PRELIMINARES

3.1. Lagoa dos Salgados

3.1.2. Sondagens SG

Nas sondagens estudadas – SG31, SG33, SG35, SG64, SG66, SG89, SG91, SG93, SG95, SG99, SG101, SG103, SG106, SG115, SG137, SG139 e SG141 – foi possível diferenciar três níveis situados, aproximadamente, entre os 0,40m e os 0,60m. Já nas restantes sondagens – SG37 (2 amostras), SG39 (1 amostra), SG41 (2 amostras), SG56 (1 amostra) e SG59 (2 amostras) – não foi possível identificar o nível intermédio, provavelmente, apenas por uma questão de amostragem. As espécies presentes (Anexo 1) são características de ambientes marinhos costeiros e estuarinos/lagunares salobros (Murray, 1991; Hayward et al., 1999; Sen Gupta, 2002).

O **"nível inferior"** ocorre nas diferentes sondagens SG entre os 0,40m (cota menos profunda do topo do nível) e os 0,58m (cota mais profunda da base do nível) e caracteriza-se pela predominância de *Haynesina germanica*, *Haynesina depressula* e

Haynesina spp. (formas jovens); *Ammonia tepida* surge menos expressivamente (Anexo 2, Fig. 1). Este nível inferior, apesar de registar as características de maior salobridade, variando as diferentes associações salobras entre 60,5% e 98% (anexo3), contém algumas espécies marinhas (ex: *Asterigerinata mamilla*, *Cibicides* spp., *Cibicides lobatulus*). A ocorrência consistente de *H. depressula* (menos tolerante a variações ambientais do que *H. germanica*), conjuntamente com algumas espécies marinhas (com presença menos significativa) nestas associações, parece indiciar um ambiente **moderadamente salobro subtidal a intertidal inferior**. O número de espécies varia entre 4 e 25 e o número de foraminíferos por grama de sedimento total entre 18,9 e 512,5 (Anexo 4).

O "**nível intermédio"** surge nas diferentes sondagens SG entre os 0,37m (cota menos profunda do topo do nível) e os 0,55m (cota mais profunda da base do nível) e caracteriza-se pela predominância de espécies marinhas costeiras (*Cibicides* spp., *Cibicides lobatulus, Cibicides pseudoungerianus, Elphidium macellum, Elphidium discoidalis, Elphidium crispum, Quinqueloculina spp., Mississippina concentrica* e *Asterigerinata mamilla*). A **tendência marinha** deste nível está bem expressa na percentagem da associação marinha que, à excepção da sondagem SG33 (55,7%), varia entre 70% e 92%. Verifica-se a ocorrência de algumas espécies salobras, sendo as mais representativas *H. germanica* e *H. depressula*, variando esta associação entre 5% e 28% (exceptuando a sondagem SG33 – 43,6%). O número de espécies oscila entre 37 e 19 e o número de foraminíferos por grama de sedimento seco total entre 7,7 e 180,8.

O "**nível superior"** ocorre nas diferentes sondagens SG entre os 0,34 m (cota menos profunda do topo do nível) e os 0,49m (cota mais profunda da base do nível) e caracteriza-se pela predominância de *Haynesina germanica*, *Haynesina depressula* e *Haynesina* spp. (formas jovens), e menos expressivamente por *Cibicides* spp., *Ammonia tepida, Cibicides lobatulus, Elphidium macellum, Elphidium discoidalis, Elphidium crispum e Quinqueloculina spp.* A associação salobra varia entre 36,8% e 91%, denotando um ambiente **moderadamente salobro subtidal a intertidal inferior,** mas com **maior influência marinha comparativamente ao "nível inferior"**. O número de espécies varia entre 25 e 11 e, em geral, ocorrem sempre mais espécies do que no nível inferior; o número de foraminíferos por grama de sedimento seco total, entre 7,5 e 140,8, apresenta menor densidade do que os outros dois níveis.

- ✓ **“Nível inferior”** – as associações sugerem um ambiente lagunar moderadamente salobro subtidal a intertidal inferior**,** onde a presença de algumas espécies marinhas e de *Haynesina depressula* revelam a entrada provável de água do mar na laguna e/ou a permanência da mesma junto ao fundo, permitindo a ocorrência, em ambiente subtidal, destas espécies.
- ✓ **“Nivél médio”** – episódio com características marinhas, ocorrendo predominantemente espécies costeiras misturadas com algumas espécies salobras como *Haynesina germanica* e *Haynesina depressula*.
- ✓ **“Nível superior”** – as associações apontam para a prevalência de um ambiente lagunar moderadamente salobro subtidal a intertidal inferior, com maior influência marinha do que o “nível inferior” ou com o retrabalhar em ambiente salobro lagunar das espécies marinhas do “nível médio”.

3.2. Lagoa de Alcantarilha

3.2.1. Amostras superficiais ALC

Nas 14 **amostras superficiais** colhidas num perfil perpendicular à linha de costa, atravessando formações dunares e a face da praia, não foram encontrados foraminíferos autóctones. As carapaças de foraminíferos marinhos costeiros presentes no sedimento encontram-se retrabalhadas exibindo-se: A) maioritariamente roladas e com a sua superfície brilhante polida nas amostras **ALC J**, **K**, **M**, **N** e **O,** colhidas em ambiente de praia ou duna próxima da face da praia, e B) roladas e baças nas amostras **ALC A**, **B**, **C**, **D**, **E**, **F**, **G**, **H** e **I,** recolhidas em ambiente dunar mais interior e na face lagunar da duna interior. O número de foraminíferos por grama de sedimento seco é baixo, variando entre 1 e 4,4.

Das 5 amostras superficiais restantes, apenas **ALC Canal Bordo do Sapal** e **ALC Fundo do Canal S** apresentam associações de foraminíferos. ***H. depressula*** é a espécie dominante no fundo do canal (Anexo 5) associada a ***H. germanica***, ***A. tepida*** e *Trochammina inflata*. As espécies salobras (intertidal a subtidal) constituem 75% da associação (Anexo 6), as espécies de sapal 12,1% (*Arenoparrella mexicana*, *Jadammina macrescens* e *T. inflata*) e as marinhas 12,9% (*Cibicides* spp. e *Quinqueloculina* spp.). O número de foraminíferos por grama de sedimento seco é de 122,7. A amostra do **Canal**

Bordo do Sapal exibe uma associação em que 98,5% das espécies são salobras intertidais a subtidais, com predominância de ***H. depressula*** e ***H. germanica*** associada a *A. tepida*. O número de foraminíferos por grama de sedimento seco é de 108,1.

Informação com importante interesse paleoambiental a extrair das amostras superficiais estudadas advém de:

- ✓ Presença de bioclastos (foraminíferos marinhos costeiros) **rolados e brilhantes,** revelando um transporte em **ambiente marinho de forte hidrodinamismo** (praia ou próximo dela);

- ✓ Presença de bioclastos (foraminíferos marinhos costeiros) **rolados e baços,** indiciando um transporte e retrabalhamento dos sedimentos em **ambiente dunar** (duna interior, face lagunar).

- ✓ Associações de canal que sugerem um ambiente lagunar moderadamente salobro subtidal a intertidal inferior, em que a espécie dominante ***H. depressula,*** associada a ***H. germanica*** e *A. tepida,* é um marcador de alguma influência marinha e/ou a permanência de condições de moderada salobridade confirmadas pelas espécies aglutinadas (*Arenoparrella mexicana*, *Jadammina macrescens* e *T. inflata*) características de “sapais de salinidade normal” (Murray, 1991; Debenay *et al*., 2000; Sen Gupta, 2002).

3.2.2. Sondagens ALC

Das 5 sondagens estudadas (ALC 3, ALC 4, ALC 6, ALC 17 e ALC 18; 45 amostras), só a **ALC18** (Fig. 2) apresenta foraminíferos que permitem o estudo das associações.

⇒ A **base da sondagem** (2,23m − 2,44m) é constituída por areia grosseira com uma importante componente bioclástica (gastrópodes, fragmentos de lamelibrânquios, espículas de equinodermes, ostracodos), na qual 96% das espécies são características de ambientes **marinhos costeiros** (Anexo2, Fig.2). Apresentam, no entanto, sinais de transporte em ambiente de forte hidrodinamismo, provavelmente em zona de praia ou de canal. Observa-se a ocorrência de **formas recristalizadas e retrabalhadas**

conjuntamente com outras bem preservadas. O número de foraminíferos por grama de sedimento seco é baixo (9,5).

⇒ Dos **2,23m** de profundidade aos **1,14m,** a fracção >63µm é formada por areia fina bioclástica (gastrópodes, fragmentos de lamelibrânquios, espículas de equinodermes, etc.). É, no entanto, possível diferenciar com clareza as amostras situadas entre os 2,23m – 1,50m e os 1,50m – 1,14m. Um aspecto a destacar é a presença de foraminíferos planctónicos no conjunto de amostras mais profundas. A influência marinha no interior da laguna parece ser mais acentuada entre os 2,23m e os 1,88m, com o maior número de espécies (25) e uma associação subtidal a intertidal inferior moderadamente salobra (59%), cujas espécies dominantes são ***H. germanica***, ***H. depressula*** e ***A. tepida***, associadas a diversas espécies marinhas como *Cibicides* spp., *A*. *mamilla*, *Elphidium* spp. e *Mississippina concentrica*. Gradualmente, a tendência salobra das associações acentua-se, correspondendo esta a 76,3% do conjunto das espécies aos 1,50m – 1,57m de profundidade. Tal tendência é expressa pelo menor peso percentual relativo de ***H. depressula*** e pelo menor número de espécies. Entre os 1,50m e os 1,14m, acentua-se o carácter salobro das associações (96%), com ***H. germanica*** (53% a 64%) como espécie dominante, associada a ***A. tepida*** e *H. depressula*. O número de espécies passa a 7 – 8 e o número máximo de foraminíferos por grama de sedimento seco (349) ocorre aos 1,50m – 1,41m, reduzindo drasticamente (11,5) para o topo (1,14m – 1,26m).

⇒ Dos **1,14m** de profundidade aos **0,46m,** verifica-se uma redução acentuada do número de foraminíferos por grama de sedimento total (0,4 a 0,2), sendo o número de espécimens insuficiente para o estudo das associações. O sedimento fino com fragmentos de plantas, associado à presença residual de exempalres de *H. germanica* e *A. tepida* com conchas baças por dissolução, podem sugerir um ambiente de baixo sapal provavelmente com maior influência fluvial.

⇒ Dos **0,48m** de profundidade aos **0,14m,** o número de foraminíferos por grama de sedimento total varia entre 6 e 7. Os foraminíferos presentes nestas areias correspondem a espécies marinhas costeiras retrabalhadas, alguns recristalizados, ocorrendo uma mistura de espécimens de concha baça com outros polidos, sugerindo origens diferenciadas, possivelmente sedimentos de praia e duna.

⇒ Dos **0,14m** de profundidade aos **0,04m,** o número de foraminíferos por grama de sedimento total é de 6. Os foraminíferos que se encontram nestas areias são espécies marinhas costeiras com aspecto baço, alguns espécimens recristalizados, provavelmenmte retrabalhadas em ambiente dunar.

⇒ Dos **0,04m** de profundidade aos **0,00m,** o sedimento diferencia-se pela presença de **fragmentos de plantas** e pelo número insuficiente de foraminíferos (apenas 3 espécimens de *J. macrescens*), podendo reflectir um ambiente de sapal.

- ✓ Areias grosseiras da base da sondagem sugerem um **ambiente marinho de forte hidrodinamismo.**
- ✓ Entre os **2,23m** e os **1,14m**, as associações de foraminíferos revelam um **ambiente lagunar moderadamente salobro,** em que essa salobridade se acentua em direcção ao topo.
- ✓ Dos **1,14m** de profundidade aos **0,46m**, poder-se-á ter um **ambiente de baixo sapal** provavelmente com **maior influência fluvial** ou então a dominância de **condições sub-aéreas.**
- ✓ Entre os **0,48m** de profundidade e os **0,14m**, verifica-se um transporte de areias que parecem sugerir **origem marinha e dunar**.
- ✓ Entre os **0,14m** de profundidade e os **0,04m**, poder-se-á estar em presença de um ambiente dunar.
- ✓ Os 4cm superficiais podem representar um período de desenvolvimento do sapal e/ou de alternância de condições fluviais e subaéreas.

3.2.2.1. Sondagem ALC 3

As 23 amostras estudadas não apresentam associações autóctones que viabilizem a interpretação paleoambiental pretendida. As espécies marinhas presentes estão maioritariamente retrabalhadas, roladas, polidas (brilhantes) ou baças, podendo reflectir a dinâmica do último ambiente em que foram mobilizadas.

⇒ Na areia grosseira da **base da sondagem (1,80m – 1,90m)** é possível encontrar alguns foraminíferos marinhos retrabalhados com a superfície baça, podendo **sugerir** alguma evolução destas areias em **regime dunar**.

⇒ Dos **1,80m aos 1,00m,** ocorrem muito poucos foraminíferos nas areias mais finas desta secção da sondagem, sendo que entre os 1,20m e os 1,05m existem algumas conchas retrabalhadas com aspecto baço.

⇒ Dos **1,00m aos 0,40m,** alternam amostras de areias mais grosseiras, em que se verifica a presença de conchas de foraminíferos marinhos: i) roladas baças e brilhantes aos **0,90m – 1,00m**; ii) roladas polidas aos **0,90m – 0,80m**, podendo **sugerir** um nível de **frente de praia** (marinho); iii) roladas baças aos **0,70m – 0,80m**, podendo **sugerir** evolução em **ambiente dunar**; iv) roladas baças e polidas aos **0,75m – 0,65m**; v) roladas polidas aos **0,60m – 0,70m,** podendo **sugerir** um nível de **frente de praia** (marinho) e vi) roladas baças e brilhantes entre os **0,60m – 0,40m**.

⇒ Dos **0,40m aos 0,00m,** passam-se a ter conchas retrabalhadas de foraminíferos marinhos roladas baças e com a presença de fragmentos de plantas, o que pode apontar para uma evolução em **regime dunar** mais interior.

3.2.2.2. Sondagem ALC 4

As 5 amostras estudadas não apresentam associações autóctones que possibilitem a interpretação paleoambiental pretendida. As espécies marinhas presentes estão maioritariamente retrabalhadas, roladas, polidas (brilhantes) ou baças, podendo reflectir a dinâmica do último ambiente em que foram mobilizadas.

⇒ A areia bioclástica grosseira da **base da sondagem (2,00m – 2,26m)** apresenta alguns foraminíferos marinhos retrabalhados com a superfície baça, podendo **sugerir** alguma evolução destas areias em **regime dunar**.

⇒ Dos **1,50m aos 0,60m,** passa-se a ter uma areia menos grosseira bioclástica com conchas retrabalhadas de foraminíferos marinhos roladas baças, o que pode **sugerir** uma evolução em **regime dunar** mais interior.

⇒ Dos **0,60m aos 0,40m**, observa-se conchas retrabalhadas de foraminíferos marinhos roladas polidas e a presença de foraminíferos planctónicos, podendo **sugerir** um nível de **frente de praia** (marinho).

⇒ Dos **0,40m aos 0,00m,** passam-se a ter conchas retrabalhadas de foraminíferos marinhos roladas baças, podendo **sugerir** uma evolução em **regime dunar** mais interior.

3.2.2.3. Sondagem ALC 6

Desta sondagem, apenas a amostra correspondente aos **0,32m** – **0,45m** foi estudada. Esta caracteriza-se pela presença de duas “gerações” de foraminíferos marinhos: uns rolados baços e recristalizados e outros com aspecto brilhante evidenciando pouco transporte. O número de foraminíferos foi insuficiente para o estudo das associações, mas é possível sugerir uma proximidade a um ambiente marinho ou uma **mistura** de sedimentos com origem **marinha e dunar**. A densidade de foraminíferos por grama de sedimento total seco é baixa (4,3).

3.2.2.4. Sondagem ALC 17

Desta sondagem, só uma das amostras (**0,33m** – **0,75m)** foi estudada, caracterizando-se pela presença de foraminíferos marinhos, algo rolados, uns com a superfície das conchas brilhante, denotando menor transporte, e outros baços e recristalizados. O número de foraminíferos presente foi insuficiente para o estudo das associações. A densidade de foraminíferos por grama de sedimento total seco é baixa (4,8). Os aspectos referidos podem permitir avançar para uma **provável origem marinha** (praia?) dos sedimentos.

A análise dos foraminíferos bênticos permite detectar alguns episódios marinhos nas sequências sedimentares lagunares provenientes da lagoa dos Salgados e de Alcantarilha, expressos pela presença de associações marinhas costeiras ou de espécies marinhas costeiras retrabalhadas em regime de forte hidrodinamismo (praia) e/ou em regime dunar.

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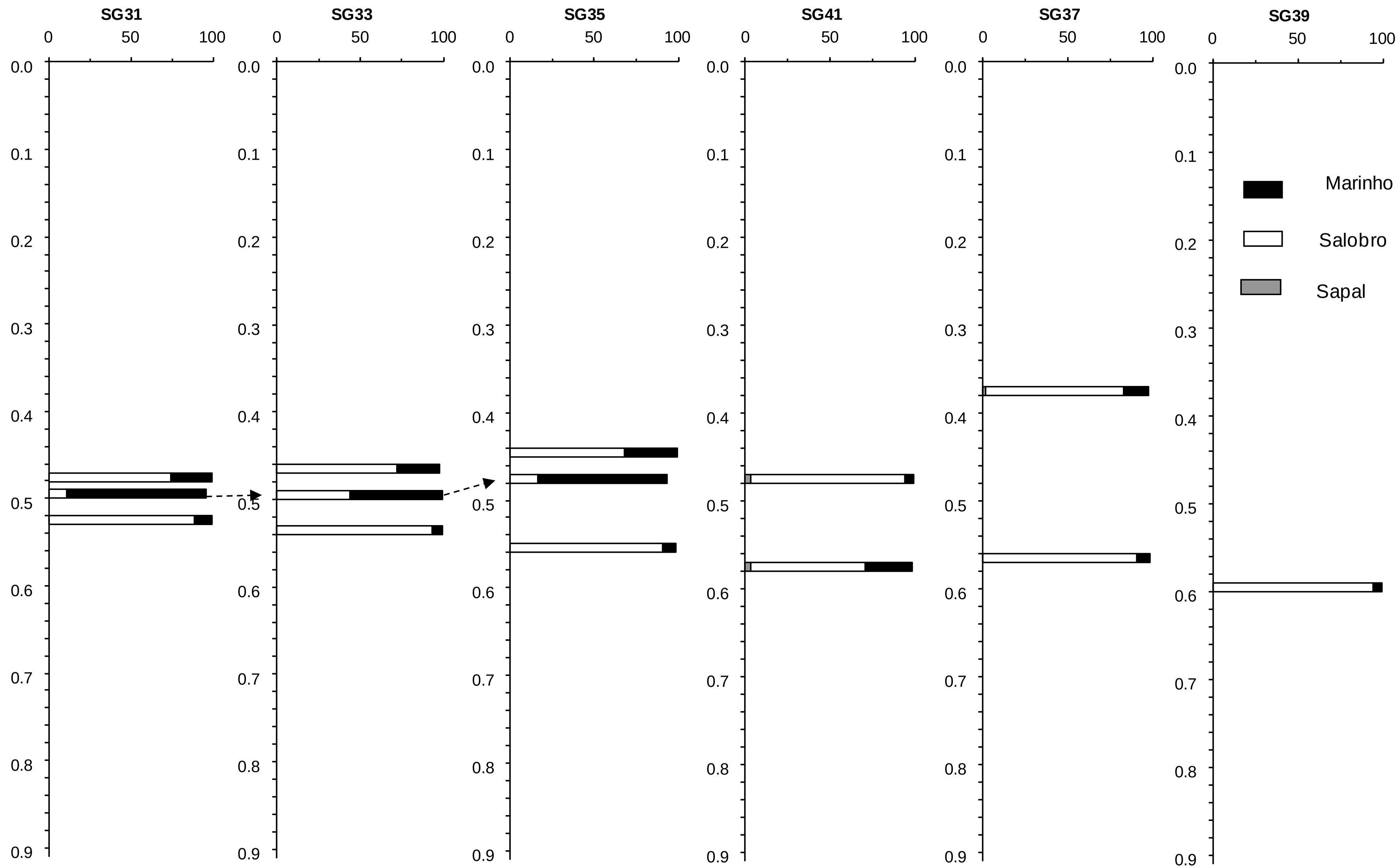

Figura 1 - Distribuição em percentagem das associações de foraminíferos bênticos nas sondagens SG31, SG33, SG35, SG41,SG37 e SG39

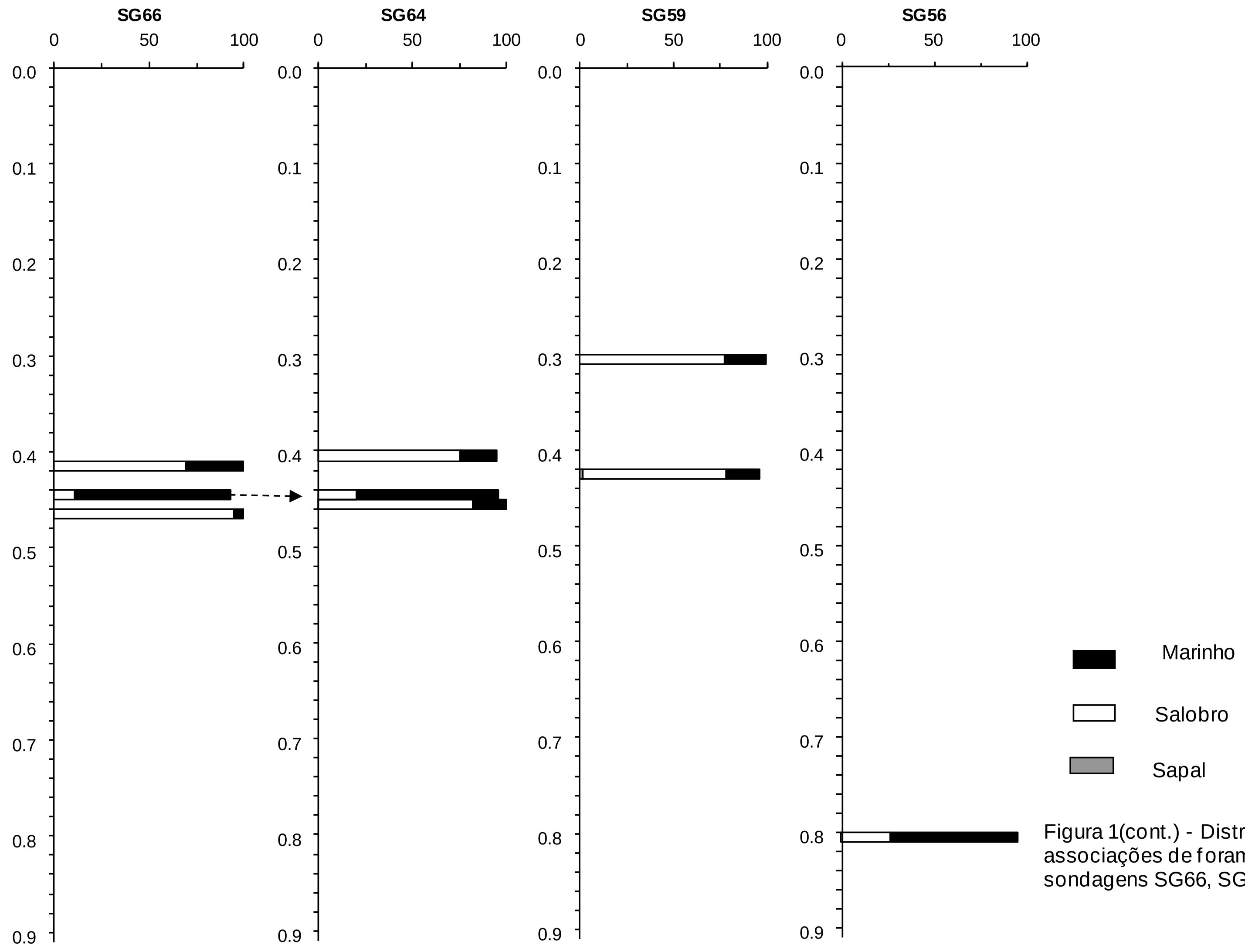

Figura 1(cont.) - Distribuição em percentagem das associações de foraminíferos bênticos nas sondagens SG66, SG64, SG59, e SG56

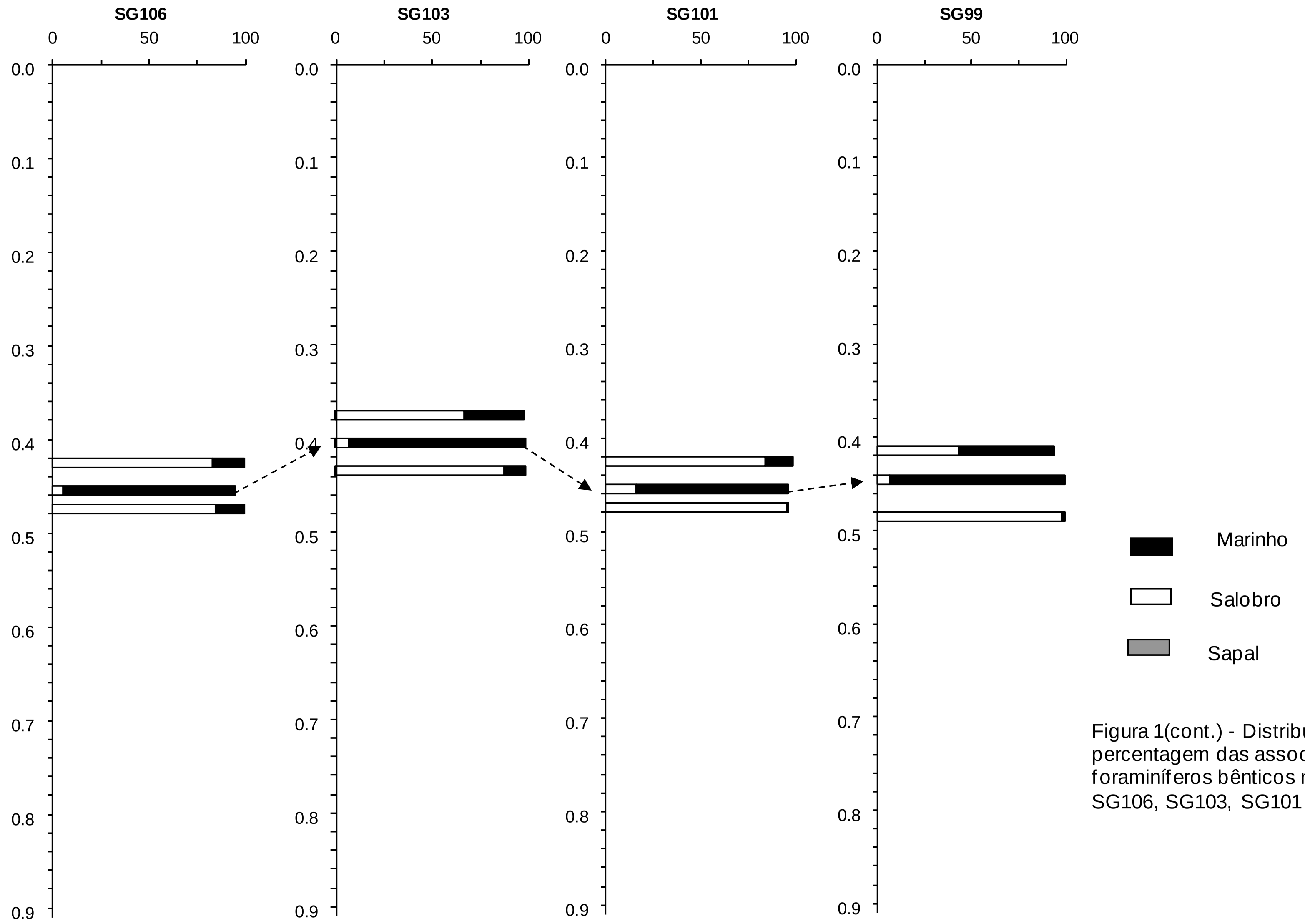

Figura 1(cont.) - Distribuição em percentagem das associações de foraminíferos bênticos nas sondagens SG106, SG103, SG101 e SG99

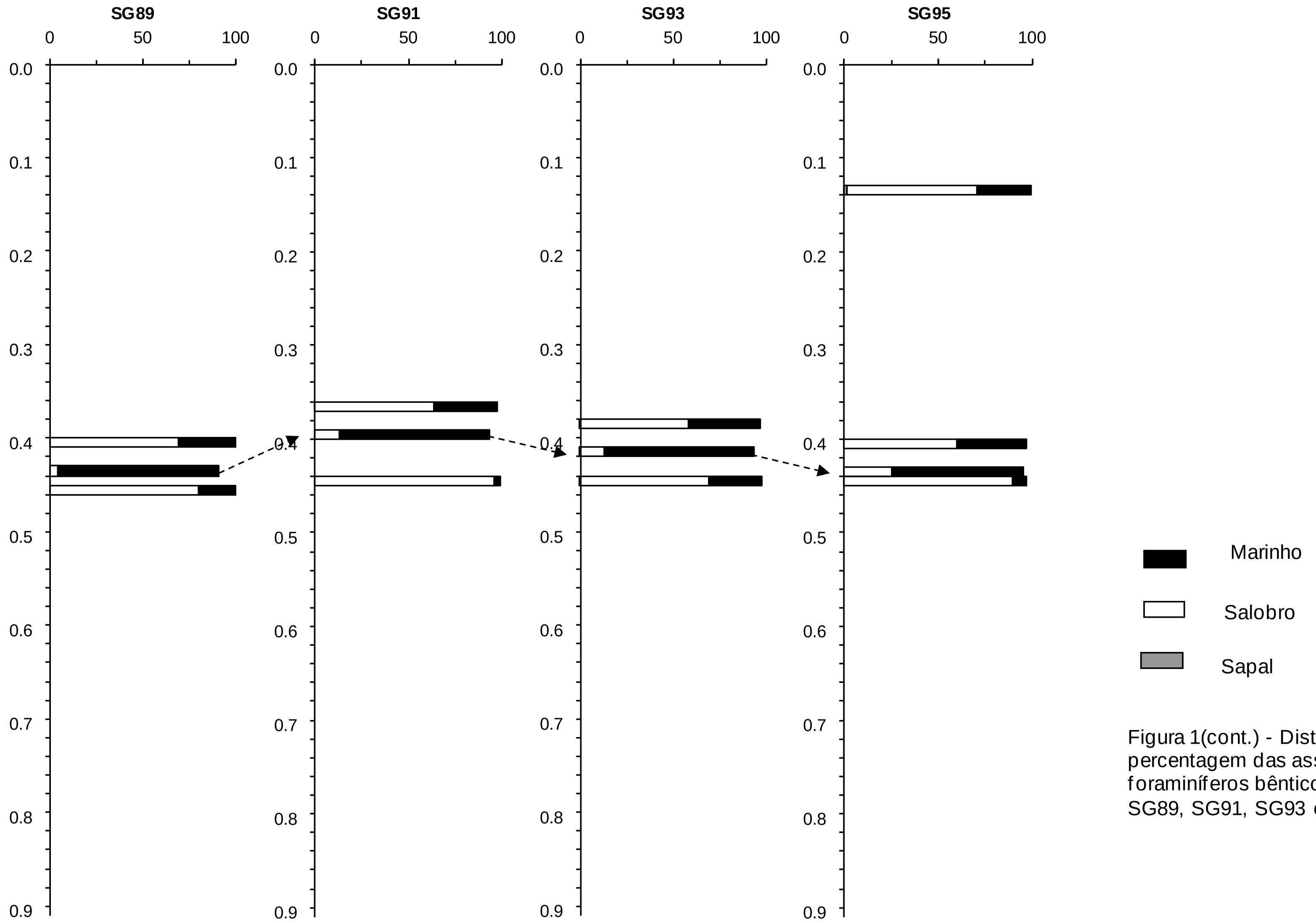

Figura 1(cont.) - Distribuição em percentagem das associações de foraminíferos bênticos nas sondagens SG89, SG91, SG93 e SG95

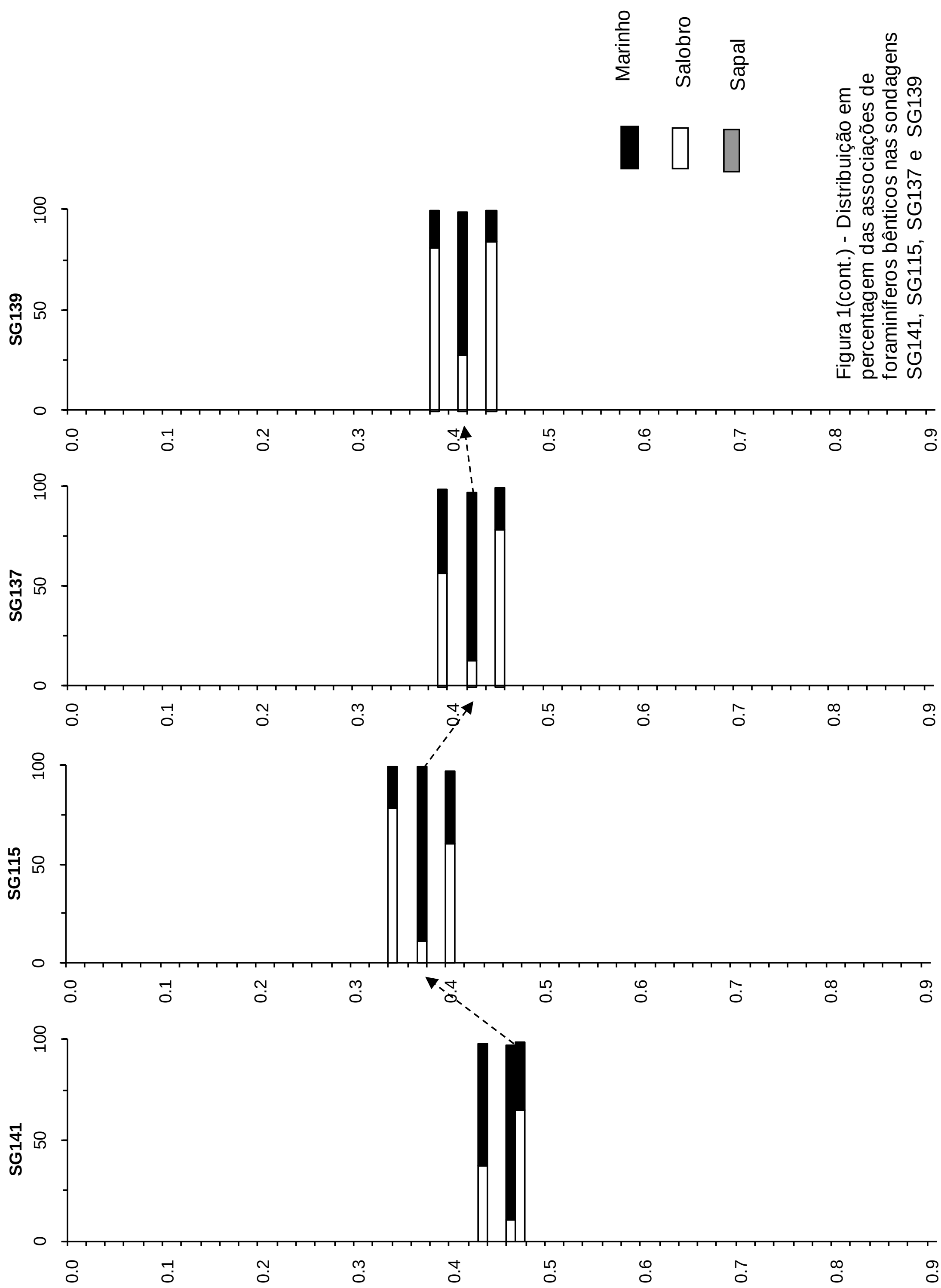

Figura 1(cont.) - Distribuição em percentagem das associações de foraminíferos bênticos nas sondagens SG141, SG115, SG137 e SG139

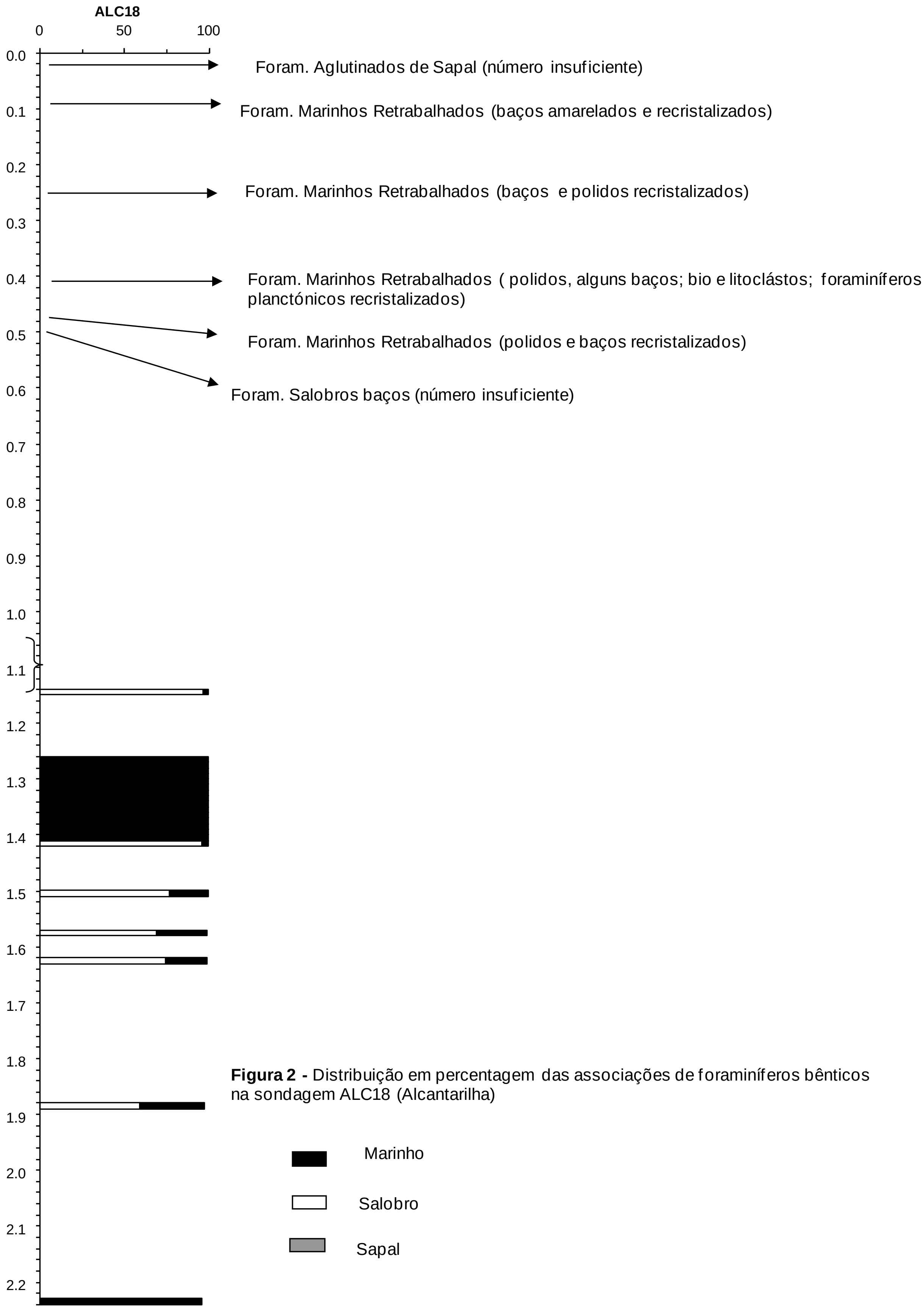

Figura 2 - Distribuição em percentagem das associações de foraminíferos bênticos na sondagem ALC18 (Alcantarilha)

Marinho

Salobro

Sapal

ANEXO 1 - Lista das Espécies

Arenoparrella mexicana (Anderson)
Jadammina macrescens (Brady, 1870)
Trochammina inflata (Montagu, 1808)
*Ammonia sp.*Brunnich, 1772
Ammonia beccarii (Linné, 1758)
Ammonia parkinsoniana (d'Orbigny, 1839)
Ammonia tepida (Cushman, 1926)
Anommalinoides sp. Brotzen, 1942
Astrononion sp. Cushman e Edwards, 1937
Astrononion gallowayi Topsent, 1892
Asterigerinata mamilla (Williamson, 1858)
Bolivina sp. d'Orbigny, 1839
*Bulimina sp.*d'Orbigny, 1826
Cassidulina sp. d'Orbigny, 1826
Cibicides lobatulus (Walker e Jacob, 1798)
Cibicides pseudoungerianus (Cushman), 1922
Cibicides refulgens Montfort, 1808
Cribroelphidium gerthi Van Voorthuysen
Discorbinella bertheloti (d'Orbigny, 1839)
Discorbis sp. Lamarck, 1804
Elphidium advenum (Cushman, 1922)
Elphidium complanatum (d'Orbigny, 1839)
Elphidium crispum (Linné, 1758)
Elphidium discoidale (d'Orbigny, 1839)
Elphidium excavatum (Terquem, 1875)
Elphidium gunteri Cole, 1931
Elphidium incertum (Williamson, 1858)
Elphidium macellum (Fichtel e Moll, 1798)
Elphidium oceanensis (d'Orbigny, 1826)
Elphidium pulvereum Todd, 1958
Elphidium selseyensis (Heron-Allen e Earland 1911)
Elphidium williamsoni Haynes, 1973
Eponides repandus (Fichtel e Moll, 1798)
Fissurina sp. Reuss, 1850
Gavelinopsis praegeri (Heron-Allen e Earland, 1913)
Glabratella sp. Dorreen, 1948
Glabratella brasiliensis Boltovskoy, 1959
Globocassidulina subglobosa (Brady,1881)
Guttulina sp. d'Orbigny, 1839
Guttulina communis. (d'Orbigny, 1826)
Haynesina germanica (Ehrenberg, 1840)
Haynesina depressula (Walker e Jacob, 1798)
*Lagena sp.*Walker e Jacob, 1798
Mississippina concentrica (Parker e Jones, 1864)
Neoconorbina sp. Hofker, 1951
Neoconorbina terquemi (Rzehak, 1888)
Nonion communis, (d'Orbigny, 1825)
Nonionoides sp. Saidova, 1975
Oolina sp. d'Orbigny, 1839
Patellina corrugata Williamson, 1858
Planorbulina mediterranensis d'Orbigny, 1826
*Rosalina sp.*d'Orbigny, 1826
Trifarina angulosa (Williamson, 1858)
Textularia Defrance, 1824
Textularia conica d'Orbigny, 1839
Textularia sagittula Defrance, 1824
*Quinqueloculina sp.*d'Orbigny, 1826
Miliolinella sp. Wiesner, 1931
Miliolinella subrotunda (Montagu, 1803)
Spirillina sp. Ehrenberg, 1843
Triloculina carinata d'Orbigny
Pateoris hauerinoides (Rhumbler, 1936)

Anexo 2- Distribuição em % de espécimens foramníferos bênticos por amostra (Sondagens SG)

Espécies (nº) / Prof. (m)	SG 31 0.47-0.49	SG 31 0.49-0.52	SG 31 0.52-0.55	SG 33 0.46-0.49	SG 33 0.49-0.53	SG 33 0.53-0.57	SG 35 0.44-0.47	SG 35 0.47-0.55	SG 35 0.55-0.58	SG 37 0.37-0.40	SG 37 0.56-0.59	SG 39 0.59-0.62	SG 41 0.47-0.49	SG 41 0.575-0.60	SG 56 0.80-0.83
Jadammina macrescens			2	1	1		1	1		2			5	2	
Textularia conica															
Ammonia spp.								3							
Ammonia beccarii		2			4		2					1			4
Ammonia tepida	1	1			2	1	8		4	4	10	3	4		1
Ammonia parkinsoniana		2						2	2	1		1			2
Anommalinoides sp.										1					
Asterigerinata mamilla	4	8	2	3	5	1	7	8	2		4	1	1	3	3
Astrononion spp.								1							
Astrononion gallowayi		1		1											
Bolivina spp.													1		
Bulimina spp.	1														
Cassidulina spp.															
Cibicides spp.	4	26	8	11	28	3	13	34	4	9	2	2	2	6	2
Cibicides sp. 2		4		1			2		1					1	1
Cibicides lobatulus	2	13		1				10	3						33
Cibicides cf. pseudoungerianus		5			6			6	1						3
Cibicides refulgens		4		4			3	1							
Cibicidoides sp.															
Cribrononion gerthi		2	1		1										
Discorbinella bertheloti									1						
Discorbis spp.															
Elphidium spp.	2		3	2	3		5	7		3		3	2	5	11
Elphidium advenum															
Elphidium complanatum	1	2	1	1			1	1					1		4
Elphidium crispum		3	2				1	2		1					5
Elphidium excavatum s.l.															
Elphidium discoidalis	2	5			7	2	2	14		3	1			1	2
Elphidium gunteri	1		1	1	3		4					3	3		2
Elphidium incertum															
Elphidium macellum	2	5		1	14		3	16		2		1		1	6
Elphidium oceanencis															
Elphidium pulvereum															
Elphidium selseyensis								1							
Elphidium williamsoni															
Eponides repandus		1													
Fissurina spp.							1								
Gavelinopsis praegeri															
Glabratella spp.	1			4	2		4	1							4
Glabratella brasiliensis															
Globocassidulina subglobosa															
Guttulina sp.															
Guttulina communis															
Haynesina germanica	25	4	68	46	21	49	36	10	57	41	45	47	62	17	10
Haynesina depressula	37	7	30	22	33	34	26	11	18	35	46	50	12	15	11
Haynesina sp. (jovens)	14		103	22	6	53	28	2	54	38	40	38	57	13	8
Lagena spp															
Miliolideos indet.															
Miliolinella spp.		1													
Miliolinella subrotunda															
Triloculina spp.															
Triloculina carinata															
Mississippina concentrica	3	5	1	1	1	1	2	1							
Nonion sp.															
Nonion commune				1											
Nonionoides sp.															
Neoconorbina terquemi					1										
Neoconorbina sp.															
Oolina spp.		1			1										
Patellina corrugata															
Pateoris hauerinoides															
Planorbulina mediterranensis															
Quinqeloculina spp.	1	8	5		8	2	1	14		1	4			1	3
Spirillina spp.															
Rosalina spp.	1			1				1			1				
Rosalina globularis															
Textularia spp.															
Textularia conica															1
Textularia sagittula															
Trifarina angulosa															
Sp1	3	2		1	2		1	2		1					3
Sp3															
Indeterminados		3	2	3		1		5		2	2		1	1	4
Nº total de Foram. Bênticos	105	115	229	128	149	147	151	154	147	144	155	150	151	66	123
Nº total de ostracodos	0	1			4			5	1			5	1		
Nº de espécies S	16	30	18	21	22	8	19	26	9	14	9	10	11	10	24

Anexo 2 (cont.)- Distribuição em % de espécimens foramníferos bênticos por amostra (Sondagens SG)

Espécies (nº) / Prof. (m)	SG 59 0.30-0.33	SG 59 0.42-0.45	SG 64 0.40-0.44	SG 64 0.44-0.455	SG 64 0.455-0.49	SG 66 0.41-0.44	SG 66 0.44-0.46	SG 66 0.46-0.49	SG 89 0.40-0.43	SG 89 0.43-0.45	SG 89 0.45-0.48	SG 91 0.36-0.39	SG 91 0.39-0.44	SG 91 0.44-0.47	SG 93 0.38-0.415
Jadammina macrescens	1	2			1							1			1
Textularia conica															
Ammonia spp.		3		3				1							
Ammonia beccarii	2			1			4								
Ammonia tepida		3	3	3	3	2				2	17	2	6	1	3
Ammonia parkinsoniana							3			4			6		1
Anommalinoides sp.							1								
Asterigerinata mamilla	1		2	10	4	3	10		2	11	6	3	11		5
Astrononion spp.															
Astrononion gallowayi													4		
Bolivina spp.															
Bulimina spp.				2		1									
Cassidulina spp.				1											1
Cibicides spp.	13	12	5	22	10	16	10	2	16	29	5	18	15	1	15
Cibicides sp. 2		2		1		1	3		1	3		3	3		
Cibicides lobatulus		1	5	15			21			15		1	13		
Cibicides cf. pseudoungerianus	1		2	10			12		3	21		4	13		3
Cibicides refulgens			1								2				
Cibicidoides sp.															
Cribrononion gerthi				3		1							4		
Discorbinella bertheloti	1												1		
Discorbis spp.						1				2					
Elphidium spp.		1	1	4	1	3	8		6	1	5	6	7	4	4
Elphidium advenum															
Elphidium complanatum		1	1			2	1		1	2		3	2		
Elphidium crispum	3		1		1		1		2				5		5
Elphidium excavatum s.l.		1													
Elphidium discoidalis	1	2	5	9	1	6	7			9			7		6
Elphidium gunteri		1													
Elphidium incertum															
Elphidium macellum		5	1	5		2	6	2	2	18			9		
Elphidium oceanencis															
Elphidium pulvereum								1		1			1		
Elphidium selseyensis															
Elphidium williamsoni													1		
Eponides repandus							1				1		2		
Fissurina spp.										1					
Gavelinopsis praegeri															
Glabratella spp.	1			2	2	2	2			3	1		1		2
Glabratella brasiliensis							2								
Globocassidulina subglobosa										1					
Guttulina sp.															
Guttulina communis															
Haynesina germanica	52	46	26	11	50	36	1	81	27	1	33	28	8	56	34
Haynesina depressula	24	42	55	9	43	45	14	14	36	4	19	34	6	23	20
Haynesina sp. (jovens)	12	34	22	5	16	14		47	22		39	21		47	14
Lagena spp															
Miliolideos indet.															
Miliolinella spp.															
Miliolinella subrotunda				4			1						3		
Triloculina spp.							2				2		1		
Triloculina carinata															1
Mississippina concentrica	2	2		5		1	13	1		4	2	6	4		1
Nonion sp.															
Nonion commune		1							1				2		
Nonionoides sp.					1										
Neoconorbina terquemi							1								
Neoconorbina sp.				1				1					1		
Oolina spp.															
Patellina corrugata															
Pateoris hauerinoides															
Planorbulina mediterranensis										1			1		
Quinqeloculina spp.		2	1	8	2	1	6		3	17		1	16		1
Spirillina spp.										1					
Rosalina spp.		1				1	1			1			1		
Rosalina globularis															
Textularia spp.					1					1	2				
Textularia conica							3			1			1		
Textularia sagittula															
Trifarina angulosa															
Sp1	1		2	2	1	1	3		1	4		1	2		3
Sp3															
Indeterminados		3	8	4	1		7			12	1	3	4		4
Nº total de Foram. Bênticos	115	165	141	140	138	139	144	150	123	170	135	135	161	132	124
Nº total de ostracodos	2	2								4			4		2
Nº de espécies S	12	18	18	25	13	20	32	8	25	31	14	16	37	8	22

Anexo 2 (cont.)- Distribuição em % de espécimens foramníferos bênticos por amostra (Sondagens SG)

Espécies (nº) / Prof. (m)	SG 93 0.415-0.445	SG 93 0.445-0.48	SG 95 0.13-0.15	SG 95 0.40-0.43	SG 95 0.43-0.44	SG 95 0.44-0.47	SG 99 0.41-0.44	SG 99 0.44-0.48	SG 99 0.48-0.50	SG 101 0.42-0.45	SG 101 0.45-0.47	SG 101 0.47-0.50	SG 103 0.37-0.40	SG 103 0.40-0.43	SG 103 0.43-0.46
Jadammina macrescens	1		1				1	1							
Textularia conica															
Ammonia spp.					3										
Ammonia beccarii	1	2	1					6			1			9	1
Ammonia tepida	1	3		2	1		1		1	1				2	1
Ammonia parkinsoniana	5	1		1	1	1	1	1			3	1			
Anommalinoides sp.													2		
Asterigerinata mamilla	13	3	3		4	1	5	6			1	1	2	5	
Astrononion spp.															
Astrononion gallowayi											1				
Bolivina spp.									1						
Bulimina spp.															
Cassidulina spp.											1			1	1
Cibicides spp.	21	8	8	16	24	2	24	23	1	5	37		10	26	
Cibicides sp. 2	2	1		1	3	1	2				5		1	4	
Cibicides lobatulus	11	2					8	12		6	2		4	8	3
Cibicides cf. pseudoungerianus	12	2	2	7	2		2	11			4		1	8	1
Cibicides refulgens								1			4			6	
Cibicidoides sp.															
Cribrononion gerthi	2									1			1		
Discorbinella bertheloti	1														
Discorbis spp.						1									
Elphidium spp.	3	2	3	1	6	5	3	3		2	5		1	7	4
Elphidium advenum							1	2							
Elphidium complanatum	2	1					2	3			2		1	5	
Elphidium crispum	6	1	1	2			3	11		1	5			2	
Elphidium excavatum s.l.															
Elphidium discoidalis	16	5	3	7	8		3	23		1	8		1	14	
Elphidium gunteri		1		3				1		1					
Elphidium incertum	1														
Elphidium macellum	10		1	7	7	1	2	8		1	10		3	10	
Elphidium oceanencis															
Elphidium pulvereum				1										1	
Elphidium selseyensis															
Elphidium williamsoni								1							
Eponides repandus	1						1				1		1		
Fissurina spp.															
Gavelinopsis praegeri										1					
Glabratella spp.		1			2		2	2			2			1	1
Glabratella brasiliensis		1													
Globocassidulina subglobosa															
Guttulina sp.		1													
Guttulina communis															
Haynesina germanica	8	61	34	37	9	51	35	6	72	48	14	59	45	1	70
Haynesina depressula	10	10	11	26	6	74	10		12	31	7	21	19	7	16
Haynesina sp. (jovens)		16	12	18	7		12		53	31		48	16		29
Lagena spp															
Miliolideos indet.															
Miliolinella spp.					1										
Miliolinella subrotunda															
Triloculina spp.		1			1										
Triloculina carinata											1				
Mississippina concentrica	2	2			3		2	7		1	2		3	6	1
Nonion sp.							1						1	1	
Nonion commune															
Nonionoides sp.															
Neoconorbina terquemi	1													1	
Neoconorbina sp.											1				
Oolina spp.															
Patellina corrugata															
Pateoris hauerinoides															
Planorbulina mediterranensis															
Quinqeloculina spp.	9		2	2	2		8	6			7		4	12	1
Spirillina spp.		2													
Rosalina spp.	3	1									1			1	
Rosalina globularis															
Textularia spp.		1												1	1
Textularia conica	1	1							1					1	
Textularia sagittula															
Trifarina angulosa															
Sp1	2			2			1	3					1	1	
Sp3				8											
Indeterminados	5	3		3		3	7			2	2	4	2	2	2
Nº total de Foram. Bênticos	150	133	82	144	90	140	137	137	141	133	127	134	119	143	132
Nº total de ostracodos	4		3	2	4	1		1			4	1		9	
Nº de espécies S	36	23	11	14	19	7	24	25	6	11	26	4	17	37	17

Anexo 2 (cont.)- Distribuição em % de espécimens foramníferos bênticos por amostra (Sondagens SG)

Espécies (nº) / Prof. (m)	SG 106 0.42-0.45	SG 106 0.45-0.465	SG 106 0.465-0.50	SG 115 0.34-0.37	SG 115 0.37-0.40	SG 115 0.40-0.43	SG 137 0.39-0.42	SG 137 0.42-0.45	SG 137 0.45-0.48	SG 139 0.38-0.41	SG 139 0.41-0.44	SG 139 0.44-0.47	SG 141 0.43-0.46	SG 141 0.46-0.465	SG 141 0.465-0.50
Jadammina macrescens															
Textularia conica															
Ammonia spp.															
Ammonia beccarii		4		3	2		1	3			4				
Ammonia tepida	3	5	3	2	1	7	2	3	5	2	4	5	1	4	7
Ammonia parkinsoniana											1		1	1	1
Anommalinoides sp.															1
Asterigerinata mamilla	2	13	1	2	10	4	4	10	4	2	1		3	11	5
Astrononion spp.				1							1	1			
Astrononion gallowayi					2			1							
Bolivina spp.															
Bulimina spp.						1									
Cassidulina spp.		1				1									
Cibicides spp.	6	36	6	13	27	12	25	29	10	12	24	5	17	22	10
Cibicides sp. 2	1	2	1		1			2			3		4	9	3
Cibicides lobatulus	4	10			20	4	3	14			11		4	11	2
Cibicides cf. pseudoungerianus		6			9	2	1	12		1	6		2	13	
Cibicides refulgens								2					3	10	
Cibicidoides sp.															
Cribrononion gerthi	1				4	2	1				11		1		
Discorbinella bertheloti		2			1										
Discorbis spp.		1			1						4				3
Elphidium spp.	3	15	4	3	3	1	5	3	6	1	8	1	2		2
Elphidium advenum														1	
Elphidium complanatum		2		1	5		2	2				1	1	4	
Elphidium crispum				1	6		1				1			4	
Elphidium excavatum s.l.		1												1	
Elphidium discoidalis		5			8	4	2	12	2			2	2	13	6
Elphidium gunteri				1		5	1			2				1	1
Elphidium incertum															
Elphidium macellum	2	7		2	4	1	3	6		1	10	2	3	8	1
Elphidium oceanencis															
Elphidium pulvereum						3								3	
Elphidium selseyensis					1	2					1				
Elphidium williamsoni					1						1				
Eponides repandus										1		1	1		
Fissurina spp.		1													
Gavelinopsis praegeri											2				
Glabratella spp.		6	3	1	2	1	1	4		2	1		1	3	
Glabratella brasiliensis		1													
Globocassidulina subglobosa															
Guttulina sp.															
Guttulina communis															
Haynesina germanica	39	1	42	41	10	21	32	6	50	32	16	31	10	4	19
Haynesina depressula	30		18	22	4	21	25	9	15	31	11	62	13	5	24
Haynesina sp. (jovens)	33		50	35		22	14		36	31	7	15	11		29
Lagena spp															
Miliolideos indet.						1									
Miliolinella spp.		2			1										
Miliolinella subrotunda															1
Triloculina spp.					1	1					2				
Triloculina carinata															
Mississippina concentrica	2	6	1	1	11	3	3	5	1		6	1	2	9	
Nonion sp.					1										
Nonion commune															2
Nonionoides sp.															
Neoconorbina terquemi		3													
Neoconorbina sp.															
Oolina spp.															
Patellina corrugata												1			
Pateoris hauerinoides															
Planorbulina mediterranensis		1			4	1		1	1		2	4	2		
Quinqeloculina spp.		9	4		17	3	2	7	4	1	6		9	4	1
Spirillina spp.															
Rosalina spp.		2			1	2		3		2		1		2	2
Rosalina globularis															
Textularia spp.					1									1	
Textularia conica															
Textularia sagittula															
Trifarina angulosa												1			2
Sp1	1				1		1	2					1	4	1
Sp3															
Indeterminados		8	1		1	4	2	4	1		1		1	3	
Nº total de Foram. Bênticos	127	150	134	129	161	129	131	140	135	121	145	134	95	151	123
Nº total de ostracodos	2					3		4	2	1	2	1	3	4	
Nº de espécies S	12	36	14	12	37	25	19	29	16	11	26	13	23	28	17

Anexo 2 (cont.)- Distribuição em número de espécimens foramníferos bênticos por amostra (Sondagens SG)

Espécies (nº) / Prof. (m)	SG 31 0.47-0.49	SG 31 0.49-0.52	SG 31 0.52-0.55	SG 33 0.46-0.49	SG 33 0.49-0.53	SG 33 0.53-0.57	SG 35 0.44-0.47	SG 35 0.47-0.55	SG 35 0.55-0.58	SG 37 0.37-0.40	SG 37 0.56-0.59	SG 39 0.59-0.62	SG 41 0.47-0.49	SG 41 0.575-0.60
Jadammina macrescens			2	1	1		1	1		2			5	2
Textularia conica														
Ammonia spp.								3						
Ammonia beccarii		2			4		2					1		
Ammonia tepida	1	1			2	1	8		4	4	10	3	4	
Ammonia parkinsoniana		2						2	2	1		1		
Anommalinoides sp.										1				
Asterigerinata mamilla	4	8	2	3	5	1	7	8	2		4	1	1	3
Astrononion spp.								1						
Astrononion gallowayi		1		1										
Bolivina spp.													1	
Bulimina spp.	1													
Cassidulina spp.														
Cibicides spp.	4	26	8	11	28	3	13	34	4	9	2	2	2	6
Cibicides sp. 2		4		1			2		1					1
Cibicides lobatulus	2	13		1				10	3					
Cibicides cf. pseudoungerianus		5			6			6	1					
Cibicides refulgens		4		4			3	1						
Cibicidoides sp.														
Cribrononion gerthi		2	1		1									
Discorbinella bertheloti									1					
Discorbis spp.														
Elphidium spp.	2		3	2	3		5	7		3		3	2	5
Elphidium advenum														
Elphidium complanatum	1	2	1	1			1	1					1	
Elphidium crispum		3	2				1	2		1				
Elphidium excavatum s.l.														
Elphidium discoidalis	2	5			7	2	2	14		3	1			1
Elphidium gunteri	1		1	1	3		4					3	3	
Elphidium incertum														
Elphidium macellum	2	5		1	14		3	16		2		1		1
Elphidium oceanencis														
Elphidium pulvereum														
Elphidium selseyensis								1						
Elphidium williamsoni														
Eponides repandus		1												
Fissurina spp.							1							
Gavelinopsis praegeri														
Glabratella spp.	1			4	2		4	1						
Glabratella brasiliensis														
Globocassidulina subglobosa														
Guttulina sp.														
Guttulina communis														
Haynesina germanica	25	4	68	46	21	49	36	10	57	41	45	47	62	17
Haynesina depressula	37	7	30	22	33	34	26	11	18	35	46	50	12	15
Haynesina sp. (jovens)	14		103	22	6	53	28	2	54	38	40	38	57	13
Lagena spp														
Miliolideos indet.														
Miliolinella spp.		1												
Miliolinella subrotunda														
Triloculina spp.														
Triloculina carinata														
Mississippina concentrica	3	5	1	1	1	1	2	1						
Nonion sp.														
Nonion commune				1										
Nonionoides sp.														
Neoconorbina terquemi					1									
Neoconorbina sp.														
Oolina spp.		1			1									
Patellina corrugata														
Pateoris hauerinoides														
Planorbulina mediterranensis														
Quinqeloculina spp.	1	8	5		8	2	1	14		1	4			1
Spirillina spp.														
Rosalina spp.	1			1				1			1			
Rosalina globularis														
Textularia spp.														
Textularia conica														
Textularia sagittula														
Trifarina angulosa														
Sp1	3	2		1	2		1	2		1				
Sp3														
Indeterminados		3	2	3		1		5		2	2		1	1
Nº total de Foram. Bênticos	105	115	229	128	149	147	151	154	147	144	155	150	151	66
Nº total de ostracodos	0	1			4			5	1			5	1	
Nº de espécies S	16	30	18	21	22	8	19	26	9	14	9	10	11	10

Anexo 2 (cont.)- Distribuição em número de espécimens de foramníferos bênticos por amostra (Sondagens SG)

Espécies (%) / Prof. (m)	SG 56 0.80-0.83	SG 59 0.30-0.33	SG 59 0.42-0.45	SG 64 0.40-0.44	SG 64 0.44-0.455	SG 64 0.455-0.49	SG 66 0.41-0.44	SG 66 0.44-0.46	SG 66 0.46-0.49	SG 89 0.40-0.43	SG 89 0.43-0.45	SG 89 0.45-0.48	SG 91 0.36-0.39	SG 91 0.39-0.44
Jadammina macrescens		0.9	1.2			0.7							0.7	
Ammonia spp.			1.8		2.1				0.7					
Ammonia beccarii	3.3	1.7			0.7			2.8						
Ammonia tepida	0.8		1.8	2.1	2.1	2.2	1.4				1.2	12.6	1.5	3.7
Ammonia parkinsoniana	1.6							2.1			2.4			3.7
Anommalinoides sp.								0.7						
Asterigerinata mamilla	2.4	0.9		1.4	7.1	2.9	2.2	6.9		1.6	6.5	4.4	2.2	6.8
Astrononion spp.														
Astrononion gallowayi														2.5
Bolivina spp.														
Bulimina spp.					1.4		0.7							
Cassidulina spp.					0.7									
Cibicides spp.	1.6	11.3	7.3	3.5	15.7	7.2	11.5	6.9	1.3	13.0	17.1	3.7	13.3	9.3
Cibicides sp. 2	0.8		1.2		0.7		0.7	2.1		0.8	1.8		2.2	1.9
Cibicides lobatulus	26.8		0.6	3.5	10.7			14.6			8.8		0.7	8.1
Cibicides cf. pseudoungerianus	2.4	0.9		1.4	7.1			8.3		2.4	12.4		3.0	8.1
Cibicides refulgens				0.7								1.5		
Cibicidoides sp.														
Cribrononion gerthi					2.1		0.7							2.5
Discorbinella bertheloti		0.9												0.6
Discorbis spp.							0.7				1.2			
Elphidium spp.	8.9		0.6	0.7	2.9	0.7	2.2	5.6		4.9	0.6	3.7	4.4	4.3
Elphidium advenum														
Elphidium complanatum	3.3		0.6	0.7			1.4	0.7		0.8	1.2		2.2	1.2
Elphidium crispum	4.1	2.6		0.7		0.7		0.7		1.6				3.1
Elphidium excavatum s.l.			0.6											
Elphidium discoidalis	1.6	0.9	1.2	3.5	6.4	0.7	4.3	4.9			5.3			4.3
Elphidium gunteri	1.6		0.6											
Elphidium incertum														
Elphidium macellum	4.9		3.0	0.7	3.6		1.4	4.2	1.3	1.6	10.6			5.6
Elphidium pulvereum									0.7		0.6			0.6
Elphidium selseyensis														
Elphidium williamsoni														0.6
Eponides repandus								0.7				0.7		1.2
Fissurina spp.											0.6			
Gavelinopsis praegeri														
Glabratella spp.	3.3	0.9			1.4	1.4	1.4	1.4			1.8	0.7		0.6
Glabratella brasiliensis								1.4						
Globocassidulina subglobosa											0.6			
Guttulina sp.														
Haynesina germanica	8.1	45.2	27.9	18.4	7.9	36.2	25.9	0.7	54.0	22.0	0.6	24.4	20.7	5.0
Haynesina depressula	8.9	20.9	25.5	39.0	6.4	31.2	32.4	9.7	9.3	29.3	2.4	14.1	25.2	3.7
Haynesina sp. (jovens)	6.5	10.4	20.6	15.6	3.6	11.6	10.1		31.3	17.9		28.9	15.6	
Lagena spp														
Miliolideos indet.														
Miliolinella spp.														
Miliolinella subrotunda					2.9			0.7						1.9
Triloculina spp.								1.4				1.5		0.6
Triloculina carinata														
Mississippina concentrica		1.7	1.2		3.6		0.7	9.0	0.7		2.4	1.5	4.4	2.5
Nonion sp.														
Nonion commune			0.6							0.8				1.2
Nonionoides sp.						0.7								
Neoconorbina terquemi								0.7						
Neoconorbina sp.					0.7				0.7					0.6
Oolina spp.														
Patellina corrugata														
Planorbulina mediterranensis											0.6			0.6
Quinqeloculina spp.	2.4		1.2	0.7	5.7	1.4	0.7	4.2		2.4	10.0		0.7	9.9
Spirillina spp.											0.6			
Rosalina spp.			0.6				0.7	0.7			0.6			0.6
Rosalina globularis														
Textularia spp.						0.7					0.6	1.5		
Textularia conica	0.8							2.1			0.6			0.6
Trifarina angulosa														
Sp1	2.4	0.9		1.4	1.4	0.7	0.7	2.1		0.8	2.4		0.7	1.2
Sp3														
Indeterminados	3.3		1.8	5.7	2.9	0.7		4.9			7.1	0.7	2.2	2.5
% total de Foram. Bênticos	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Nº de espécies S	24	12	18	18	25	13	20	32	8	25	31	14	16	37

Anexo 2 (cont.)- Distribuição em número de espécimens foramníferos bênticos por amostra (Sondagens SG)

Espécies (%) / Prof. (m)	SG 103 0.37-0.40	SG 103 0.40-0.43	SG 103 0.43-0.46	SG 106 0.42-0.45	SG 106 0.45-0.465	SG 106 0.465-0.50	SG 115 0.34-0.37	SG 115 0.37-0.40	SG 115 0.40-0.43	SG 137 0.39-0.42	SG 137 0.42-0.45	SG 137 0.45-0.48	SG 139 0.38-0.41	SG 139 0.41-0.44
Jadammina macrescens														
Ammonia spp.														
Ammonia beccarii		6.3	0.8		2.7		2.3	1.2		0.8	2.1			2.8
Ammonia tepida		1.4	0.8	2.4	3.3	2.2	1.6	0.6	5.4	1.5	2.1	3.7	1.7	2.8
Ammonia parkinsoniana														0.7
Anommalinoides sp.	1.7													
Asterigerinata mamilla	1.7	3.5		1.6	8.7	0.7	1.6	6.2	3.1	3.1	7.1	3.0	1.7	0.7
Astrononion spp.							0.8							0.7
Astrononion gallowayi								1.2			0.7			
Bolivina spp.														
Bulimina spp.									0.8					
Cassidulina spp.		0.7	0.8		0.7				0.8					
Cibicides spp.	8.4	18.2		4.7	24.0	4.5	10.1	16.8	9.3	19.1	20.7	7.4	9.9	16.6
Cibicides sp. 2	0.8	2.8		0.8	1.3	0.7		0.6			1.4			2.1
Cibicides lobatulus	3.4	5.6	2.3	3.1	6.7			12.4	3.1	2.3	10.0			7.6
Cibicides cf. pseudoungerianus	0.8	5.6	0.8		4.0			5.6	1.6	0.8	8.6		0.8	4.1
Cibicides refulgens		4.2									1.4			
Cibicidoides sp.														
Cribrononion gerthi	0.8			0.8				2.5	1.6	0.8				7.6
Discorbinella bertheloti					1.3			0.6						
Discorbis spp.					0.7			0.6						2.8
Elphidium spp.	0.8	4.9	3.0	2.4	10.0	3.0	2.3	1.9	0.8	3.8	2.1	4.4	0.8	5.5
Elphidium advenum														
Elphidium complanatum	0.8	3.5			1.3		0.8	3.1		1.5	1.4			
Elphidium crispum		1.4					0.8	3.7		0.8				0.7
Elphidium excavatum s.l.					0.7									
Elphidium discoidalis	0.8	9.8			3.3			5.0	3.1	1.5	8.6	1.5		
Elphidium gunteri							0.8		3.9	0.8			1.7	
Elphidium incertum														
Elphidium macellum	2.5	7.0		1.6	4.7		1.6	2.5	0.8	2.3	4.3		0.8	6.9
Elphidium pulvereum		0.7							2.3					
Elphidium selseyensis								0.6	1.6					0.7
Elphidium williamsoni								0.6						0.7
Eponides repandus	0.8												0.8	
Fissurina spp.					0.7									
Gavelinopsis praegeri														1.4
Glabratella spp.		0.7	0.8		4.0	2.2	0.8	1.2	0.8	0.8	2.9		1.7	0.7
Glabratella brasiliensis					0.7									
Globocassidulina subglobosa														
Guttulina sp.														
Haynesina germanica	37.8	0.7	53.0	30.7	0.7	31.3	31.8	6.2	16.3	24.4	4.3	37.0	26.4	11.0
Haynesina depressula	16.0	4.9	12.1	23.6		13.4	17.1	2.5	16.3	19.1	6.4	11.1	25.6	7.6
Haynesina sp. (jovens)	13.4		22.0	26.0		37.3	27.1		17.1	10.7		26.7	25.6	4.8
Lagena spp														
Miliolideos indet.									0.8					
Miliolinella spp.					1.3			0.6						
Miliolinella subrotunda														
Triloculina spp.								0.6	0.8					1.4
Triloculina carinata														
Mississippina concentrica	2.5	4.2	0.8	1.6	4.0	0.7	0.8	6.8	2.3	2.3	3.6	0.7		4.1
Nonion sp.	0.8	0.7						0.6						
Nonion commune														
Nonionoides sp.														
Neoconorbina terquemi		0.7			2.0									
Neoconorbina sp.														
Oolina spp.														
Patellina corrugata														
Planorbulina mediterranensis					0.7			2.5	0.8		0.7	0.7		1.4
Quinqeloculina spp.	3.4	8.4	0.8		6.0	3.0		10.6	2.3	1.5	5.0	3.0	0.8	4.1
Spirillina spp.														
Rosalina spp.		0.7			1.3			0.6	1.6		2.1		1.7	
Rosalina globularis														
Textularia spp.		0.7	0.8					0.6						
Textularia conica		0.7												
Trifarina angulosa														
Sp1	0.8	0.7		0.8				0.6		0.8	1.4			
Sp3														
Indeterminados	1.7	1.4	1.5		5.3	0.7		0.6	3.1	1.5	2.9	0.7		0.7
% total de Foram. Bênticos	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Nº de espécies S	17	37	17	12	36	14	12	37	25	19	29	16	11	26

Anexo 2 (cont.)- Distribuição em número de espécimens foramníferos bênticos por amostra (Sondagens SG)

Espécies (%) Prof. (m)	SG 139 0.44-0.47	SG 141 0.43-0.46	SG 141 0.46-0.465	SG 141 0.465-0.50
Jadammina macrescens				
Ammonia spp.				
Ammonia beccarii				
Ammonia tepida	3.7	1.1	2.6	5.7
Ammonia parkinsoniana		1.1	0.7	0.8
Anommalinoides sp.				0.8
Asterigerinata mamilla		3.2	7.3	4.1
Astrononion spp.	0.7			
Astrononion gallowayi				
Bolivina spp.				
Bulimina spp.				
Cassidulina spp.				
Cibicides spp.	3.7	17.9	14.6	8.1
Cibicides sp. 2		4.2	6.0	2.4
Cibicides lobatulus		4.2	7.3	1.6
Cibicides cf. pseudoungerianus		2.1	8.6	
Cibicides refulgens		3.2	6.6	
Cibicidoides sp.				
Cribrononion gerthi		1.1		
Discorbinella bertheloti				
Discorbis spp.				2.4
Elphidium spp.	0.7	2.1		1.6
Elphidium advenum			0.7	
Elphidium complanatum	0.7	1.1	2.6	
Elphidium crispum			2.6	
Elphidium excavatum s.l.			0.7	
Elphidium discoidalis	1.5	2.1	8.6	4.9
Elphidium gunteri			0.7	0.8
Elphidium incertum				
Elphidium macellum	1.5	3.2	5.3	0.8
Elphidium pulvereum			2.0	
Elphidium selseyensis				
Elphidium williamsoni				
Eponides repandus	0.7	1.1		
Fissurina spp.				
Gavelinopsis praegeri				
Glabratella spp.		1.1	2.0	
Glabratella brasiliensis				
Globocassidulina subglobosa				
Guttulina sp.				
Haynesina germanica	23.1	10.5	2.6	15.4
Haynesina depressula	46.3	13.7	3.3	19.5
Haynesina sp. (jovens)	11.2	11.6		23.6
Lagena spp				
Miliolideos indet.				
Miliolinella spp.				
Miliolinella subrotunda				0.8
Triloculina spp.				
Triloculina carinata				
Mississippina concentrica	0.7	2.1	6.0	
Nonion sp.				
Nonion commune				1.6
Nonionoides sp.				
Neoconorbina terquemi				
Neoconorbina sp.				
Oolina spp.				
Patellina corrugata	0.7			
Planorbulina mediterranensis	3.0	2.1		
Quinqeloculina spp.		9.5	2.6	0.8
Spirillina spp.				
Rosalina spp.	0.7		1.3	1.6
Rosalina globularis				
Textularia spp.			0.7	
Textularia conica				
Trifarina angulosa	0.7			1.6
Sp1		1.1	2.6	0.8
Sp3				
Indeterminados		1.1	2.0	
% total de Foram. Bênticos	100	100	100	100
Nº de espécies S	13	23	28	17

Anexo 3 - Associações de foraminíferos bénticos presentes nas sondagens SG (Lagoa dos Salgados); nº de espécies **S**

REFERÊNCIA	**SAPAL**	SUBTIDAL- INTERTIDAL INF. (**Salobro**)	**MARINHO**	**S**
SG31 0,47- 0,49		74.3	25.7	16
SG31 0,49-0,52		10.4	85.2	30
SG31 0,52-0,55	0.9	88.2	10.0	18
SG 33 0.46-0.49	0.8	71.1	25.8	21
SG 33 0.49-0.53	0.7	43.6	55.7	22
SG 33 0.53-0.57		93.2	6.1	8
SG 35 0.44-0.47	0.7	67.5	31.8	19
SG 35 0.47-0.55	0.6	15.6	77.3	26
SG 35 0.55-0.58		90.5	8.2	9
SG 37 0.37-0.40	1.4	81.9	14.6	14
SG 37 0.56-0.59		91.0	7.7	9
SG 39 0.59-0.62		94.0	5.3	10
SG 41 0.47-0.49	3.3	91.4	4.6	11
SG 41 0.575-0.60	3.0	68.2	27.3	10
SG 56 0.80-0.83		26.0	69.1	24
SG 59 0.30-0.33	0.9	76.5	22.6	12
SG 59 0.42-0.45	1.2	77.0	18.2	18
SG 64 0.40-0.44		75.2	19.1	18
SG 64 0.44-0.455		20.0	75.0	25
SG 64 0.455-0.49	0.7	81.2	17.4	13
SG 66 0.41-0.44		69.8	30.2	20
SG 66 0.44-0.46		10.4	82.6	32
SG 66 0.46-0.49		94.7	4.7	8
SG 89 0.40-0.43		69.1	30.9	25
SG 89 0.43-0.45		4.1	86.5	31
SG 89 0.45-0.48		80.0	19.3	14
SG 91 0.36-0.39	0.7	63.0	34.1	16
SG 91 0.39-0.44		13.0	80.7	37
SG 91 0.44-0.47		96.2	3.8	8
SG 93 0.38-0.415	0.8	57.3	37.9	22
SG 93 0.415-0.445	0.7	12.7	80.0	36
SG 93 0.445-0.48		68.4	28.6	23
SG 95 0.13-0.15	1.2	69.5	29.3	11
SG 95 0.40-0.43		59.7	37.5	14
SG 95 0.43-0.44		25.6	70.0	19
SG 95 0.44-0.47		89.3	7.9	7
SG 99 0.41-0.44	0.7	42.3	51.1	24
SG 99 0.44-0.48	0.7	5.8	92.7	25
SG 99 0.48-0.50		97.9	2.1	6
SG 101 0.42-0.45		84.2	14.3	11
SG 101 0.45-0.47		16.5	79.5	26
SG 101 0.47-0.50		95.5	0.7	4
SG 103 0.37-0.40		67.2	31.1	17
SG 103 0.40-0.43		7.0	91.6	37
SG 103 0.43-0.46		87.9	10.6	17
SG 106 0.42-0.45		82.7	17.3	12
SG 106 0.45-0.465		4.7	90.0	36
SG 106 0.465-0.50		84.3	14.9	14
SG 115 0.34-0.37		78.3	21.7	12
SG 115 0.37-0.40		10.6	88.8	37
SG 115 0.40-0.43		60.5	36.4	25
SG 137 0.39-0.42		56.5	42.0	19
SG 137 0.42-0.45		12.9	84.3	29
SG 137 0.45-0.48		78.5	20.7	16
SG 139 0.38-0.41		81.0	19.0	11
SG 139 0.41-0.44		27.6	71.0	26
SG 139 0.44-0.47		84.3	15.7	13
SG 141 0.43-0.46		36.8	61.1	23
SG 141 0.46-0.465		9.9	87.4	28
SG 141 0.465-0.50		65.0	34.1	17

Anexo 4 – Número de foraminíferos por grama de sedimento seco total (Alcantarilha e Lagoa dos Salgados)

ALCANTARILHA		SALGADOS	
REFª	Foram/g de sed. seco total	REFª	Foram/g de sed. seco total
ALC A 19/06/08	4.4	SG 31 0.47-0.49	17.50
ALC B BASE DUNA 19/06/08	1.3	SG 31 0.49-0.52	71.50
ALC C MEIO DUNA INTERNA 19/06/08	3.3	SG 31 0.52-0.55	23.00
ALC D TOPO DUNA INTERNA 19/06/08	2.6		
ALC E 19/06/08	3.1	SG 33 0.46-0.49	23.34
ALC F 19/06/08	0.9	SG 33 0.49-0.53	7.77
ALC G 19/06/08	1.3	SG 33 0.53-0.57	59.20
ALC H 19/06/08	2.7		
ALC I 19/06/08	1.4	SG 35 0.44-0.47	23.46
ALC J 19/06/08	2.0	SG 35 0.47-0.55	7.16
ALC M 19/06/08	3.4	SG 35 0.55-0.58	34.53
ALC O Face Praia 19/06/08	0.4		
ALC N BERMA 19/06/08	7.6	SG 37 0.37-0.40	32.71
ALC K 19/06/08	2.9	SG 37 0.56-0.59	76.57
ALC Canal Bordo Sapal 19/06/08	108.1		
ALC Fundo de canal S 19/06/08	122.7	SG 39 0.59-0.62	22.98
RIBª ALC 1 Sup (cascalheira) 1 19/06/08			
RIBª ALC 2 19/06/08		SG 41 0.47-0.49	135.47
ALC TALUDE 3 FOTOS 19/06/08		SG 41 0.575-0.60	9.12
ALC 3 0,00-0,10 19/06/08	3.0	SG 56 0.80-0.83	41.80
ALC 3 0,10-0,20 19/06/08	3.3		
ALC 3 0,20-0,30 19/06/08	25.0	SG 59 0.30-0.33	23.16
ALC 3 0,30-0,40 19/06/08	6.0	SG 59 0.42-0.45	26.63
ALC 3 0,40-0,50 19/06/08	3.0		
ALC 3 0,40-0,50 17/06/08	4.1	SG 64 0.40-0.44	68.00
ALC 3 0,50-0,60 19/06/08	5.1	SG 64 0.44-0.455	86.57
ALC 3 0,60-0,70 19/06/08	1.7	SG 64 0.455-0.49	18.90
ALC 3 0,65-0,75 17/06/08	0.7		
ALC 3 0,70-0,80 19/06/08	3.6	SG 66 0.41-0.44	35.62
ALC 3 0,80-0,90 19/06/08	2.1	SG 66 0.44-0.46	85.50
ALC 3 0,90-1,00 19/06/08	3.3	SG 66 0.46-0.49	59.91
ALC 3 1,00-1,10 19/06/08	0		
ALC 3 1,00-1,10 Prof. 1,05m (Coimbra) 19/06/08	0.1	SG 89 0.40-0.43	18.74
ALC 3 1,10-1,20 19/06/08	0.1	SG 89 0.43-0.45	115.04
ALC 3 1,20-1,30 19/06/08	0	SG 89 0.45-0.48	44.56
ALC 3 1,30-1,40 19/06/09	0		
ALC 3 1,40-1,50 19/06/10	0	SG 91 0.36-0.39	45.76
ALC 3 1,50-1,60 19/06/11	0	SG 91 0.39-0.44	100.47
ALC 3 1,60-1,70 19/06/12	0.1	SG 91 0.44-0.47	275.81
ALC 3 1,70-1,74 19/06/13	0		
ALC 3 1,74-1,80 19/06/08	0	SG 93 0.38-0.415	46.54
ALC 3 1,80-1,90 19/06/08	0.7	SG 93 0.415-0.445	61.43
		SG 93 0.445-0.48	30.89
ALC 4 0,00-0,40 17/06/08	3.1		
ALC 4 0,40-0,60 17/06/08	5.4	SG 95 0.13-0.15	22.97
ALC 4 0,60-0,80 17/06/08	3.5	SG 95 0.40-0.43	53.97
ALC 4 0,80-1,50 17/06/08	0.6	SG 95 0.43-0.44	420.00
ALC 4 2,00-2,26 17/06/08	4.1		
		SG 99 0.41-0.44	44.39
ALC 6 0,32-0,45 19/06/08	4.3	SG 99 0.44-0.48	52.52
		SG 99 0.48-0.50	302.94
ALC 17 0,33-0,75 18/06/08	4.8		
		SG 101 0.42-0.45	42.08
ALC 18 0,00-0,04 18/06/08	0.3	SG 101 0.45-0.47	42.75
ALC 18 0,04-0,14 18/06/08	6.1	SG 101 0.47-0.50	96.09
ALC 18 0,14-0,35 18/06/08	7.3		
ALC 18 0,35-0,44 18/06/08		SG 103 0.37-0.40	54.34
ALC 18 0,44-0,48 18/06/08	6.2	SG 103 0.40-0.43	64.28
ALC 18 0,46-0,50 18/06/08	0.2	SG 103 0.43-0.46	138.04
ALC 18 1,04-1,14 18/06/08	0.4		
ALC 18 1,14-1,26 18/06/08	11.5	SG 106 0.42-0.45	62.91
ALC 18 1,26-1,41 18/06/08		SG 106 0.45-0.465	44.78
ALC 18 1,41-1,50 18/06/08	349.1	SG 106 0.465-0.50	134.15
ALC 18 1,50-1,57 18/06/08	251.2		
ALC 18 1,57-1,62 18/06/08	244.2	SG 115 0.34-0.37	60.69
ALC 18 1,62-1,88 18/06/08	236.9	SG 115 0.37-0.40	180.88
ALC 18 1,88-2,23 18/06/08	275.4	SG 115 0.40-0.43	96.88
ALC 18 2,23-2,44 18/06/08	9.5		
		SG 137 0.39-0.42	95.06
		SG 137 0.42-0.45	88.40
		SG 137 0.45-0.48	512.50
		SG 139 0.38-0.41	74.48
		SG 139 0.41-0.44	117.12
		SG 139 0.44-0.47	291.43
		SG 141 0.43-0.46	140.77
		SG 141 0.46-0.465	72.51
		SG 141 0.465-0.50	49.91

Anexo 5 – Distribuição em % de espécimens foramníferos bênticos por amostra (Superficiais Sondagens ALC Alcantarilha)

Espécies (%) Ref./Prof. (m)	ALC A	ALC B BASE DUNA	ALC C MEIO DUNA INTERNA	ALC D TOPO DUNA INTERNA	ALC E	ALC F	ALC G	ALC H	ALC I	ALC J	ALC M	ALC O FACE PRAIA	ALC N BERMA	ALC K
Arenoparrella mexicana														
Jadammina macrescens														
Trochammina inflata														
Ammonia spp.														
Ammonia beccarii														
Ammonia tepida														
Ammonia parkinsoniana														
Anommalinoides sp.														
Asterigerinata mamilla														
Astrononion spp.														
Astrononion gallowayi														
Bolivina spp.														
Bulimina spp.														
Cassidulina spp.														
Cibicides spp.														
Cibicides Sp2														
Cibicides lobatulus														
Cibicides cf. pseudoungerianus														
Cibicides refulgens														
Cibicidoides sp.														
Cribrononion gerthi														
Discorbinella bertheloti														
Discorbis spp.														
Elphidium spp.														
Elphidium advenum														
Elphidium complanatum														
Elphidium crispum														
Elphidium excavatum s.l.														
Elphidium discoidalis														
Elphidium gunteri														
Elphidium incertum														
Elphidium macellum														
Elphidium oceanencis														
Elphidium pulvereum														
Elphidium simplex														
Elphidium williamsoni														
Eponides repandus														
Fissurina spp.														
Gavelinopsis praegeri														
Glabratella spp.														
Glabratella brasiliensis														
Globocassidulina subglobosa														
Guttulina sp.														
Guttulina communis														
Haynesina germanica														
Haynesina depressula														
Haynesina sp. (jovens)														
Lagena spp														
Miliolideos indet.														
Miliolinella spp.														
Miliolinella subrotunda														
Triloculina spp.														
Triloculina carinata														
Mississippina concentrica														
Nonion sp.														
Nonion commune														
Nonionoides sp.														
Neoconorbina terquemi														
Neoconorbina sp.														
Oolina spp.														
Patellina corrugata														
Pateoris hauerinoides														
Planorbulina mediterranensis														
Quinqeloculina spp.														
Spirillina spp.														
Rosalina spp.														
Rosalina globularis														
Textularia spp.														
Textularia conica														
Textularia sagittula														
Trifarina angulosa														
Sp1														
Sp3														
Indeterminados														
% total de Foram. Bênticos	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nº de espécies S														

Anexo 5 (cont.) – Distribuição em % de espécimens foramníferos bênticos por amostra (Superficiais Sondagens ALC Alcantarilha)

Espécies (%) Ref./Prof. (m)	ALC CANAL BORDO SAPAL	ALC Fundo de canal S	RIB[a] ALC 1 Sup (cascalheira) 1	RIB[a] ALC 2	ALC TALUDE 3	ALC 3 0,00-0,10	ALC 3 0,10-0,20	ALC 3 0,20-0,30	ALC 3 0,30-0,40	ALC 3 0,40-0,50	ALC 3 0,40-0,50 17/06/08	ALC 3 0,50-0,60	ALC 3 0,60-0,70
Arenoparrella mexicana		1.6											
Jadammina macrescens		3.2											
Trochammina inflata		7.3											
Ammonia spp.													
Ammonia beccarii													
Ammonia tepida	13.2	10.5											
Ammonia parkinsoniana													
Anommalinoides sp.													
Asterigerinata mamilla	0.7												
Astrononion spp.	0.7												
Astrononion gallowayi													
Bolivina spp.													
Bulimina spp.													
Cassidulina spp.													
Cibicides spp.		4.0											
Cibicides Sp2													
Cibicides lobatulus													
Cibicides cf. pseudoungerianus													
Cibicides refulgens													
Cibicidoides sp.													
Cribrononion gerthi													
Discorbinella bertheloti													
Discorbis spp.		0.8											
Elphidium spp.													
Elphidium advenum													
Elphidium complanatum		0.8											
Elphidium crispum													
Elphidium excavatum s.l.	2.2												
Elphidium discoidalis													
Elphidium gunteri	0.7												
Elphidium incertum													
Elphidium macellum													
Elphidium oceanencis													
Elphidium pulvereum													
Elphidium simplex													
Elphidium williamsoni													
Eponides repandus													
Fissurina spp.													
Gavelinopsis praegeri													
Glabratella spp.		0.8											
Glabratella brasiliensis													
Globocassidulina subglobosa													
Guttulina sp.													
Guttulina communis													
Haynesina germanica	35.3	21.0											
Haynesina depressula	39.7	41.1											
Haynesina sp. (jovens)	7.4	2.4											
Lagena spp													
Miliolideos indet.													
Miliolinella spp.													
Miliolinella subrotunda		0.8											
Triloculina spp.													
Triloculina carinata													
Mississippina concentrica													
Nonion sp.													
Nonion commune													
Nonionoides sp.													
Neoconorbina terquemi													
Neoconorbina sp.													
Oolina spp.													
Patellina corrugata													
Pateoris hauerinoides													
Planorbulina mediterranensis													
Quinqeloculina spp.		3.2											
Spirillina spp.		0.8											
Rosalina spp.		1.6											
Rosalina globularis													
Textularia spp.													
Textularia conica													
Textularia sagittula													
Trifarina angulosa													
Sp1													
Sp3													
Indeterminados													
% total de Foram. Bênticos	100	100.0											
Nº de espécies S	8	14											

Anexo 5 (cont.) – Distribuição em % de espécimens foramníferos bênticos por amostra (Superficiais Sondagens ALC Alcantarilha)

Espécies (%) Ref./Prof. (m)	ALC 3 0,65-0,75 17/06/08	ALC 3 0,70-0,80	ALC 3 0,80-0,90	ALC 3 0,90-1,00	ALC 3 1,00-1,10	ALC 3 1,05	ALC 3 1,10-1,20	ALC 3 1,20-1,30	ALC 3 1,30-1,40	ALC 3 1,40-1,50	ALC 3 1,50-1,60	ALC 3 1,60-1,70
Arenoparrella mexicana												
Jadammina macrescens												
Trochammina inflata												
Ammonia spp.												
Ammonia beccarii												
Ammonia tepida												
Ammonia parkinsoniana												
Anommalinoides sp.												
Asterigerinata mamilla												
Astrononion spp.												
Astrononion gallowayi												
Bolivina spp.												
Bulimina spp.												
Cassidulina spp.												
Cibicides spp.												
Cibicides Sp2												
Cibicides lobatulus												
Cibicides cf. pseudoungerianus												
Cibicides refulgens												
Cibicidoides sp.												
Cribrononion gerthi												
Discorbinella bertheloti												
Discorbis spp.												
Elphidium spp.												
Elphidium advenum												
Elphidium complanatum												
Elphidium crispum												
Elphidium excavatum s.l.												
Elphidium discoidalis												
Elphidium gunteri												
Elphidium incertum												
Elphidium macellum												
Elphidium oceanencis												
Elphidium pulvereum												
Elphidium simplex												
Elphidium williamsoni												
Eponides repandus												
Fissurina spp.												
Gavelinopsis praegeri												
Glabratella spp.												
Glabratella brasiliensis												
Globocassidulina subglobosa												
Guttulina sp.												
Guttulina communis												
Haynesina germanica												
Haynesina depressula												
Haynesina sp. (jovens)												
Lagena spp												
Miliolideos indet.												
Miliolinella spp.												
Miliolinella subrotunda												
Triloculina spp.												
Triloculina carinata												
Mississippina concentrica												
Nonion sp.												
Nonion commune												
Nonionoides sp.												
Neoconorbina terquemi												
Neoconorbina sp.												
Oolina spp.												
Patellina corrugata												
Pateoris hauerinoides												
Planorbulina mediterranensis												
Quinqeloculina spp.												
Spirillina spp.												
Rosalina spp.												
Rosalina globularis												
Textularia spp.												
Textularia conica												
Textularia sagittula												
Trifarina angulosa												
Sp1												
Sp3												
Indeterminados												
% total de Foram. Bênticos												
Nº de espécies S												

Anexo 5 (cont.) – Distribuição em % de espécimens foramníferos bênticos por amostra (Superficiais Sondagens ALC Alcantarilha)

Espécies (%) Ref./Prof. (m)	ALC 3 1,70-1,74	ALC 3 1,74-1,80	ALC 3 1,80-1,90	ALC 4 0,00-0,40	ALC 4 0,40-0,60	ALC 4 0,60-0,80	ALC 4 0,80-1,50	ALC 4 2,00-2,26	ALC 6 0,32-0,45	ALC 17 0,33-0,75	ALC 18 0,00-0,04	ALC 18 0,04-0,14
Arenoparrella mexicana												
Jadammina macrescens												
Trochammina inflata												
Ammonia spp.												
Ammonia beccarii												
Ammonia tepida												
Ammonia parkinsoniana												
Anommalinoides sp.												
Asterigerinata mamilla												
Astrononion spp.												
Astrononion gallowayi												
Bolivina spp.												
Bulimina spp.												
Cassidulina spp.												
Cibicides spp.												
Cibicides Sp2												
Cibicides lobatulus												
Cibicides cf. pseudoungerianus												
Cibicides refulgens												
Cibicidoides sp.												
Cribrononion gerthi												
Discorbinella bertheloti												
Discorbis spp.												
Elphidium spp.												
Elphidium advenum												
Elphidium complanatum												
Elphidium crispum												
Elphidium excavatum s.l.												
Elphidium discoidalis												
Elphidium gunteri												
Elphidium incertum												
Elphidium macellum												
Elphidium oceanencis												
Elphidium pulvereum												
Elphidium simplex												
Elphidium williamsoni												
Eponides repandus												
Fissurina spp.												
Gavelinopsis praegeri												
Glabratella spp.												
Glabratella brasiliensis												
Globocassidulina subglobosa												
Guttulina sp.												
Guttulina communis												
Haynesina germanica												
Haynesina depressula												
Haynesina sp. (jovens)												
Lagena spp												
Miliolideos indet.												
Miliolinella spp.												
Miliolinella subrotunda												
Triloculina spp.												
Triloculina carinata												
Mississippina concentrica												
Nonion sp.												
Nonion commune												
Nonionoides sp.												
Neoconorbina terquemi												
Neoconorbina sp.												
Oolina spp.												
Patellina corrugata												
Pateoris hauerinoides												
Planorbulina mediterranensis												
Quinqeloculina spp.												
Spirillina spp.												
Rosalina spp.												
Rosalina globularis												
Textularia spp.												
Textularia conica												
Textularia sagittula												
Trifarina angulosa												
Sp1												
Sp3												
Indeterminados												
% total de Foram. Bênticos												
Nº de espécies S												

Anexo 5 (cont.) – Distribuição em % de espécimens foramníferos bênticos por amostra (Superficiais Sondagens ALC Alcantarilha)

Espécies (%) \ Ref./Prof. (m)	ALC 18 0,14-0,35	ALC 18 0,44-0,48	ALC 18 0,46-0,50	ALC 18 1,04-1,14	ALC 18 1,14-1,26	ALC 18 1,41-1,50	ALC 18 1,50-1,57	ALC 18 1,57-1,62	ALC 18 1,62-1,88	ALC 18 1,88-2,23	ALC 18 2,23-2,44
Arenoparrella mexicana											
Jadammina macrescens											
Trochammina inflata											
Ammonia spp.											
Ammonia beccarii								0.8			11.0
Ammonia tepida					20.5	27.0	28.8	23.3	25.2	17.9	
Ammonia parkinsoniana											
Anommalinoides sp.											
Asterigerinata mamilla							3.4	5.3	8.1	6.0	
Astrononion spp.											
Astrononion gallowayi											
Bolivina spp.										0.9	
Bulimina spp.										0.9	
Cassidulina spp.											
Cibicides spp.					0.8	0.7	9.3	9.0	7.3	8.5	19.2
Cibicides Sp2										0.9	1.4
Cibicides lobatulus								3.8		2.6	8.2
Cibicides cf. pseudoungerianus								0.8		1.7	
Cibicides refulgens								1.5	0.8	0.9	
Cibicidoides sp.											
Cribrononion gerthi											
Discorbinella bertheloti											
Discorbis spp.						0.7					
Elphidium spp.					0.8	0.7	5.1	5.3	2.4	2.6	32.9
Elphidium advenum											
Elphidium complanatum					0.8		1.7	0.8		1.7	
Elphidium crispum							1.7		0.8	0.9	6.8
Elphidium excavatum s.l.								0.8		0.9	
Elphidium discoidalis					0.8			0.8	0.8	0.9	4.1
Elphidium gunteri											
Elphidium incertum										3.4	
Elphidium macellum							0.8	0.8	0.8	2.6	6.8
Elphidium oceanencis											
Elphidium pulvereum								0.8			
Elphidium simplex										0.9	
Elphidium williamsoni											
Eponides repandus											1.4
Fissurina spp.											
Gavelinopsis praegeri											
Glabratella spp.											
Glabratella brasiliensis											
Globocassidulina subglobosa											
Guttulina sp.											
Guttulina communis											
Haynesina germanica					63.6	52.5	31.4	27.8	25.2	20.5	
Haynesina depressula					9.1	10.6	16.1	14.3	23.6	19.7	
Haynesina sp. (jovens)					3.0	5.7		3.0			
Lagena spp											
Miliolideos indet.											
Miliolinella spp.											
Miliolinella subrotunda											
Triloculina spp.											
Triloculina carinata											
Mississippina concentrica									2.4	2.6	
Nonion sp.						0.7					
Nonion commune											
Nonionoides sp.											
Neoconorbina terquemi											
Neoconorbina sp.											
Oolina spp.											
Patellina corrugata											
Pateoris hauerinoides											
Planorbulina mediterranensis											
Quinqeloculina spp.											4.1
Spirillina spp.											
Rosalina spp.										0.9	
Rosalina globularis											
Textularia spp.						0.7			0.8		
Textularia conica											
Textularia sagittula											
Trifarina angulosa											
Sp1							1.7		0.8		
Sp3											
Indeterminados					0.8	0.7		1.5	0.8	2.6	4.1
% total de Foram. Bênticos					100	100	100		100	100	100
Nº de espécies S					7	8	13	16	13	25	14

Anexo 5 (cont.) – Distribuição em nº de espécimens foramníferos bênticos por amostra (Superficiais Sondagens ALC Alcantarilha)

Espécies (nº) Ref./Prof. (m)	ALC A	ALC B BASE DUNA	ALC C MEIO DUNA INTERNA	ALC D TOPO DUNA INTERNA	ALC E	ALC F	ALC G	ALC H	ALC I	ALC J	ALC M	ALC O FACE PRAIA	ALC N BERMA	ALC K
Arenoparrella mexicana														
Jadammina macrescens														
Trochammina inflata														
Ammonia spp.														
Ammonia beccarii	4	3	3	2				2			1		5	3
Ammonia tepida														
Ammonia parkinsoniana														
Anommalinoides sp.														
Asterigerinata mamilla														
Astrononion spp.														
Astrononion gallowayi														
Bolivina spp.														
Bulimina spp.														
Cassidulina spp.													1	
Cibicides spp.	4	4	5	3	5	1	3	2	4	3	2	1	4	1
Cibicides Sp2						1	1						1	
Cibicides lobatulus														
Cibicides cf. pseudoungerianus														
Cibicides refulgens														
Cibicidoides sp.														
Cribrononion gerthi														
Discorbinella bertheloti														
Discorbis spp.														
Elphidium spp.	10	7	11	7	8	2	3	8	2	7	12	4	12	9
Elphidium advenum														
Elphidium complanatum										1			1	
Elphidium crispum					3								2	
Elphidium excavatum s.l.														
Elphidium discoidalis					1								6	
Elphidium gunteri														
Elphidium incertum														
Elphidium macellum					1			1			1			
Elphidium oceanencis														
Elphidium pulvereum														
Elphidium simplex														
Elphidium williamsoni														
Eponides repandus														1
Fissurina spp.														
Gavelinopsis praegeri														
Glabratella spp.														1
Glabratella brasiliensis														
Globocassidulina subglobosa														
Guttulina sp.														
Guttulina communis														
Haynesina germanica														
Haynesina depressula														
Haynesina sp. (jovens)														
Lagena spp														
Miliolideos indet.														
Miliolinella spp.														
Miliolinella subrotunda														
Triloculina spp.														
Triloculina carinata														
Mississippina concentrica														
Nonion sp.														
Nonion commune														
Nonionoides sp.														
Neoconorbina terquemi														
Neoconorbina sp.														
Oolina spp.														
Patellina corrugata														
Pateoris hauerinoides														
Planorbulina mediterranensis														
Quinqeloculina spp.	1		1		1									
Spirillina spp.														
Rosalina spp.														
Rosalina globularis														
Textularia spp.														
Textularia conica														
Textularia sagittula														
Trifarina angulosa														
Sp1					1								2	
Sp3														
Indeterminados		1		2	1		2	2	1		5	1	2	2
Nº total de Foram. Bênticos	19	15	20	14	21	4	9	15	7	11	21	6	36	17
Nº total de ostracodos														
Nº de espécies S														

Anexo 5 (cont.) – Distribuição em nº de espécimens foramníferos bênticos por amostra (Superficiais Sondagens ALC Alcantarilha)

Espécies (nº) / Ref./Prof. (m)	ALC CANAL BORDO SAPAL	ALC Fundo de canal S	RIBª ALC 1 Sup (cascalheira) 1	RIBª ALC 2	ALC TALUDE 3	ALC 3 0,00-0,10	ALC 3 0,10-0,20	ALC 3 0,20-0,30	ALC 3 0,30-0,40	ALC 3 0,40-0,50	ALC 3 0,40-0,50 17/06/08	ALC 3 0,50-0,60
Arenoparrella mexicana		2										
Jadammina macrescens		4										
Trochammina inflata		9										
Ammonia spp.												
Ammonia beccarii						6	1	6			4	3
Ammonia tepida	18	13										
Ammonia parkinsoniana												
Anommalinoides sp.												
Asterigerinata mamilla	1											
Astrononion spp.	1											
Astrononion gallowayi												
Bolivina spp.												
Bulimina spp.												
Cassidulina spp.												
Cibicides spp.		5				8	6	13	13	3	4	1
Cibicides Sp2						1						
Cibicides lobatulus									1			
Cibicides cf. pseudoungerianus												
Cibicides refulgens												
Cibicidoides sp.												
Cribrononion gerthi												
Discorbinella bertheloti												
Discorbis spp.		1										
Elphidium spp.						16	8	24	23	9	12	16
Elphidium advenum												
Elphidium complanatum		1										2
Elphidium crispum								1		2		
Elphidium excavatum s.l.	3											
Elphidium discoidalis								1				
Elphidium gunteri	1											
Elphidium incertum												
Elphidium macellum						3	1	4	2		4	2
Elphidium oceanencis												
Elphidium pulvereum												
Elphidium simplex												
Elphidium williamsoni												
Eponides repandus											1	
Fissurina spp.												
Gavelinopsis praegeri												
Glabratella spp.		1				1						
Glabratella brasiliensis												
Globocassidulina subglobosa												
Guttulina sp.												
Guttulina communis												
Haynesina germanica	48	26										
Haynesina depressula	54	51										
Haynesina sp. (jovens)	10	3										
Lagena spp												
Miliolideos indet.												
Miliolinella spp.												
Miliolinella subrotunda		1										
Triloculina spp.												
Triloculina carinata												
Mississippina concentrica												
Nonion sp.												
Nonion commune												
Nonionoides sp.												
Neoconorbina terquemi												
Neoconorbina sp.												
Oolina spp.												
Patellina corrugata												
Pateoris hauerinoides												
Planorbulina mediterranensis												
Quinqeloculina spp.		4					1		1			
Spirillina spp.		1										
Rosalina spp.		2										
Rosalina globularis												
Textularia spp.												
Textularia conica												
Textularia sagittula												
Trifarina angulosa												
Sp1						2			1			
Sp3												
Indeterminados						3	4	8	5	3	3	6
Nº total de Foram. Bênticos	136	124	0	0	0	40	21	57	46	17	28	30
Nº total de ostracodos												
Nº de espécies S	8	14										

Anexo 5 (cont.) – Distribuição em nº de espécimens foramníferos bênticos por amostra (Superficiais Sondagens ALC Alcantarilha)

Espécies (nº) \ Ref./Prof. (m)	ALC 3 0,60-0,70	ALC 3 0,65-0,75 17/06/08	ALC 3 0,70-0,80	ALC 3 0,80-0,90	ALC 3 0,90-1,00	ALC 3 1,00-1,10	ALC 3 1,05	ALC 3 1,10-1,20	ALC 3 1,20-1,30	ALC 3 1,30-1,40	ALC 3 1,40-1,50	ALC 3 1,50-1,60
Arenoparrella mexicana												
Jadammina macrescens												
Trochammina inflata												
Ammonia spp.												
Ammonia beccarii	2	3			3		1					
Ammonia tepida												
Ammonia parkinsoniana												
Anommalinoides sp.												
Asterigerinata mamilla												
Astrononion spp.												
Astrononion gallowayi												
Bolivina spp.												
Bulimina spp.												
Cassidulina spp.												
Cibicides spp.	1		2	1	3		1	1				
Cibicides Sp2												
Cibicides lobatulus												
Cibicides cf. pseudoungerianus												
Cibicides refulgens												
Cibicidoides sp.												
Cribrononion gerthi												
Discorbinella bertheloti												
Discorbis spp.												
Elphidium spp.	8	3	9	13	10		6	2				
Elphidium advenum												
Elphidium complanatum												
Elphidium crispum	3	2			1			1				
Elphidium excavatum s.l.												
Elphidium discoidalis							1					
Elphidium gunteri												
Elphidium incertum												
Elphidium macellum	1	1		1	1							
Elphidium oceanencis												
Elphidium pulvereum												
Elphidium simplex												
Elphidium williamsoni												
Eponides repandus												
Fissurina spp.												
Gavelinopsis praegeri												
Glabratella spp.												
Glabratella brasiliensis												
Globocassidulina subglobosa												
Guttulina sp.												
Guttulina communis												
Haynesina germanica												
Haynesina depressula												
Haynesina sp. (jovens)												
Lagena spp												
Miliolideos indet.												
Miliolinella spp.												
Miliolinella subrotunda												
Triloculina spp.												
Triloculina carinata												
Mississippina concentrica												
Nonion sp.												
Nonion commune												
Nonionoides sp.												
Neoconorbina terquemi												
Neoconorbina sp.												
Oolina spp.												
Patellina corrugata												
Pateoris hauerinoides												
Planorbulina mediterranensis												
Quinqeloculina spp.	1											
Spirillina spp.												
Rosalina spp.												
Rosalina globularis												
Textularia spp.												
Textularia conica												
Textularia sagittula												
Trifarina angulosa												
Sp1			1	1								
Sp3												
Indeterminados	2	1	7	3	3		2					
Nº total de Foram. Bênticos	18	10	19	19	21	0	11	4	0	0	0	0
Nº total de ostracodos												
Nº de espécies S												

Anexo 5 (cont.) – Distribuição em nº de espécimens foramníferos bênticos por amostra (Superficiais Sondagens ALC Alcantarilha)

Espécies (nº) / Ref./Prof. (m)	ALC 3 1,60-1,70	ALC 3 1,70-1,74	ALC 3 1,74-1,80	ALC 3 1,80-1,90	ALC 4 0,00-0,40	ALC 4 0,40-0,60	ALC 4 0,60-0,80	ALC 4 0,80-1,50	ALC 4 2,00-2,26	ALC 6 0,32-0,45	ALC 17 0,33-0,75	ALC 18 0,00-0,04
Arenoparrella mexicana												
Jadammina macrescens												3
Trochammina inflata												
Ammonia spp.												
Ammonia beccarii						3		1		3		1
Ammonia tepida							1			1		
Ammonia parkinsoniana												
Anommalinoides sp.												
Asterigerinata mamilla												
Astrononion spp.												
Astrononion gallowayi												
Bolivina spp.												
Bulimina spp.												
Cassidulina spp.												
Cibicides spp.				2	1	6	2	1		8	3	
Cibicides Sp2							1		1	2		
Cibicides lobatulus												
Cibicides cf. pseudoungerianus												
Cibicides refulgens												
Cibicidoides sp.												
Cribrononion gerthi												
Discorbinella bertheloti												
Discorbis spp.												
Elphidium spp.				5	1	11	8	1	16	3	11	
Elphidium advenum												
Elphidium complanatum												
Elphidium crispum					2		1		2		5	
Elphidium excavatum s.l.												
Elphidium discoidalis										1		
Elphidium gunteri												
Elphidium incertum												
Elphidium macellum					1		1		4	1	1	
Elphidium oceanencis												
Elphidium pulvereum												
Elphidium simplex												
Elphidium williamsoni												
Eponides repandus												
Fissurina spp.												
Gavelinopsis praegeri												
Glabratella spp.												
Glabratella brasiliensis												
Globocassidulina subglobosa												
Guttulina sp.												
Guttulina communis												
Haynesina germanica												
Haynesina depressula												
Haynesina sp. (jovens)												
Lagena spp												
Miliolideos indet.												
Miliolinella spp.												
Miliolinella subrotunda												
Triloculina spp.												
Triloculina carinata												
Mississippina concentrica										1		
Nonion sp.											1	
Nonion commune												
Nonionoides sp.												
Neoconorbina terquemi												
Neoconorbina sp.												
Oolina spp.												
Patellina corrugata												
Pateoris hauerinoides												
Planorbulina mediterranensis												
Quinqeloculina spp.				1						1		
Spirillina spp.												
Rosalina spp.												
Rosalina globularis												
Textularia spp.												
Textularia conica												
Textularia sagittula												
Trifarina angulosa												
Sp1												
Sp3												
Indeterminados	1				3	1	1		1	1	3	
Nº total de Foram. Bênticos	1	0	0	8	8	21	15	3	24	22	24	4
Nº total de ostracodos												
Nº de espécies S												

Anexo 5 (cont.) – Distribuição em nº de espécimens foramníferos bênticos por amostra (Superficiais Sondagens ALC Alcantarilha)

Espécies (nº) \ Ref./Prof. (m)	ALC 18 0,04-0,14	ALC 18 0,14-0,35	ALC 18 0,44-0,48	ALC 18 0,46-0,50	ALC 18 1,04-1,14	ALC 18 1,14-1,26	ALC 18 1,41-1,50	ALC 18 1,50-1,57	ALC 18 1,57-1,62	ALC 18 1,62-1,88	ALC 18 1,88-2,23	ALC 18 2,23-2,44
Arenoparrella mexicana												
Jadammina macrescens												
Trochammina inflata												
Ammonia spp.												
Ammonia beccarii	2	3							1			8
Ammonia tepida				3	4	27	38	34	31	31	21	
Ammonia parkinsoniana												
Anommalinoides sp.												
Asterigerinata mamilla								4	7	10	7	
Astrononion spp.												
Astrononion gallowayi												
Bolivina spp.											1	
Bulimina spp.											1	
Cassidulina spp.												
Cibicides spp.	1	6	5			1	1	11	12	9	10	14
Cibicides Sp2											1	1
Cibicides lobatulus					3				5		3	6
Cibicides cf. pseudoungerianus									1		2	
Cibicides refulgens									2	1	1	
Cibicidoides sp.												
Cribrononion gerthi												
Discorbinella bertheloti												
Discorbis spp.							1					
Elphidium spp.	10	7	2	1	2	1	1	6	7	3	3	24
Elphidium advenum												
Elphidium complanatum						1		2	1		2	
Elphidium crispum	1	2						2		1	1	5
Elphidium excavatum s.l.									1		1	
Elphidium discoidalis						1			1	1	1	3
Elphidium gunteri												
Elphidium incertum											4	
Elphidium macellum	1	1						1	1	1	3	5
Elphidium oceanencis												
Elphidium pulvereum									1			
Elphidium simplex											1	
Elphidium williamsoni												
Eponides repandus												1
Fissurina spp.												
Gavelinopsis praegeri												
Glabratella spp.												
Glabratella brasiliensis												
Globocassidulina subglobosa												
Guttulina sp.												
Guttulina communis												
Haynesina germanica				1	11	84	74	37	37	31	24	
Haynesina depressula				1		12	15	19	19	29	23	
Haynesina sp. (jovens)						4	8		4			
Lagena spp												
Miliolideos indet.												
Miliolinella spp.												
Miliolinella subrotunda												
Triloculina spp.												
Triloculina carinata												
Mississippina concentrica										3	3	
Nonion sp.		1					1					
Nonion commune												
Nonionoides sp.												
Neoconorbina terquemi												
Neoconorbina sp.												
Oolina spp.												
Patellina corrugata												
Pateoris hauerinoides												
Planorbulina mediterranensis												
Quinqeloculina spp.			2									3
Spirillina spp.												
Rosalina spp.											1	
Rosalina globularis												
Textularia spp.	1						1			1		
Textularia conica												
Textularia sagittula												
Trifarina angulosa												
Sp1								2		1		
Sp3												
Indeterminados			2		2	1	1		2	1	3	3
Nº total de Foram. Bênticos	16	20	11	6	22	132	141	118	133	123	117	73
Nº total de ostracodos												
Nº de espécies S						7	8	13	16	13	25	14

REFERÊNCIA	**SAPAL**	SUBTIDAL- INTERTIDAL INF. (**Salobro**)	**MARINHO**	**S**
ALC CANAL BORDO SAPAL	0	98.5	1.5	8
ALC Fundo de canal **S**	12.1	75.0	12.9	14
ALC 18 0,00-0,04				
ALC 18 0,04-0,14				
ALC 18 0,14-0,35				
ALC 18 0,44-0,48				
ALC 18 0,46-0,50				
ALC 18 1,04-1,14				
ALC 18 1,14-1,26	0	96.2	3.0	7
ALC 18 1,41-1,50	0	95.7	3.5	8
ALC 18 1,50-1,57	0	76.3	23.7	13
ALC 18 1,57-1,62	0	69.2	29.3	16
ALC 18 1,62-1,88	0	74.0	25.2	13
ALC 18 1,88-2,23	0	59.0	38.5	25
ALC 18 2,23-2,44	0	0.0	95.9	14

PART II

Estudo dos Foraminíferos Bênticos das Sondagens Médias e Longas SG e ALC (Salgados e Alcantarilha)

João Carlos Jorge Moreno

2009

INDICE

RELATÓRIO

O presente relatório descreve o trabalho executado por **João Carlos Jorge Moreno**, no âmbito do projecto de investigação NEAREST, no que se refere ao período Setembro 2008 a Fevereiro de 2009. **O estudo dos foraminíferos bênticos em sondagens da lagoa dos Salgados e da lagoa de Alcantarilha,** a que se reporta este relatório, integra-se na caracterização de evidências geológicas de inundação por tsunami de segmentos litorais no Algarve e numa aproximação *multiproxi* das assinaturas deposicionais associadas a tsunamis em sequências sedimentares costeiras, com vista ao estabelecimento de intervalos de recorrência.

1. INTRODUÇÃO

Os microfósseis têm sido comummente utilizados como meio de investigação no reconhecimento e caracterização de sedimentos gerados por paleotsunamis, quer globalmente quer na costa portuguesa (Hindson *et al*., 1996; Hindson *et al*., 1999; Kortekaas & Dawson, 2007).

Os registos paleontológicos são reveladores não só da elevada energia associada ao evento (ex.: presença de raízes, fragmentos de plantas, conchas partidas, etc.), mas também de condições hidrológicas e geodinâmicas específicas que podem levar a um acréscimo na abundância de fósseis marinhos e salobros. Com efeito, dependendo da hidrodinâmica da linha de costa, da geomorfologia costeira e do comportamento das ondas de tsunami, o registo fóssil vai apresentar características particulares/distintas. As associações dependem, por exemplo, dos habitats atravessados pelas ondas de tsunami no seu percurso em direcção à costa. Mas proceder a generalizações é sempre difícil, razão pela qual se torna importante contextualizar os foraminíferos encontrados, com os dados conhecidos dos habitats marinhos costeiros e da plataforma continental e com o registo micropaleontológico das unidades sedimentares imediatamente inferior e superior.

Os critérios paleontológicos *per si* podem ser inconclusivos na sua diferenciação de outros episódios marinhos, daí a reconhecida necessidade de conjugar vários critérios de interpretação e análise (análise histórica, sondagens e descrição estratigráfica, susceptibilidade magnética, raios-X e fotografia digital, fluorescência de raios-X, perda ao rubro, análise geoquímica, análise granulométrica e métodos de datação – termoluminescência e ^{210}Pb).

2. OBJECTIVOS

Os objectivos gerais da tarefa 4 incluem:

- ✓ Interpretação do conteúdo micropaleontológico (foraminíferos bênticos) de 73 amostras em 17 sondagens médias e longas, para reconstituição paleoambiental de sequências sedimentares costeiras na lagoa dos Salgados (Algarve);
- ✓ Interpretação do conteúdo micropaleontológico (foraminíferos bênticos) de duas amostras da sondagem ALC 18, para reconstituição paleoambiental de sequências sedimentares costeiras na lagoa de Alcantarilha (Algarve).

3. RESULTADOS PRELIMINARES

3.1. Lagoa dos Salgados

3.1.2. Sondagem Longa SG1

Foram estudadas quatro amostras da base desta sondagem, entre as profundidades de 4,41m e 4,08m.

⇒ A **base da sondagem** (4,41m – 4,29m) é constituída por areia fina com grãos angulosos e uma componente bioclástica composta por gastrópodes, fragmentos de lamelibrânquios, espículas de equinodermes e siliciosas, ostracodos, foraminíferos planctónicos e alguns fragmentos de plantas. O número de espécies varia entre 19 e 30 e o número de foraminíferos por grama de sedimento seco entre 68 e 50. O carácter salobro das associações (60% a 86%), com ***H. germanica*** (39% a 51%) como espécie dominante, associada a ***A. tepida*** é, no entanto, marcado pela presença de espécies marinhas costeiras, as quais representam 39% a 13,2% das espécies presentes (Anexo 1, Fig. 1).

⇒ Dos **4,20m** de profundidade aos **4,08m,** a fracção >63µm é formada por areia fina com grãos angulosos e a componente bioclástica é essencialmente constituída por restos de plantas, alguns gastrópodes e espículas siliciosas. Os foraminíferos bênticos ou estão ausentes ou estão presentes em número insuficiente.

3.1.3. Sondagem Longa SG3

Foi estudada uma amostra da base desta sondagem, entre as profundidades de 2,17m e 2,12m.

⇒ A **base da sondagem** (2,17m − 2,12m) é constituída por areia heterogénea (dimensão; rolados, angulosos, subangulosos baços, **litoclastos com foraminíferos**) com uma importante componente bioclástica (gastrópodes, fragmentos de lamelibrânquios, espículas, ostracodos), na qual 95% das espécies são características de ambientes **marinhos costeiros** (Anexo 1, Fig. 1). Observa-se a ocorrência de **formas recristalizadas e retrabalhadas polidas e roladas** (sinais de transporte em ambiente de forte hidrodinamismo) **conjuntamente com outras bem preservadas**. O número de foraminíferos por grama de sedimento seco é baixo (1; Anexo 2). A associação caracteriza-se pela predominância de espécies marinhas (*Cibicides* spp., *Cibicides lobatulus, Cibicides pseudoungerianus, Elphidium* spp., *Elphidium macellum, Elphidium discoidalis, Quinqueloculina spp.* e *Asterigerinata mamilla*), sendo 23 o número de espécies presentes.

3.1.4. Sondagem Longa SG5

Foram estudadas três amostras da base desta sondagem, entre as profundidades de 2,88m e 2,74m.

⇒ Na **base da sondagem** (2,88m − 2,80m), a fracção >63µm é constituída por areia fina com uma componente bioclástica formada por gastrópodes, fragmentos de lamelibrânquios, ostracodos e foraminíferos planctónicos. O número de espécies varia entre 20 e 22 e o número de foraminíferos por grama de sedimento seco entre 131 e 62. Apesar de a associação salobra ser dominante (57% a 59%), com ***H. germanica*** (26% a 28%) como espécie mais abundante, associada a ***A. tepida*** (17,4% a 18%) e ***Haynesina***

depressula (14% a 10%) é, no entanto, marcada pela presença de espécies marinhas costeiras, que representam entre 39% a 41% das espécies presentes (Anexo 1, Fig. 1).

⇒ Dos **2,76m** de profundidade aos **2,74m,** a fracção >63µm é formada por areia muito fina; a componente bioclástica, essencialmente constituida por fragmentos de plantas, é muito rica em ostracodos. O número de espécies baixa para 14 e o número de foraminíferos por grama de sedimento seco para 6. O carácter mais salobro da associação (76%), com ***H. germanica*** (48%) como espécie dominante, associada a ***A. tepida*** (12%) e ***Haynesina depressula*** (8%) é, no entanto, ainda marcado pela presença de espécies marinhas costeiras, representando 24% das espécies presentes (Anexo 1, Fig. 1).

3.1.5. Sondagem Longa SG6

Foram estudadas quatro amostras desta sondagem, entre as profundidades de 2,62m e 1,69m.

⇒ Na **base da sondagem** (2,62m − 2,60m), a fracção >63µm (10% do sedimento total) é formada por uma areia fina; a componente bioclástica é maioritariamente constituída por fragmentos de plantas e ostracodos. O número insuficiente de foraminíferos (apenas 6 espécimens de ***H. germanica*** e 1 espécimen de ***Elphidium* sp**.) não permite o estudo das associações, podendo, no entanto, o sedimento fino e a componente micropaleontológica residual reflectir um ambiente **salobro de fraco hidrodinamismo** com menor influência marinha.

⇒ Dos **2,58m** de profundidade aos **2,43m,** a fracção >63µm (97% do sedimento total) é formada por uma areia granulométrica e mineralogicamente heterogénea com **litoclastos** e bioclastos retrabalhados. O número insuficiente de foraminíferos não permite o estudo das associações, verificando-se a presença de conchas de espécies marinhas roladas e brilhantes, outras apenas retrabalhadas, sugerindo um **ambiente marinho de forte hidrodinamismo**.

⇒ Dos **2,43m** de profundidade aos **2,00m,** a fracção >63µm (96% do sedimento total) é constituída por uma areia heterogénea com **litoclastos** e uma componente bioclástica formada por gastrópodes, fragmentos de lamelibrânquios, espículas de equinodermes e siliciosas, ostracodos e foraminíferos com diferentes processos de fossilização. O número de espécies é de 24 e o número de foraminíferos por grama de sedimento seco é de 34. O carácter marinho da associação (76%) destaca-se pela predominância de espécies marinhas costeiras (*Cibicides* spp., *Elphidium discoidalis, Elphidium macellum, Elphidium crispum, Elphidium complanatum, Quinqueloculina spp., Mississippina concentrica, Rosalina spp., Asterigerinata mamilla* e *Ammonia beccarii*). A associação sugere um ambiente subtidal **lagunar aberto com forte hidrodinamismo e influência marinha**.

⇒ Dos **2,00m** de profundidade aos **1,69m,** a fracção >63µm (88% do sedimento total) é constituída por uma areia fina com uma componente bioclástica composta por gastrópodes, fragmentos de lamelibrânquios, espículas de equinodermes e siliciosas, ostracodos e foraminíferos planctónicos. Encontram-se presentes alguns foraminíferos retrabalhados e outros com aspectos de dissolução. O número de espécies é de 21 e o número de foraminíferos por grama de sedimento seco é de 413. O carácter marinho da associação (83%) destaca-se pela predominância de espécies marinhas costeiras (*Cibicides* spp., *Elphidium discoidalis, Elphidium macellum, Elphidium crispum, Elphidium complanatum, Elphidium pulvereum, Quinqueloculina spp., Discorbis spp., Mississippina concentrica, Asterigerinata mamilla* e *Ammonia beccarii*). A componente salobra representa 17% da associação e é composta pelas espécies *A. tepida, H. germanica* e *H. depressula*. A associação sugere um ambiente **subtidal lagunar aberto** com forte influência marinha.

3.1.6. Sondagem Longa SG7

Foram estudadas seis amostras desta sondagem, entre as profundidades de 3,18m e 0,42m.

⇒ Na **base da sondagem** (3,18m − 3,15m), a fracção >63µm (22% do sedimento total) é constituída por uma areia fina, com ostracodos, restos de plantas, alguns gastrópodes e fragmentos de lamelibrânquios. O insuficiente número de foraminíferos não permite o estudo das associações, verificando-se a presença de conchas de espécies marinhas e salobras. Ocorrem 2 foraminíferos por grama de sedimento seco total.

⇒ Dos **0,52m** de profundidade aos **0,42m,** estão presentes os três níveis já referenciados nas sondagens curtas:

− O **"nível inferior"** ocorre entre os 0,52m e os 0,48m e caracteriza-se pela predominância de *Haynesina* spp. (formas jovens), *Haynesina germanica* e *Haynesina depressula*; *Ammonia tepida* surge menos expressivamente (Anexo 1, Fig. 1). Este nível inferior, apesar de registar as características de maior salobridade, variando as diferentes associações salobras entre 88% e 96% (anexo), contém algumas espécies marinhas (ex.: *Asterigerinata mamilla*, *Cibicides* spp., *Quinqueloculina spp.*). A ocorrência consistente de *H. depressula* (menos tolerante a variações ambientais do que *H. germanica*), conjuntamente com algumas espécies marinhas (com presença menos significativa) nestas associações, parece indiciar um ambiente **moderadamente salobro subtidal a intertidal inferior**. O número de espécies varia entre 6 e 8 e o número de foraminíferos por grama de sedimento total entre 60 e 64 (Anexo 2).

− O **"nível intermédio"** ocorre entre os 0,48m e os 0,46m e particulariza-se pela predominância de espécies marinhas costeiras (*Cibicides* spp., *Cibicides lobatulus, Elphidium discoidalis, Quinqueloculina spp., Mississippina concentrica* e *Asterigerinata mamilla*). A **tendência marinha** deste nível está bem expressa na percentagem da associação marinha (83%). Verifica-se a ocorrência de algumas espécies salobras, sendo a mais representativa *H. germanica* (15%). O número de espécies é de 27 e o número de foraminíferos por grama de sedimento seco total é de 79.

− O "**nível superior"** ocorre entre os 0,46m e os 0,42m e caracteriza-se pela predominância de *Haynesina germanica*, *Haynesina depressula* e *Haynesina* spp. (formas jovens) e, menos expressivamente, por *Cibicides* spp., *Cibicides lobatulus, Mississippina concentrica* e *Asterigerinata mamilla*). A associação salobra varia entre 70% e 94%, denotando um ambiente **moderadamente salobro subtidal a intertidal inferior**. O número de espécies varia entre 15 e 4 e o número de foraminíferos por grama de sedimento seco total entre 77 e 122.

- ✓ **"Nível inferior"** – as associações sugerem um ambiente lagunar moderadamente salobro subtidal a intertidal inferior, onde a presença de algumas espécies marinhas e de *Haynesina depressula* revelam a entrada provável de água do mar na laguna e/ou a permanência da mesma junto ao fundo, permitindo a ocorrência, em ambiente subtidal, destas espécies.

- ✓ **“Nivel médio”** – episódio com características marinhas, ocorrendo predominantemente espécies costeiras misturadas com algumas espécies salobras como *Haynesina germanica* e *Haynesina depressula*.

- ✓ **“Nível superior”** – as associações apontam para a prevalência de um ambiente lagunar moderadamente salobro subtidal a intertidal inferior. **A maior importância da associação marinha entre os 0,44m − 0,46m relativamente à amostra mais superficial** pode dever-se ao retrabalhamento em ambiente salobro lagunar das espécies marinhas do “nível médio”.

3.1.7. Sondagem Longa SG7A

Foi estudada apenas uma amostra desta sondagem, entre as profundidades de 0,44m e 0,42m. Esta amostra apresenta todas as características do **“nível intermédio”** já descritas na sondagem SG7, diferindo por ocorrer a uma cota mais superficial (Anexo 1, Fig. 1).

3.1.8. Sondagem Longa SG8

Foram estudadas seis amostras desta sondagem, entre as profundidades de 2,90m e 0,40m.

⇒ Na **base da sondagem** (2,90m − 2,72m), a fracção >63µm (27% a 34% do sedimento total) é constituída por uma areia fina; a componente bioclástica é essencialmente formada por fragmentos de lamelibrânquios, gastrópodes, alguns restos de plantas, espículas siliciosas, radíolas de equinodermes, alguns **foraminíferos planctónicos** e **ostracodos**.

Entre os 2,74m e os 2,72m encontram-se presentes alguns grãos de glauconite.

O número de espécies varia entre 16 e 17 e o número de foraminíferos por grama de sedimento seco entre 49 e 11. O carácter marinho das associações (84% a 88%) expressa-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1)

(*Cibicides* spp., *Elphidium macellum, Elphidium crispum, Elphidium complanatum, Mississippina concentrica, Asterigerinata mamilla* e *Ammonia beccarii*).

A associação sugere um ambiente **subtidal lagunar com marcada influência marinha**.

⇒ Dos **2,10m** de profundidade aos **1,60m,** a fracção >63µm (98% a 99% do sedimento total) é muito heterogénea com litoclastos que, para o topo, apresentam maior dimensão e a componente arenosa, granulometricamente heterogénea, é composta por uma matriz de areia fina com arestas angulosas e grãos mais grosseiros rolados e baços. Entre os **2,10m e 1,80m** verifica-se a presença de **glauconite**. A componente bioclástica é composta por gastrópodes, fragmentos de lamelibrânquios, espículas de equinodermes e siliciosas, fragmentos de corais, ostracodos e **foraminíferos planctónicos**. Alguns destes bioclastos são retrabalhados e em particular os foraminíferos bênticos marinhos apresentam vários aspectos (rolados e polidos) e graus de recristalização.
A **tendência marinha** deste nível está bem expressa na percentagem da associação marinha, que varia entre 85% e 93% (Anexo 1, Fig. 1) (*Cibicides* spp., *Elphidium* spp.*, Elphidium macellum, Elphidium crispum, Mississippina concentrica, Glabratella* spp.*, Asterigerinata mamilla* e *Quinqueloculina* spp.*, Rosalina* spp.). Verifica-se a ocorrência de algumas espécies salobras que representam entre 3% e 5% da associação (*H. germanica* e *H. depressula*, *A. tepida*, *E. gunteri*). O número de espécies oscila entre 19 e 23 e o número de foraminíferos por grama de sedimento seco total varia entre 14 e 180. O conjunto dos dados parece apontar para um episódio **marinho de forte hidrodinamismo.**

⇒ Dos **1,60m** de profundidade ao **1,00m,** a fracção >63µm (97% do sedimento total) é constituída por uma areia fina, com gastrópodes, fragmentos de lamelibrânquios, ostracodos e alguns foraminíferos planctónicos. O carácter marinho da associação (95%) exprime-se pela predominância de espécies marinhas costeiras (*Cibicides* spp., *Cibicides lobatulus, Cibicides pseudoungerianus, Elphidium* spp.*, Elphidium discoidalis, Cribrononion gerthi, Glabratella* spp.*, Quinqueloculina* spp.*, Mississippina concentrica* e *Asterigerinata mamilla*). A associação sugere um ambiente **subtidal lagunar com marcada influência marinha**.

⇒ Dos **0,45m** de profundidade aos **0,40m,** a amostra apresenta todas as características do **"nível intermédio"** já descritas nas sondagens SG7 e SG7A (Anexo 1, Fig. 1).

3.1.9. Sondagem Longa SG44

Foram estudadas três amostras desta sondagem, entre as profundidades de 2,96m e 2,20m. Destas, apenas a mais superficial apresenta foraminíferos em número suficiente para o seu estudo.

⇒ Dos **2,25m** de profundidade aos **2,20m,** a fracção >63µm (97% do sedimento total) é constituída por uma areia com bioclastos de gastrópodes, fragmentos de lamelibrânquios, ostracodos e espículas de equinodermes. O número de espécies é de 24 e o número de foraminíferos por grama de sedimento seco é de 48. O carácter marinho da associação (90%) caracteriza-se pela predominância de espécies marinhas costeiras (*Cibicides* spp., *Cibicides lobatulus, Elphidium* spp.*, Elphidium discoidalis, Elphidium crispum* e *Quinqueloculina* spp.). A associação sugere um ambiente **subtidal lagunar com marcada influência marinha**.

3.1.10. Sondagem Longa SG45

Foram estudadas duas amostras desta sondagem, entre as profundidades de 2,88m e 2,54m.

⇒ Dos **2,88m** de profundidade aos **2,85m**, a fracção >63µm (26% do sedimento total) é constituída por uma areia fina, com bioclastos de gastrópodes, fragmentos de lamelibrânquios, ostracodos, espículas de equinodermes e foraminíferos planctónicos. O número de espécies é de 21 e o número de foraminíferos por grama de sedimento seco é de 80. Verifica-se um equilíbrio percentual entre as associações marinha (49%) e salobra (47%), o que, juntamente com a característica do sedimento, parece indicar um **ambiente subtidal lagunar protegido, mas com influência marinha**. A componente marinha da associação caracteriza-se pela predominância de espécies costeiras (*Cibicides* spp., *Cibicides lobatulus, Elphidium* spp.*, Discorbis* spp. e *Asterigerinata mamilla*) e a componente salobra pelas espécies *Ammonia tepida* e *Haynesina germanica*.

⇒ Dos **2,56m** de profundidade aos **2,54m,** a fracção >63µm (7% do sedimento total) é formada por uma areia muito fina, com fragmentos de lamelibrânquios, ostracodos, espículas de equinodermes, alguns fragmentos de plantas e foraminíferos planctónicos. O número de espécies é de 22 e o número de foraminíferos por grama de sedimento seco é de 4. A associação marinha tem neste nível maior peso (70%), estando presentes as espécies já referidas no nível anterior, assim como *Elphidium discoidalis*, *Elphidium pulvereum, Elphidium complanatum* e *Quinqueloculina* spp.. Parece acentuar-se a influência marinha neste **ambiente subtidal lagunar protegido**.

3.1.11. Sondagem Longa SG46

Foram estudadas seis amostras desta sondagem entre as profundidades de 3,72m e 0,34m. Apenas 4 amostras apresentam foraminíferos em número ou estado de conservação que permitam o estudo das associações.

⇒ Na **base da sondagem** (3,72m − 2,68m), a fracção >63µm (19% do sedimento total) é constituída por uma areia fina; a componente bioclástica é fundamentalmente constituída por alguns fragmentos de lamelibrânquios e gastrópodes, espículas siliciosas, alguns **foraminíferos planctónicos** e **ostracodos**. O número de espécies é de 18 e o número de foraminíferos por grama de sedimento seco é de 10. O carácter marinho da associação (69%) expressa-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *Discorbis* spp., *Quinqueloculina* spp., *Rosalina* spp., *Elphidium* spp., *C. Gerthi, Bolivina pseudoplicata* e *Mississippina concentrica*). A associação salobra (29%) tem como espécie principal *A. tepida* associada a *H. germanica*. As espécies presentes (de pequena dimensão), juntamente com o sedimento fino a que estão associadas, sugerem um ambiente **subtidal lagunar de baixa energia com marcada influência marinha**.

⇒ Dos **2,68m** de profundidade aos **2,66m,** a fracção >63µm (26% do sedimento total) é constituída por uma areia fina, com alguns fragmentos de lamelibrânquios e plantas; **os foraminíferos estão presentes em número insuficiente, sendo alguns retrabalhados**. Os ostracodos ocorrem de forma mais significativa. O número de espécies é de 6 e o número de foraminíferos por grama de sedimento seco é de 2 (ambiente **intertidal? lagunar de baixa energia – baixo sapal ?**).

⇒ Dos **2,60m** de profundidade aos **2,30m,** a fracção >63µm (97% do sedimento total) é muito heterogénea com litoclastos de dimensão e composição diversas, estando presente

glauconite na fracção arenosa. A componente bioclástica é formada por gastrópodes, fragmentos de lamelibrânquios, espículas de equinodermes, fragmentos de corais e **foraminíferos planctónicos.** Alguns destes bioclastos são retrabalhados e em particular os foraminíferos bênticos marinhos (*Cibicides* spp., *Elphidium* spp., *Elphidium macellum, Elphidium crispum, Mississippina concentrica, Glabratella* spp., *Asterigerinata mamilla* e *Quinqueloculina* spp.) apresentam vários aspectos (rolados e polidos) e graus de recristalização. O número de espécies é de 22 e o número de foraminíferos por grama de sedimento seco total é de 1. O conjunto dos dados parece apontar para um episódio **marinho de forte hidrodinamismo.**

⇒ Dos **0,43m** de profundidade aos **0,34m** estão presentes os três níveis já referenciados nas sondagens curtas:

− O **"nível inferior"** ocorre entre os 0,43m e os 0,40m e caracteriza-se pela predominância de *Haynesina* spp. (formas jovens), *Haynesina germanica* e *Haynesina depressula*; *Ammonia tepida* surge menos expressivamente (Anexo 1, Fig. 1). Este nível inferior, apesar de registar as características de maior salobridade (88%), contém algumas espécies marinhas (ex.: *Cibicides* spp., *Elphidium* spp., *Quinqueloculina* spp.). A ocorrência consistente de *H. depressula* (menos tolerante a variações ambientais do que *H. germanica*), juntamente com algumas espécies marinhas (com presença menos significativa) nestas associações, parece indiciar um ambiente **moderadamente salobro subtidal a intertidal inferior**. O número de espécies é de 14 e o número de foraminíferos por grama de sedimento total é de 162 (Anexo 2).

− O **"nível intermédio"** ocorre entre os 0,40m e os 0,37m e caracteriza-se pela predominância de espécies marinhas costeiras (*Cibicides* spp., *Elphidium discoidalis, Elphidium macellum, Neoconorbina* spp., *Quinqueloculina* spp., e *Asterigerinata mamilla*). A **tendência marinha** deste nível está bem expressa na percentagem da associação marinha (79%). Verifica-se a ocorrência de algumas espécies salobras, sendo a mais representativa *H. depressula* (8,5%). O número de espécies é de 32 e o número de foraminíferos por grama de sedimento seco total é de 367. A percentagem da fracção >63µm (60% do sedimento total) é mais um factor diferenciador deste nível, estando presentes alguns grãos de **glauconite**. A componente bioclástica é fundamentalmente constituída por alguns fragmentos de lamelibrânquios e gastrópodes, espículas siliciosas e de equinodermes, corais, espongiários e alguns **foraminíferos planctónicos** e ostracodos.

− O "**nível superior**" ocorre entre os 0,37m e os 0,34m e caracteriza-se pela predominância de *Haynesina germanica*, *Haynesina depressula* e *Haynesina* spp. (formas jovens) e, menos expressivamente, por *Cibicides* spp. e *Asterigerinata mamilla*). A associação salobra representa 82% do conjunto das espécies, denotando um ambiente **moderadamente salobro subtidal a intertidal inferior**. O número de espécies é de 7 e o número de foraminíferos por grama de sedimento seco total é de 66.

- ✓ **"Nível inferior"** – as associações sugerem um ambiente lagunar moderadamente salobro subtidal a intertidal inferior, onde a presença de algumas espécies marinhas e de *Haynesina depressula* revelam a entrada provável de água do mar na laguna e/ou a permanência da mesma junto ao fundo, permitindo a ocorrência, em ambiente subtidal, destas espécies.
- ✓ **"Nivél médio"** – episódio com características marinhas, ocorrendo predominantemente espécies costeiras misturadas com algumas espécies salobras como *Haynesina germanica* e *Haynesina depressula*.
- ✓ **"Nível superior"** – as associações apontam para a prevalência de um ambiente lagunar moderadamente salobro subtidal a intertidal inferior.

3.1.12. Sondagem Longa SG47

Foram estudadas 4 amostras desta sondagem, entre as profundidades de 3,06m e 1,11m. Somente uma amostra (1,22m – 1,11m) apresenta foraminíferos em número suficiente ou estado de conservação adequado para o estudo das associações.

⇒ Na **base da sondagem** (3,06m − 3,03m), a fracção >63µm (13% do sedimento total) é constituída por uma areia heterogénea **sem foraminíferos**.

⇒ Dos **2,71m** de profundidade aos **2,68m,** a fracção >63µm (7% do sedimento total) é constituída por uma areia fina, com alguns fragmentos de ostracodos e plantas.

⇒ Dos **2,68m** de profundidade aos **2,56m,** a fracção >63µm (93% do sedimento total) é formada por uma areia mais grosseira, com alguns **litoclastos**. Estão presentes alguns foraminíferos marinhos retrabalhados e recristalizados (**episódio marinho de forte hidrodinamismo, cordão dunar?**).

⇒ Dos **1,22m** de profundidade aos **1,11m,** a fracção >63µm (59% do sedimento total) é constituída por uma areia fina amarelada com **litoclastos (arenito)**. A componente bioclástica é constituída por gastrópodes, fragmentos de lamelibrânquios, ostracodos, espículas de equinodermes e **foraminíferos planctónicos**. O número de espécies é de 28 e o número de foraminíferos por grama de sedimento seco é de 439. Os foraminíferos apresentam-se algo partidos e calcificados. A **tendência marinha** deste nível está bem expressa na percentagem da associação marinha (78%), a qual se caracteriza pela predominância de espécies costeiras (*Cibicides* spp., *Cibicides lobatulus, Elphidium* spp.*, C. gerthi, Discorbis* spp.*, Quinqueloculina* spp. e *Asterigerinata mamilla*). Verifica-se a ocorrência de algumas espécies salobras, sendo as mais representativas *H. germanica* e *A. tepida* (8,5%). **Episódio marinho** com **transporte de litoclastos** para o interior do ambiente lagunar.

3.1.13. Sondagem Média SG50

Foram estudadas sete amostras desta sondagem, entre as profundidades de 1,20m e 0,03m. Apenas 5 amostras apresentam foraminíferos em número ou estado de conservação que permitam o estudo das associações.

⇒ Na **base da sondagem** (1,20m − 1,00m), a fracção >63µm (88% do sedimento total) é constituída por uma areia bioclástica com alguns fragmentos de plantas e **foraminíferos bênticos marinhos retrabalhados**.

O número de espécies é de 14 e o número de foraminíferos por grama de sedimento seco é de 54. O carácter marinho da associação (96%) manifesta-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *Elphidium* spp.*, E. discoidalis, E. macellum, E. crispum* e *Mississippina concentrica*). A associação pode caracterizar um episódio marinho em ambiente **subtidal lagunar aberto próximo do cordão arenoso**.

⇒ Dos **1,00m − 0,67m** a fracção >63µm (93% do sedimento total) é constituída por uma areia bioclástica mais grosseira, com **litoclastos de rocha carbonatada de dimensão**

superior a 1cm. Estão presentes alguns foraminíferos marinhos retrabalhados e recristalizados e fragmentos de pequenos troncos. **Episódio marinho de forte hidrodinamismo – praia/ cordão dunar?**

⇒ Dos **0,67m − 0,59m** a fracção >63µm (48% do sedimento total) é constituída por uma areia amarelada bioclástica (material marinho retrabalhado) e alguns **litoclastos**. Estão presentes alguns **restos de plantas** e **foraminíferos planctónicos**. A associação salobra (90%) caracteriza-se pela predominância de *Haynesina* spp. (formas jovens), *Haynesina germanica*, *Haynesina depressula* e *Ammonia tepida* (Anexo 1, Fig. 1). O número de espécies é de 7 e o número de foraminíferos por grama de sedimento total é de 245 (Anexo 2). A ocorrência consistente de *H. depressula* (menos tolerante a variações ambientais do que *H. germanica*), juntamente com algumas espécies marinhas (com presença menos significativa) nesta associação, parece indiciar um ambiente **moderadamente salobro subtidal a intertidal inferior**.

⇒ Dos **0,59m − 0,27m** a fracção >63µm (93% do sedimento total) é constituída por uma areia "grosseira" com bioclastos retrabalhados. Estão presentes alguns foraminíferos marinhos retrabalhados e recristalizados e fragmentos longos de plantas (**raízes?**). Os dados poderão sugerir um ambiente **de cordão dunar (interior)/praia?**

⇒ Dos **0,27m − 0,16m** a fracção >63µm (72% do sedimento total) é constituída por uma areia "grosseira" com bioclastos retrabalhados. Estão presentes alguns foraminíferos marinhos retrabalhados e recristalizados, ostracodos e fragmentos longos de plantas (**raízes?**) e pequenos troncos. A associação salobra (72%) caracteriza-se pela predominância de *Haynesina germanica*, *Haynesina depressula* e *Haynesina* spp. (formas jovens) (Anexo 1, Fig. 1). O número de espécies é de 13 e o número de foraminíferos por grama de sedimento seco total é de 12 (Anexo 2). A ocorrência de *H. depressula* (menos tolerante a variações ambientais do que *H. germanica*), juntamente com algumas espécies marinhas (21,7%) nesta associação, parece indiciar um ambiente **intertidal moderadamente salobro**. A proximidade ao **baixo sapal** é dada pela ocorrência de *Jadammina macrescens* na associação (6,2%).

⇒ Dos **0,16m − 0,12m** a fracção >63µm (49% do sedimento total) é formada por uma areia "grosseira" com bioclastos retrabalhados. Estão presentes alguns foraminíferos marinhos retrabalhados e recristalizados e fragmentos de plantas. A associação salobra (66%) caracteriza-se pela predominância de *Haynesina germanica* e *Haynesina* spp. (formas jovens) (Anexo 1, Fig. 1). O número de espécies é de 9 e o número de foraminíferos por grama de sedimento total é de 18 (Anexo 2). A ocorrência de *H. depressula* (menos tolerante a variações ambientais do que *H. germanica*), juntamente com algumas espécies marinhas (24%) nesta associação, parece indiciar um ambiente **intertidal moderadamente salobro/baixo sapal**. A proximidade ao **baixo sapal** é dada pela ocorrência de *Jadammina macrescens* e *Miliammina fusca* na associação (4,3%).

⇒ Dos **0,09m − 0,03m** a fracção >63µm (13% do sedimento total) é constituída por alguma areia e abundantes fragmentos de plantas. A associação de sapal (97%) caracteriza-se pela predominância de ***Jadammina macrescens*** associada a *M. fusca* e *H. germanica* (Anexo 1, Fig. 1). O número de espécies é de 3 e o número de foraminíferos por grama de sedimento total é de 173 (Anexo 2). A associação é típica de um ambiente de **alto sapal** com características de **salinidade normal** (Murray, 1991; Debenay *et al*., 2000; Sen Gupta, 2002) .

3.1.14. Sondagem Média SG51

Foram estudadas quatro amostras desta sondagem, entre as profundidades de 1,60m e 0,20m. Apenas 3 amostras apresentam foraminíferos em número ou estado de conservação que permitam o estudo das associações.

⇒ Na **base da sondagem** (1,60m − 1,50m), a fracção >63µm (95% do sedimento total) é constituída por uma areia bioclástica com **foraminíferos bênticos marinhos retrabalhados**. Estão presentes alguns grãos de **glauconite**. O número de espécies é de 18 e o número de foraminíferos por grama é de 1. O carácter marinho da associação (90%) manifesta-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *Cibicides lobatulus*, *Elphidium* spp., *E. discoidalis, E. macellum*). A associação pode caracterizar um episódio marinho em ambiente **subtidal lagunar aberto próximo do cordão arenoso**.

⇒ Dos **0,90m − 0,64m** a fracção >63µm (83% e 80% do sedimento total) é constituída por uma areia bioclástica com **foraminíferos bênticos marinhos retrabalhados**. O número de espécies varia entre 5 e 7 e o número de foraminíferos por grama é de 1. As características do sedimento e dos foraminíferos que ocorrem neste nível podem sugerir um episódio marinho em ambiente **subtidal lagunar aberto próximo do cordão arenoso**.

⇒ Dos **0,55m − 0,20m** a fracção >63µm (91% do sedimento total) é constituída por uma areia grosseira bioclástica com **foraminíferos bênticos marinhos retrabalhados**. O número de espécies é de 11 e o número de foraminíferos por grama é de 6. A associação salobra (65%) caracteriza-se pela predominância de *Haynesina germanica, Haynesina depressula* e *Haynesina* spp. (formas jovens) (Anexo 1, Fig. 1). A ocorrência de *H. depressula* (menos tolerante a variações ambientais do que *H. germanica*), juntamente com algumas espécies marinhas (35%) nesta associação, parece indiciar um ambiente **moderadamente salobro subtidal a intertidal inferior**.

3.1.15. Sondagem Média SG53

Foram estudadas três amostras desta sondagem, entre as profundidades de 0,47m e 0,37m, estando presentes os três níveis já referenciados nas sondagens curtas:

− O **"nível inferior"** ocorre entre os 0,47m e os 0,44m. A fracção >63µm (5% do sedimento total) é constituída por uma areia fina rica em fragmentos de plantas e caracteriza-se pela predominância de *Haynesina* spp. (formas jovens), *Haynesina depressula* e *Haynesina germanica* (Anexo 1, Fig. 1). Este nível inferior regista características de salobridade, correspondendo esta associação a 99%. Registe-se que já nesta amostra ocorre *J. macrescens,* indiciando a proximidade do sapal. O número de espécies é de 6 e o número de foraminíferos por grama de sedimento é de 313 (Anexo 2). Este nível parece corresponder a um ambiente **moderadamente salobro subtidal a intertidal inferior próximo do sapal.**

− O **"nível intermédio"** ocorre entre os 0,44m e os 0,40m e caracteriza-se pela predominância de espécies marinhas costeiras (*Cibicides* spp., *Cibicides lobatulus, Elphidium discoidalis, Elphidium crispum, Quinqueloculina* spp. e *Asterigerinata mamilla*). A **tendência marinha** deste nível está bem expressa na percentagem da associação marinha (81%). Verifica-se a ocorrência de algumas espécies salobras, sendo a mais representativa *H. depressula* (12%). A fracção superior a 63µm (75% do sedimento total) é constituída por uma areia com alguns grãos de **glauconite**, bioclástica, onde se encontram **foraminíferos planctónicos** e bênticos retrabalhados, ostracodos e espículas siliciosas. O número de espécies é de 22 e o número de foraminíferos por grama de sedimento seco total é de 122.

− O "**nível superior"** ocorre entre os 0,40m e os 0,37m e caracteriza-se pela predominância de *Haynesina germanica*, *Haynesina depressula* e *Haynesina* spp. (formas jovens) e, menos expressivamente, por espécies marinhas. A associação salobra representa 69% do conjunto das espécies, denotando um ambiente **moderadamente salobro subtidal a intertidal inferior**. O número de espécies é de 19 e o número de foraminíferos por grama de sedimento seco total é de 58. A fracção >63µm (37% do sedimento total) é constituída por uma areia com alguns grãos de **glauconite**, bioclástica, onde se encontram foraminíferos bênticos retrabalhados, ostracodos, gastrópodes, corais e fragmentos de plantas.

- ✓ **"Nível inferior"** – as associações sugerem um **ambiente lagunar moderadamente salobro subtidal a intertidal inferior,** onde a presença de algumas espécies marinhas e de *Haynesina depressula* revelam a entrada provável de água do mar na laguna e/ou a permanência da mesma junto ao fundo, possibilitando a ocorrência, em ambiente subtidal, destas espécies.
- ✓ **"Nivél médio"** – **episódio com características marinhas**, ocorrendo predominantemente espécies costeiras misturadas com algumas espécies salobras como *Haynesina depressula*.
- ✓ **"Nível superior"** – as associações apontam para a prevalência de um **ambiente lagunar moderadamente salobro subtidal a intertidal inferior**.

3.1.16. Sondagem SG54

Foram estudadas três amostras desta sondagem, entre as profundidades de 1,61m e 0,52m.

⇒ Na **base da sondagem** (1,61m − 1,40m), a fracção >63µm (94% do sedimento total) é constituída por uma areia **lito** e bioclástica com **foraminíferos bênticos marinhos retrabalhados**, gastrópodes, fragmentos de lamelibrânqueos, espículas de equinodermes e **foraminíferos planctónicos**. O número de espécies é de 17 e o número de foraminíferos por grama é de 44. O carácter marinho da associação (98%) expressa-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *Cibicides lobatulus*, *Elphidium* spp., *E. discoidalis, E. macellum, E. crispum*). A associação pode caracterizar um **episódio marinho de forte hidrodinamismo**.

⇒ Dos **0,90m − 0,74m** a fracção >63µm (81% do sedimento total) é formada por uma areia bioclástica com **foraminíferos bênticos marinhos retrabalhados**, ostracodos, espículas e restos de plantas. O número de espécies é de 14 e o número de foraminíferos por grama é de 25. O carácter marinho da associação (99%) exprime-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *Cibicides lobatulus*, *Elphidium* spp., *E. discoidalis, E. macellum, E. crispum* e *Asterigerinata mamilla*). As características do sedimento e dos foraminíferos que ocorrem neste nível podem sugerir um **episódio marinho** em ambiente **subtidal lagunar aberto**.

⇒ Dos **0,74m − 0,52m** a fracção >63µm (80% do sedimento total) é formada por uma areia bioclástica com **foraminíferos bênticos marinhos retrabalhados**. O número de espécies é de 12 e o número de foraminíferos por grama é de 1. O carácter marinho da associação (85%) expressa-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides lobatulus*, *Elphidium* spp., *E. macellum, Quinqueloculina spp.* e *Asterigerinata mamilla*). Embora com características nitidamente marinhas, a associação salobra (11%) encontra-se representada pelas espécies *Haynesina germanica, Haynesina depressula* e *Haynesina* spp. (formas jovens) (Anexo 1, Fig. 1). A associação parece indiciar um **ambiente subtidal, lagunar com forte influência marinha**.

3.1.17. Sondagem Média SG55

Foram estudadas quatro amostras desta sondagem, entre as profundidades de 1,72m e 0,39m.

⇒ Na **base da sondagem** (1,72m − 1,25m), a fracção >63µm (95% do sedimento total) é formada por uma areia **lito** e bioclástica com **foraminíferos bênticos marinhos retrabalhados**, gastrópodes, espículas siliciosas, fragmentos de lamelibrânqueos, corais e restos de plantas. O número de espécies é de 10 e o número de foraminíferos por grama é de 45. O carácter marinho da associação (90%) expressa-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *Elphidium* spp., *E. macellum, E. crispum*). A associação pode caracterizar um **episódio marinho de forte hidrodinamismo**.

⇒ Dos **0,90m − 0,68m** a fracção >63µm (86% do sedimento total) é formada por uma areia bioclástica com **foraminíferos bênticos marinhos retrabalhados**, espículas siliciosas, fragmentos de lamelibrânqueos e **foraminíferos planctónicos**. O número de espécies é de 16 e o número de foraminíferos por grama é de 37. O carácter marinho da associação (96%) manifesta-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp, *Elphidium* spp., *E. macellum, Quinqueloculina* spp. e *Asterigerinata mamilla*). As características do sedimento e dos foraminíferos que ocorrem neste nível podem sugerir um **episódio marinho** em ambiente **subtidal lagunar aberto**.

⇒ Dos **0,63m − 0,42m** a fracção >63µm (87% do sedimento total) é formada por uma areia bioclástica com **foraminíferos bênticos marinhos retrabalhados** e por alguns fragmentos de plantas. O número de espécies é de 13 e o número de foraminíferos por grama é de apenas 1. O carácter marinho da associação (96%) exprime-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *Elphidium* spp., *E. discoidalis, Quinqueloculina* spp., *Elphidium crispum, Elphidium complanatum* e *Glabratella* spp.). A associação parece indiciar um **ambiente subtidal**, **lagunar com forte influência marinha**.

⇒ Dos **0,42m − 0,39m** a fracção >63µm (30% do sedimento total) é constituída por uma areia **lito** e bioclástica com restos de plantas. Não ocorrem foraminíferos nesta amostra.

3.1.18. Sondagem SG96

Foram estudadas seis amostras desta sondagem, entre as profundidades de 1,50m e 0,33m.

⇒ Na **base da sondagem** (1,50m − 1,17m), a fracção >63µm (94% do sedimento total) é constituída por uma areia **lito**-bioclástica com **foraminíferos bênticos marinhos retrabalhados**, gastrópodes, fragmentos de lamelibrânqueos, espículas de equinodermes e alguns restos de plantas. O número de espécies é de 17 e o número de foraminíferos por grama é de 99. O carácter marinho da associação (96%) manifesta-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *C. lobatulus*, *Elphidium* spp.*, E. macellum, E. discoidalis, E. crispum, Glabratella* spp.*, A. mamilla* e *A. beccarii*). A associação pode caracterizar um **episódio marinho de forte hidrodinamismo**.

⇒ Dos **1,17m − 1,01m** a fracção >63µm (90% do sedimento total) é constituída por uma areia **lito**-bioclástica com **foraminíferos bênticos marinhos retrabalhados**, espículas siliciosas, fragmentos de lamelibrânqueos e **foraminíferos planctónicos**. Estão presentes de forma significativa **fragmentos de raízes**. O número de espécies é de 19 e o número de foraminíferos por grama é de 70. O carácter marinho da associação (93%) exprime-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *C. lobatulus*, *Elphidium* spp.*, E. macellum, E. discoidalis, E. crispum, Glabratella* spp.*, A. mamilla* e *A. beccarii*). A associação pode caracterizar um **episódio marinho de forte hidrodinamismo**.

⇒ Dos **1,01m − 0,61m** a fracção >63µm (84% do sedimento total) é constituída por uma areia bioclástica com **foraminíferos bênticos marinhos retrabalhados** e alguns fragmentos de plantas (raízes), **foraminíferos planctónicos** e gastrópodes. O número de espécies é de 11 e o número de foraminíferos por grama é de 60. O carácter marinho da associação (94%) caracteriza-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *Elphidium* spp.*, E. macellum* e *A. mamilla*). A associação parece sugerir um **ambiente subtidal**, **lagunar com forte influência marinha**.

⇒ Dos **0,61m − 0,36m** a fracção >63µm (91% a 65% do sedimento total) é constituída por uma areia mais fina (grãos de menor dimensão com arestas angulosas), com alguns restos de plantas (raízes) e **foraminíferos bênticos marinhos retrabalhados**. O número de foraminíferos é insuficiente para o estudo das associações. (**Ambiente dunar?**)

⇒ Dos **0,36m − 0,33m** a fracção >63µm (28% do sedimento total) é constituída por uma areia fina amarelada **lito**-bioclástica com **foraminíferos bênticos marinhos retrabalhados e salobros recristalizados** e abundantes fragmentos de plantas. O número de espécies é de 9 e o número de foraminíferos por grama de sedimento total é de 5. A associação marinha (50%) expressa-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *C. lobatulus e Elphidium discoidalis*) juntamente com espécies salobras (44%) (*Haynesina germanica, Haynesina depressula* e *Haynesina* spp. (formas jovens) e *A. tepida*). A presença de espécies como *J. macrescens* e *T. Inflata*, as únicas em bom estado de conservação, pode apontar para uma proximidade ao sapal que se forma sobre **sedimentos retrabalhados**, registo de um **episódio marinho de forte hidrodinamismo**.

3.1.19. Sondagem SG97

Foram estudadas quatro amostras desta sondagem, entre as profundidades de 0,52 m e 0,24m, verificando-se a ocorrência de foraminíferos apenas na amostra mais superficial.

⇒ Na **base da sondagem** (0,52m − 0,34m), a fracção >63µm (90% a 72% do sedimento total) é constituída por uma **areia fina** com alguns **restos de plantas.**

⇒ Dos **0,34m − 0,31m** a fracção >63µm (39% do sedimento total) é constituída por uma **areia fina** com **litoclastos** e alguns **fragmentos de plantas.**

⇒ Dos **0,26m − 0,24m** a fracção >63µm (75% do sedimento total) é formada por uma areia bioclástica com **foraminíferos bênticos marinhos retrabalhados** e alguns restos de plantas. O número de espécies é de 14 e o número de foraminíferos por grama é de 31. O carácter marinho da associação (90%) caracteriza-se pela predominância de espécies marinhas costeiras (Anexo 1, Fig. 1) (*Cibicides* spp., *Elphidium discoidalis, E. macellum* e *A. mamilla*). A associação parece indicar um **ambiente subtidal**, **lagunar com forte influência marinha**.

3.2. Lagoa de Alcantarilha

3.2.1. Sondagem ALC 18

Foram estudadas mais duas amostras (**0,35m – 0,44m** e **1,26m – 1,41m**) desta sondagem que são integradas na interpretação referente ao relatório anterior (Anexo 3, Fig. 2). Destas, apenas uma apresenta foraminíferos que permitem o estudo das associações.

⇒ A **base da sondagem** (2,23m − 2,44m) é constituída por areia grosseira com uma importante componente bioclástica (gastrópodes, fragmentos de lamelibrânquios, espículas de equinodermes, ostracodos), na qual 96% das espécies são características de ambientes **marinhos costeiros** (Anexo 3, Fig.2). Apresentam, no entanto, sinais de transporte em ambiente de **forte hidrodinamismo**, provavelmente em zona de praia ou de canal. Observa-se a ocorrência de **formas recristalizadas e retrabalhadas juntamente com outras bem preservadas**. O número de foraminíferos por grama de sedimento seco é baixo (9,5).

⇒ Dos **2,23m** de profundidade aos **1,14m,** a fracção >63µm é formada por areia fina bioclástica (gastrópodes, fragmentos de lamelibrânquios, espículas de equinodermes, etc.). É, no entanto, possível diferenciar com clareza as amostras situadas entre os 2,23m – 1,50m e os 1,50m – 1,14m. Um aspecto a destacar é a presença de **foraminíferos planctónicos** no conjunto de amostras mais profundas. A influência marinha no interior da laguna parece ser mais acentuada entre 2,23m e 1,88m, com o maior número de espécies (25) e uma associação subtidal a intertidal inferior moderadamente salobra (59%), cujas espécies dominantes são ***H. germanica***, ***H. depressula*** e ***A. tepida*,** associadas a diversas espécies marinhas como *Cibicides* spp., *A. mamilla*, *Elphidium* spp. e *Mississippina concentrica*. Gradualmente, a tendência salobra das associações aumenta, correspondendo esta a 76,3% do conjunto das espécies a 1,50m – 1,57m de profundidade. Tal tendência é expressa pelo menor peso percentual relativo de ***H. depressula*** e pelo menor número de espécies. Entre 1,50m e 1,14m, acentua-se ainda mais o carácter salobro das associações (96% a 100%), com ***H. germanica*** (53% a 77%) como espécie dominante, associada a ***A. tepida*** e *H. depressula*. **O período com características mais salobras ocorre entre os 1,41m e 1,26m, onde a associação salobra representa 100% das espécies presentes.** O número de espécies passa de 8 para 3 e o número máximo de foraminíferos por grama de sedimento seco (349) ocorre aos 1,50m – 1,41m, reduzindo drasticamente (11,5) para o topo (1,14m – 1,26m) (Anexo 4).

⇒ Dos **1,14m** de profundidade aos **0,46m,** verifica-se uma redução acentuada do número de foraminíferos por grama de sedimento total (0,4 a 0,2), sendo o número de espécimens insuficiente para o estudo das associações. O sedimento fino com fragmentos de plantas, associado à presença residual de exemplares de *H. germanica* e *A. tepida* com conchas baças por dissolução, pode sugerir um ambiente de baixo sapal provavelmente com maior influência fluvial.

⇒ Dos **0,48m** de profundidade aos **0,14m,** o número de foraminíferos por grama de sedimento total varia entre 6 e 7. Os foraminíferos presentes nestas areias correspondem a espécies marinhas costeiras retrabalhadas, alguns recristalizados, ocorrendo uma mistura de espécimens de concha baça com outros polidos, sugerindo origens diferenciadas, possivelmente sedimentos de praia e duna. **É, no entanto, possível diferenciar um episódio com transporte de material bioclástico marinho e litoclastos entre os 0,44m e os 0,35m, onde o número de foraminíferos por grama de sedimento total sobe para 12.**

⇒ Dos **0,14m** de profundidade aos **0,04m,** o número de foraminíferos por grama de sedimento total é de 6. Os foraminíferos que se encontram nestas areias são espécies marinhas costeiras com aspecto baço, alguns espécimens recristalizados, provavelmenmteretrabalhadas em ambiente dunar.

⇒ Dos **0,04m** de profundidade aos **0,00m,** o sedimento diferencia-se pela presença de **restos de plantas** e pelo número insuficiente de foraminíferos (apenas 3 espécimens de *J. macrescens*), podendo reflectir um ambiente de sapal.

✓ Areias grosseiras da base da sondagem sugerem um **ambiente marinho de forte hidrodinamismo.**

✓ Entre os **2,23m** e os **1,14m**, as associações de foraminíferos revelam um **ambiente lagunar moderadamente salobro,** em que essa salobridade se acentua em direcção ao topo.

- ✓ Dos **1,14m** de profundidade aos **0,46m** poder-se-á ter um **ambiente de baixo sapal** provavelmente com **maior influência fluvial** ou então a predominância de **condições subaéreas.**
- ✓ Entre os **0,48m** de profundidade e os **0,14m** verifica-se um transporte de areias que parece indiciar **origem marinha e dunar, com um episódio de transporte marinho entre os 0,44m e 0,35m**.
- ✓ Entre os **0,14m** de profundidade e os **0,04m** poder-se-á estar em presença de um ambiente dunar.
- ✓ Os **4cm** superficiais podem representar um período de desenvolvimento do sapal e/ou de alternância de condições fluviais e subaéreas.

4. CONCLUSÕES

As espécies presentes (Anexo 5) são características de ambientes marinhos costeiros e estuarinos/lagunares salobros (Murray, 1991; Hayward et al., 1999; Sen Gupta, 2002). As associações reflectem um testemunho sedimentar em ambiente lagunar de baixa energia (subtidal a intertidal inferior moderadamente salobro com episódios de maior influência marinha; sapal de salinidade normal e duna) aonde é possível diferenciar episódios marinhos de forte hidrodinamismo caracterizados pela ocorrência de sedimentos arenosos mais grosseiros, granulometricamente heterogéneos, com litoclastos, que parecem ter natureza e dimensão diferenciadas (Fig 3). As componentes macro e micropaleontológicas revelam uma origem marinha costeira destes sedimentos aonde se misturam espécimens com diferentes graus de fossilização e transporte (origem e processos). Podem estar igualmente presentes algumas espécies salobras, normalmente em pequena percentagem.

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Anexo 1- Distribuição em número de espécimens de foraminíferos bênticos por amostra (Sondagens SG)

Espécies (nº) / Prof. (m)	SG 1 4.08-4.10	SG 1 4.18-4.20	SG 1 4.29-4.31	SG 1 4.33-4.41	SG 3 2.12-2.17	SG 5 2.74-2.76	SG 5 2.80-2.82	SG 5 2.86-2.88	SG 6 1.69-2.00	SG 6 2.00-2.43	SG 6 2.43-2.58	SG 6 2.60-2.62	SG 7 0.42-0.44	SG 7a 0.42-0.44	SG 7 0.44-0.46	SG 7 0.46-0.48	SG 7 0.48-0.50
Jadammina macrescens																	
Miliammina fusca																	
Textularia conica																	
Trochammina inflata			1														
Ammonia spp.											1						
Ammonia beccarii				2	2				2	2						2	
Ammonia tepida	1		37	14	1	12	20	20	8	3				2		1	4
Ammonia parkinsoniana														2		2	
Anommalinoides sp.																	
Asterigerinata mamilla	2		7	6	5	5	3	1	8	3	1			3	5	5	4
Astrononion spp.									1								
Astrononion gallowayi																	
Bolivina spp.									1								
Bolivina pseudoplicata			1					1									
Bulimina spp.				1	1	3		1									
Bulimina elongata							1		2								
Bulimina giba							2										
Bulimina alazanensis																	
Cassidulina spp.														1			
Cassidulina crassa																	
Cassidulina carinata																	
Cibicides spp.	3			9	24	6	16	10	35	35	7		7	44	7	31	6
Cibicides sp. 2						1			1					4	1	4	
Cibicides lobatulus			3	1	6		3	2							8	9	
Cibicides cf. pseudoungerianus							1								1		
Cibicides refulgens					10												
Cibicidoides sp.																	
Cornuspira sp.																	
Cribrononion gerthi				4				3		2						4	1
Discorbinella bertheloti							1										
Discorbis spp.					1	1	1	6	10	1				2			
Elphidium spp.			4	2	17	4	4	10	4		12	1	1	20	2	4	3
Elphidium advenum				1				3								1	
Elphidium complanatum			1	1	1		2		4	2				1	1	1	
Elphidium crispum				1					3	2				2			
Elphidium excavatum s.l.			6	4			3										
Elphidium discoidalis				7	4		4	1	6	6					2	9	
Elphidium gunteri															1		
Elphidium incertum					1			2									
Elphidium macellum	1			6	14		1			2	1						
Elphidium oceanencis																	
Elphidium pulvereum						2		3	3								
Elphidium selseyensis				1		1											
Elphidium simplex																	
Elphidium williamsoni						1											
Eponides repandus																	
Fissurina spp.			1	1						1							
Gavelinopsis praegeri				1													
Glabratella spp.														1	2	3	
Glabratella brasiliensis																	
Globocassidulina subglobosa																1	
Guttulina sp.																	
Guttulina communis																	
Haynesina germanica			66	44	1	48	31	30	7	2		6	40	3	45	16	33
Haynesina depressula			2	4	1	8	11	16	7	2	1		44	11	28		28
Haynesina sp. (jovens)				1		6							33		14	1	57
Lagena spp																	
Miliolideos indet.																	
Miliolinella spp.																	
Miliolinella subrotunda																	
Triloculina spp.																	
Triloculina carinata																	
Mississippina concentrica				1			1	1	7	4					4	5	
Neoconorbina sp.														1			
Nonion sp.																	
Nonion commune						1											
Nonionella turgida																	
Nonionoides sp.																	
Neoconorbina terquemi																	
Neoconorbina sp.																	
Oolina spp.																	
Patellina corrugata																1	
Pateoris hauerinoides																	
Planorbulina mediterranensis							1		5	3							
Poroeponides lateralis																	
Quinqeloculina spp.	1				10	1			12	7	1			5		3	1
Spirillina spp.																	
Rectrouvigerina spp.																	
Reussella spp.																	
Rosalina spp.					1		1	1	2	4				1	1	1	
Rosalina globularis																	
Svratkina tuberculata																	
Textularia spp.									1	1							
Textularia conica									1							1	
Textularia sagittula																	
Trifarina angulosa								1								2	
Uvigerina sp.								1									
Sp1							2							3	1	2	1
Sp2	1																
Indeterminados				1	2		2	2		17	2			6	2	1	
Nº total de Foram. Bênticos	9		129	113	102	100	111	115	130	99	26	7	125	112	125	110	138
Nº total de ostracodos			1	11	4	102	26	9	16	1	2	9		2			
Nº de espécies S	6		30	19	23	14	22	20	21	24	8	2	4	22	15	27	8

Anexo 1(cont.) - Distribuição em número de espécimens de foraminíferos bênticos por amostra (Sondagens SG)

Espécies (nº) / Prof. (m)	SG 7 0.50-0.52	SG 7 3.15-3.18	SG 8 0.40-0.45	SG 8 1.00-1.60	SG 8 1.60-1.80	SG 8 1.80-2.10	SG 8 2.72-2.74	SG 8 2.88-2.90	SG 44 2.20-2.25	SG 44 2.61-2.63	SG 44 2.91-2.96	SG 45 2.54-2.56	SG 45 2.85-2.88	SG 46 0.34-0.37	SG 46 0.37-0.40	SG 46 0.40-0.47	SG 46 2.30-2.60
Jadammina macrescens																	
Miliammina fusca																	
Textularia conica																	
Trochammina inflata																	
Ammonia spp.				2													
Ammonia beccarii			2		1		3	1	3	1	1	1			5		1
Ammonia tepida	2			1	4		2	9				11	29		6	4	
Ammonia parkinsoniana									1								
Anommalinoides sp.																	
Asterigerinata mamilla			8	4	7		6	9	1			9	4	9	5	1	4
Astrononion spp.				1													
Astrononion gallowayi																	
Bolivina spp.					1							3					
Bolivina pseudoplicata																	
Bulimina spp.									1			1	2		1		
Bulimina elongata													1				
Bulimina giba																	
Bulimina alazanensis								1									
Cassidulina spp.								1					1				
Cassidulina crassa																	
Cassidulina carinata																	
Cibicides spp.		2	39	45	69	28	31	33	41	1		11	20	10	28	4	35
Cibicides sp. 2			2	4			3	3	5					1	1	1	4
Cibicides lobatulus			17	9					24								
Cibicides cf. pseudoungerianus			3	2	1		2								1		
Cibicides refulgens																	
Cibicidoides sp.																	
Cornuspira sp.															1		
Cribrononion gerthi				5	5	1	2		1			6	3		2		
Discorbinella bertheloti			1				1								1		
Discorbis spp.			2	1			1	3	2			2	5		3		1
Elphidium spp.	3		4	8	13	5	8	24	18			5	8	6	1	2	17
Elphidium advenum													2				
Elphidium complanatum			2	1	3		2	5	1			4			7	2	
Elphidium crispum			3		2	4	3		7			1			1		
Elphidium excavatum s.l.																	
Elphidium discoidalis			4	6	5				7			5			4		2
Elphidium gunteri			2			1											
Elphidium incertum																	
Elphidium macellum			3	2	12	1	3	11	4				2		8		4
Elphidium oceanencis																	
Elphidium pulvereum												5					
Elphidium selseyensis																	
Elphidium simplex													3		1		
Elphidium williamsoni																	
Eponides repandus			1														
Fissurina spp.																1	
Gavelinopsis praegeri													1				
Glabratella spp.			5	5	7	5	1								2		2
Glabratella brasiliensis																	
Globocassidulina subglobosa			1														
Guttulina sp.																	
Guttulina communis																	
Haynesina germanica	24	4	8	2	2	1	4	7	3			14	22	60	6	37	
Haynesina depressula	27		3	1	2	1	1	2				1	3	39	11	10	3
Haynesina sp. (jovens)	75		4											24	2	53	
Lagena spp																	
Miliolideos indet.																	
Miliolinella spp.				3		1	1								2		1
Miliolinella subrotunda																	
Triloculina spp.																	
Triloculina carinata																	
Mississippina concentrica			5	5	5	2		4	1				2		4	1	2
Neoconorbina sp.																	
Nonion sp.				1								1					
Nonion commune																	
Nonionella turgida																	
Nonionoides sp.												1					
Neoconorbina terquemi												1					
Neoconorbina sp.			3												8		
Oolina spp.																	
Patellina corrugata															1		
Pateoris hauerinoides																	
Planorbulina mediterranensis		1			1							3				1	
Poroeponides lateralis																	
Quinqeloculina spp.	2	1	7	5	5	5	1		7					2	11	2	8
Spirillina spp.																	
Rectrouvigerina spp.																	
Reussella spp.								1									
Rosalina spp.			1	2	3	3		1	2			1				1	1
Rosalina globularis																	
Svratkina tuberculata																	
Textularia spp.			1										2		2		
Textularia conica									1						2		
Textularia sagittula																	
Trifarina angulosa			3														
Uvigerina sp.																	
Sp1			1												1		1
Sp2																	
Indeterminados	1		2	2	3	7	2		12				5		2		5
Nº total de Foram. Bênticos	134	8	137	117	151	65	77	115	142	2	1	86	115	151	130	120	91
Nº total de ostracodos		33	2	12	4	2	19	80	2	1		16	9		6	1	
Nº de espécies S	6	4	32	27	23	19	17	16	24	2	1	22	21	7	32	14	22

Anexo 1(cont.) - Distribuição em número de espécimens de foraminíferos bênticos por amostra (Sondagens SG)

Espécies (nº) / Prof. (m)	SG 46 2.66-2.68	SG 46 3.68-3.72	SG 47 1.11-1.22	SG 47 2.56-2.68	SG 50 0.03-0.09	SG 50 0.12-0.16	SG 50 0.16-0.27	SG 50 0.27-0.59	SG 50 0.59-0.67	SG 50 0.67-1.00	SG 50 1.00-1.20	SG 51 0.20-0.56	SG 51 0.64-0.75	SG 51 0.75-0.90	SG 51 1.50-1.60	SG 53 0.37-0.40	SG 53 0.40-0.44
Jadammina macrescens					118	4	8									1	
Miliammina fusca					13	2											
Textularia conica																	
Trochammina inflata																	
Ammonia spp.																	
Ammonia beccarii							2	1			3	3		3	2		3
Ammonia tepida		18	12				4		26			8		3		1	
Ammonia parkinsoniana							1										
Anommalinoides sp.																	
Asterigerinata mamilla			11								1	2		2		5	5
Astrononion spp.																	
Astrononion gallowayi																	
Bolivina spp.		3	2														
Bolivina pseudoplicata		4	2														
Bulimina spp.		1															
Bulimina elongata																	
Bulimina giba																	
Bulimina alazanensis																	
Cassidulina spp.																	
Cassidulina crassa																	
Cassidulina carinata																	1
Cibicides spp.	1	13	20	2		14	10	12	6		41	10	3	21	21		25
Cibicides sp. 2	2		1	1							4				3	1	3
Cibicides lobatulus			17			1						2			17	10	8
Cibicides cf. pseudoungerianus			1									1			1		3
Cibicides refulgens																	
Cibicidoides sp.																	
Cornuspira sp.																	
Cribrononion gerthi		4	8														
Discorbinella bertheloti																	
Discorbis spp.		13	10												2		3
Elphidium spp.		6	6	4		10	8		5		10	16	5	5	9	1	4
Elphidium advenum																	
Elphidium complanatum			2								1				3		2
Elphidium crispum							2	3			5			1	2		5
Elphidium excavatum s.l.	1																
Elphidium discoidalis		1	3	1		5		1			13				5	6	5
Elphidium gunteri							5					1				2	
Elphidium incertum																	
Elphidium macellum	1		1	1		3	2				18			6	5	5	3
Elphidium oceanencis																	
Elphidium pulvereum		2	1														
Elphidium selseyensis																1	
Elphidium simplex																	
Elphidium williamsoni																	
Eponides repandus				1							3						
Fissurina spp.																	
Gavelinopsis praegeri																	
Glabratella spp.			2								4	1			3		4
Glabratella brasiliensis																	
Globocassidulina subglobosa																	
Guttulina sp.																	
Guttulina communis																	
Haynesina germanica	3	10	12		4	58	42	2	25			24	2	1	1	30	
Haynesina depressula	1		3			8	26		36			20	1		3	31	13
Haynesina sp. (jovens)						27	16		31			16				25	2
Lagena spp																	
Miliolideos indet.																	
Miliolinella spp.		1							1								
Miliolinella subrotunda																	
Triloculina spp.											1						
Triloculina carinata																	
Mississippina concentrica		3	3				1				5	2			1	3	3
Neoconorbina sp.																	3
Nonion sp.			1													1	
Nonion commune																	
Nonionella turgida		2															
Nonionoides sp.																	
Neoconorbina terquemi																	
Neoconorbina sp.																	
Oolina spp.																	
Patellina corrugata																	
Pateoris hauerinoides																	
Planorbulina mediterranensis			2														
Poroeponides lateralis																	
Quinqeloculina spp.		7	8	3			2		1						1	3	6
Spirillina spp.																	
Rectrouvigerina spp.			1														
Reussella spp.																	
Rosalina spp.		6	2	1											1	2	1
Rosalina globularis																	
Svratkina tuberculata																	
Textularia spp.			1								1				1		
Textularia conica																	
Textularia sagittula																	
Trifarina angulosa																1	
Uvigerina sp.																	
Sp1															1		1
Sp2																	
Indeterminados		2	3	2		8					5	1	2		5	2	6
Nº total de Foram. Bênticos	9	96	135	16	135	140	129	19	131	0	115	107	13	42	87	131	109
Nº total de ostracodos	29	8	8				2			4			2			4	4
Nº de espécies S	6	18	28	7	3	9	13	5	7	26	14	11	4	7	18	19	22

Anexo 1(cont.) - Distribuição em número de espécimens de foraminíferos bênticos por amostra (Sondagens SG)

Espécies (nº) / Prof. (m)	SG 53 0.44-0.47	SG 54 0.52-0.74	SG 54 0.74-0.90	SG 54 1.40-1.61	SG 55 0.42-0.63	SG 55 0.68-0.90	SG 55 1.25-1.72	SG 96 0.33-0.36	SG 96 0.41-0.61	SG 96 0.61-1.01	SG 96 1.01-1.17	SG 96 1.17-1.50	SG 97 0.24-0.26	SG 97 0.31-0.34	SG 97 0.34-0.36	SG 97 0.36-0.52
Jadammina macrescens	2							2					1			
Miliammina fusca																
Textularia conica																
Trochammina inflata								1								
Ammonia spp.																
Ammonia beccarii			2		1	1			1			5	1			
Ammonia tepida	1			1				3					1			
Ammonia parkinsoniana				4		1										
Anommalinoides sp.																
Asterigerinata mamilla		1	6	4	1	3		2	2	4	5	5	5			
Astrononion spp.																
Astrononion gallowayi																
Bolivina spp.																
Bolivina pseudoplicata																
Bulimina spp.																
Bulimina elongata																
Bulimina giba																
Bulimina alazanensis																
Cassidulina spp.																
Cassidulina crassa												1				
Cassidulina carinata																
Cibicides spp.			43	41	18	44	28	9	8	38	54	40	31			
Cibicides sp. 2		1	2			2		1		1	3	3	1			
Cibicides lobatulus		20	7	2				10			5	7				
Cibicides cf. pseudoungerianus												2				
Cibicides refulgens																
Cibicidoides sp.																
Cornuspira sp.																
Cribrononion gerthi				1												
Discorbinella bertheloti																
Discorbis spp.				1						2	4		1			
Elphidium spp.		12	10	7	5	24	5	2		11	9	7	3			
Elphidium advenum																
Elphidium complanatum			1	3	2	2										
Elphidium crispum			4	5	2		2				6	4	1	1		
Elphidium excavatum s.l.																
Elphidium discoidalis			10	12	10			3		2	8	11	13			
Elphidium gunteri	3															
Elphidium incertum																
Elphidium macellum		2	6	8	1	4	5			5	8	9	6		6	
Elphidium oceanencis																
Elphidium pulvereum			1													
Elphidium selseyensis																
Elphidium simplex																
Elphidium williamsoni																
Eponides repandus											2					
Fissurina spp.																
Gavelinopsis praegeri																
Glabratella spp.			2	2	2					2	8	5				
Glabratella brasiliensis																
Globocassidulina subglobosa											1					
Guttulina sp.																
Guttulina communis																
Haynesina germanica	18	2	1	1	1	1		9	1	1	2	1	4			
Haynesina depressula	37	2			1			8					2			
Haynesina sp. (jovens)	71	1						4								
Lagena spp																
Miliolideos indet.																
Miliolinella spp.						1										
Miliolinella subrotunda																
Triloculina spp.												1				
Triloculina carinata																
Mississippina concentrica				1		2	1				2	1	3			
Neoconorbina sp.																
Nonion sp.					1		1				2					
Nonion commune																
Nonionella turgida																
Nonionoides sp.																
Neoconorbina terquemi																
Neoconorbina sp.																
Oolina spp.													1			
Patellina corrugata																
Pateoris hauerinoides																
Planorbulina mediterranensis																
Poroeponides lateralis											1					
Quinqeloculina spp.		2	3	2	3	3	1			2	3	2	3			
Spirillina spp.																
Rectrouvigerina spp.																
Reussella spp.		1														
Rosalina spp.				3		1					2	1				
Rosalina globularis																
Svratkina tuberculata											1					
Textularia spp.		1										1				
Textularia conica																
Textularia sagittula																
Trifarina angulosa																
Uvigerina sp.																
Sp1			1			1										
Sp2				6			1									
Indeterminados		2			1	3	5			3	8	4				
Nº total de Foram. Bênticos	132	47	99	104	49	93	49	54	12	71	134	110	77	1		
Nº total de ostracodos		1	1							1						
Nº de espécies S	6	12	14	17	13	16	10	9	4	11	19	17	14	1		

Anexo 2 – Peso do sedimento total das amostras SG e da fracção superior a 63 micron; número de foraminíferos bênticos por grama de sedimento seco total - Foram./g (Sondagens SG)

REF[a]	Am. TOTAL(g)	F > 63 (g)	Nº de Foram.	Foram/g de sed. seco total	REF[a]	Am. TOTAL(g)	F > 63 (g)	Nº de Foram.	Foram/g de sed. seco total
SG 1 4.08-4.10	6.18	0.92	9	2.9	**SG 46 2.66-2.68**	25.75	6.65	8	2.48
SG 1 4.18-4.20	7.85	1.03	0	0	**SG 46 3.68-3.72**	9.66	1.79	100	9.66
SG 1 4.29-4.31	9.35	2.25	117	50	**SG 47 1.11-1.22**	43.9	25.73	100	438.59
SG 1 4.33-4.41	46.12	35.61	98	68	**SG 47 2.56-2.68**	59.39	55.24	3	1.61
SG 3 2.12-2.17	111.49	108.72	97	0.9	**SG 47 2.68-2.71**	38.52	2.7		
SG 5 2.00-2.10	62.7	61.41			**SG 47 3.03-3.06**	7.58	0.97		
SG 5 2.50-2.60	78.53	75.3			**SG 50 0.03-0.09**	12.83	1.7	116	173.13
SG 5 2.74-2.76	15.88	1.82	100	6.3	**SG 50 0.12-0.16**	17.72	8.6	106	17.94
SG 5 2.80-2.82	10.9	3.71	112	61.5	**SG 50 0.16-0.27**	46.78	33.79	70	11.96
SG 5 2.86-2.88	12.56	4.89	103	131.2	**SG 50 0.27-0.59**	73.91	68.67	1	0.43
SG 6 1.69-2.00	40.23	35.36	99	412.5	**SG 50 0.59-0.67**	23.99	11.53	108	245.45
SG 6 2.00-2.43	95.23	90.99	95	33.6	**SG 50 0.67-1.00**	63.15	58.78	3	0.76
SG 6 2.43-2.585	69.93	67.86	2	0.6	**SG 50 1.00-1.20**	61.71	54.1		
SG 6 2.60-2.62	9.53	0.9	8	1.7	**SG 51 0.20-0.55**	28.86	26.16	23	6.37
SG 7 0.42-0.44	9.83	0.62	124	122	**SG 51 0.64-0.75**	44.43	35.61	1	0.36
SG 7A 0.42-0.44	5.08	2.94	115	45.3	**SG 51 0.75-0.90**	56.29	46.79	2	1.14
SG 7 0.44-0.46	9.33	1.46	118	75.6	**SG 51 1.50-1.60**	46.97	44.52	2	0.68
SG 7 0.46-0.48	5.6	3.8	110	78.6	**SG 53 0.37-0.40**	10.43	3.88	107	57.84
SG 7 0.48-0.50	5.34	0.23	124	63.9	**SG 53 0.40-0.44**	10.66	8	109	122.47
SG 7 0.50-0.52	10.37	0.16	112	59.3	**SG 53 0.44-0.47**	9.09	0.46	119	313.16
SG 7 3.15-3.18	15.03	3.25	8	2	**SG 54 0.52-0.74**	42.06	33.99	2	0.76
SG 8 0.40-0.45	10.19	8.6	116	161	**SG 54 0.74-0.90**	29.52	24.01	47	25.41
SG 8 1.00-1.60	103.07	99.6	118	140	**SG 54 1.40-1.61**	73.79	69.27	102	44.16
SG 8 1.60-1.80	130.7	127.94	137	180	**SG 55 0.39-0.42**	13.39	4.01		
SG 8 1.80-2.10	112.68	111.41	55	14.6	**SG 55 0.42-0.63**	39.94	34.57	3	1.20
SG 8 2.72-2.74	29.99	8.15	79	10.5	**SG 55 0.68-0.90**	39.81	34.38	93	37.35
SG 8 2.88-2.90	26.65	9.01	107	48.6	**SG 55 1.25-1.72 (calhaus)**	73.08	69.46	51	44.74
SG 44 2.20-2.25	48.36	46.68	145	48.00	**SG 96 0.33-0.36**	18.23	5.13	50	5.49
SG 44 2.61-2.63	30.55	10.87	2	0.50	**SG 96 0.36-0.41**	19.02	12.35		
SG 44 2.91-2.96	51.54	36.23	1	0.31	**SG 96 0.41-0.61**	43.82	39.96	11	8.03
SG 44 3.21-3.26	63.74	41.27			**SG 96 0.61-1.01**	77.71	65.6	73	60.33
SG 44 3.28-3.38	99.14	57.79			**SG 96 1.01-1.17**	60.64	54.81	134	70.53
SG 45 2.54-2.56	21.02	1.38	91	4.30	**SG 96 1.17-1.50**	37.8	35.57	117	99.15
SG 45 2.85-2.88	21.18	5.57	105	79.54	**SG 97 0.24-0.26**	9.76	7.36	76	31.15
SG 46 0.34-0.37	16.96	0.89	125	65.98	**SG 97 0.31-0.34**	14.6	5.63	1	0.27
SG 46 0.37-0.40	7.6	4.56	116	367.09	**SG 97 0.34-0.36**	5.17	3.72		
SG 46 0.40-0.43	8.83	0.69	119	161.68	**SG 97 0.36-0.52**	32.59	29.04		
SG 46 2.30-2.60	100.06	97.46	91	0.91					

Anexo 3 - Distribuição em número de espécimens de foraminíferos bênticos por amostra (Sondagem ALC 18 – Alcantarilha)

Espécies (nº) / Ref./Prof. (m)	ALC 18 0,00-0,04	ALC 18 0,04-0,14	ALC 18 0,14-0,35	ALC 18 0,35-0,44	ALC 18 0,44-0,48	ALC 18 0,46-0,50	ALC 18 1,04-1,14	ALC 18 1,14-1,26	ALC 18 1,26-1,41	ALC 18 1,41-1,50	ALC 18 1,50-1,57	ALC 18 1,57-1,62	ALC 18 1,62-1,88	ALC 18 1,88-2,23	ALC 18 2,23-2,44
Arenoparrella mexicana															
Jadammina macrescens	3														
Trochammina inflata															
Ammonia spp.															
Ammonia beccarii	1	2	3	7								1			8
Ammonia tepida						3	4	27	23	38	34	31	31	21	
Ammonia parkinsoniana															
Anommalinoides sp.															
Asterigerinata mamilla											4	7	10	7	
Astrononion spp.															
Astrononion gallowayi															
Bolivina spp.														1	
Bulimina spp.														1	
Cassidulina spp.															
Cibicides spp.		1	6	10	5			1		1	11	12	9	10	14
Cibicides Sp2														1	1
Cibicides lobatulus							3					5		3	6
Cibicides cf. pseudoungerianus												1		2	
Cibicides refulgens												2	1	1	
Cibicidoides sp.															
Cribrononion gerthi															
Discorbinella bertheloti															
Discorbis spp.										1					
Elphidium spp.		10	7	19	2	1	2	1		1	6	7	3	3	24
Elphidium advenum															
Elphidium complanatum								1			2	1		2	
Elphidium crispum		1	2								2		1	1	5
Elphidium excavatum s.l.												1		1	
Elphidium discoidalis								1				1	1	1	3
Elphidium gunteri															
Elphidium incertum														4	
Elphidium macellum		1	1								1	1	1	3	5
Elphidium oceanencis															
Elphidium pulvereum												1			
Elphidium simplex														1	
Elphidium williamsoni															
Eponides repandus															1
Fissurina spp.															
Gavelinopsis praegeri															
Glabratella spp.															
Glabratella brasiliensis															
Globocassidulina subglobosa															
Guttulina sp.															
Guttulina communis															
Haynesina germanica						1	11	84	111	74	37	37	31	24	
Haynesina depressula						1		12	2	15	19	19	29	23	
Haynesina sp. (jovens)								4	8	8		4			
Lagena spp															
Miliolideos indet.															
Miliolinella spp.															
Miliolinella subrotunda															
Triloculina spp.															
Triloculina carinata															
Mississippina concentrica													3	3	
Nonion sp.			1							1					
Nonion commune															
Nonionoides sp.															
Neoconorbina terquemi															
Neoconorbina sp.															
Oolina spp.															
Patellina corrugata															
Pateoris hauerinoides															
Planorbulina mediterranensis															
Quinqeloculina spp.				3	2										3
Spirillina spp.															
Rosalina spp.														1	
Rosalina globularis															
Textularia spp.		1								1			1		
Textularia conica															
Textularia sagittula															
Trifarina angulosa															
Sp1											2		1		
Sp3															
Indeterminados				14	2		2	1		1		2	1	3	3
Nº total de Foram. Bênticos	4	16	20	53	11	6	22	132	144	141	118	133	123	117	73
Nº total de ostracodos				1											
Nº de espécies S								7	3	8	13	16	13	25	14

Anexo 3 - Distribuição em % de espécimens de foraminíferos bênticos por amostra (Sondagem ALC 18 – Alcantarilha)

Espécies (%) / Ref./Prof. (m)	ALC 18 0,00-0,04	ALC 18 0,04-0,14	ALC 18 0,14-0,35	**ALC 18 0,35-0,44**	ALC 18 0,44-0,48	ALC 18 0,46-0,50	ALC 18 1,04-1,14	ALC 18 1,14-1,26	**ALC 18 1,26-1,41**	ALC 18 1,41-1,50	ALC 18 1,50-1,57	ALC 18 1,57-1,62	ALC 18 1,62-1,88	ALC 18 1,88-2,23	ALC 18 2,23-2,44
Arenoparrella mexicana															
Jadammina macrescens															
Trochammina inflata															
Ammonia spp.															
Ammonia beccarii				13.2								0.8			11.0
Ammonia tepida								20.5	16.0	27.0	28.8	23.3	25.2	17.9	
Ammonia parkinsoniana															
Anommalinoides sp.															
Asterigerinata mamilla											3.4	5.3	8.1	6.0	
Astrononion spp.															
Astrononion gallowayi															
Bolivina spp.														0.9	
Bulimina spp.														0.9	
Cassidulina spp.															
Cibicides spp.				18.9				0.8		0.7	9.3	9.0	7.3	8.5	19.2
Cibicides Sp2														0.9	1.4
Cibicides lobatulus												3.8		2.6	8.2
Cibicides cf. pseudoungerianus												0.8		1.7	
Cibicides refulgens												1.5	0.8	0.9	
Cibicidoides sp.															
Cribrononion gerthi															
Discorbinella bertheloti															
Discorbis spp.										0.7					
Elphidium spp.				35.8				0.8		0.7	5.1	5.3	2.4	2.6	32.9
Elphidium advenum															
Elphidium complanatum								0.8			1.7	0.8		1.7	
Elphidium crispum											1.7		0.8	0.9	6.8
Elphidium excavatum s.l.												0.8		0.9	
Elphidium discoidalis								0.8				0.8	0.8	0.9	4.1
Elphidium gunteri															
Elphidium incertum														3.4	
Elphidium macellum											0.8	0.8	0.8	2.6	6.8
Elphidium oceanencis															
Elphidium pulvereum												0.8			
Elphidium simplex														0.9	
Elphidium williamsoni															
Eponides repandus															1.4
Fissurina spp.															
Gavelinopsis praegeri															
Glabratella spp.															
Glabratella brasiliensis															
Globocassidulina subglobosa															
Guttulina sp.															
Guttulina communis															
Haynesina germanica								63.6	77.1	52.5	31.4	27.8	25.2	20.5	
Haynesina depressula								9.1	1.4	10.6	16.1	14.3	23.6	19.7	
Haynesina sp. (jovens)								3.0	5.6	5.7		3.0			
Lagena spp															
Miliolideos indet.															
Miliolinella spp.															
Miliolinella subrotunda															
Triloculina spp.															
Triloculina carinata															
Mississippina concentrica													2.4	2.6	
Nonion sp.										0.7					
Nonion commune															
Nonionoides sp.															
Neoconorbina terquemi															
Neoconorbina sp.															
Oolina spp.															
Patellina corrugata															
Pateoris hauerinoides															
Planorbulina mediterranensis															
Quinqeloculina spp.				5.7											4.1
Spirillina spp.															
Rosalina spp.														0.9	
Rosalina globularis															
Textularia spp.										0.7			0.8		
Textularia conica															
Textularia sagittula															
Trifarina angulosa															
Sp1											1.7		0.8		
Sp3															
Indeterminados				26.4				0.8		0.7		1.5	0.8	2.6	4.1
% total de Foram. Bênticos				100				100	100	100	100		100	100	100
Nº de espécies S				4				7	3	8	13	16	13	25	14

Anexo 4 – Peso do sedimento total das amostras ALC 18 e da fracção superior a 63 micron; número de foraminíferos bênticos por grama de sedimento seco total – Foram./g – (Alcantarilha)

REFª	Am. TOTAL(g)	F > 63µm(g)	Nº de Foram	Foram/g de sed. seco total
ALC 18 0,00-0,04 18/06/08	38.29	1.88	4	0.33
ALC 18 0,04-0,14 18/06/08	57.64	36.96	23	6.06
ALC 18 0,14-0,35 18/06/08	65.53	58.48	21	7.31
ALC 18 0,35-0,44 18/06/08	18.58	18.23	56	12.05
ALC 18 0,44-0,48 18/06/08	59.67	55.86	12	6.19
ALC 18 0,46-0,50 18/06/08	24.25	0.63	6	0.24
ALC 18 1,04-1,14 18/06/08	59.79	1.88	21	0.35
ALC 18 1,14-1,26 18/06/08	48.49	1.79	132	11.45
ALC 18 1,26-1,41 18/06/08	61.42	7.09	118	92.19
ALC 18 1,41-1,50 18/06/08	48.6	8.65	132	349.11
ALC 18 1,50-1,57 18/06/08	51.88	18.09	106	251.24
ALC 18 1,57-1,62 18/06/08	22.96	12.04	120	244.2
ALC 18 1,62-1,88 18/06/08	54.48	33.94	100	236.91
ALC 18 1,88-2,23 18/06/08	39.1	25.58	113	275.41
ALC 18 2,23-2,44 18/06/08	65.25	58.99	80	9.51

Arenoparrella mexicana (Anderson)
Jadammina macrescens (Brady, 1870)
Trochammina inflata (Montagu, 1808)
*Ammonia sp.*Brunnich, 1772
Ammonia beccarii (Linné, 1758)
Ammonia parkinsoniana (d'Orbigny, 1839)
Ammonia tepida (Cushman, 1926)
Anommalinoides sp. Brotzen, 1942
Astrononion sp. Cushman e Edwards, 1937
Astrononion gallowayi Topsent, 1892
Asterigerinata mamilla (Williamson, 1858)
Bolivina sp. d'Orbigny, 1839
*Bulimina sp.*d'Orbigny, 1826
Bulimina alazanensis Cushman, 1927
Bulimina elongata d'Orbigny, 1826
Bulimina giba Fornasini, 1902
Cassidulina sp. d'Orbigny, 1826
Cibicides lobatulus (Walker e Jacob, 1798)
Cibicides pseudoungerianus (Cushman), 1922
Cibicides refulgens Montfort, 1808
Cribroelphidium gerthi Van Voorthuysen
Discorbinella bertheloti (d'Orbigny, 1839)
Discorbis sp. Lamarck, 1804
Elphidium advenum (Cushman, 1922)
Elphidium complanatum (d'Orbigny, 1839)
Elphidium crispum (Linné, 1758)
Elphidium discoidale (d'Orbigny, 1839)
Elphidium excavatum (Terquem, 1875)
Elphidium gunteri Cole, 1931
Elphidium incertum (Williamson, 1858)
Elphidium macellum (Fichtel e Moll, 1798)
Elphidium oceanensis (d'Orbigny, 1826)
Elphidium pulvereum Todd, 1958
Elphidium selseyensis (Heron-Allen e Earland 1911)
Elphidium williamsoni Haynes, 1973
Eponides repandus (Fichtel e Moll, 1798)
Fissurina sp. Reuss, 1850
Gavelinopsis praegeri (Heron-Allen e Earland, 1913)
Glabratella sp. Dorreen, 1948
Glabratella brasiliensis Boltovskoy, 1959
Globocassidulina subglobosa (Brady,1881)
Guttulina sp. d'Orbigny, 1839
Guttulina communis. (d'Orbigny, 1826)
Haynesina germanica (Ehrenberg, 1840)
Haynesina depressula (Walker e Jacob, 1798)
*Lagena sp.*Walker e Jacob, 1798
Mississippina concentrica (Parker e Jones, 1864)
Neoconorbina sp. Hofker, 1951
Neoconorbina terquemi (Rzehak, 1888)
Nonion communis, (d'Orbigny, 1825)
Nonionoides sp. Saidova, 1975
Oolina sp. d'Orbigny, 1839
Patellina corrugata Williamson, 1858
Planorbulina mediterranensis d'Orbigny, 1826
Poroeponides lateralis (Terquem 1878)
*Rosalina sp.*d'Orbigny, 1826
Svratkina tuberculata (Balkwill e Wright, 1885)
Trifarina angulosa (Williamson, 1858)
Textularia Defrance, 1824
Textularia conica d'Orbigny, 1839
Textularia sagittula Defrance, 1824
*Quinqueloculina sp.*d'Orbigny, 1826
Spirillina sp. Ehrenberg, 1843
Triloculina carinata d'Orbigny
Pateoris hauerinoides (Rhumbler, 1936)
Miliolinella sp. Wiesner, 1931

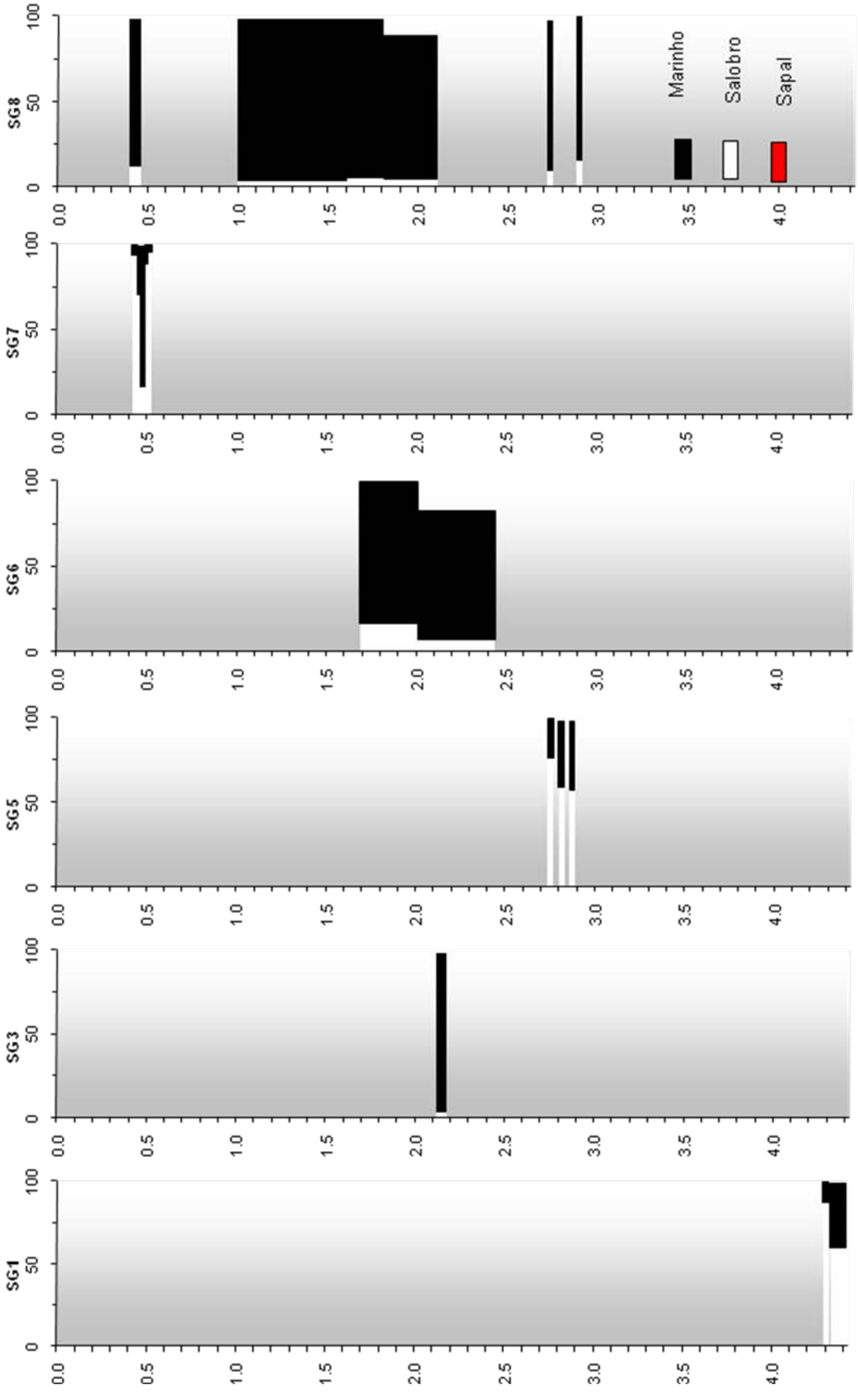

Figura 1 - Distribuição em percentagem das associações de foraminíferos bênticos nas sondagens SG1, SG3, SG5, SG6,SG7 e SG8

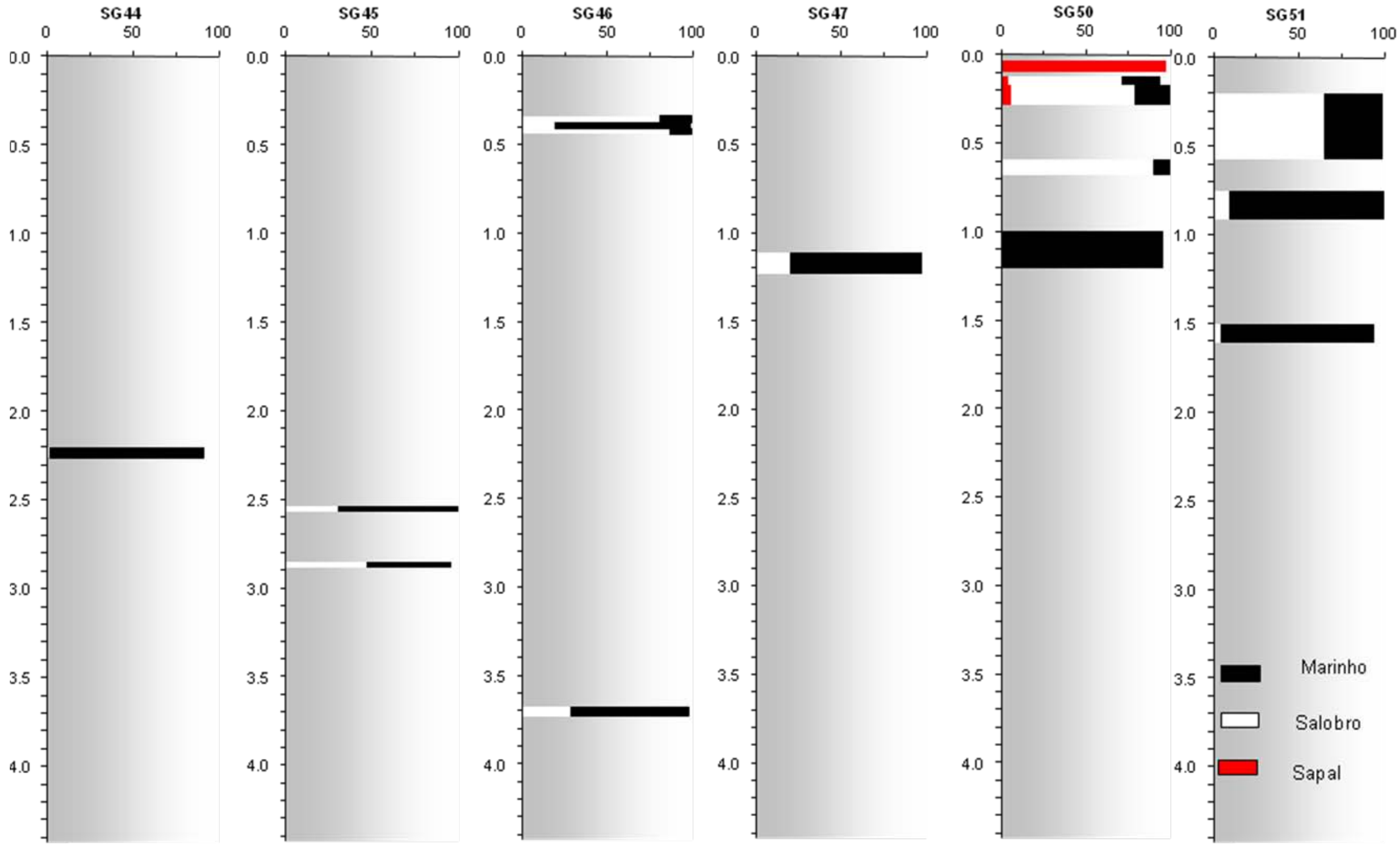

Figura 1(cont.) - Distribuição em percentagem das associações de foraminíferos bênticos nas sondagens SG44, SG45, SG46, SG 47, SG50 e SG51

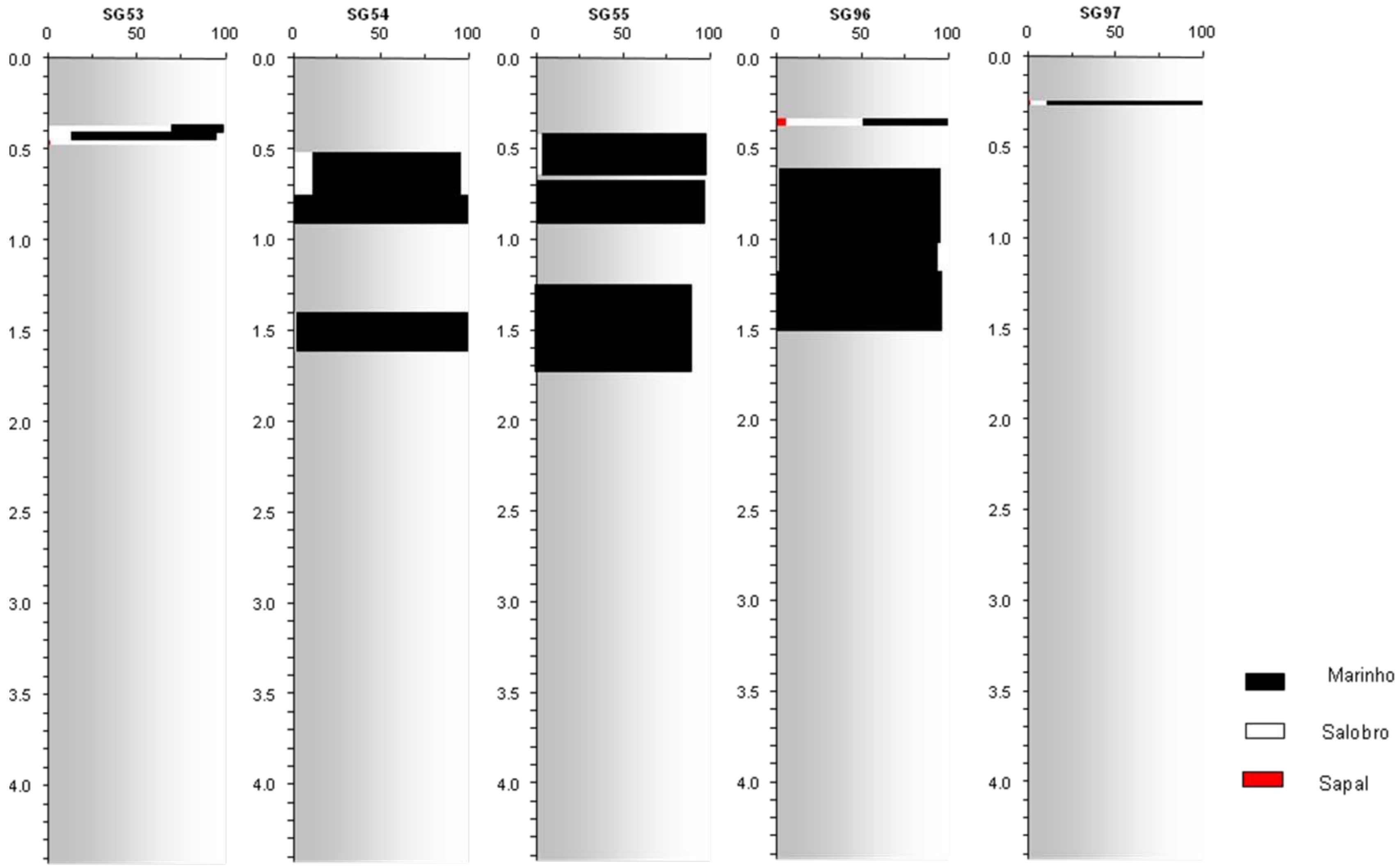

Figura 1(cont.) - Distribuição em percentagem das associações de foraminíferos bênticos nas sondagens SG53, SG54, SG55, SG96 e SG97

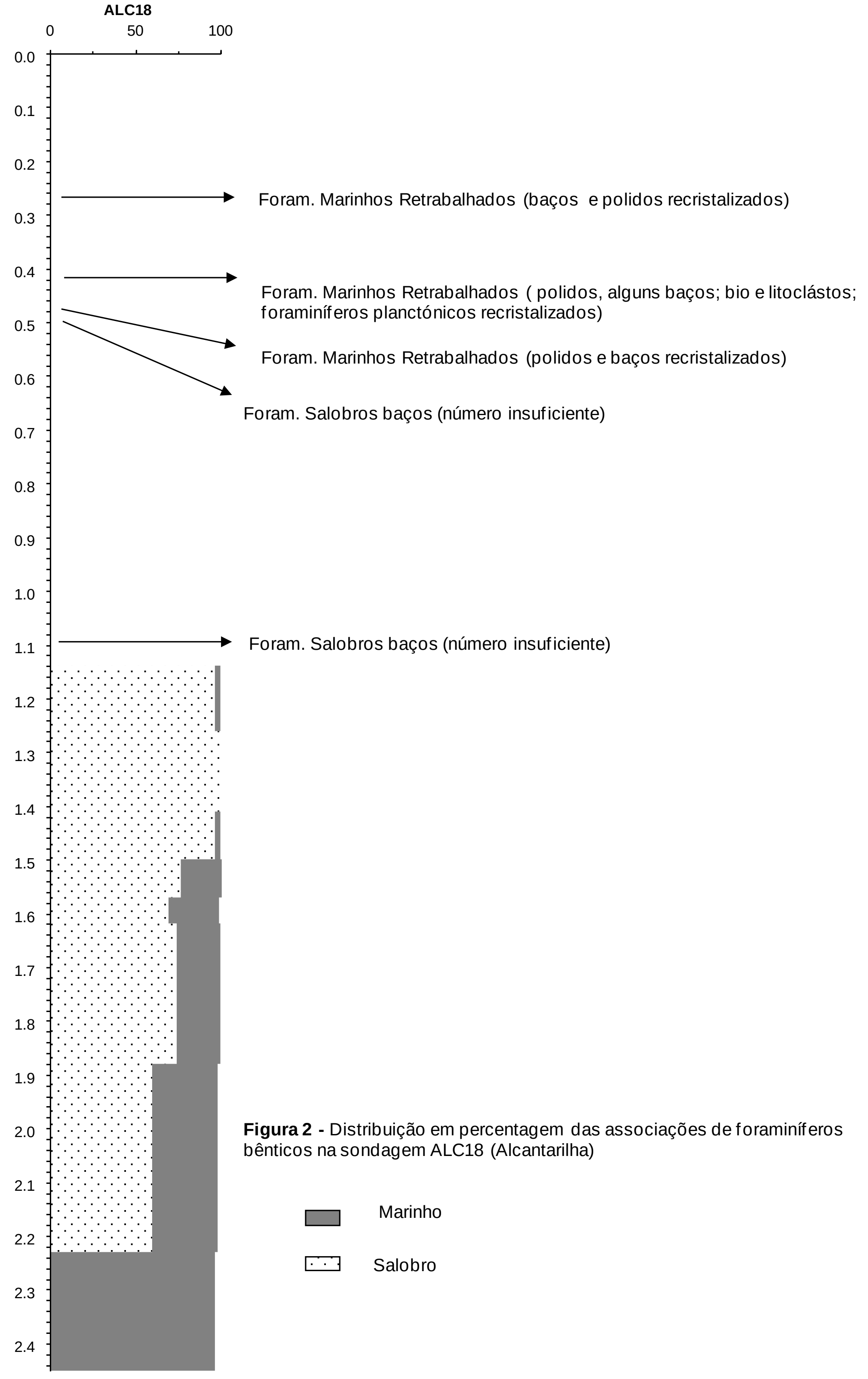

Figura 2 - Distribuição em percentagem das associações de foraminíferos bênticos na sondagem ALC18 (Alcantarilha)

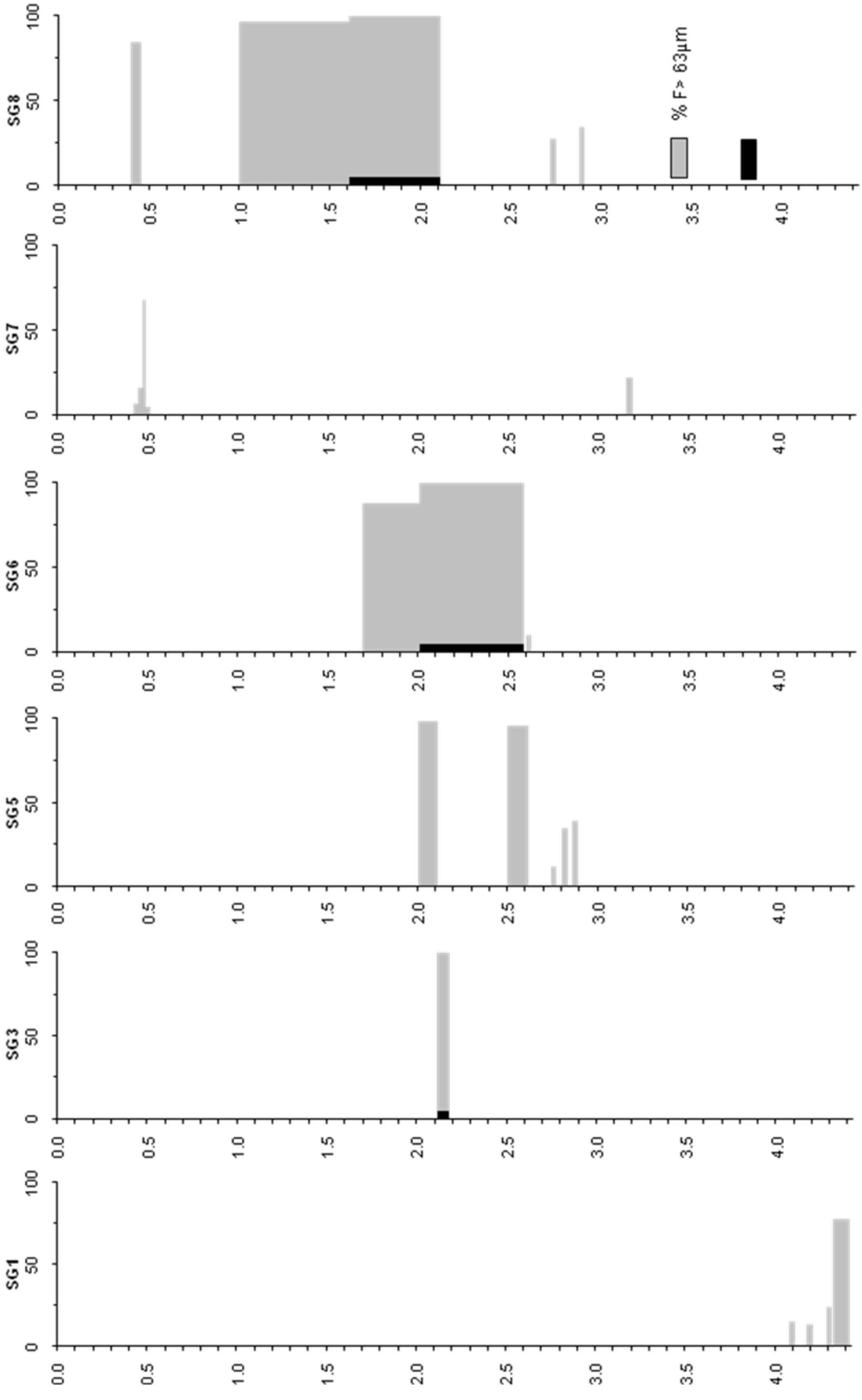

Figura 3 - Distribuição em percentagem da fracção superior a 63µm e ocorrência de litoclástos nas sondagens SG1, SG3, SG5, SG6,SG7 e SG8

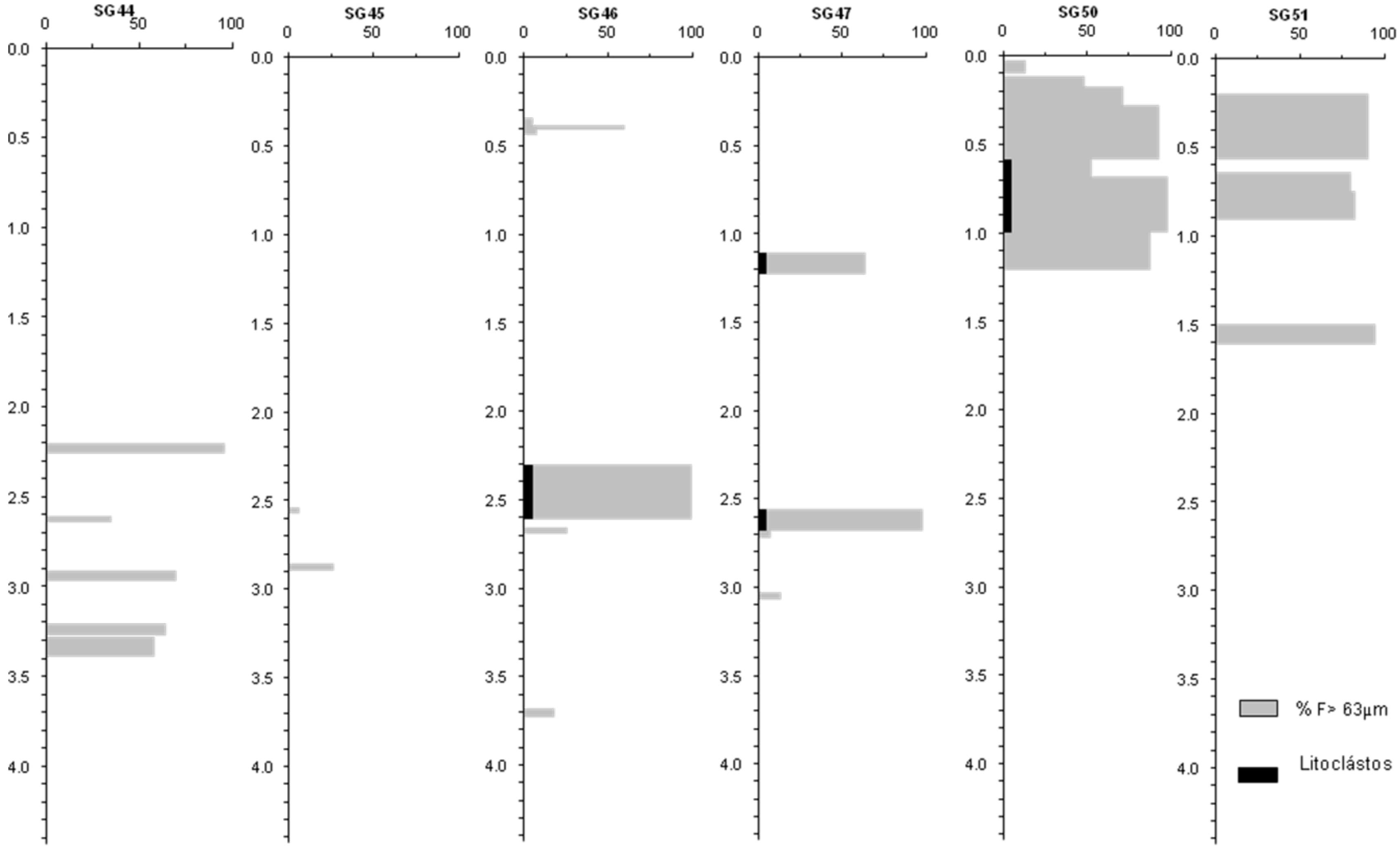

Figura 3(cont.) - Distribuição em percentagem da fracção superior a 63µm e ocorrência de litoclástos nas sondagensSG44, SG45, SG46, SG 47, SG50 e SG51

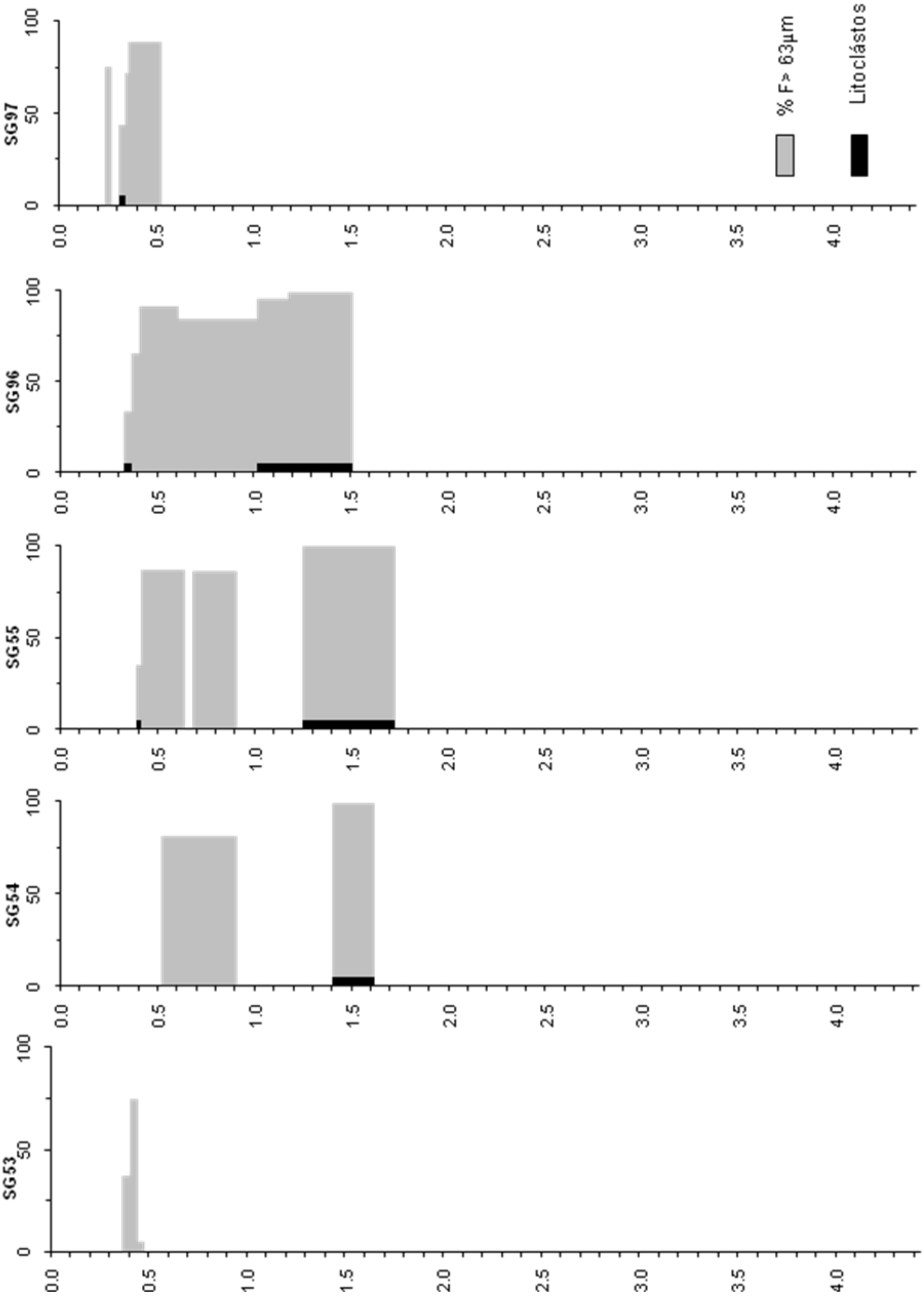

Figura 3(cont.) - Distribuição em percentagem da fracção superior a 63µm e ocorrência de litoclástos nas sondagens SG53, SG54, SG55, SG96 e SG97

Project n. 037110

NEAREST

"Integrated observations from NEAR shore sourcES of Tsunamis: towards an early warning system"

Instrument: STREP

Thematic priority: 1.1.6.3 GOCE (GlObal Change and Ecosystems)

D21: REPORT ON ONSHORE TSUNAMI RECORDS ANNEXE 5 – RESULTS ON TAPHONOMIC AND PALAEOECOLOGICAL STUDY OF ALGARVE BOULDERS

Due date of deliverable: 30 November 2009 (26 months)

Actual submission date: 5 June 2010

Start date of project: 1/10/2006

Duration: 36 + 6 months

Organisation name of lead contractor for this deliverable: **CSIC**

Revision: template

Project Co founded By the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination level		
PU	Public	
PP	Restricted to other programme participants (including Commission Services)	
RE	Restricted to a group specified by the Consortium (including Commission Services)	RE
CO	Confidential, only for members of the Consortium (including Commission Services)	

WP6 - Paleotsunami and Paleoseismic records

D21: REPORT ON *ONSHORE TSUNAMI RECORDS* ANNEXE 5 – RESULTS ON TAPHONOMIC AND PALAEOECOLOGICAL STUDY OF ALGARVE BOULDERS

Leader WP 6: CSIC

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Responsable Task 6.1:

Onshore sedimentological evidence of tsunami records

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Project n. 037110

NEAREST

"Integrated observations from NEAR shore sourcES of Tsunamis: towards an early warning system"

Instrument: STREP

Thematic priority: 1.1.6.3 GOCE (GlObal Change and Ecosystems)

D21: REPORT ON ONSHORE TSUNAMI RECORDS
ANNEXE 6 – RESULTS OF MANUAL CORES IN RIO PIEDRAS LOWLAND

Due date of deliverable: 30 November 2009 (26 months)

Actual submission date: 5 June 2010

Start date of project: 1/10/2006

Duration: 36 + 6 months

Organisation name of lead contractor for this deliverable: **CSIC**

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WP6 - Paleotsunami and Paleoseismic records

D21: REPORT ON *ONSHORE TSUNAMI RECORDS* ANNEXE 6 – RESULTS OF MANUAL CORES IN RIO PIEDRAS LOWLAND

Leader WP 6: CSIC

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Responsible Task 6.1:

Onshore sedimentological evidence of tsunami records

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Responsible Scientist
for contents of this Annexe: J. Lario, UNED/CSIC

RP-1

Date: 2-6-2004
Location: El Catalán Marsh. E La Antilla. N Arroyo del Fraile
Coordinates: 37º 13’ 2.82’’ N / 7º 11’ 6.28’’ W
UTM: x 661037.88m / y 412060.586m (Huso 29)
Elevation: +2 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 4.10 m
Age: Holocene

Description of the sediments (cm):

0-12: Orange grey fine sand with roots

12-22: Orange grey oxidation mottled silty sand

22-49: Orange grey oxidation mottled sand

49-88: Grey oxidation mottled silty sand with roots and fragments of herbaceous plants

88-116: Grey brown clayey silt with organics throughout and oxidation mottled.

116-127: Grey clayey silt with roots, fragments of herbaceous plants, and oxidation mottled.

127-142: Black organic clayey silt reduce stained with depth, with roots and fragments of herbaceous plants s

142-169: Dark grey clay silt with organics throughout

169-226: Dark grey silt with roots and shells fragments

226-231: Dark grey sandy silt with shells fragments

231-242: Dark grey silty sand

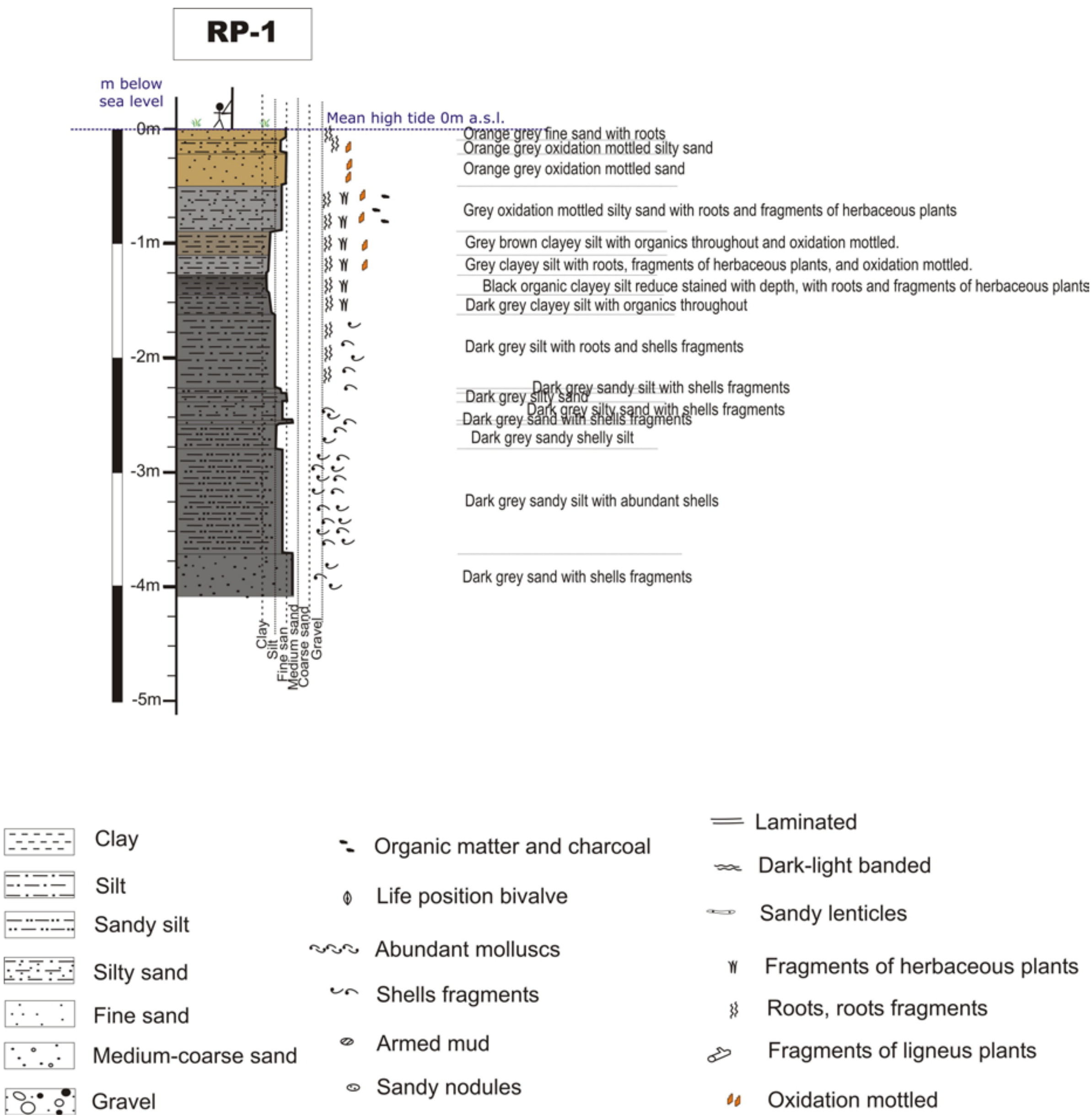
242-254: Dark grey silty sand with shells fragments

254-256: Dark grey sand with shells fragments

256-276: Dark grey sandy shelly silt

276-374: Dark grey sandy silt with abundant shells

374-410: Dark grey sand with shells fragments


RP-1
m below sea level
0m
-1m
-2m
-3m
-4m
-5m
Mean high tide 0m a.s.l.
Orange grey fine sand with roots
Orange grey oxidation mottled silty sand
Orange grey oxidation mottled sand
Grey oxidation mottled silty sand with roots and fragments of herbaceous plants
Grey brown clayey silt with organics throughout and oxidation mottled.
Grey clayey silt with roots, fragments of herbaceous plants, and oxidation mottled.
Black organic clayey silt reduce stained with depth, with roots and fragments of herbaceous plants
Dark grey clayey silt with organics throughout
Dark grey silt with roots and shells fragments
Dark grey sandy silt with shells fragments
Dark grey silty sand
Dark grey silty sand with shells fragments
Dark grey sand with shells fragments
Dark grey sandy shelly silt
Dark grey sandy silt with abundant shells
Dark grey sand with shells fragments
Clay
Silt
Fine san
Medium sand
Coarse sand
Gravel
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled

RP-2

Date: 3-6-2004
Location: San Miguel Marsh. N Cabezos del Terrón. S Estero del Carbón
Coordinates 37º 13' 31.96'' N / 7º 9' 30.08'' W
UTM: x 663391.86m / y 4121549.72m (Huso 29)
Elevation: +2 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 6.70 m
Age: Holocene

Description of the sediments (cm):

0-11: Brown silt with roots and oxidation mottled.

11-21: Orange brown silt with roots, oxidation mottled and fragments of herbaceous plants.

21-30: Grey clayey silt with roots, oxidation mottled and fragments of herbaceous plants.

30-38: Grey black clay silt with fragments of roots, herbaceous plants and organic matter.

38-74: Grey clayey silt with fragments of roots, herbaceous plants and organic matter.

74-78: Dark grey organic silt with fragments of roots and herbaceous plants.

78-115: Grey silt with shells, fragments of roots and herbaceous plants

115-117: Grey sandy silt with fragments of roots.

117-156: Grey silt with fragments of herbaceous plants.

156-160: Grey sandy silt with fragments of roots.

160-177: Grey silt with fragments of herbaceous plants.

177-196: Grey sandy silt with fragments of herbaceous plants.

196-212: Grey sandy silt fragments of roots and herbaceous plants.

212-236: Grey banded silts and sands with fragments of herbaceous plants.

236-256: Grey sandy silt with fragments of herbaceous plants and shells.

256-384: Grey silts and sands with fragments of herbaceous plants and shells.

384-420: Grey silty sand with shells.

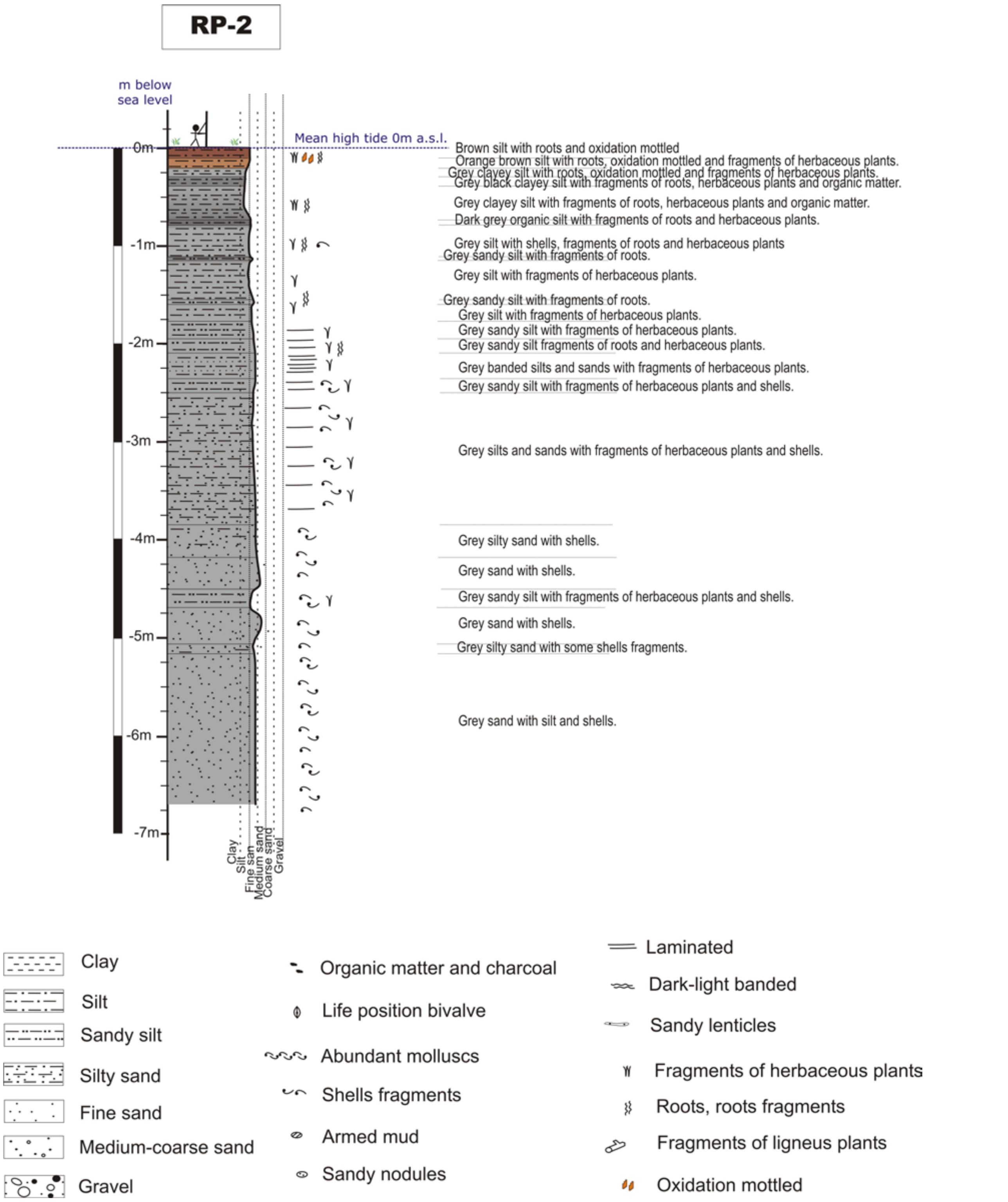
420-450: Grey sand with shells.

450-488: Grey sandy silt with fragments of herbaceous plants and shells.

488-506: Grey sand with shells.

506-517: Grey silty sand with some shells fragments.

517-671: Grey sand with silt and shells.


RP-2
m below
sea level
Mean high tide 0m a.s.l.
0m
-1m
-2m
-3m
-4m
-5m
-6m
-7m
Clay
Silt
Fine sand
Medium sand
Coarse sand
Gravel
Brown silt with roots and oxidation mottled
Orange brown silt with roots, oxidation mottled and fragments of herbaceous plants.
Grey clayey silt with roots, oxidation mottled and fragments of herbaceous plants.
Grey black clayey silt with fragments of roots, herbaceous plants and organic matter.
Grey clayey silt with fragments of roots, herbaceous plants and organic matter.
Dark grey organic silt with fragments of roots and herbaceous plants.
Grey silt with shells, fragments of roots and herbaceous plants
Grey sandy silt with fragments of roots.
Grey silt with fragments of herbaceous plants.
Grey sandy silt with fragments of roots.
Grey silt with fragments of herbaceous plants.
Grey sandy silt with fragments of herbaceous plants.
Grey sandy silt fragments of roots and herbaceous plants.
Grey banded silts and sands with fragments of herbaceous plants.
Grey sandy silt with fragments of herbaceous plants and shells.
Grey silts and sands with fragments of herbaceous plants and shells.
Grey silty sand with shells.
Grey sand with shells.
Grey sandy silt with fragments of herbaceous plants and shells.
Grey sand with shells.
Grey silty sand with some shells fragments.
Grey sand with silt and shells.
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled

RP-3

Date: 3-6-2004
Location: W El Rompido. Caño Tendal
Coordinates: 37º 13’ 21.65’’ N / 7º 7’ 55.51’’ W
UTM: x 665728.95m / y 4121277.72m (Huso 29)
Elevation: +1 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 6.50 m
Age: Holocene

Description of the sediments (cm):

0-29: Grey orange clayey silt with roots and oxidation mottled.

29-68: Grey clayey silt with roots and oxidation mottled.

68-70: Grey sand.

70-106: Grey silty clay with roots, oxidation mottled, and organic matter.

106-125: Grey silts and clays with roots and oxidation mottled.

125-308: Grey silt with roots and oxidation mottled.

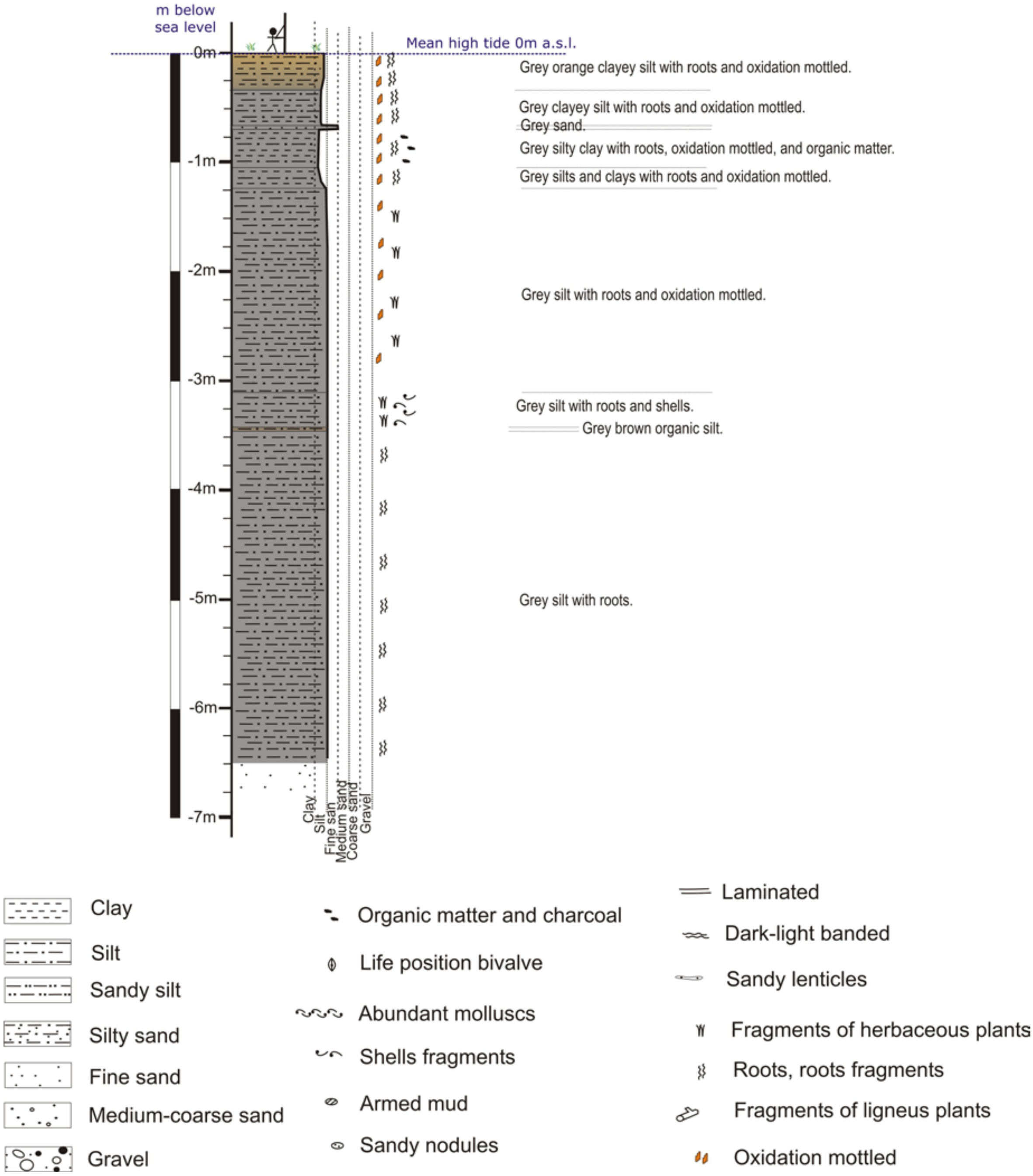
308-346: Grey silt with roots and shells.

346-347: Grey brown organic silt.

347-648: Grey silt with roots.

648-700: unrecovered sands.

RP-3


m below sea level
Mean high tide 0m a.s.l.
0m
-1m
-2m
-3m
-4m
-5m
-6m
-7m
Clay
Silt
Fine san
Medium sand
Coarse sand
Gravel
Grey orange clayey silt with roots and oxidation mottled.
Grey clayey silt with roots and oxidation mottled.
Grey sand.
Grey silty clay with roots, oxidation mottled, and organic matter.
Grey silts and clays with roots and oxidation mottled.
Grey silt with roots and oxidation mottled.
Grey silt with roots and shells.
Grey brown organic silt.
Grey silt with roots.
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled

RP- 4

Date: 3-6-2004
Location: Road from El Rompido to Cartaya. Marisma del Estero del Carbón. S Churrulita.
Coordinates: 37º 14' 35.77'' N / 7º 8' 0.182'' W
UTM: x 665568.82m / y 4123559.93m (Huso 29)
Elevation: +3 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 3 m
Age: Holocene

Description of the sediments (cm):

0-6: Grey brown sandy silt with oxidation mottled and organic matter.

6-24: Grey silty sand with roots and oxidation mottled.

24-34: Gray silty clay with roots and oxidation mottled.

34-45: Grey silts and clays with roots and organic matter.

45-46: Grey silt and sand with roots.

46-56: Grey silts and clays with roots and organic matter.

56-86: Grey silt and clay with sand and gravel; with oxidation mottled, and fragments of roots and herbaceous plants.

86-100: Grey clayey silt with gravel and shells and roots.

100-141: Grey silt with some shells fragment.

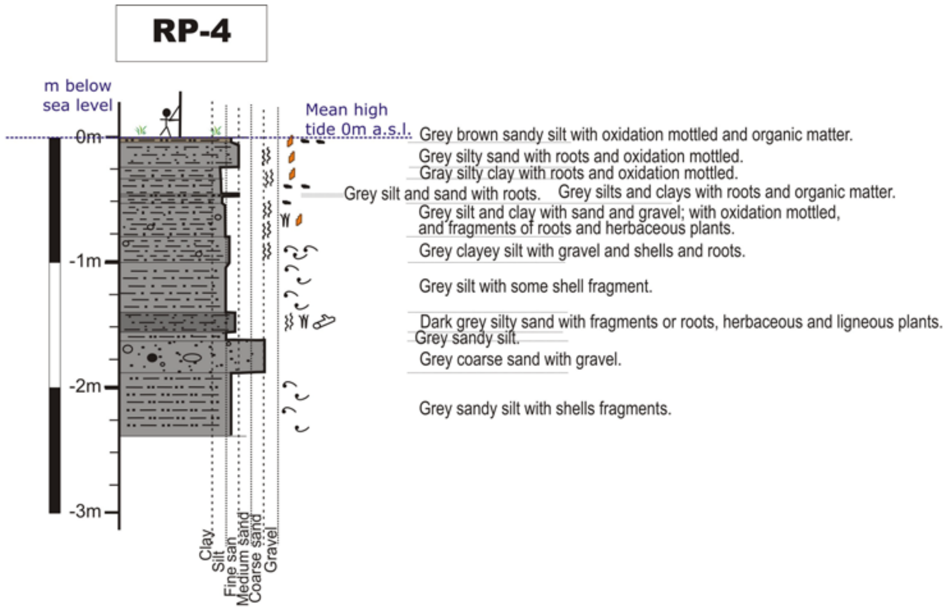
141-155: Dark grey silty sand with fragments or roots, herbaceous and ligneous plants.

155-161: Grey sandy silt.

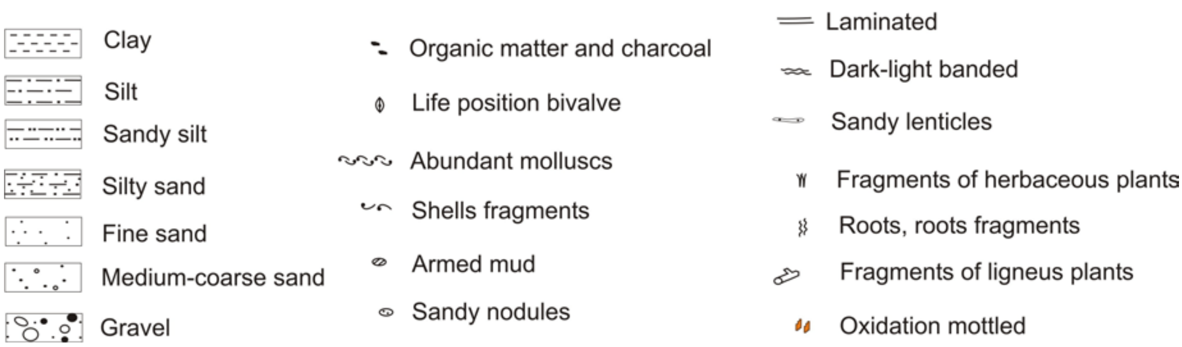
161-189: Grey coarse sand with gravel.

189-242: Grey sandy silt with shells fragments.

242-310: Unsampled, substrate?.



RP-4
m below sea level
Mean high tide 0m a.s.l.
0m
-1m
-2m
-3m
Grey brown sandy silt with oxidation mottled and organic matter.
Grey silty sand with roots and oxidation mottled.
Gray silty clay with roots and oxidation mottled.
Grey silt and sand with roots.
Grey silts and clays with roots and organic matter.
Grey silt and clay with sand and gravel; with oxidation mottled, and fragments of roots and herbaceous plants.
Grey clayey silt with gravel and shells and roots.
Grey silt with some shell fragment.
Dark grey silty sand with fragments or roots, herbaceous and ligneous plants.
Grey sandy silt.
Grey coarse sand with gravel.
Grey sandy silt with shells fragments.
Clay
Silt
Fine san
Medium sand
Coarse sand
Gravel



Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled

RP-5

Date: 3-6-2004
Location: Los Manueles Valley. Caño de La Rivera
Coordinates: 37º 16' 6.68'' N / 7º 8' 19.29'' W
UTM: x 665042.74m / y 41263352.65m (Huso 29)
Elevation: +2 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 4.74 m
Age: Holocene

Description of the sediments (cm):
0-31: Orange silty sand with oxidation mottled.

31-34: Orange grey sandy clayey silt with oxidation mottled.

34-90: Orange grey sandy silt with oxidation mottled.

90-103: Orange grey silty clay with oxidation mottled, roots and organic matter.

103-135: Grey silty clay with oxidation mottled, organic matter and fragments of roots and herbaceous plants.

135-142: Grey brown sand with oxidation mottled.

142-143: Grey brown silty clay with oxidation mottled.

143-154: Orange grey banded silty clays and sands, with oxidation mottled.

154-160: Grey silty clay with fragments of herbaceous plants.

160-176: Orange grey silty sands with oxidation mottled.

176-189: Grey silty clay with oxidation mottled.

189-216: Orange grey clayey silt with oxidation mottled and fragments of herbaceous plants.

216-225: Grey silt with roots.

225-226: Dark grey silty sand.

226-302: Grey silt with oxidation mottled and roots.

302-308: Dark grey sandy silt with fragments of roots and herbaceous plants.

308-314: Dark grey sandy silt with fragments of herbaceous plants.

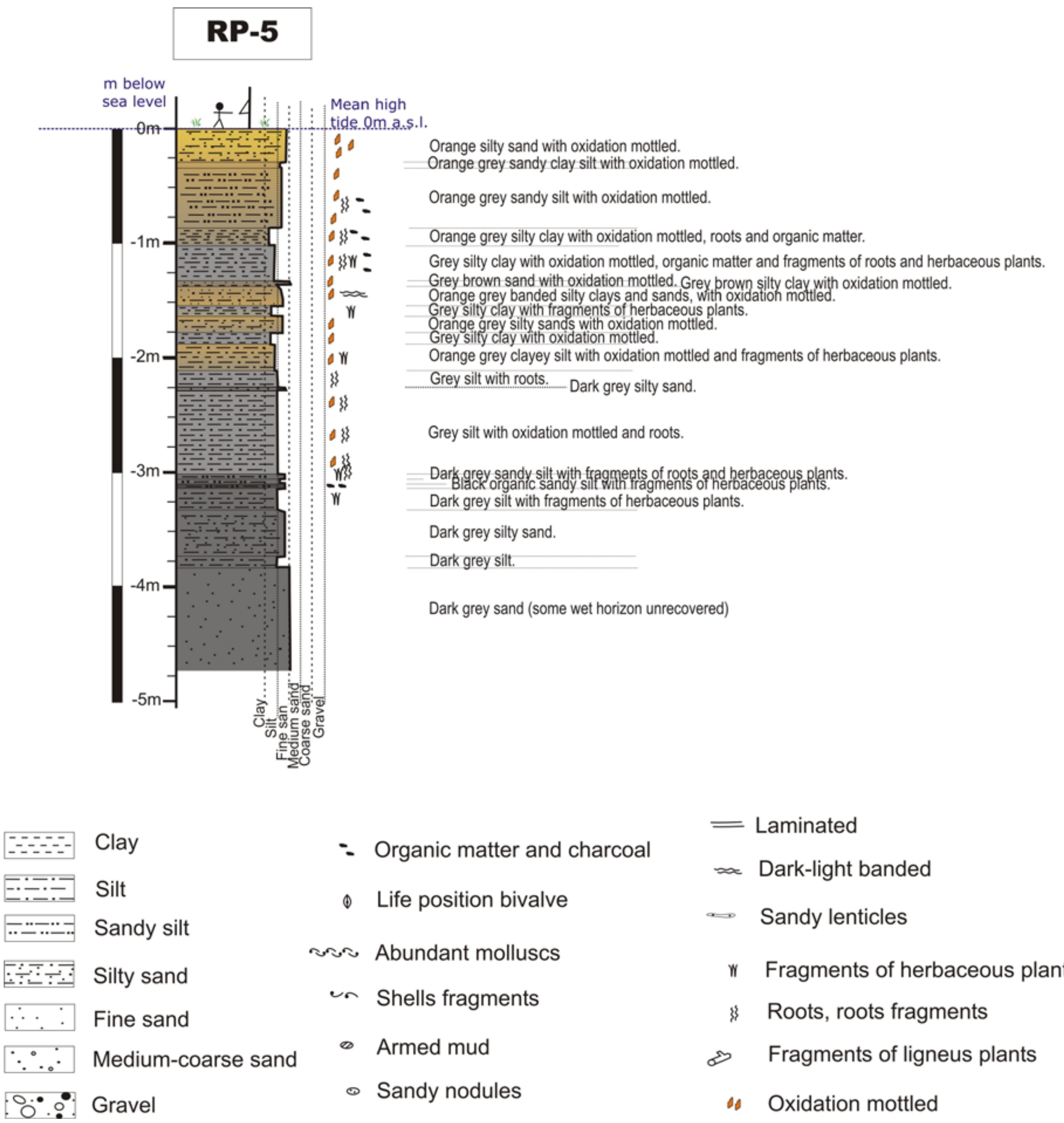
314-315: Black organic sandy silt with fragments of herbaceous plants.

315-329: Dark grey silt with fragments of herbaceous plants.

329-374: Dark grey silty sand.

374-384: Dark grey silt.

384-474: Dark grey sand (some wet horizon unrecovered)


RP-5
m below sea level
Mean high tide 0m a.s.l.
0m
-1m
-2m
-3m
-4m
-5m
Orange silty sand with oxidation mottled.
Orange grey sandy clay silt with oxidation mottled.
Orange grey sandy silt with oxidation mottled.
Orange grey silty clay with oxidation mottled, roots and organic matter.
Grey silty clay with oxidation mottled, organic matter and fragments of roots and herbaceous plants.
Grey brown sand with oxidation mottled. Grey brown silty clay with oxidation mottled.
Orange grey banded silty clays and sands, with oxidation mottled.
Grey silty clay with fragments of herbaceous plants.
Orange grey silty sands with oxidation mottled.
Grey silty clay with oxidation mottled.
Orange grey clayey silt with oxidation mottled and fragments of herbaceous plants.
Grey silt with roots.
Dark grey silty sand.
Grey silt with oxidation mottled and roots.
Dark grey sandy silt with fragments of roots and herbaceous plants.
Black organic sandy silt with fragments of herbaceous plants.
Dark grey silt with fragments of herbaceous plants.
Dark grey silty sand.
Dark grey silt.
Dark grey sand (some wet horizon unrecovered)
Clay
Silt
Fine san
Medium sand
Coarse sand
Gravel
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled

RP-6

Date: 3-6-2004
Location: E Piscifactoría Esteros de Huelva, W Huertas Valley
Coordinates 37º 14' 46.86'' N / 7º 9' 5.58'' W
UTM: x 663950.49m / y 4123870.04m (Huso 29)
Elevation: +2 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 7.3 m
Age: Holocene

Description of the sediments (cm):

0-6: Grey silt with roots and oxidation mottled.

6-30: Grey brown silty clay with oxidation mottled and roots.

30-146: Dark grey silt with fragments of roots and herbaceous plats.

146-202: Dark grey silt with roots and many shells.

202-257: Grey silt.

257-404: Dark grey silt with some shells.

404-452: Dark grey silt with some fragments of roots and herbaceous plants.

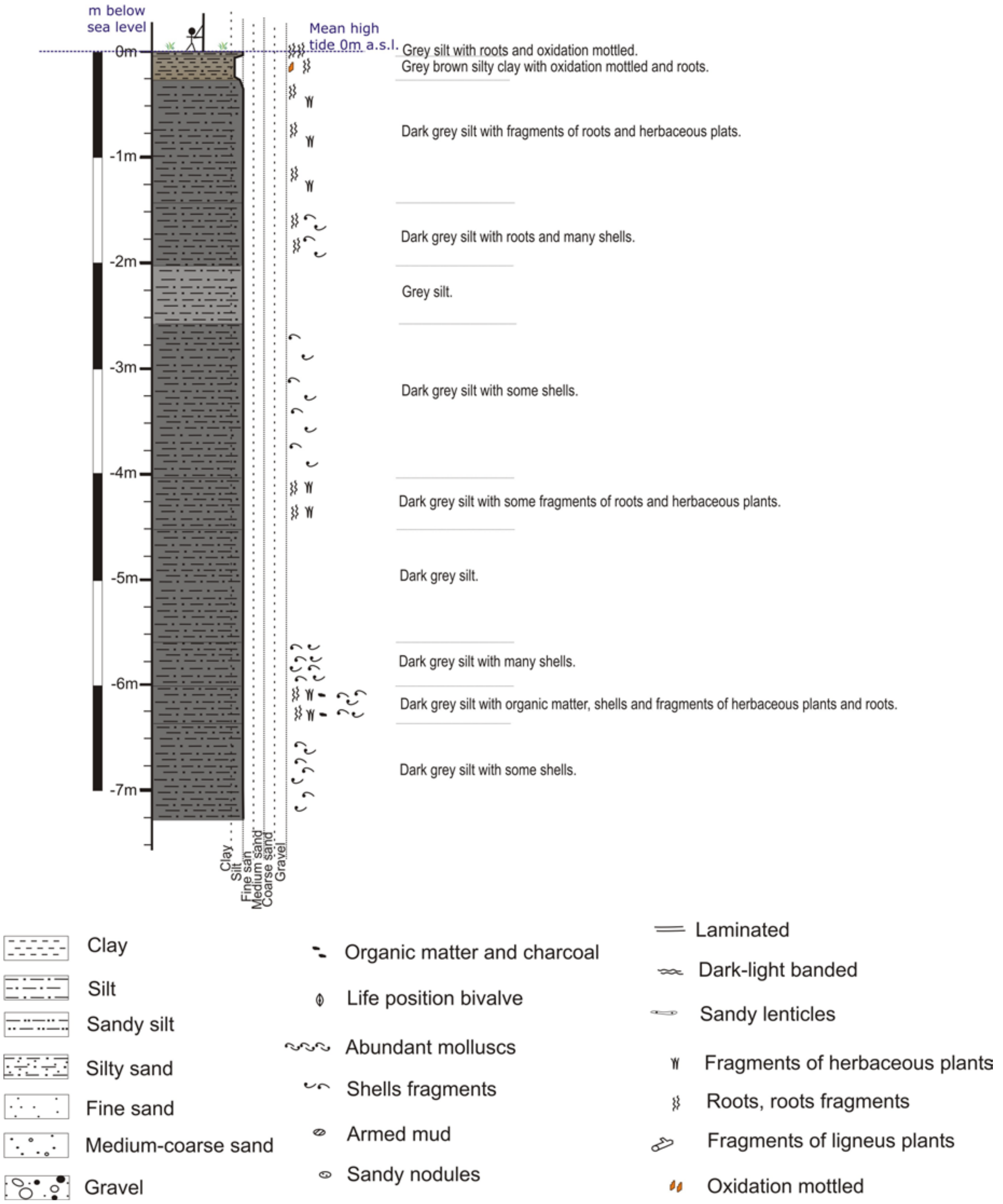
452-559: Dark grey silt.

559-602: Dark grey silt with many shells.

602-642: Dark grey silt with organic matter, shells and fragments of herbaceous plants and roots.

642-728: Dark grey silt with some shells.

RP-6


m below
sea level
Mean high
tide 0m a.s.l.
0m
-1m
-2m
-3m
-4m
-5m
-6m
-7m
Grey silt with roots and oxidation mottled.
Grey brown silty clay with oxidation mottled and roots.
Dark grey silt with fragments of roots and herbaceous plats.
Dark grey silt with roots and many shells.
Grey silt.
Dark grey silt with some shells.
Dark grey silt with some fragments of roots and herbaceous plants.
Dark grey silt.
Dark grey silt with many shells.
Dark grey silt with organic matter, shells and fragments of herbaceous plants and roots.
Dark grey silt with some shells.
Clay
Silt
Fine san
Medium sand
Coarse sand
Gravel
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled

RP-7

Date: 4-6-2004
Location: El Catalán Marsh. E La Antilla. N Arroyo del Fraile.
Coordinates 37º 13’ 6.59’’ N / 7º 10’ 28.62’’ W
UTM: x 661964.11m / y 4120739.88m (Huso 29)
Elevation: +1 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 2.8 m
Age: Holocene

Description of the sediments (cm):

0-17: Grey brown silt with roots, herbaceous plants and oxidation mottled.

17-35: Grey clayey silt with roots, herbaceous plants and oxidation mottled.

35-65: Grey silt with roots, organic matter and oxidation mottled.

65-112: Grey silt with organic matter and fragments of herbaceous plants.

112-119: Dark grey silty sand with roots.

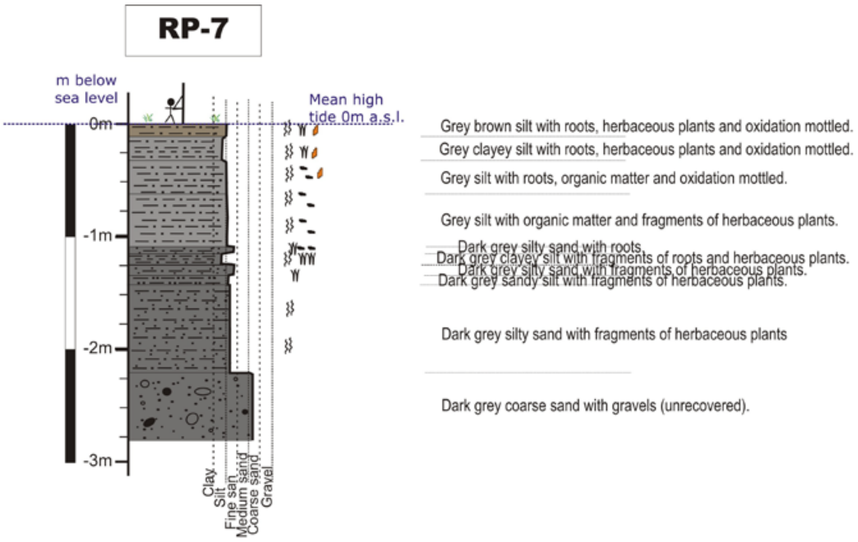
119-125: Dark grey clayey silt with fragments of roots and herbaceous plants.

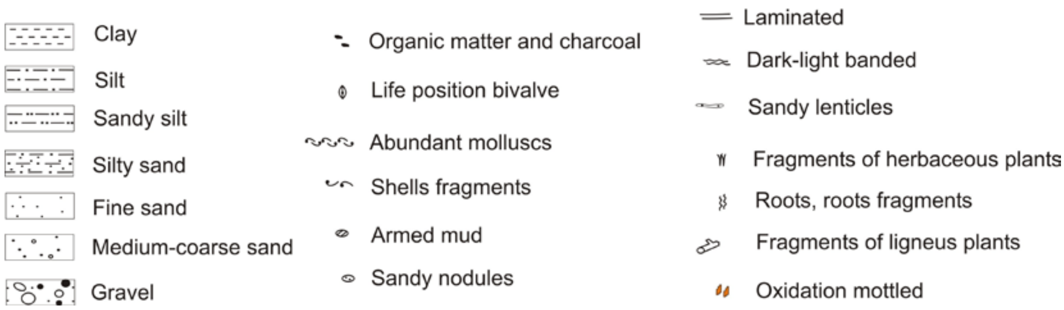
125-134: Dark grey silty sand with fragments of herbaceous plants.

134-146: Dark grey sandy silt with fragments of herbaceous plants.

146-222: Dark grey silty sand with fragments of herbaceous plants.

222-282: Dark grey coarse sand with gravels (unrecovered).


RP-7
m below sea level
Mean high tide 0m a.s.l.
0m
-1m
-2m
-3m
Clay
Silt
Fine sand
Medium sand
Coarse sand
Gravel
Grey brown silt with roots, herbaceous plants and oxidation mottled.
Grey clayey silt with roots, herbaceous plants and oxidation mottled.
Grey silt with roots, organic matter and oxidation mottled.
Grey silt with organic matter and fragments of herbaceous plants.
Dark grey silty sand with roots.
Dark grey clayey silt with fragments of roots and herbaceous plants.
Dark grey silty sand with fragments of herbaceous plants.
Dark grey sandy silt with fragments of herbaceous plants.
Dark grey silty sand with fragments of herbaceous plants
Dark grey coarse sand with gravels (unrecovered).


Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled

RP-8

Date: 4-6-2004
Location: San Miguel Marsh. W Estero del Carbón. S Piscifactoría Esteros de Huelva.
Coordinates: 37º 14' 7.14'' N / 7º 9' 39.09'' W
UTM: x 663149.5m / y 4122629.8m (Huso 29)
Elevation: +2 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 5.20 m
Age: Holocene

Description of the sediments (cm):

0-4: Dark grey silt with roots and oxidation mottled.

4-12: Dark grey sandy silt with roots, herbaceous plants, organic matter and oxidation mottled.

12-35: Orange grey clayey silt with roots, herbaceous plants and oxidation mottled.

35-59: Grey silts and clays with charcoal and oxidation mottled.

59-112: Grey silt with oxidation mottled.

112-142: Dark grey silt with some roots, herbaceous plants and organic matter.

142-174: Dark grey silt with roots.

174-200: Dark grey silt.

200-264: Dark grey silt with fragments of herbaceous plants.

264-279: Dark grey silt with sand, shells and fragments of ligneous plants.

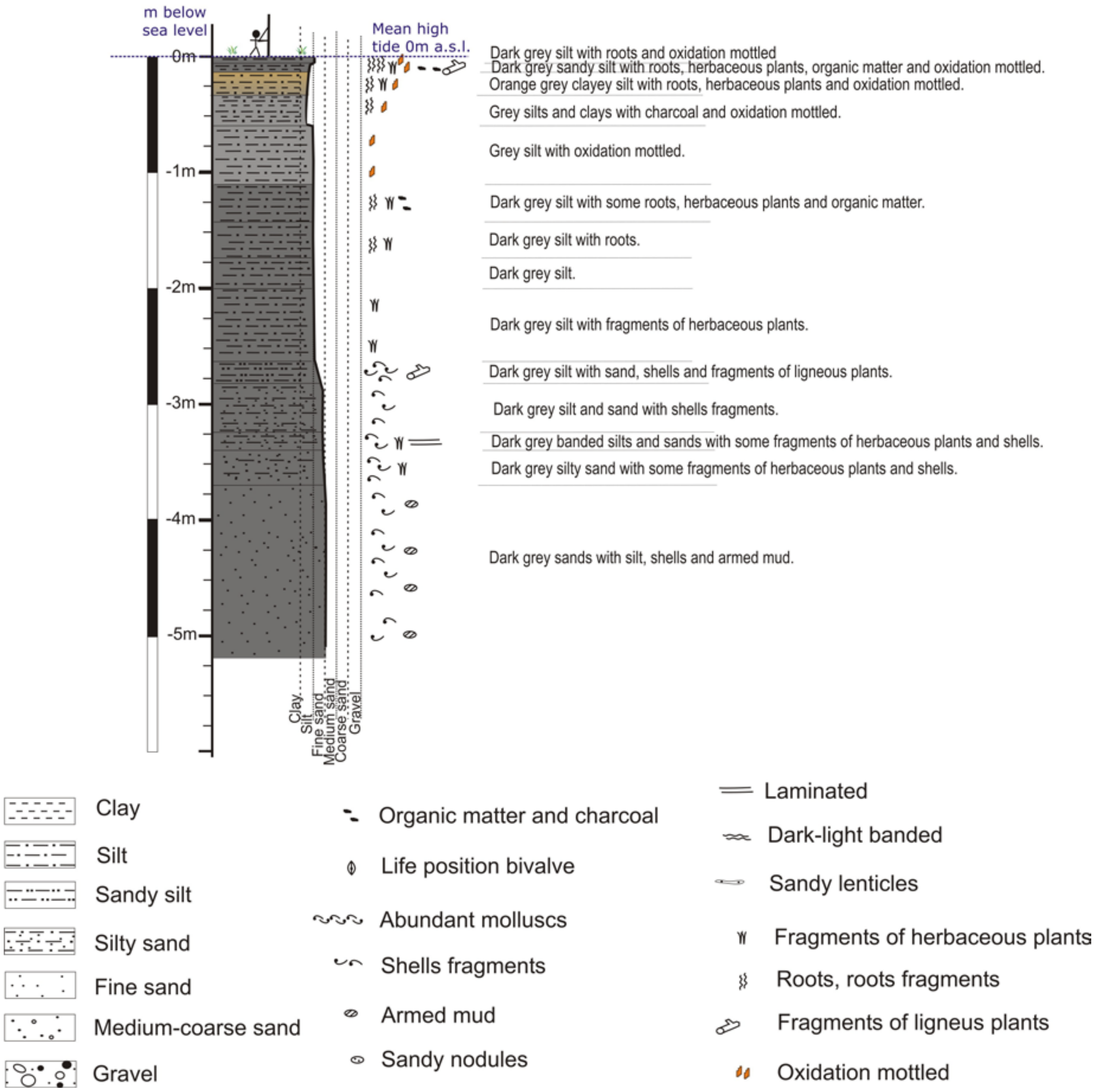
279-325: Dark grey silt and sand with shells fragments.

325-341: Dark grey banded silts and sands with some fragments of herbaceous plants and shells.

341-371: Dark grey silty sand with some fragments of herbaceous plants and shells.

371-521: Dark grey sands with silt, shells and armed mud.

RP-8


m below sea level
Mean high tide 0m a.s.l.
0m
-1m
-2m
-3m
-4m
-5m
Clay
Silt
Fine sand
Medium sand
Coarse sand
Gravel
Dark grey silt with roots and oxidation mottled
Dark grey sandy silt with roots, herbaceous plants, organic matter and oxidation mottled.
Orange grey clayey silt with roots, herbaceous plants and oxidation mottled.
Grey silts and clays with charcoal and oxidation mottled.
Grey silt with oxidation mottled.
Dark grey silt with some roots, herbaceous plants and organic matter.
Dark grey silt with roots.
Dark grey silt.
Dark grey silt with fragments of herbaceous plants.
Dark grey silt with sand, shells and fragments of ligneous plants.
Dark grey silt and sand with shells fragments.
Dark grey banded silts and sands with some fragments of herbaceous plants and shells.
Dark grey silty sand with some fragments of herbaceous plants and shells.
Dark grey sands with silt, shells and armed mud.
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled

RP-9

Date: 4-6-2004
Location: N Piscifactoría Esteros de Huelva
Coordinates 37º 14' 38.86'' N / 7º 9' 41.83'' W
UTM: x 663062.2m / y 4123606.1m (Huso 29)
Elevation: +2 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 6.90 m
Age: Holocene (radiocarbon ages: 2750±40 BP, 6670±50 BP, 6800±60 BP)

Description of the sediments (cm):
0-6: Grey brown silts with roots, herbaceous plants, and oxidation mottled.

6-26: Grey silt with roots, herbaceous and ligneous plants, and oxidation mottled.

26-30: Dark grey silt with roots, herbaceous and ligneous plants.

30-42: Dark grey silt with roots, herbaceous plants, and organic matter.

42-64: Dark grey silt with roots, herbaceous plants, and shells.

64-118: Grey silt with shells and some roots.

118-128: Grey silt with roots.

128-195: Dark grey silt with roots.

195-249: Dark grey silt with some sand lamination, and fragments of roots and herbaceous plants.

249-257: Dark Grey silt with shells and organics.

257-301: Dark grey silt

301-330: Dark grey silt with some fragments of herbaceous plants.

330-414: Dark grey silt with some shells.

414-429: Dark grey silt with sand laminations and herbaceous plants.

429-528: Dark grey silt with some sand and shells.

528-539: Dark grey silty sand.

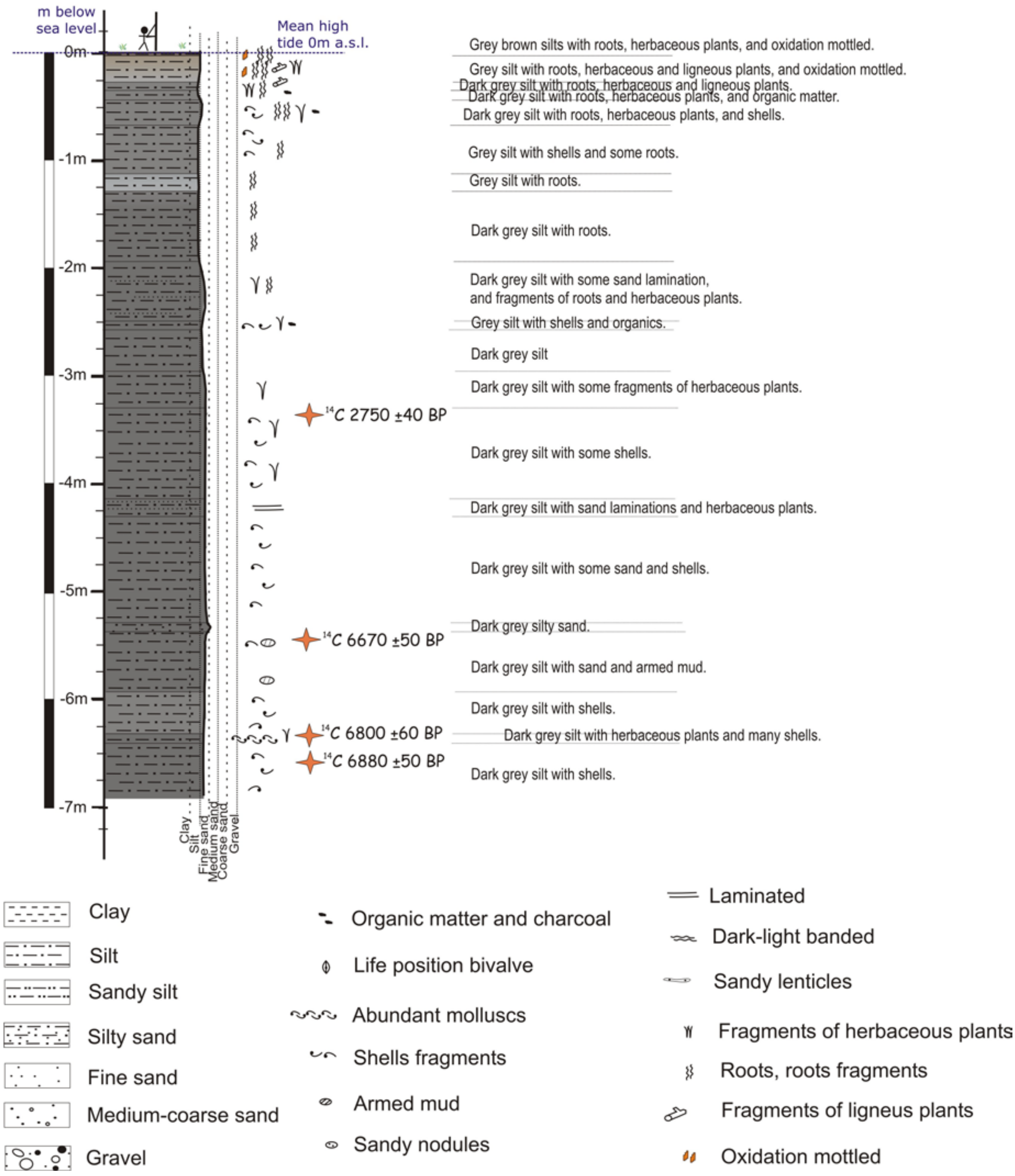
538-595: Dark grey silt with sand and armed mud.

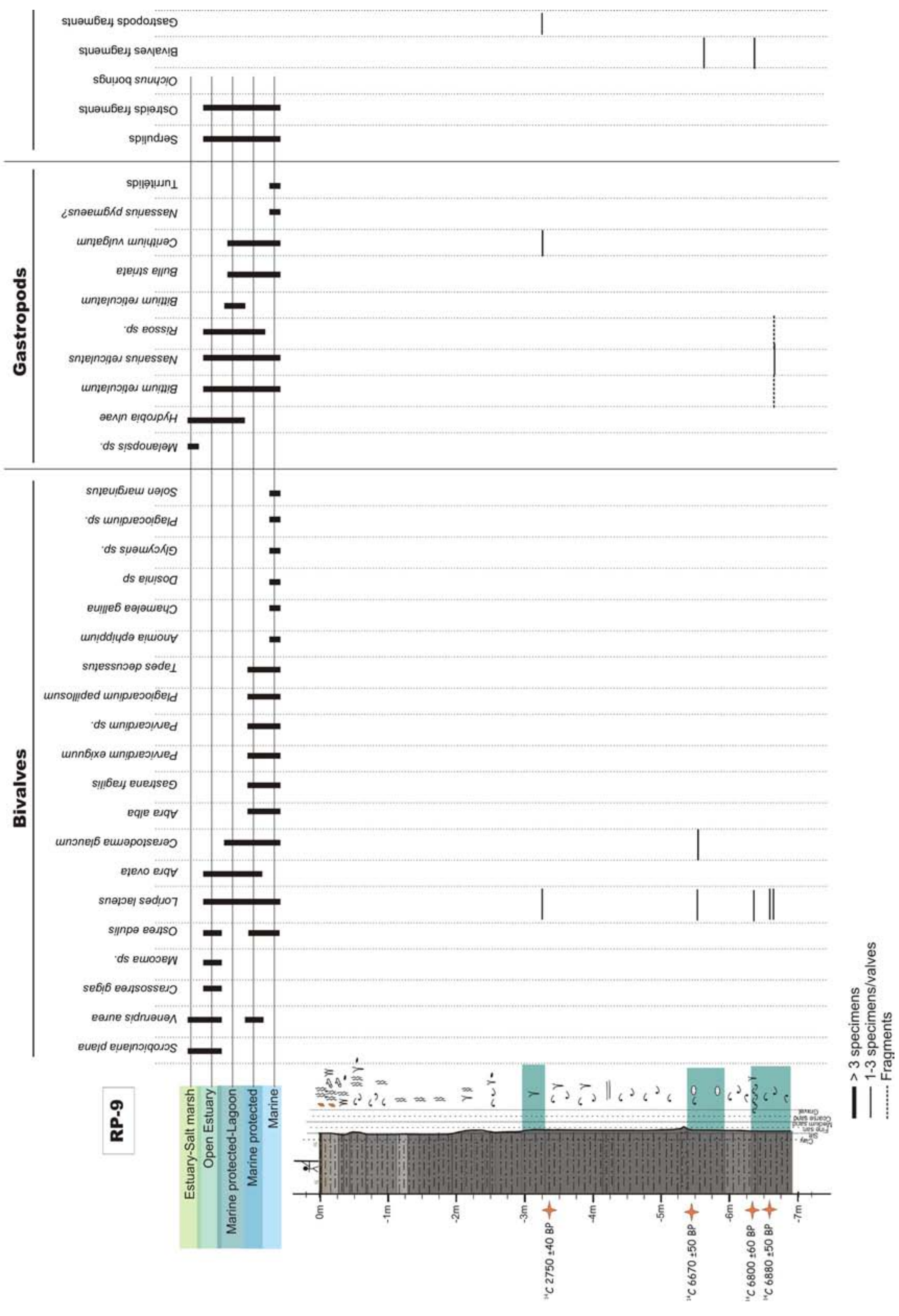
595-630: Dark grey silt with shells.

630-341: Dark grey silt with herbaceous plants and many shells.

641-690: Dark grey silt with shells.

RP-9


m below sea level
Mean high tide 0m a.s.l.
0m
-1m
-2m
-3m
-4m
-5m
-6m
-7m
Grey brown silts with roots, herbaceous plants, and oxidation mottled.
Grey silt with roots, herbaceous and ligneous plants, and oxidation mottled.
Dark grey silt with roots, herbaceous and ligneous plants.
Dark grey silt with roots, herbaceous plants, and organic matter.
Dark grey silt with roots, herbaceous plants, and shells.
Grey silt with shells and some roots.
Grey silt with roots.
Dark grey silt with roots.
Dark grey silt with some sand lamination,
and fragments of roots and herbaceous plants.
Grey silt with shells and organics.
Dark grey silt
Dark grey silt with some fragments of herbaceous plants.
14C 2750 ±40 BP
Dark grey silt with some shells.
Dark grey silt with sand laminations and herbaceous plants.
Dark grey silt with some sand and shells.
Dark grey silty sand.
14C 6670 ±50 BP
Dark grey silt with sand and armed mud.
Dark grey silt with shells.
14C 6800 ±60 BP
Dark grey silt with herbaceous plants and many shells.
14C 6880 ±50 BP
Dark grey silt with shells.
Clay
Silt
Fine sand
Medium sand
Coarse sand
Gravel
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled



RP-9
Bivalves
Gastropods
Scrobicularia plana
Venerupis aurea
Crassostrea gigas
Macoma sp.
Ostrea edulis
Loripes lacteus
Abra ovata
Cerastoderma glaucum
Abra alba
Gastrana fragilis
Parvicardium exiguum
Parvicardium sp.
Plagiocardium papillosum
Tapes decussatus
Anomia ephippium
Chamelea gallina
Dosinia sp
Glycymeris sp.
Plagiocardium sp.
Solen marginatus
Melanopsis sp.
Hydrobia ulvae
Bittium reticulatum
Nassarius reticulatus
Rissoa sp.
Bittium reticulatum
Bulla striata
Cerithium vulgatum
Nassarius pygmaeus?
Turritellids
Serpulids
Ostreids fragments
Oichnus borings
Bivalves fragments
Gastropods fragments
Estuary-Salt marsh
Open Estuary
Marine protected-Lagoon
Marine protected
Marine
0m
-1m
-2m
-3m
-4m
-5m
-6m
-7m
14C 2750 ±40 BP
14C 6670 ±50 BP
14C 6800 ±60 BP
14C 6880 ±50 BP
> 3 specimens
1-3 specimens/valves
Fragments

Molluscs samples:

RP-9	324-325

Gastropod: *Cerithium vulgatum*

RP-9	324-325

Bivalve: *Loripes lacteus* (2 valves)

RP-9	553

Bivalves: *Loripes lacteus* (2 valves)
Cerastoderma glaucum (1valve y 1 frag.).

RP- 9	560

Fragments of Bivalves

RP-9	635

Bivalve: *Loripes lacteus* (2 valves)

RP-9	655

Bivalves: *Loripes lacteus* (2 valves)
Ostrea sp.
Fragments

RP-9	660

Bivalve: *Loripes lacteus* (1 valva)
Gastropod: *Nassarius reticulatus* (2 ej.)
Fragments of *Bittium reticulatum*
Fragments of *Rissoa sp.*

RP-10

Date: 4-6-2004
Location: N Terrón. Los Cangrejos Valley, S Arroyo del Pozo del Pilar.
Coordinates 37º 14’ 39.95’’ N / 7º 11’ 0.14’’ W
UTM: x 661131.92m / y 4123602.24m (Huso 29)
Elevation: +5 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 8.80 m
Age: Holocene (radiocarbon age: 6840±50 BP)
Description of the sediments (cm):
0-34: Orange grey silty sand with organic matter and oxidation mottled.

34-48: Orange fine sand.

48-84: Orange grey silty sand with oxidation mottled.

84-91: Orange grey banded silts and sands with oxidation mottled.

91-100: Orange grey sand with oxidation mottled.

100-104: Orange silty clay with oxidation mottled.

104-114: Orange silty sand with charcoal, oxidation mottled and shells fragments.

114-124: Orange banded silty clays and sands, with oxidation mottled.

124-134: Orange silty clay sand with bands, oxidation mottled and roots.

134-146: Orange silty clay with some sand lamination, oxidation mottled and roots.

146-169: Orange grey silts and clays with oxidation mottled, roots and shells fragments.

169-229: Dark grey organic silt with organic matter, roots and shells fragments.

229-269: Dark grey silt with organics through out and shells.

269-277: Dark grey organic silt with roots and some shell fragment.

277-326: Dark grey silt with roots.

326-342: Dark grey sandy silt with fragments of herbaceous plants.

342-395: Dark grey silt with fragments of herbaceous plants and shells.

395-490: Dark grey silty sand with shells through out and herbaceous plants.

490-547: Dark grey coarse sand with shells and fragments of ligneous plants.

547-553: Dark grey silty sand with fragments of ligneous plants and shells.

553-572: Dark grey coarse sand with silt, shells fragments and turritellids.

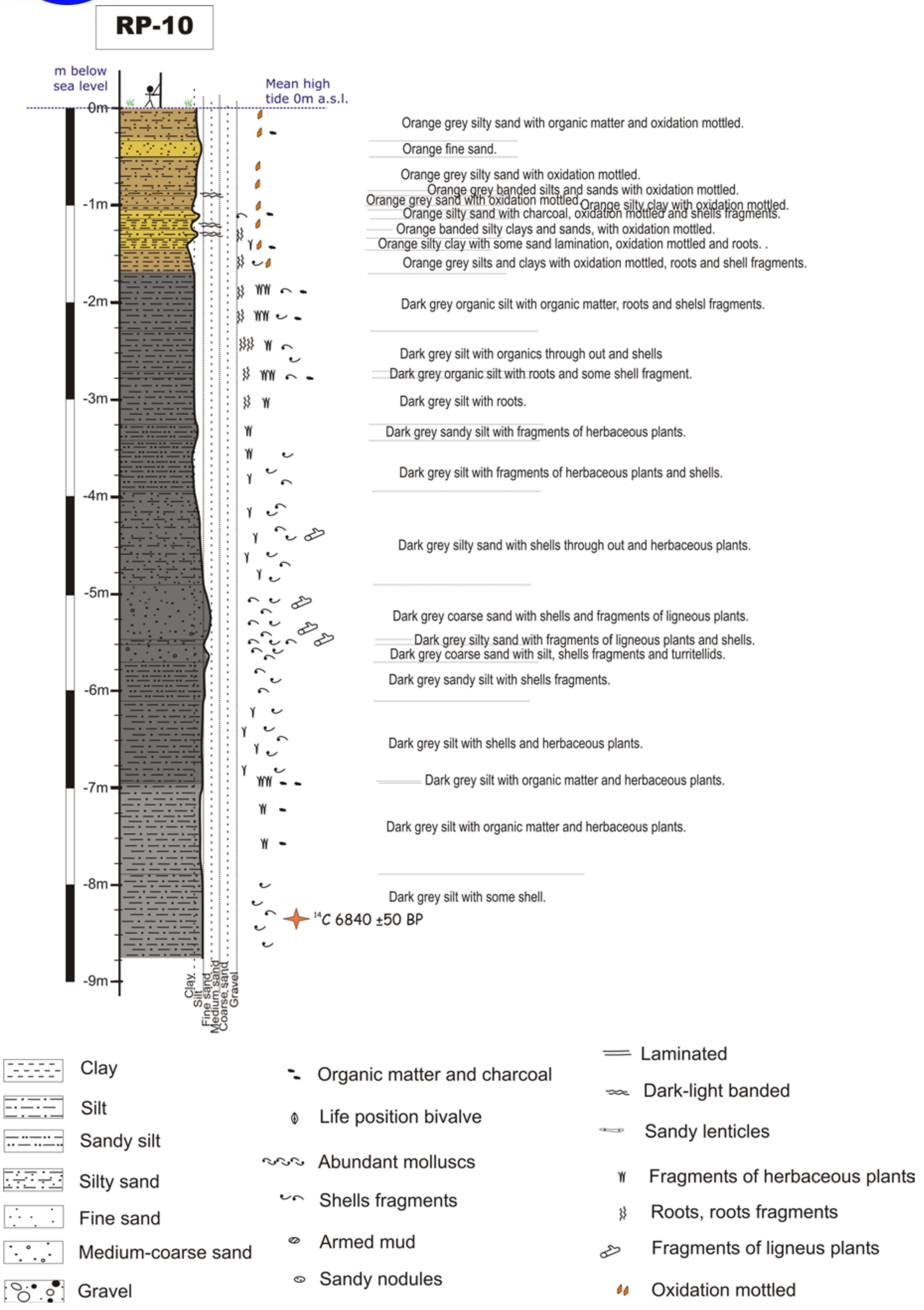
572-611: Dark grey sandy silt with shells fragments.

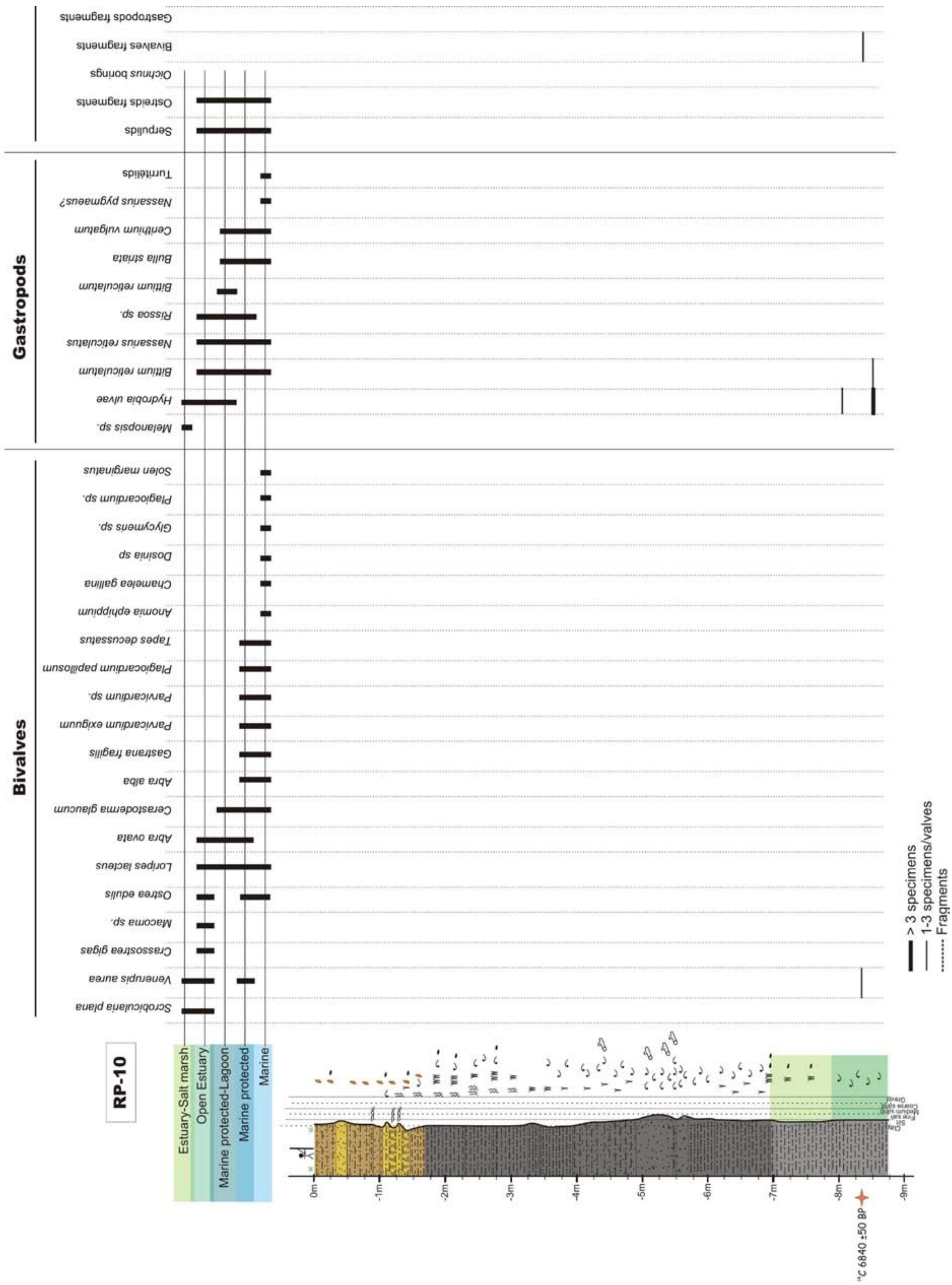
611-694: Dark grey silt with shells and herbaceous plants.

694-696: Dark grey silt with organic matter and herbaceous plants.

696-790: Dark grey silt with organic matter and herbaceous plants.

790-878: Dark grey silt with some shell.


RP-10
m below sea level
Mean high tide 0m a.s.l.
0m
-1m
-2m
-3m
-4m
-5m
-6m
-7m
-8m
-9m
Orange grey silty sand with organic matter and oxidation mottled.
Orange fine sand.
Orange grey silty sand with oxidation mottled.
Orange grey banded silts and sands with oxidation mottled.
Orange grey sand with oxidation mottled.
Orange silty clay with oxidation mottled.
Orange silty sand with charcoal, oxidation mottled and shells fragments.
Orange banded silty clays and sands, with oxidation mottled.
Orange silty clay with some sand lamination, oxidation mottled and roots. .
Orange grey silts and clays with oxidation mottled, roots and shell fragments.
Dark grey organic silt with organic matter, roots and shelsl fragments.
Dark grey silt with organics through out and shells
Dark grey organic silt with roots and some shell fragment.
Dark grey silt with roots.
Dark grey sandy silt with fragments of herbaceous plants.
Dark grey silt with fragments of herbaceous plants and shells.
Dark grey silty sand with shells through out and herbaceous plants.
Dark grey coarse sand with shells and fragments of ligneous plants.
Dark grey silty sand with fragments of ligneous plants and shells.
Dark grey coarse sand with silt, shells fragments and turritellids.
Dark grey sandy silt with shells fragments.
Dark grey silt with shells and herbaceous plants.
Dark grey silt with organic matter and herbaceous plants.
Dark grey silt with organic matter and herbaceous plants.
Dark grey silt with some shell.
14C 6840 ±50 BP
Clay
Silt
Fine sand
Medium sand
Coarse sand
Gravel
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled



Gastropods fragments
Bivalves fragments
Serpulids
Gastropods
Turritellids
Nassarius pygmaeus?
Cerithium vulgatum
Bulla striata
Bittium reticulatum
Rissoa sp.
Nassarius reticulatus
Bittium reticulatum
Hydrobia ulvae
Melanopsis sp.
Bivalves
Solen marginatus
Plagiocardium sp.
Glycymeris sp.
Dosinia sp
Chamelea gallina
Anomia ephippium
Tapes decussatus
Plagiocardium papillosum
Parvicardium sp.
Parvicardium exiguum
Gastrana fragilis
Abra alba
Cerastoderma glaucum
Abra ovata
Loripes lacteus
Ostrea edulis
Macoma sp.
Crassostrea gigas
Venerupis aurea
Scrobicularia plana
RP-10
Estuary-Salt marsh
Open Estuary
Marine protected-Lagoon
Marine protected
Marine
0m
-1m
-2m
-3m
-4m
-5m
-6m
-7m
-8m
-9m
^{14}C 6840 ±50 BP
> 3 specimens
1-3 specimens/valves
Fragments

Molluscs samples:

RP-10	807

Gastropod: *Hydrobia ulvae* (3 ej.)

RP-10	837

Bivalve: *Venerupis aurea* (*Paphia aurea*), 2 valves

RP- 10	850- 852

Gastropods: *Bittium reticulaum* (2ej).
Hydrobia ulvae (fragments)

Bivalves: fragments of *Cardidae* specimens.

RP-11

Date: 5-6-2004
Location: W Cartaya (Huelva), N of La Barca Bridge
Coordinates 37º 17’ 18.53’’ N / 7º 10’ 31.98’’ W
UTM: x 661731.51m / y 4128503.21m (Huso 29)
Elevation: +3 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 7.76 m
Age: Holocene (radiocarbon ages: 6960±60 BP, 7330±50 BP, 7340±50 BP)

Description of the sediments (cm):

0-7: Orange grey silt with roots and oxidation mottled.

7-30: Orange grey silty clay with roots and oxidation mottled.

30-64: Orange grey silt with iron concretions, roots and some charcoal.

64-79: Grey silt with roots and armed mud.

79-88: Grey silt with some sand, roots and herbaceous plants.

88-116: Grey brown organic silt, with herbaceous plants and some roots.

116-176: Grey silt with many roots.

176-203: Dark grey silt with roots and herbaceous plants.

203-230: Dark grey silt with shells and roots.

230-415: Dark grey silt with roots.

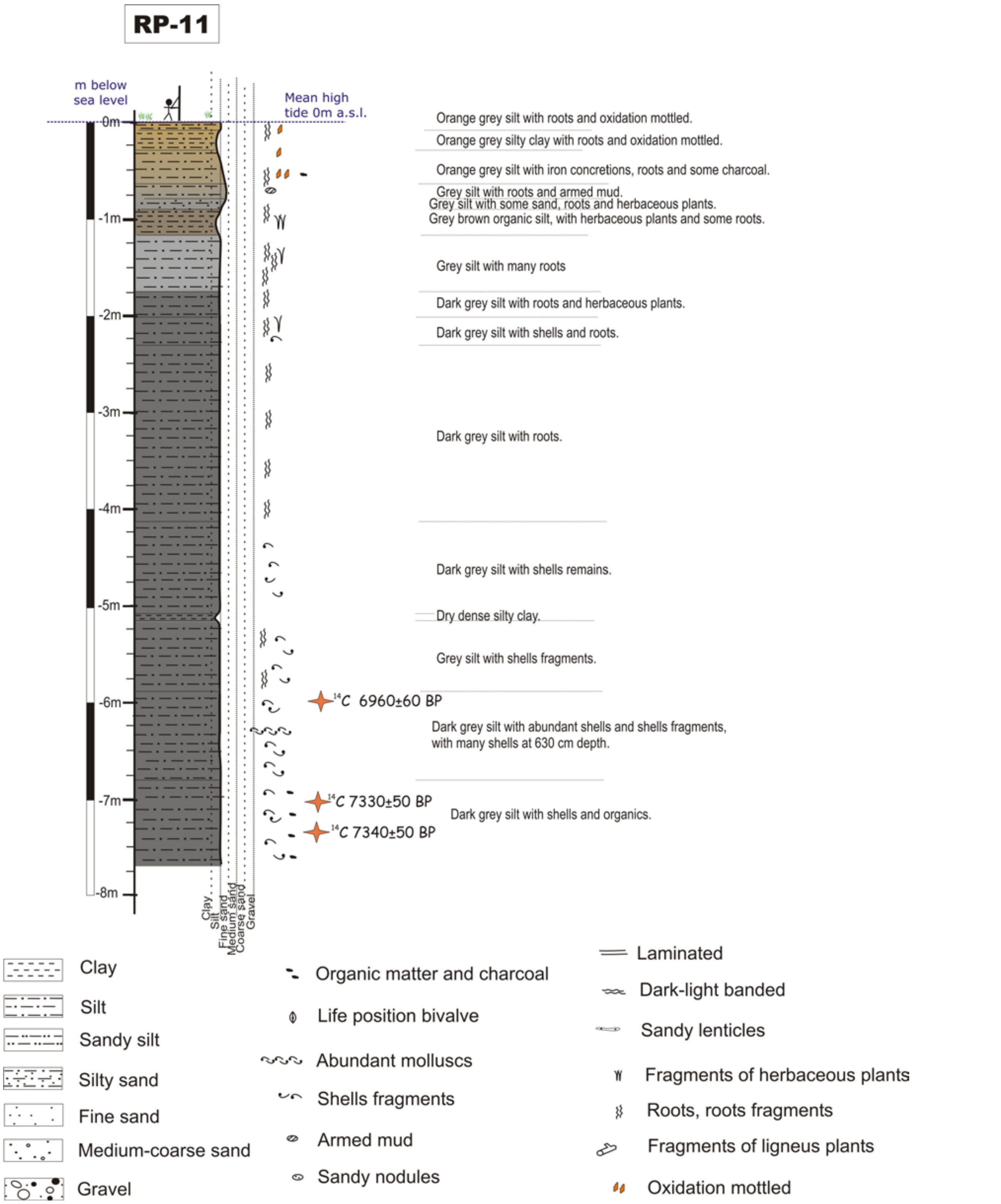
415-509: Dark grey silt with shells remains.

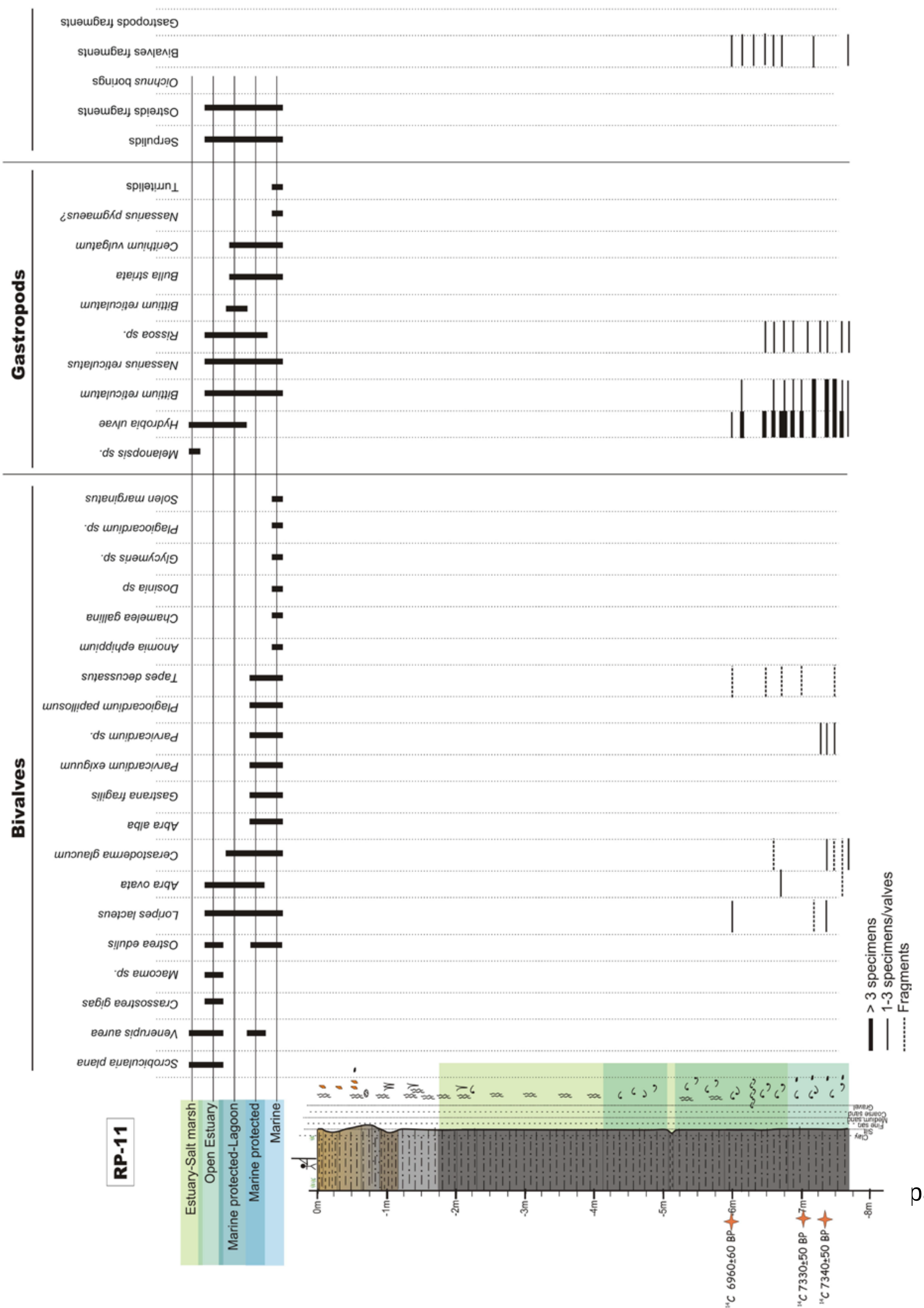
509-515: Dry dense silty clay.

515-590: Grey silt with shells fragments.

590-680: Dark grey silt with abundant shells and shells fragments, with many shells at 630 cm depth.

680-776: Dark grey silt with shells and organics.


RP-11
m below sea level
Mean high tide 0m a.s.l.
0m
-1m
-2m
-3m
-4m
-5m
-6m
-7m
-8m
Clay
Silt
Fine sand
Medium sand
Coarse sand
Gravel
Orange grey silt with roots and oxidation mottled.
Orange grey silty clay with roots and oxidation mottled.
Orange grey silt with iron concretions, roots and some charcoal.
Grey silt with roots and armed mud.
Grey silt with some sand, roots and herbaceous plants.
Grey brown organic silt, with herbaceous plants and some roots.
Grey silt with many roots
Dark grey silt with roots and herbaceous plants.
Dark grey silt with shells and roots.
Dark grey silt with roots.
Dark grey silt with shells remains.
Dry dense silty clay.
Grey silt with shells fragments.
14C 6960±60 BP
Dark grey silt with abundant shells and shells fragments, with many shells at 630 cm depth.
14C 7330±50 BP
14C 7340±50 BP
Dark grey silt with shells and organics.
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled


RP-11
Estuary-Salt marsh
Open Estuary
Marine protected-Lagoon
Marine protected
Marine
Bivalves
Scrobicularia plana
Venerupis aurea
Crassostrea gigas
Macoma sp.
Ostea edulis
Loripes lacteus
Abra ovata
Cerastoderma glaucum
Abra alba
Gastrana fragilis
Parvicardium exiguum
Parvicardium sp.
Plagiocardium papillosum
Tapes decussatus
Anomia ephippium
Chamelea gallina
Dosinia sp
Glycymeris sp.
Plagiocardium sp.
Solen marginatus
Gastropods
Melanopsis sp.
Hydrobia ulvae
Bittium reticulatum
Nassarius reticulatus
Rissoa sp.
Bittium reticulatum
Bulla striata
Cerithium vulgatum
Nassarius pygmaeus?
Turritelids
Serpulids
Osteids fragments
Oichnus borings
Bivalves fragments
Gastropods fragments
0m
-1m
-2m
-3m
-4m
-5m
-6m
-7m
-8m
^{14}C 6960±60 BP
^{14}C 7330±50 BP
^{14}C 7340±50 BP
Clay
Silt
Fine sand
Medium sand
Coarse sand
Gravel
> 3 specimens
1-3 specimens/valves
Fragments

Molluscs samples:

RP- 11	590- 630

Bivalves: fragments of Cardidae specimens and *Tapes decussatus*?

Gastropod: *Hydrobia ulvae*

RP-11	600

Bivalve: *Loripes lacteus* (1 valve)

RP- 11	610- 612

Bivalves: fragments of *Cardidae* specimens and *Veneridade*
Gastropod s: *Bittium reticulaum* (1ej).
Hydrobia ulvae (6 ej.)

RP- 11	630

Bivalves: Fragments of *Tellina sp.*

RP- 11	646- 650

Bivalves: fragments of *Cardidae* specimens and others

Gastropod: *Hydrobia ulvae* (5 ej.)

RP- 11	650

Bivalves: Fragments of *Tapes decussatus*.

RP- 11	650- 652

Gastropods: *Hydrobia ulvae* (4 ej.)
Rissoa sp. (1ej).

RP- 11	652- 660

Gastropods: *Bittium reticulatum* (3ej)
Hydrobia ulvae (5 ej.)
Rissoa sp. (1ej)

Bivalves: Fragments of *Cerastoderma glaucum*

RP- 11	662- 670

Gastropods: *Hydrobia ulvae* (8 ej.)
fragments of *Bittium reticulatum*

Bivalvos: fragments of *Cardidae* specimens and 1 valve of *Abra ovata?*

RP- 11	672- 680 (no seguro)

Gastropods: *Bittium reticulatum* (2ej)
Hydrobia ulvae (13 ej.)
Rissoa sp. (2ej)

Bivalves: Fragments of *Tapes decussatus*, and *Cardidae*

RP- 11	682- 690

Gastropods: *Bittium reticulatum* (2ej)
Hydrobia ulvae (16 ej.)
Rissoa sp. (2ej)

RP- 11	685

Bivalve: *Loripes lacteus* (1 valve)

RP- 11	700-702 ok

Gastropods: *Bittium reticulatum* (1ej)
Hydrobia ulvae (4 ej.)

Bivalve: *Loripes lacteus* (1 valve)

RP- 11	700-702

Bivalves: Fragments of *Tapes decussatus?*

RP- 11	702-710

Bivalves: Fragments of *Tapes decussatus?*

Gastropods: *Bittium reticulaum* (5ej.)
Hydrobia ulvae (6ej.)
Rissoa sp. (2ej.)

RP- 11?	712-720

Gastropods: *Bittium reticulatum* (3ej)
Hydrobia ulvae (2 ej.)

Bivalves: Fragments of *Loripes lacteus*, pectinidae, and cardidae

RP- 11	**722-730 (no seguro)**

Gastropods: *Rissoa sp.*

Bivalves: *Parvicardium* sp.?

RP- 11	**733- 740**

Bivalves: *Cerastoderma glaucum* (3 valves)
Loripes lacteus (2 valves)
Parvicardium sp. (1 valve)

Gastropods: *Bittium reticulaum* (14ej).
Hydrobia ulvae (21 ej.)
Rissoa sp. (2ej)

RP- 11	**740-742**

Gastropods: *Bittium reticulatum* (6ej)
Hydrobia ulvae (7 ej.)

Bivalves: *Parvicardium* sp.?
Fragments of *C. glaucum*?
Fragments of *Tapes decussatus*?

RP- 11	**745-750**

Bivalvos: Fragments of *Cerastoderma glaucum*, and *Abra ovata*?,

Gastropods: *Bittium reticulaum* (3ej).
Hydrobia ulvae (18 ej.)
Rissoa sp. (3ej)

RP- 11	**752-760**

Bivalves: Fragments of *Cerastoderma glaucum*

Gastropods: *Bittium reticulaum* (3ej).
Hydrobia ulvae (1 ej.)
Rissoa sp. (1ej)

RP-12

Date: 5-6-2004
Location: Las Gavias, N Molino de la Rivera, WArroyo de la Puntazuela.
Coordinates: 37º 16’ 29.25’’ N / 7º 9’ 55.92’’ W
UTM: x 662649.03m / y 4127001.51m (Huso 29)
Elevation: +2 m a. s.l.
Type: Manual, Eijelkanp corer
Depth: 6 m
Age: Holocene

Description of the sediments (cm):
0-19: Orange grey silt with roots, herbaceous and ligneous plants, and oxidation mottled.

19-35: Orange grey silt with roots, herbaceous plants and oxidation mottled.

35-52: Dark grey to black silt with roots, herbaceous plants and organic matter.

52-100: Dark grey silt with organics through out.

100-135: Dark grey silty clay with roots and herbaceous plants

135-226: Dark grey silt with some shell, roots and herbaceous plants.

226-282: Dark grey silt with some sand.

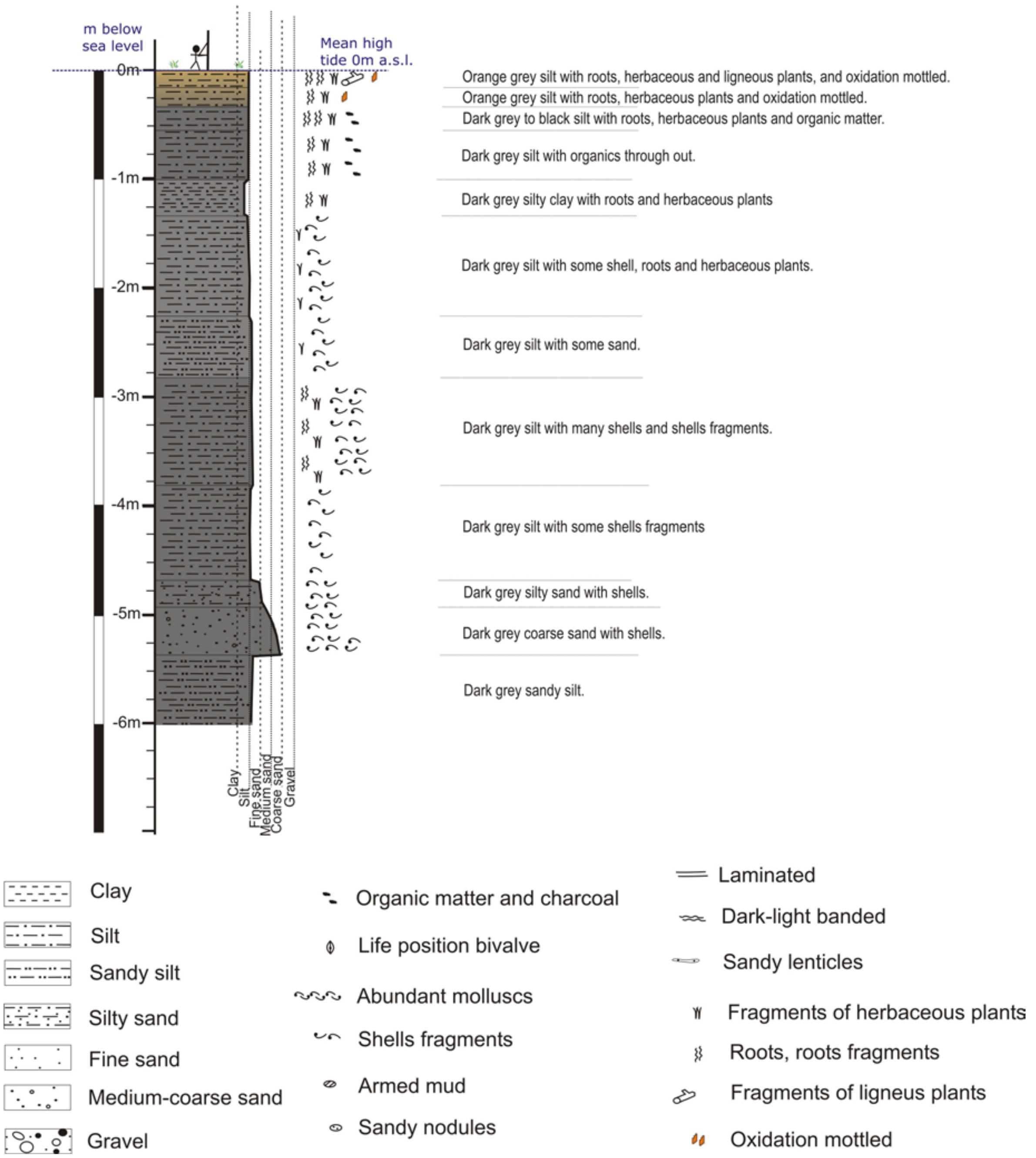
282-380: Dark grey silt with many shells and shells fragments.

380-471: Dark grey silt with some shells fragments

471-497: Dark grey silty sand with shells.

497-540: Dark grey coarse sand with shells.

540-603: Dark grey sandy silt.


RP-12
m below sea level
0m
-1m
-2m
-3m
-4m
-5m
-6m
Mean high tide 0m a.s.l.
Clay
Silt
Fine sand
Medium sand
Coarse sand
Gravel
Orange grey silt with roots, herbaceous and ligneous plants, and oxidation mottled.
Orange grey silt with roots, herbaceous plants and oxidation mottled.
Dark grey to black silt with roots, herbaceous plants and organic matter.
Dark grey silt with organics through out.
Dark grey silty clay with roots and herbaceous plants
Dark grey silt with some shell, roots and herbaceous plants.
Dark grey silt with some sand.
Dark grey silt with many shells and shells fragments.
Dark grey silt with some shells fragments
Dark grey silty sand with shells.
Dark grey coarse sand with shells.
Dark grey sandy silt.
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled

RP-13

Date: 5-6-2004
Location: El Prado Marsh
Coordinates 37º 15' 20.25'' N / 7º 10' 13.65'' W
UTM: x 662253.37m / y 4124866.35m (Huso 29)
Elevation: +4 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 7 m
Age: Holocene

Description of the sediments (cm):

0-8: Orange sand with oxidation mottled.

8-12: Orange brown silty sand with oxidation mottled.

12-14: Very dark grey silt with some lamination and organic matter.

14-23: Orange sand with oxidation mottled.

23-27: Dark grey clayey silt with oxidation mottled.

27-53: Orange grey silty clay with roots, herbaceous plants and oxidation mottled.

53-71: Orange grey clayey silt with roots, herbaceous plants and oxidation mottled.

71-87: Dark grey black stein silt, with roots, herbaceous plants and oxidation mottled.

87-123: Grey silt with roots, herbaceous plants and oxidation mottled.

123-130: Very dark grey silt.

130-534: Dark grey silt, increase sand with depth from 300 cm.

534-554: Grey sandy silt with very small fragments of shells.

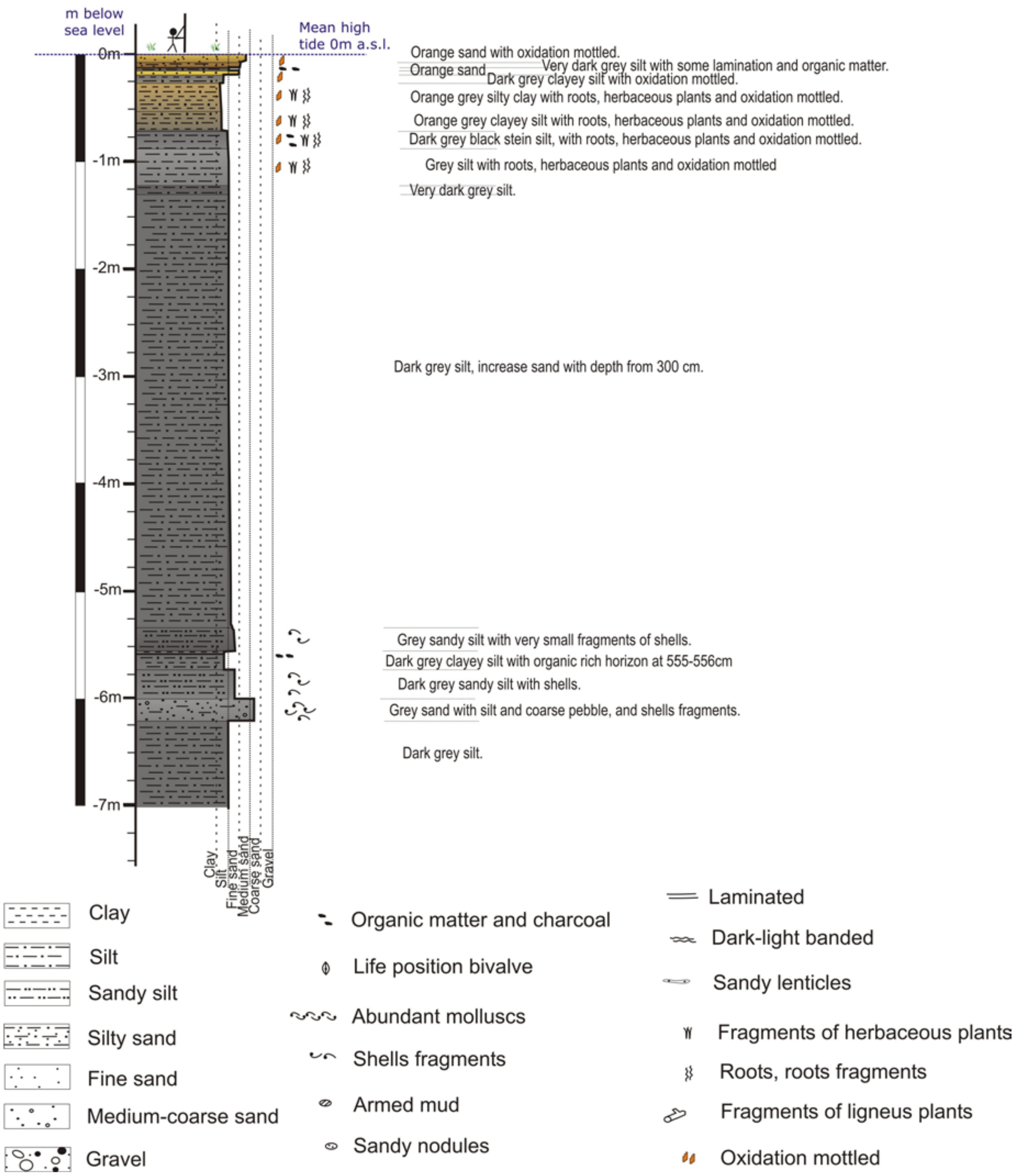
554-572: Dark grey clayey silt with organic rich horizon at 555-556cm

572-600: Dark grey sandy silt with shells.

600-620: Grey sand with silt and coarse pebble, and shells fragments.

620-701: Dark grey silt.

RP-13



m below sea level
Mean high tide 0m a.s.l.
0m
-1m
-2m
-3m
-4m
-5m
-6m
-7m
Orange sand with oxidation mottled.
Orange sand
Very dark grey silt with some lamination and organic matter.
Dark grey clayey silt with oxidation mottled.
Orange grey silty clay with roots, herbaceous plants and oxidation mottled.
Orange grey clayey silt with roots, herbaceous plants and oxidation mottled.
Dark grey black stein silt, with roots, herbaceous plants and oxidation mottled.
Grey silt with roots, herbaceous plants and oxidation mottled
Very dark grey silt.
Dark grey silt, increase sand with depth from 300 cm.
Grey sandy silt with very small fragments of shells.
Dark grey clayey silt with organic rich horizon at 555-556cm
Dark grey sandy silt with shells.
Grey sand with silt and coarse pebble, and shells fragments.
Dark grey silt.
Clay
Silt
Fine sand
Medium sand
Coarse sand
Gravel
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled

RP-14

Date: 6-6-2004
Location: W El Rompido
Coordinates 37º 13’ 13.52’’ N / 7º 8’ 55.93’’ W
UTM: x 664244.48m / y 4120997.71m (Huso 29)
Elevation: +2 m a.s.l.
Type: Manual, Eijelkanp corer
Depth: 1.60 m
Age: Holocene

Description of the sediments (cm):

0-12: Orange grey silt with roots and oxidation mottled.

12-23: Grey silt with roots and oxidation mottled.

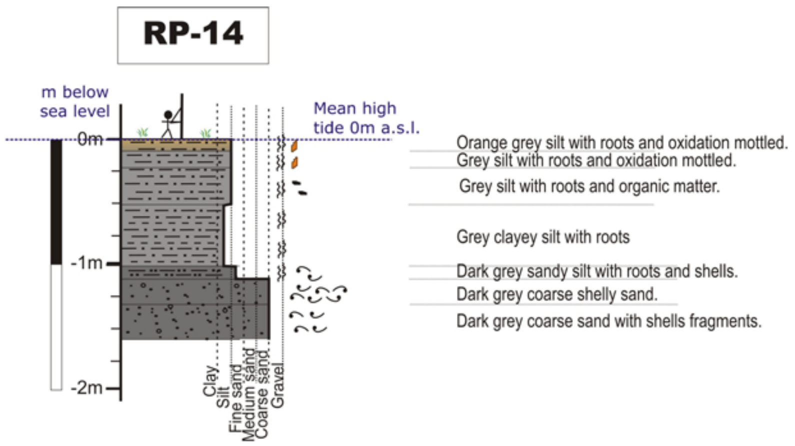
23-52: Grey silt with roots and organic matter.

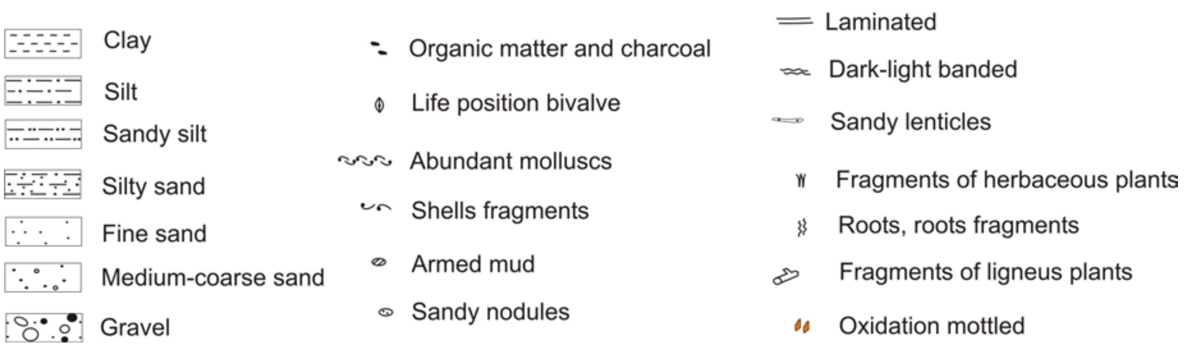
52-101: Grey clayey silt with roots.

101-116: Dark grey sandy silt with roots and shells.

116-130: Dark grey coarse shelly sand.

130-160: Dark grey coarse sand with shells fragments.





Project n. 037110

NEAREST

"Integrated observations from NEAR shore sourcES of Tsunamis: towards an early warning system"

Instrument: STREP

Thematic priority: 1.1.6.3 GOCE (GlObal Change and Ecosystems)

D21: REPORT ON ONSHORE TSUNAMI RECORDS ANNEXE 7 – RESULTS OF ROTARY CORES IN RIO PIEDRAS LOWLAND

Due date of deliverable: 30 November 2009 (26 months)

Actual submission date: 5 June 2010

Start date of project: 1/10/2006 Duration: 36 + 6 months

Organisation name of lead contractor for this deliverable: **CSIC**

Revision: template

Project Co founded By the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination level		
PU	Public	
PP	Restricted to other programme participants (including Commission Services)	
RE	Restricted to a group specified by the Consortium (including Commission Services)	RE
CO	Confidential, only for members of the Consortium (including Commission Services)	

WP6 - Paleotsunami and Paleoseismic records

D21: REPORT ON *ONSHORE TSUNAMI RECORDS* ANNEXE 7 – RESULTS OF ROTARY CORES IN RIO PIEDRAS LOWLAND

Leader WP 6: CSIC

Dr Eulalia Gracia

Unitat de Tecnologia Marina - CSIC
Centre Mediterrani d'Investigacions Marines i Ambientals (CMIMA)
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Responsible Task 6.1:

Onshore sedimentological evidence of tsunami records

C. Andrade

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FCUL, FFCUL, Lisboa, Portugal
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Responsible Scientist
for contents of this Annexe: J. Lario, UNED/CSIC

RP-2b

Date: 12-7-2007
Location: W El Rompido. San Miguel Marshes. N Cabezos del Terrón. S Estero del Carbón
Coordinates 37º 13' 31.98'' N / 7º 9' 31.13'' W
UTM: x 663365.85m / y 4121549.77m (Huso 29)
Elevation: +2 m a.s.l.
Type: Rotation, Drilling truck
Depth: PR-2b-1: 8m; RP-2b-2: 3m
Age: Holocene

Description of the sediments (cm):

-130-180 cm: Grey-green sandy silt- silt with organics, oxidation mottled and some fragments of herbaceous plants.

-180-285 cm: Green to dark grey sandy silt with organic matter and sand lencicles around 260 cm.

-285-290 cm: Green grey clayey silt with organic matter

-290-380 cm: Dark yellow fine-medium rounded sand with some small shells fragments and pebbles.

-380 -500 cm: Progressive change to yellow grey fine sand with dark grey sandy silt and black micaceous sand laminations at the base.

-505 -510 cm: Dark grey silty sand

-510-548 cm: Grey sands and gravels with abundant rounded shells fragments (fragments of echinoids, molluscs, planktonic foraminifera, and ostracods)

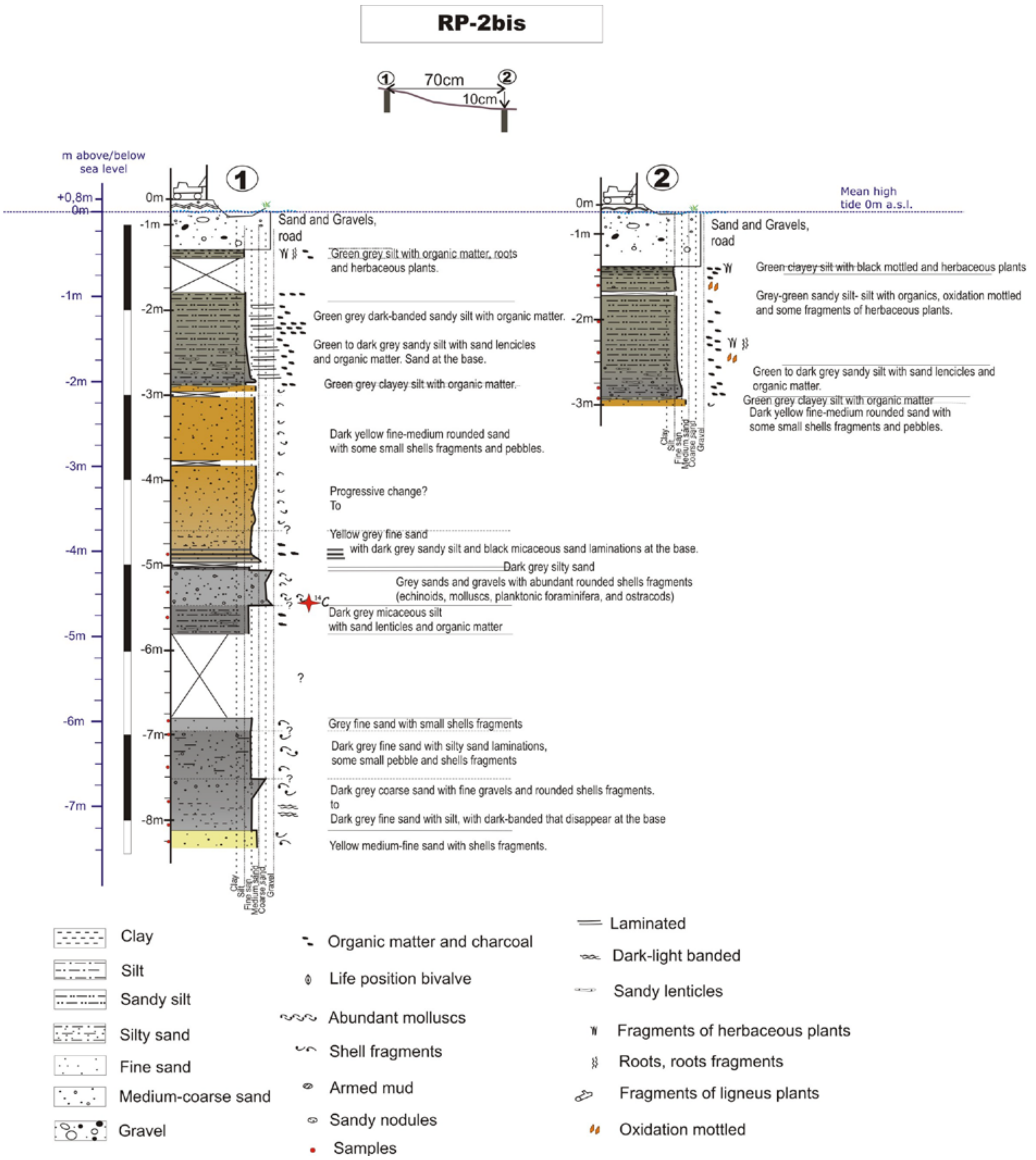
-548-580 cm: Dark grey micaceous silt with sand lenticles and organic matter

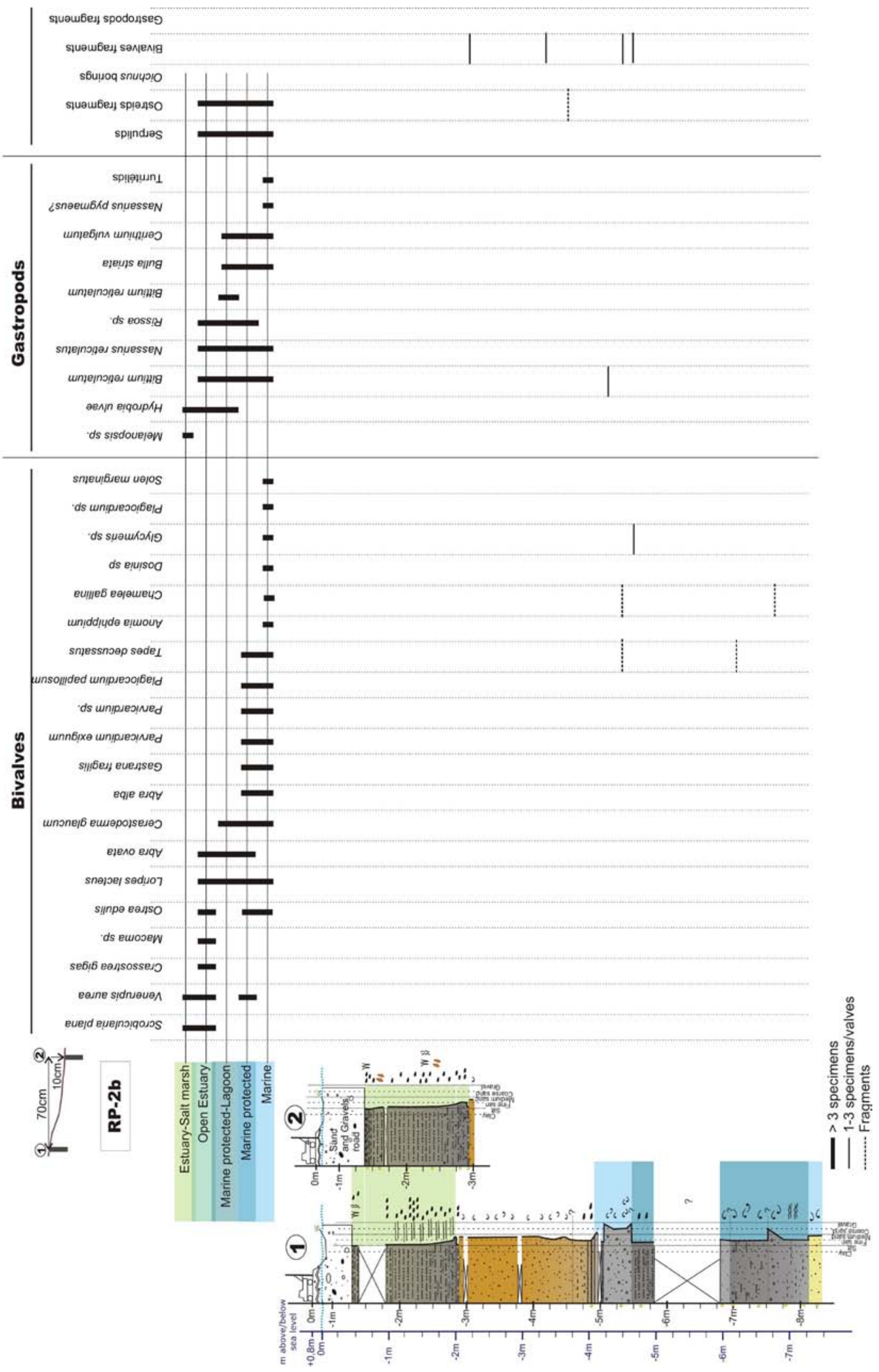
-680 -695 cm: Grey fine sand with small shells fragments

-695 -750 cm: Dark grey fine sand with silty sand laminations, some small pebble and shells fragments

-750 - 810 cm: Dark grey coarse sand with fine gravels and rounded shells fragments at the top. Dark grey fine sand with silt, with dark-banded that disappear at the base

-810-830 cm: Yellow medium-fine sand with shells fragments (some *Bittium* and turritelids identified)


RP-2bis
70cm
10cm
m above/below sea level
Mean high tide 0m a.s.l.
Sand and Gravels, road
Green grey silt with organic matter, roots and herbaceous plants.
Green grey dark-banded sandy silt with organic matter.
Green to dark grey sandy silt with sand lencicles and organic matter. Sand at the base.
Green grey clayey silt with organic matter.
Dark yellow fine-medium rounded sand with some small shells fragments and pebbles.
Progressive change? To
Yellow grey fine sand with dark grey sandy silt and black micaceous sand laminations at the base.
Dark grey silty sand
Grey sands and gravels with abundant rounded shells fragments (echinoids, molluscs, planktonic foraminifera, and ostracods)
Dark grey micaceous silt with sand lenticles and organic matter
Grey fine sand with small shells fragments
Dark grey fine sand with silty sand laminations, some small pebble and shells fragments
Dark grey coarse sand with fine gravels and rounded shells fragments. to Dark grey fine sand with silt, with dark-banded that disappear at the base
Yellow medium-fine sand with shells fragments.
Green clayey silt with black mottled and herbaceous plants
Grey-green sandy silt- silt with organics, oxidation mottled and some fragments of herbaceous plants.
Green to dark grey sandy silt with sand lencicles and organic matter.
Green grey clayey silt with organic matter
Dark yellow fine-medium rounded sand with some small shells fragments and pebbles.
Clay
Silt
Fine sand
Medium sand
Coarse sand
Gravel
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shell fragments
Armed mud
Sandy nodules
Samples
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled



Bivalves
Gastropods
Scrobicularia plana
Venerupis aurea
Crassostrea gigas
Macoma sp.
Ostrea edulis
Loripes lacteus
Abra ovata
Cerastoderma glaucum
Abra alba
Gastrana fragilis
Parvicardium exiguum
Parvicardium sp.
Plagiocardium papillosum
Tapes decussatus
Anomia ephippium
Chameleа gallina
Dosinia sp
Glycymeris sp.
Plagiocardium sp.
Solen marginatus
Melanopsis sp.
Hydrobia ulvae
Bittium reticulatum
Nassarius reticulatus
Rissoa sp.
Bulla striata
Cerithium vulgatum
Nassarius pygmaeus?
Turritelids
Serpulids
Ostreids fragments
Ocinus borings
Bivalves fragments
Gastropods fragments
RP-2b
70cm
10cm
Estuary-Salt marsh
Open Estuary
Marine protected-Lagoon
Marine protected
Marine
> 3 specimens
1-3 specimens/valves
Fragments
m above/below sea level
Sand and Gravels road
Clay
Silt
Fine san
Medium sand
Coarse sand
Gravel

Molluscs Results:

The mollusc content is scarce, there is abundance of small shells fragments, unbroken shells are scarce. The identified species are:

0~290cm: green-grey silt and sandy silt without molluscs rests

~290~500cm: yellow-grey fine sands with small rounded shells fragments; some of them of ostreids with abrasion and superficial dissolution signs.

~500~810cm: Grey sands, sandy silts and silty sands, with rounded bivalves and gastropods fragments with abrasion and superficial dissolution signs. There are fragments of *Tapes decussates, Cahmelea gallina, Glycymeris* sp., Cardidade, and *Bittium reticulatum.*

~810~830cm: Yellow sand with small rounded bivalves fragments; some *Bittium* fragment.

Tapes decussates, Cahmelea gallina, Glycymeris sp., Cardidade, and *Bittium reticulatum* are coastal marine species (*Bittium reticulatum* is eurihaline, and lives from brackish to marine environments). They live at low depths in silt and sand bottoms, from low tide level to 20-25m depth.

According to sedimentary facies and mollusc content, the possible palaeoenvironments are:

0~290cm: High salt marsh- flood plain

~290~500cm: Tidal channel? Sand flood plain?

~500~810cm: possible open estuary with marine influence, to protected marine environment (channel of the estuary mouth, to lagoon near spit-bar?)

~810~830cm: possible beach-barrier

RP-11b

Date: 17-10-2007
Location: W Cartaya (Huelva), N La Barca Bridge,
Coordinates 37º 17’ 16.79’’ N / 7º 10’ 31.27’’ W
UTM: x 661749.92m / y 4128449.96m (Huso 29)
Elevation: +3 m a.s.l.
Type: Rotation, Drilling truck
Depth: 8 m
Age: Holocene (radiocarbon ages: 2090±40 a BP, 1420±40 a BP, 660±40 a BP, 6020±60 a BP) + Tertiary substrate

Description of the sediments (cm):

0-7 cm: Orange brown silt

7-18 cm: Orange brown oxidation mottled silt

18-26 cm: Green brown oxidation mottled sandy silt with organic matter

26-41 cm: Dark green brown silt with charcoal?

41-47 cm: original sediment mixed with superficial reddish sands and gravels.

47-71 cm: Green grey banded sandy silt with small armed mud and fragments of herbaceous plants and shells.

71-172 cm: Dark grey silt with fragments of herbaceous plants, organic matter, shells fragments and reddish armed mud. Radiocarbon age: *Scrobicularia plana* **2090**± **40 BP** (112cm depth). Sand lamina at 165cm depth.

172-263cm: Grey sandy silt to silt with fragments of herbaceous plants and shells. 210-215 cm depth, sandy lenticles; some armed mud at 250cm depth. Radiocarbon age: *Scrobicularia plana* **1420**± **40 BP** (191cm depth).

263-309 cm: Grey silt to silty sand with fragments of herbaceous plants and shells, and thin sandy laminae at 286-293cm.

309-310cm: Sand lamina

310-366cm: Green grey sandy silt with fragments of herbaceous plants, shells and reddish armed mud. Radiocarbon age: *Scrobicularia plana* **660**± **40 BP** (330cm depth).

366-394cm: Grey silty sand with fragments of herbaceous plants, and some shell fragment.

394-445cm: Grey sandy silt with fragments of herbaceous plants and shells, and some small pebble from 420cm depth.

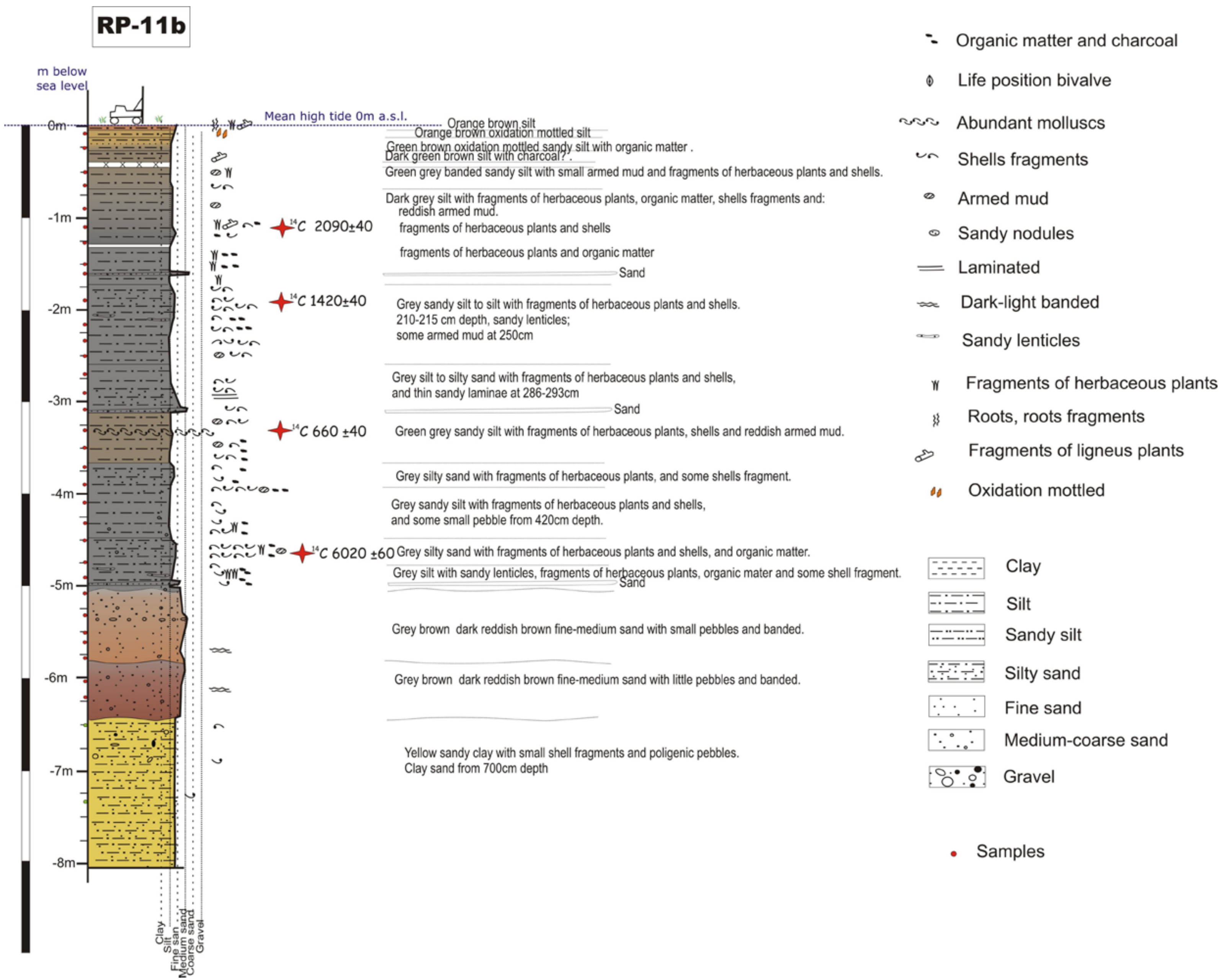
445-470cm: Grey silty sand with fragments of herbaceous plants and shells, and organic matter. Radiocarbon age: *Scrobicularia plana* **6020**± **60 BP** (466cm depth)

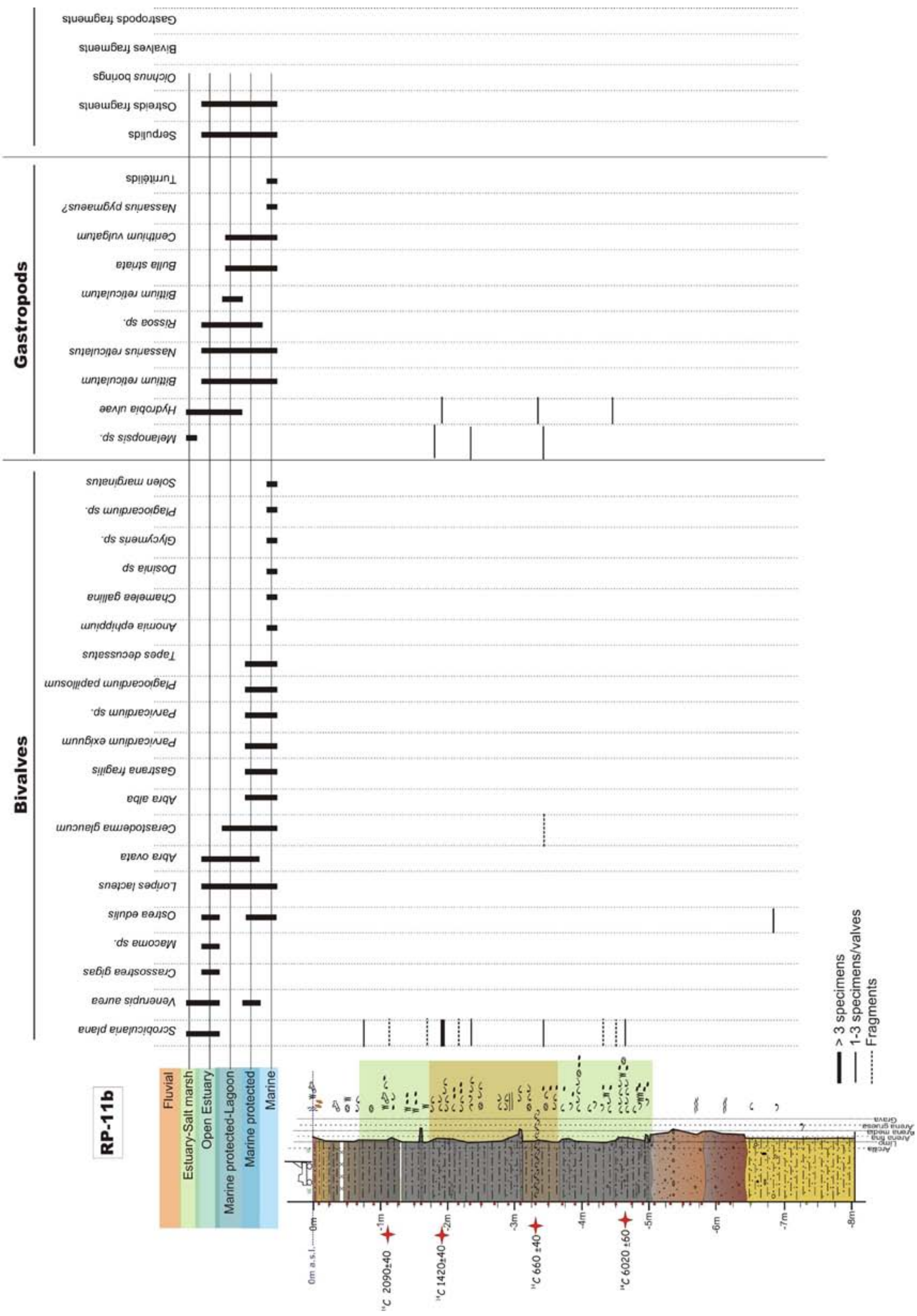
470-502 cm: Grey silt with sandy laminae, fragments of herbaceous plants, organic mater and some shell fragment. Sandy lenticles at 493-496 cm depth.

Erosive contact

502-646 cm: Grey brown – dark reddish brown fine-medium sand with small pebbles and banded. There are two sand bodies limited by an erosive surface at 580 cm depth.

Erosive contact
645-800cm: Yellow sandy clay with small shells fragments and poligenic pebbles. Clayey sand from 700cm depth. Miocene basement, probably.


RP-11b
m below sea level
Mean high tide 0m a.s.l.
0m
-1m
-2m
-3m
-4m
-5m
-6m
-7m
-8m
Clay
Silt
Fine san
Medium sand
Coarse sand
Gravel
14C 2090±40
14C 1420±40
14C 660 ±40
14C 6020 ±60
Orange brown silt
Orange brown oxidation mottled silt
Green brown oxidation mottled sandy silt with organic matter .
Dark green brown silt with charcoal? .
Green grey banded sandy silt with small armed mud and fragments of herbaceous plants and shells.
Dark grey silt with fragments of herbaceous plants, organic matter, shells fragments and:
reddish armed mud.
fragments of herbaceous plants and shells
fragments of herbaceous plants and organic matter
Sand
Grey sandy silt to silt with fragments of herbaceous plants and shells.
210-215 cm depth, sandy lenticles;
some armed mud at 250cm
Grey silt to silty sand with fragments of herbaceous plants and shells,
and thin sandy laminae at 286-293cm
Sand
Green grey sandy silt with fragments of herbaceous plants, shells and reddish armed mud.
Grey silty sand with fragments of herbaceous plants, and some shells fragment.
Grey sandy silt with fragments of herbaceous plants and shells,
and some small pebble from 420cm depth.
Grey silty sand with fragments of herbaceous plants and shells, and organic matter.
Grey silt with sandy lenticles, fragments of herbaceous plants, organic mater and some shell fragment.
Sand
Grey brown dark reddish brown fine-medium sand with small pebbles and banded.
Grey brown dark reddish brown fine-medium sand with little pebbles and banded.
Yellow sandy clay with small shell fragments and poligenic pebbles.
Clay sand from 700cm depth
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shells fragments
Armed mud
Sandy nodules
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Samples


RP-11b
Fluvial
Estuary-Salt marsh
Open Estuary
Marine protected-Lagoon
Marine protected
Marine
Bivalves
Scrobicularia plana
Venerupis aurea
Crassostea gigas
Macoma sp.
Ostrea edulis
Loripes lacteus
Abra ovata
Cerastoderma glaucum
Abra alba
Gastrana fragilis
Parvicardium exiguum
Parvicardium sp.
Plagiocardium papillosum
Tapes decussatus
Anomia ephippium
Chameleа gallina
Dosinia sp
Glycymeris sp.
Plagiocardium sp.
Solen marginatus
Gastropods
Melanopsis sp.
Hydrobia ulvae
Bittium reticulatum
Nassarius reticulatus
Rissoa sp.
Bittium reticulatum
Bulla striata
Cerithium vulgatum
Nassarius pygmaeus?
Turritellids
Serpulids
Ostreids fragments
Oichnus bourings
Bivalves fragments
Gastropods fragments
> 3 specimens
1-3 specimens/valves
Fragments
0m a.s.l.
^{14}C 2090±40
^{14}C 1420±40
^{14}C 660 ±40
^{14}C 6020 ±60

Molluscs Results:

The mollusc content is scarce, there is abundance of small shells fragments, unbroken shells are scarce. The identified species are:

0-70 cm: small unidentified shell fragments.

~70 ~170: angular fragments of *Scrobicularia plana* and some well preserved valve.

~170~370: separate valves and fragments of *Scrobicularia plana,* generally well preserved. Angular fragments of *Cerastoderma edule,* some shell of *Hydrobia ulvae* and *Melanopsis sp.* with abrasion signs.

~370~510: angular fragments of *Scrobicularia plana* with abrasion and superficial dissolution signs, and some valve well preserved. Some shell of *Hydrobia ulvae.*

~510~650: without molluscs rests

~650~800: some well preserved valve and fragments of *Ostrea edulis*.

Scrobicularia plana, *Cerastoderma edule* and *Hydrobia ulvae* are eurihaline species. They live at low depths in silt- silty sand bottoms, with organic matter and algae. *Scrobicularia plana* is abundant in Salt marshes and mud flats; *Cerastoderma edule* and *Hydrobia ulvae* are also abundant in these environments, and in lagoons and open estuaries.

According to sedimentary facies and mollusc content, the possible palaeoenvironments are:

0-170: Salt marsh

170-370: High salt marsh- flood plain

370-510: Salt marsh

510-650: alluvial?

RP-15

Date: 18-10-2007
Location: 47m to the E of RP-9 y 9b. N Piscifactoría Esteros de Huelva.
Coordinates 37º 14' 39.42'' N / 7º 9' 31.59'' W
UTM: x 663314.24m / y 4123628.1m (Huso 29)
Elevation: +3 m a.s.l.
Type: Rotation, Drilling truck
Depth: 15 m
Age: Holocene (radiocarbon ages: 6040±50 a BP, 7240±50 a BP, 7190±50 a BP) + Tertiary substrate

Description of the sediments (cm):

362-370 cm: Alternation of grey sandy silt and organic clayey silt

Horizontal contact

370-380 cm: Grey sandy silt with charcoal and shells fragments

380-398 cm: Banded sandy silt with organic matter

398-417 cm: Grey sandy silt with organic matter and sandy lenticles

417-418 cm: Grey sand

418- 436 cm: Grey banded clayey silt with organic matter

436-440 cm: lost sediment, not recovered

440-487 cm: Grey micaceous sandy silt with organic matter and some dark bands.

487-505 cm: Dark grey sandy silt

505-520 cm: Dark grey silt with some shells fragment and organic matter.

520-570 cm: Dark grey silt - sandy silt with fragments of herbaceous plants and shells. Radiocarbon age:
Scrobicularia plana **6040 ±50 a BP** (530 cm depth)

570-580: lost sediment, not recovered

580-588 cm: Dark grey- black micaceous silt with sandy laminae and lenticles, shells fragments and organic matter.

588-590: Dark grey silt with micaceous sandy laminae, shells fragments and organic matter.

590-603 cm: Dark grey micaceous silt and sand with shells fragments and some organic matter.

Undulate contact

603-650 cm: Grey silt- sandy silt with organic matter, shells fragments, sandy nodules and fragments of herbaceous plants. Original sediment probably mixed with reddish superficial sands.

650-685 cm: Grey silt with shells fragments, organic matter, and fragments of herbaceous plants.

685-705 cm: Grey clayey silt with sand laminae and abundant mollusc shells.

705-726 cm: Grey sandy silt with organic matter and fragments of herbaceous plants.

726-766 cm: Dark grey silty sand with shells fragments

766-800 cm: Dark grey silty sand with abundant shells fragments

800-893/894 cm: Alternation of clayey silt with abundant shells fragments, and shelly sand. Radiocarbon ages: *Loripes lacteus* **7240** ±**50 a BP** (834 cm depth).

Gastrana fragilis **7190** ±**50 a BP** (863 cm depth).

Erosive contact

894-932/935 cm: Dark grey sandy silt with organic matter and fragments of herbaceous plants.

Undulate contact

935-963 cm: Grey medium-fine sand with small pebbles and dark bands at the base.

~963 cm: Black sand

963-965cm: Grey silt with shells fragments

965-975 cm: lost sediment

975-1006 cm: Green-grey fine sand with dark bands.

1006-1012 cm: Yellow-brown fine sand with very thin dark laminae.

1012-1018 cm: Grey silty sand

1018-1027 cm: Reddish-brown fine sand with small pebbles

1027-1031 cm: Grey silty sand with yellow sandy nodules

1031-1050 cm: Alternation of grey clayey sand, and reddish-brown sand.

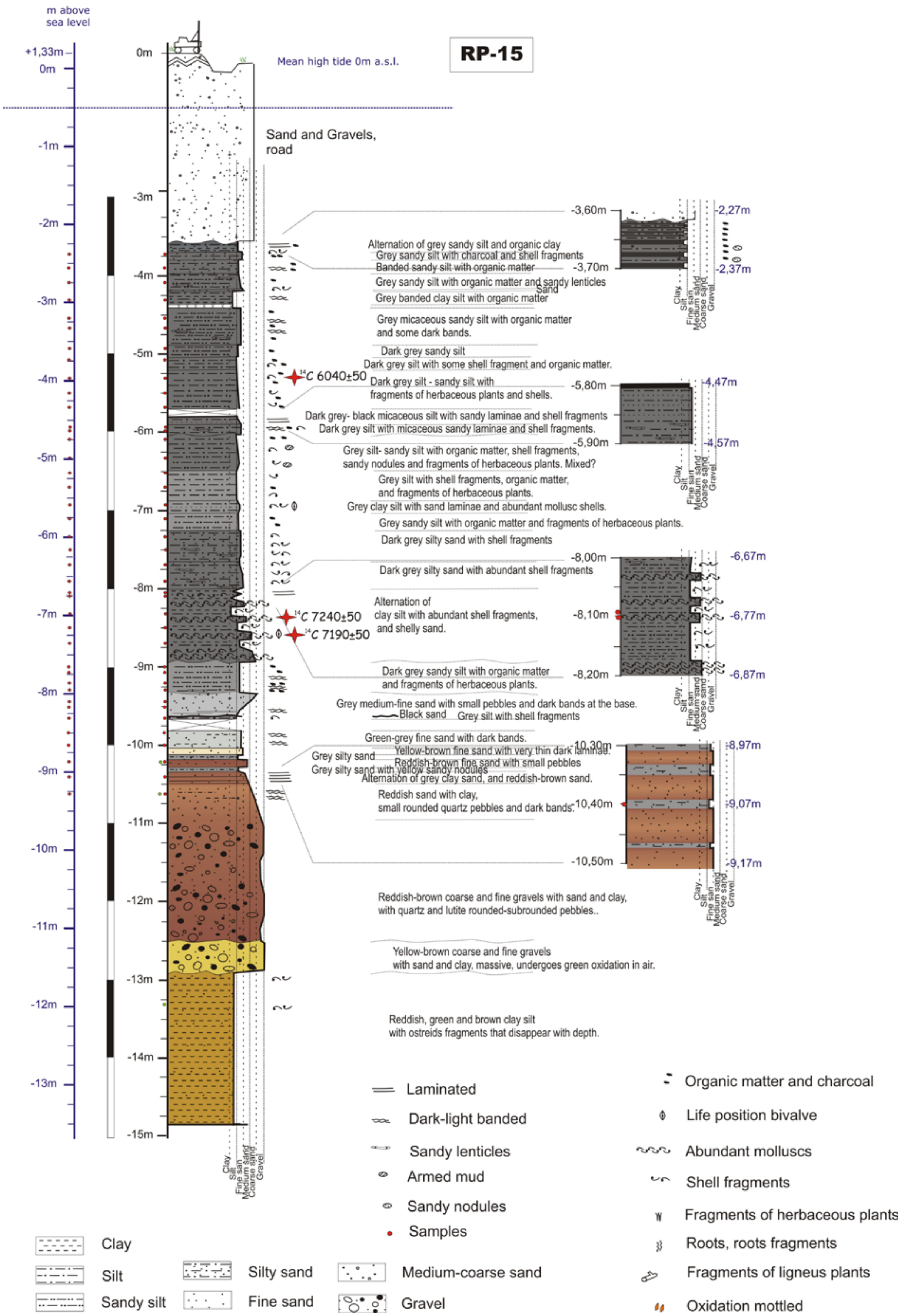
1050-1085 cm: Reddish sand with clay, small rounded quartz pebbles and dark bands.

1085-1250/1260cm: Reddish-brown coarse and fine gravels with sand and clay, with quartz and lutite rounded-subrounded pebbles.

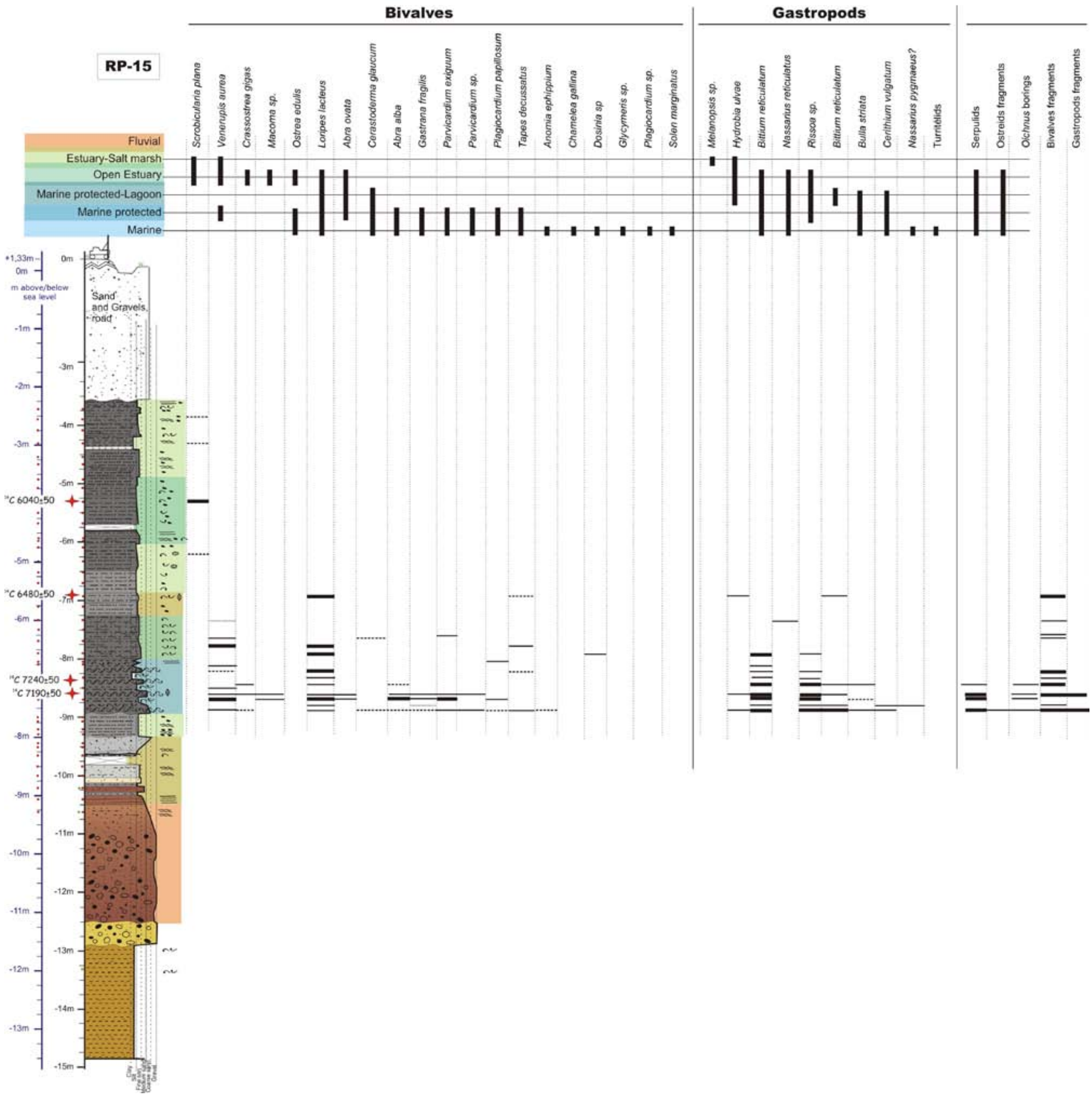
1260-1288 cm: Yellow-brown coarse and fine gravels with sand and clay, massive, undergoes green oxidation in air.

Erosive contact

1288-1485 cm: Reddish, green and brown clay silt with ostreids fragments that disappear with depth. Miocene basement probably.



m above sea level
RP-15
Mean high tide 0m a.s.l.
Sand and Gravels, road
Alternation of grey sandy silt and organic clay
Grey sandy silt with charcoal and shell fragments
Banded sandy silt with organic matter
Grey sandy silt with organic matter and sandy lenticles
Sand
Grey banded clay silt with organic matter
Grey micaceous sandy silt with organic matter and some dark bands.
Dark grey sandy silt
Dark grey silt with some shell fragment and organic matter.
14C 6040±50
Dark grey silt - sandy silt with fragments of herbaceous plants and shells.
Dark grey- black micaceous silt with sandy laminae and shell fragments
Dark grey silt with micaceous sandy laminae and shell fragments.
Grey silt- sandy silt with organic matter, shell fragments, sandy nodules and fragments of herbaceous plants. Mixed?
Grey silt with shell fragments, organic matter, and fragments of herbaceous plants.
Grey clay silt with sand laminae and abundant mollusc shells.
Grey sandy silt with organic matter and fragments of herbaceous plants.
Dark grey silty sand with shell fragments
Dark grey silty sand with abundant shell fragments
Alternation of clay silt with abundant shell fragments, and shelly sand.
14C 7240±50
14C 7190±50
Dark grey sandy silt with organic matter and fragments of herbaceous plants.
Grey medium-fine sand with small pebbles and dark bands at the base.
Black sand
Grey silt with shell fragments
Green-grey fine sand with dark bands.
Grey silty sand
Yellow-brown fine sand with very thin dark laminae.
Grey silty sand with yellow sandy nodules
Reddish-brown fine sand with small pebbles
Alternation of grey clay sand, and reddish-brown sand.
Reddish sand with clay, small rounded quartz pebbles and dark bands.
Reddish-brown coarse and fine gravels with sand and clay, with quartz and lutite rounded-subrounded pebbles..
Yellow-brown coarse and fine gravels with sand and clay, massive, undergoes green oxidation in air.
Reddish, green and brown clay silt with ostreids fragments that disappear with depth.
-3,60m -3,70m -2,27m -2,37m
-5,80m -5,90m -4,47m -4,57m
-8,00m -8,10m -8,20m -6,67m -6,77m -6,87m
-10,30m -10,40m -10,50m -8,97m -9,07m -9,17m
Clay Silt Fine san Medium sand Coarse sand Gravel
Laminated
Dark-light banded
Sandy lenticles
Armed mud
Sandy nodules
Samples
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shell fragments
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel


Bivalves
Gastropods
RP-15
Scrobicularia plana
Venerupis aurea
Crassostrea gigas
Macoma sp.
Ostrea edulis
Loripes lacteus
Abra ovata
Cerastoderma glaucum
Abra alba
Gastrana fragilis
Parvicardium exiguum
Parvicardium sp.
Plagiocardium papillosum
Tapes decussatus
Anomia ephippium
Chamelea gallina
Dosinia sp
Glycymeris sp.
Plagiocardium sp.
Solen marginatus
Melanopsis sp.
Hydrobia ulvae
Bittium reticulatum
Nassarius reticulatus
Rissoa sp.
Bittium reticulatum
Bulla striata
Cerithium vulgatum
Nassarius pygmaeus?
Turritelids
Serpulids
Ostreids fragments
Oichnus borings
Bivalves fragments
Gastropods fragments
Fluvial
Estuary-Salt marsh
Open Estuary
Marine protected-Lagoon
Marine protected
Marine
Sand and Gravels road
m above/below sea level
^{14}C 6040±50
^{14}C 6480±50
^{14}C 7240±50
^{14}C 7190±50

Molluscs Results:

The first 3m of the core are gravels and sands, not recovered. The mollusc fragments and samples are between 3.5m – 9m. From 9m to 10.5m the shells fragments are scarce and disappear.

~350~490cm: Grey horizons of sandy silt and clayey silt, with organic matter and some shells fragments. The shells fragments are small and angular, possibly of the bivalve *Scrobicularia plana***.**

~490~600cm: Dark grey horizons of silt and sandy micaceous silt with shells fragments and organic matter. There are small angular fragments of bivalves, and some well preserved (2 valves) specimen of *Scrobicularia plana.*

~600~685cm: Grey silt – sandy silt with shells fragments, organic matter, and fragments of herbaceous plants. The shells fragments are small and angular, possibly of the bivalve *Scrobicularia plana***.**

~685 ~725cm: Grey clayey silt **-** sandy silt, with organic matter and mollusc shells. There are fragments of gastropods and bivalves (some of *Tapes decussates*), and well preserved specimens of *Loripes lacteus, Bittium reticulatum* and *Hydrobia ulvae*. All of them present a reddish coloration.

~ 725 ~800cm: Dark grey silty sand with shells fragments. The abrasion and fragmentation decrease with depth, and between 774-800cm appear well preserved specimens (with 2 valves) of *Loripes lacteus, Dosinia sp.* and *Venerupis aurea.* There are also other species less preserved and some of them fragmented: *Nassarius reticulatus, Parvicardium exiguum, Cerastoderma edule, Tapes decussatus*, *Bittium reticulatum* and *Rissoa sp.* Some of the shells present a reddish coloration.

~ 800 ~895cm: Alternation of clayey silt with abundant shells fragments, and shelly sand. The shelly sand bands contains abundant molluscs fragments with variable preservation, abundant serpulids rests (*Spirorbis*), organic matter and micas; these bands have no detritic sand. The preservation of the shells is better through the top, where appear preserved specimens (with 2 valves) of *Loripes lacteus, Gastrana fragilis, Abra alba, Venerupis aurea, Parvicardium exiguum,* and the gastropod *Bulla striata.* Appear also specimens of *Bittium reticulatum* (abundant), *Rissoa sp.* and *Hydrobia sp. Cerithium vulgatum, Nassarius pygmaeus, Nassarius reticulatus,* with different states of preservation; fragments of the previous species, and fragments of *Tapes decussates, Crassostrea sp., Parvicardium sp., Plagiocardium sp., Abra sp., Cerastoderma sp., Tellina sp.,* Muricidae, Cardiidae, ostreids and some crab fragment.

~895 ~930cm: Dark grey sandy silt with organic matter and fragments of herbaceous plants. Without shells or shells fragments

~930~1012cm: Grey fine sand with some dark bands, and some small shells fragments unidentified.

~1012~1050cm: Alternation of grey silty sand, and reddish-brown sand; without shells or shells fragments.

~1050~1260cm: Reddish to reddish-brown clayey sand and gravels with quartz and lutite rounded-subrounded pebbles and dark bands at the top. Without shells or shells fragments

~1260~1500cm: Yellow-brown coarse and fine gravels with sand and clay, massive; and reddish, green and brown clay silt with ostreids fragments that disappear with depth. Miocene basement probably.

According to sedimentary facies and mollusc content, the possible palaeoenvironments are:

~350~490cm: High salt marsh- flood plain

~490~600cm: Salt marsh- estuary

~600~685cm: High salt marsh

~685 ~725 cm: High salt marsh?

~ 725 ~800cm: open estuary with marine

~ 800 ~895cm: marine protected environment, lagoon,

~895 ~930cm: High salt marsh

~930~1050cm: estuary

~1050~1260cm: alluvial / fluvial

~1260~1500cm: Miocene basement probably

RP-16

Date: 18 and 19-10-2007
Location: W El Rompido. San Miguel Marshes. N Cabezos del Terrón. S Estero del Carbón
Coordinates 37º 13' 31.98'' N / 7º 9' 31.13'' W
UTM: x 663365.85m / y 4121549.77m (Huso 29)
Elevation: +2 m a.s.l.
Type: Rotation, Drilling truck
Depth: 24 m
Age: Holocene (radiocarbon ages: 3110±40 a BP, 7870±50 a BP, 7710±50 a BP, 8610±60 a BP) + Tertiary substrate

Description of the sediments (cm):

203-214cm: Green-brown oxidation mottled sandy silt with some organics.

214-217cm: Organic clayey silt.

217-262 cm: Dark grey organic mottled silt to banded organic mottled sandy silt. Sand lamination at 255cm depth.

Undulate contact

262-300cm: Dark grey fine sand with silt to reddish-brown medium sand. Some sands unrecovered.

300-310cm: Green-brown sandy silt, similar to 203-214cm horizon…¿mixed?

310-420cm: Yellow-brown medium-coarse sand with small rounded pebbles, to yelow-grey fine sand around 420cm depth. Progressive change?

420-560cm: Grey fine homogeneous sand to medium-coarse sand with some rounded shells fragments and pebbles. Some sands unrecovered at 445-450cm depth.

560-595cm: Dark grey medium-fine sand with some dark-banded silty sand.

595-610cm: Dark grey fine sand

610-745cm: unrecovered

745-780cm: Dark grey medium-fine sand to fine rounded sand with some small shells fragments.

780-900cm: Grey medium-coarse sand to fine sand, with abundant shells fragments and dark-banded; with silts and sands laminations without shells fragments at the base.

900-960cm: Grey medium-coarse shelly sand to fine sand. Radiocarbon age: *Anomia ephippium*, **3110± 40 yr BP** (900cm depth).

960-1008cm: Alternation of medium-coarse shelly sand, and dark grey silty fine sand with some small pebble and shells fragments. The lamination disappear at the base.

1008-1020cm**:** Dark grey silty sand with reddish oxidation bands at the base and top.

1020-1140cm: Yellow fine-medium sand to coarse sand with shells fragments and small pebbles.

1140-1380cm: Unrecovered sands and clays.

1380-1410cm: Alternation of: dark grey fine-medium silty sands with ostreids and shells fragments, and dark grey massive clayey silt. Radiocarbon age: *Crassostrea gigas*, **7870± 50 yr BP** (1395cm depth).

1410-1439cm: Grey silty sand with shells fragments.

~1455 cm: Reddish sand with yellow sandy nodules ¿mixed?

1439-1522cm: Alternation of massive silt with herbaceous plants, and silty sand with shells fragments. Silt laminae disappear with depth. Radiocarbon age: *Crassostrea gigas*, **7710± 50 yr BP** (1515cm depth).

1522-1560cm: Grey silt, with sand lenticles and sand laminations that increase with depth, shells fragments and small pebbles.

1560-1770cm: Unrecovered, sand and gravel?

1770-1795cm: Gravels with sand and clay, to reddish coarse gravels.

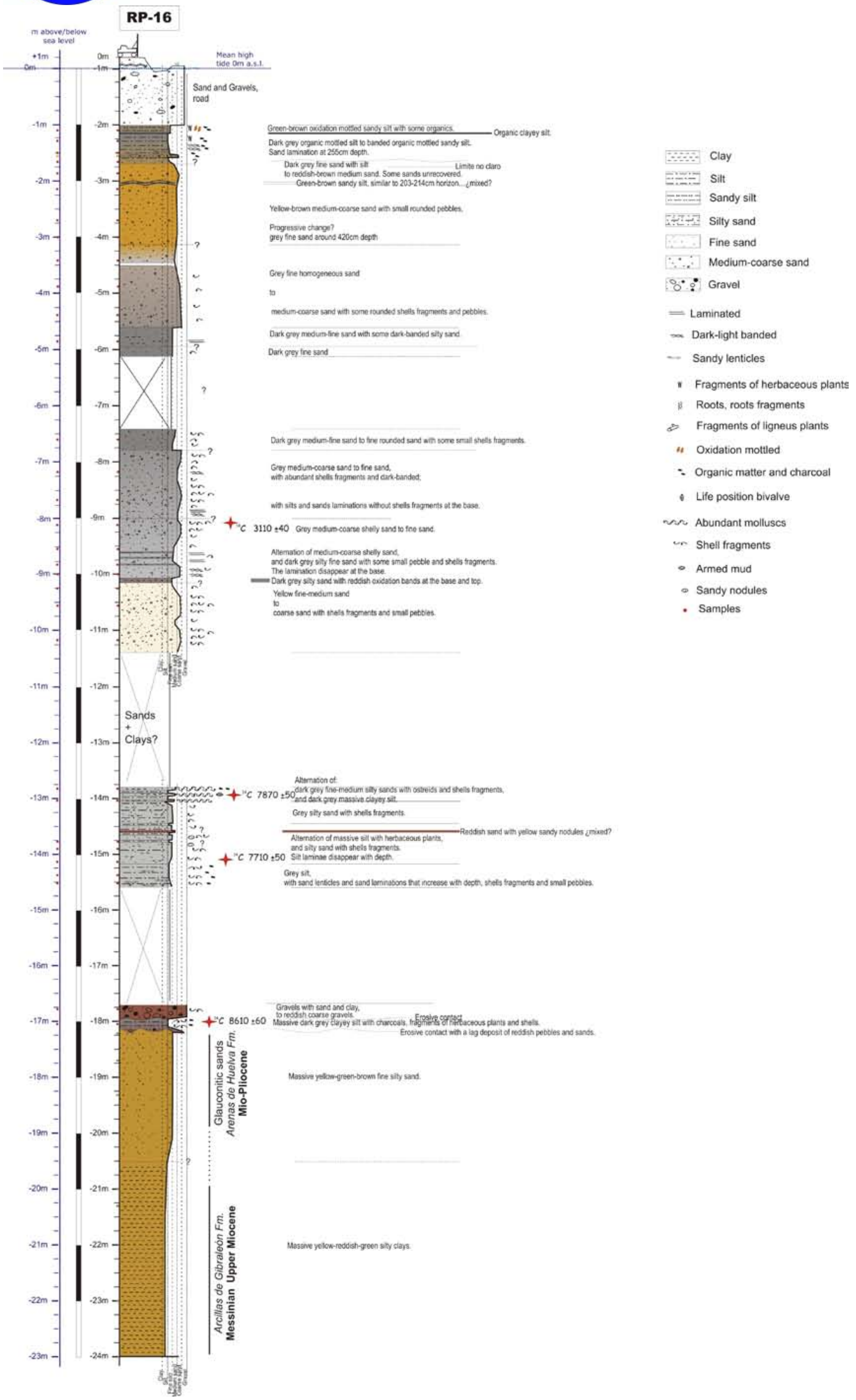
Erosive contact

1795-1815cm: Massive dark grey clayey silt with charcoals, fragments of herbaceous plants and shells. Radiocarbon age: *Tapes decussates* **8610± 60 yr BP** (1810cm depth).

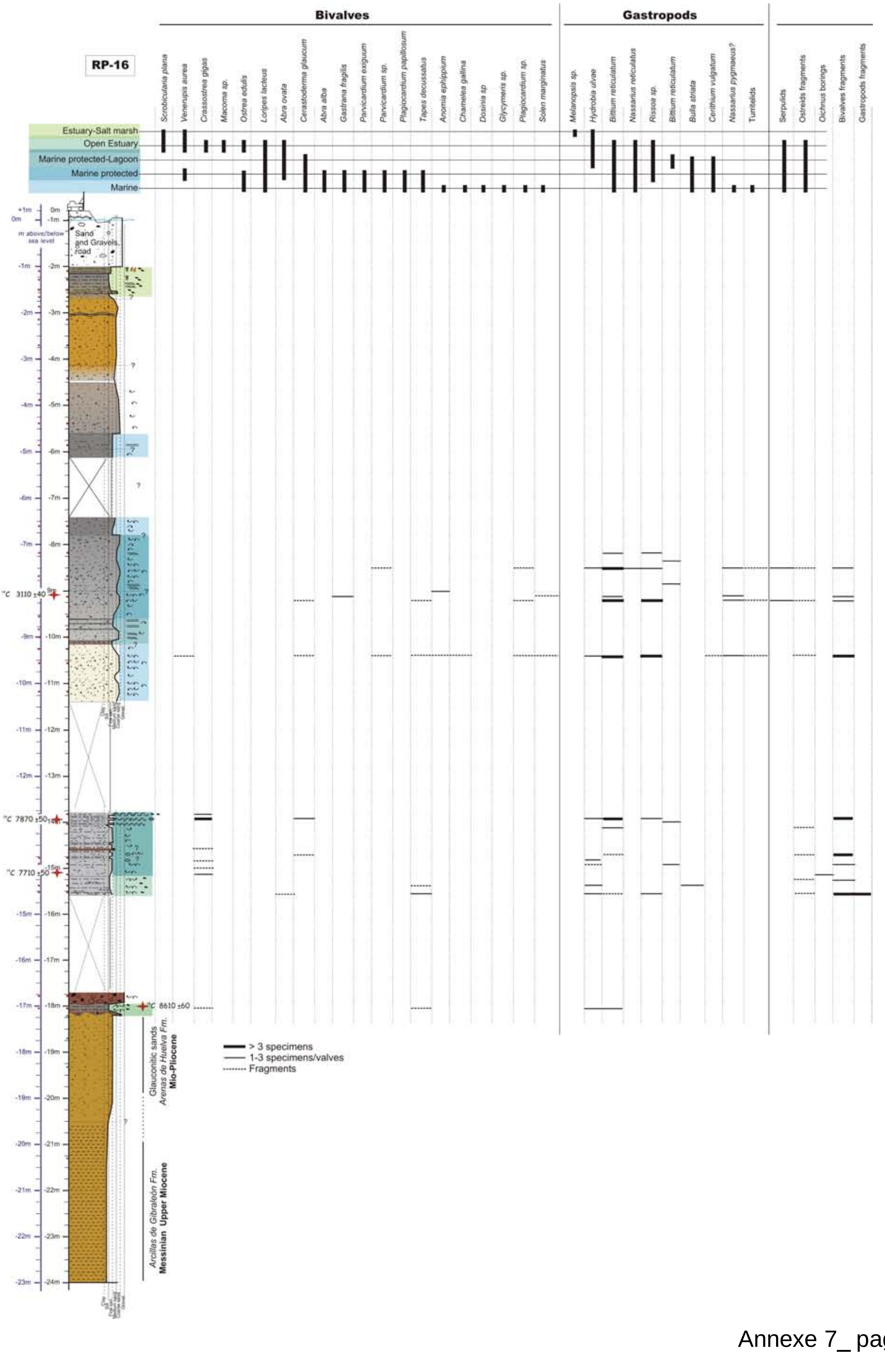
Erosive contact with a lag deposit of reddish pebbles and sands.

~1815-2050 cm: Massive yellow-green-brown fine silty sand. Mio-Pliocene basement: Glauconitic sands of the *Arenas de Huelva Formation.*

~2050-2400cm: Massive yellow-reddish-green silty clays. Upper Miocene basement (Messinian), *Arcillas de Gibraleón Formation.*



RP-16
m above/below sea level
Mean high tide 0m a.s.l.
Sand and Gravels, road
Green-brown oxidation mottled sandy silt with some organics.
Organic clayey silt
Dark grey organic mottled silt to banded organic mottled sandy silt.
Sand lamination at 255cm depth.
Dark grey fine sand with silt
Limite no claro
to reddish-brown medium sand. Some sands unrecovered.
Green-brown sandy silt, similar to 203-214cm horizon...¿mixed?
Yellow-brown medium-coarse sand with small rounded pebbles.
Progressive change?
grey fine sand around 420cm depth
Grey fine homogeneous sand
to
medium-coarse sand with some rounded shells fragments and pebbles.
Dark grey medium-fine sand with some dark-banded silty sand
Dark grey fine sand
Dark grey medium-fine sand to fine rounded sand with some small shells fragments.
Grey medium-coarse sand to fine sand,
with abundant shells fragments and dark-banded;
with silts and sands laminations without shells fragments at the base.
14C 3110 ±40 Grey medium-coarse shelly sand to fine sand.
Alternation of medium-coarse shelly sand,
and dark grey silty fine sand with some small pebble and shells fragments.
The lamination disappear at the base.
Dark grey silty sand with reddish oxidation bands at the base and top.
Yellow fine-medium sand
to
coarse sand with shells fragments and small pebbles.
Sands + Clays?
Alternation of:
dark grey fine-medium silty sands with ostreids and shells fragments,
14C 7870 ±50
and dark grey massive clayey silt.
Grey silty sand with shells fragments.
Reddish sand with yellow sandy nodules ¿mixed?
Alternation of massive silt with herbaceous plants,
and silty sand with shells fragments.
14C 7710 ±50 Silt laminae disappear with depth.
Grey silt,
with sand lenticles and sand laminations that increase with depth, shells fragments and small pebbles.
Gravels with sand and clay,
to reddish coarse gravels.
Erosive contact
14C 8610 ±60 Massive dark grey clayey silt with charcoals, fragments of herbaceous plants and shells.
Erosive contact with a lag deposit of reddish pebbles and sands.
Glauconitic sands
Arenas de Huelva Fm.
Mio-Pliocene
Massive yellow-green-brown fine silty sand.
Arcillas de Gibraleón Fm.
Messinian Upper Miocene
Massive yellow-reddish-green silty clays.
Clay
Silt
Sandy silt
Silty sand
Fine sand
Medium-coarse sand
Gravel
Laminated
Dark-light banded
Sandy lenticles
Fragments of herbaceous plants
Roots, roots fragments
Fragments of ligneus plants
Oxidation mottled
Organic matter and charcoal
Life position bivalve
Abundant molluscs
Shell fragments
Armed mud
Sandy nodules
Samples



Bivalves
Gastropods
RP-16
Scrobicularia plana
Venerupis aurea
Crassostrea gigas
Macoma sp.
Ostrea edulis
Loripes lacteus
Abra ovata
Cerastoderma glaucum
Abra alba
Gastrana fragilis
Parvicardium exiguum
Parvicardium sp.
Plagiocardium papillosum
Tapes decussatus
Anomia ephippium
Chamelea gallina
Dosinia sp
Glycymeris sp.
Plagiocardium sp.
Solen marginatus
Melanopsis sp.
Hydrobia ulvae
Bittium reticulatum
Nassarius reticulatus
Rissoa sp.
Bittium reticulatum
Bulla striata
Cerithium vulgatum
Nassarius pygmaeus?
Turritelids
Serpulids
Ostreids fragments
Oichnus borings
Bivalves fragments
Gastropods fragments
Estuary-Salt marsh
Open Estuary
Marine protected-Lagoon
Marine protected
Marine
m above/below sea level
Sand and Gravels, road
¹⁴C 3110 ±40
¹⁴C 7870 ±50
¹⁴C 7710 ±50
¹⁴C 8610 ±60
Glauconitic sands
Arenas de Huelva Fm.
Mio-Pliocene
Arcillas de Gibraleón Fm.
Messinian Upper Miocene
> 3 specimens
1-3 specimens/valves
Fragments

Molluscs Results :

The first 8m of the core are similar to RP-2b, in this case there was more unrecovered sediment, and the first samples of molluscs are at ~800 cm depth.

0~200cm: sands and gravels, road material.

200~270cm: green-grey silt and sandy silt without molluscs rests

~270~560cm: yellow-grey fine sands with small rounded shells fragments.

~560~780cm: Grey sands, sandy silts and silty sands, with rounded bivalves and gastropods fragments.

~780~910cm: Grey medium-coarse sand to fine sand, with abundant shells fragments and dark-banded. Coarse sizes are essentially bioclasts with variable preservation (some with high abrasion and fragmentation, some with color and sculpture preserved). There are fragments of bivalves and gastropods. The identified species are:
Bittium reticulatum, Rissoa sp., Hydrobia sp., Nassarius incrassatus/pygmaeus?, Nassarius reticulatus, turritelids fragments (possible *Turritella communis*), *Plagiocardium sp., Parvicardium sp.* and abundant bivalves fragments of Pectinidae, Ostraea, Veneridae, Cardidae…

~910~1020cm: Grey medium-coarse shelly sand to fine sand, with lamination of dark grey silty sand at the base. There are bioclasts and quartz grains in the coarse sizes. The shells and fragments are better preserved (minor abrasion and fragmentation). There are fragments of bivalves, gastropods and serpulids. The identified species are:
Bittium reticulatum, Rissoa sp., Nassarius incrassatus/pygmaeus?, turritelids fragments (possible *Turritella communis*), *Plagiocardium sp., Cerastoderma sp. Tapes decussates, Gastrana fragilis, Anomia epphipium, Solen marginatus*, and abundant bivalves fragments of Pectinidae, Ostraea, Veneridae, Cardidae…with variable preservation.

~1020~1140cm: Yellow fine-medium sand to coarse sand with shells fragments and small pebbles. There are more quartz grains in the coarse sizes. The shells and fragments present variable preservation (high abrasion and fragmentation in the finner sizes). There are fragments of bivalves, gastropods and echinoids spines. The identified species are:
Abundant *Bittium reticulatum,* some *Rissoa sp.* and *Hydrobia* (poor preserved), *Nassarius incrassatus/pygmaeus?,* turritelids fragments (possible *Turritella communis*),
Solen marginatus, Chamelea gallina, Tapes decussates, Parvicardium sp., Plagiocardium sp., Anomia epphipium, Cerastoderma sp., Venerupis sp., and fragments of Pectinidae, Ostraea, Veneridae, with variable preservation.

~1140-1380cm: unrecovered

~1380~1530cm: Alternation of: dark grey fine-medium silty sands with ostreids and shells fragments, and dark grey massive clayey silt. Grain size of lamination increase with depth. Shells and fragments of *Crassostrea gigas* well preserved appear with fragments of bivalves (*Cerastoderma, Tapes, Venus, Parvicardium* and others unidentified) with abrasion and transport signs. The gastropods *Bittium reticulatum, Rissoa sp.* and *Hydrobia sp.* are also present, poor preserved (*Rissoa sp.* and *Hydrobia sp.*) or with variable preservation (*Bittium*)

~1530~1560cm: Grey silt, with sand lenticles and sand laminations that increase with depth, shells fragments and small pebbles. The shells and fragments present variable preservation: some *Rissoa, Bittium* and *Hydrobia* with high abrasion signs, other gastropods and bivalves appear better preserved although many bivalves are fragmented. The identified species are:
Tapes decussatus, Bulla striata, cardidae, ostreidae.

~1560~1770cm: unrecovered

~1770~1790cm: Gravels with sand and clay, to reddish coarse gravels, with small molluscs fragments unidentified.

~1790~1820cm: Massive dark grey clayey silt with charcoals, fragments of herbaceous plants and shells. The gastropods and bivalves fragments are scarce and present abrasion and transport signs. The identified species are:
Crassostrea gigas, Hydrobia ulvae, Bittium reticulatum and *Tapes decussates.*

~1820~2400cm: Massive yellow-green-brown fine silty sand (Mio-Pliocene basement: Glauconitic sands of the *Arenas de Huelva Formation)* and massive yellow-reddish-green silty clays (Upper Miocene basement (Messinian), *Arcillas de Gibraleón Formation)*

According to sedimentary facies and mollusc content, the possible palaeoenvironments are:

0~270cm: High salt marsh- flood plain

~270~560cm: Tidal channel? Sand flood plain?

~560~780cm: possible open estuary with marine influence (channel of the estuary mouth?)

~780~910cm: protected marine environment (lagoon near spit-bar?)

910~1020cm: coastal marine protected environment, probably near spit-bar?, low depth.

1020~1140cm: coastal marine low depth – superficial environment, near the estuary mouth, possible beach-barrier

1380~1530cm: Low salt marsh - estuary mouth, sedimentation between beach-barrier islands or behind spit-bar?

1530~1560cm: protected environment, estuary mouth?

~1770~1820cm: Low salt marsh, with tidal influence and more energetic environment, near tidal channel or estuary channel?

Project n. 037110

NEAREST

"Integrated observations from NEAR shore sourcES of Tsunamis: towards an early warning system"

Instrument: STREP

Thematic priority: 1.1.6.3 GOCE (GlObal Change and Ecosystems)

D21: REPORT ON ONSHORE TSUNAMI RECORDS
ANNEXE 8 – LARIO ET AL. (IN PRESS)
TSUNAMI VS. STORM SURGE DEPOSITS: A REVIEW OF THE SEDIMENTOLOGICAL AND GEOMORPHOLOGICAL RECORDS OF EXTREME WAVE EVENTS (EWE) DURING THE HOLOCENE IN THE GULF OF CADIZ, SPAIN.
ZEIT. GEOM.

Due date of deliverable: 30 November 2009 (26 months)

Actual submission date: 5 June 2010

Start date of project: 1/10/2006

Duration: 36 + 6 months

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Revision: template

Project Co founded By the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination level		
PU	Public	
PP	Restricted to other programme participants (including Commission Services)	
RE	Restricted to a group specified by the Consortium (including Commission Services)	RE
CO	Confidential, only for members of the Consortium (including Commission Services)	

WP6 - Paleotsunami and Paleoseismic records

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ZEIT. GEOM.

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Responsible Task 6.1:

Onshore sedimentological evidence of tsunami records

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Tsunami vs. Storm surge deposits: a review of the sedimentological and geomorphological records of extreme wave events (EWE) during the Holocene in the Gulf of Cadiz, Spain.

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2 Figures, 2 tables

Abstract

The Gulf of Cadiz region of Spain has undergone many studies examining Holocene tsunami and storm deposits. Some of the studies aimed at determining recurrence intervals of events interpreted of tsunamigenic origin.

A review of geomorphologic, sedimentary and paleontological features of these deposits suggests that only a few of them can be accurately ascribed to tsunami events; instead, most of them lack conclusive evidence of a tsunamigenic genesis and should be referred to as generated by extreme wave events (EWE).

1. Introduction

Numerous recent studies tried to characterize the sedimentological features of tsunami and paleotsunami events (DAWSON ET AL., 1996; GOFF ET AL., 1998; DAWSON & SHI, 2000; NOTT, 2003; SHEFTERS & KELLETAT, 2003; DOMINEY-HOWES ET AL., 2006), or were intended to finding the distinguishing features of tsunamis and deposits of other high energy events (EWE) such as severe storms or storm surges (FOSTER ET AL., 1991; NANAYAMA ET AL., 2000; LARIO ET AL., 2001; KORTEKAAS, 2002; KORTEKAAS & DAWSON, 2007; MORTON ET AL., 2007; SWITZER & JONES, 2008). A summary of the most relevant invoked features is presented in Table 1. Differences between the sedimentary imprint of both phenomena have been found when these were studied at the same site. GOFF ET AL. (1998) proposed identifying criteria for deposits interpreted as generated by paleotsunamis, but KORTEKAAS (2002) concluded that most of these features are also found in storm deposits. MORTON ET AL. (2007) analyzed the sedimentary record of two modern tsunamis and two hurricanes and identified some characteristic features. For example: tsunamigenic sandy deposits are generally less than 25 cm thick while storm deposits usually exceed 30 cm in thickness. They also concluded that the occurrence of mud intraclasts and mud laminae within the deposits is a good indicator of tsunami origin. An additional distinguishing criterion is the number of layers or laminae in the depositional units: lower (one to three) in tsunamis and higher (more than seven, usually 15 to 20) in hurricane deposits.

Most studies concluded that the deposits generated by both types of events exhibit similar textural, structural and sedimentary properties; therefore no univocal criteria can be proposed to identify conclusively tsunami deposits based on sedimentological studies (MORTON ET AL., 2007, 2008a, 2008b; JAFFE ET AL., 2008). A common conclusion is that, as such deposits indicate only the occurrence of high-energy event, the marine origin of the event, and the inundation of coastal areas by sea water, they can only be referred to as extreme wave events or EWE (KORTEKAAS, 2002; SWITZER, 2008, SWITZER & JONES, 2008). Recent discussions on this issue concluded that the differentiation of coastal subaerial deposits laid down by tsunamis and storms remains a major challenge (KORTEKAAS & DAWSON, 2007; BRIDGE, 2008; JAFFE ET AL., 2008), as the distinction relays in differences in hydrodynamic and sediment-sorting processes taking place during high energy transport (MORTON ET AL., 2008a).

As there are no univocal conclusive criteria, it must be concluded that the best available way of distinguishing both types of deposits is a conjunction of geomorphologic, sedimentological and palaeontological characteristics. And such distinction is essential for calculating the recurrence intervals of these extreme events.

2. Extreme wave events (EWE) in the Gulf of Cadiz

Tsunami and storm deposits of Holocene age have been identified along the Spanish coast of the Gulf of Cadiz. This coastal tract can be described as semidiurnal mesotidal, with tidal ranges around 2.1 m (BORREGO ET AL., 1993). Wave fronts approach the coast obliquely from the SW inducing longshore transport and littoral drift toward the east and southeast in the Spanish side of the Gulf of Cadiz that adds to the general flow towards the Gibraltar Straits which, eventually, concentrates in the superficial Atlantic flow into the Mediterranean. This concurrence favours the growth of spit bars that shelter broad littoral lowlands extending some kilometres inland, occupied by large tidal flats and fresh-water marshes that often dry out seasonally.

Historical and present extreme marine climate records in the area available in the net (http://www.puertos.es/es/oceanografia_y_meteorologia/banco_de_datos/index.html) are most interesting for the purposes of this paper. Maximum wave heights recorded during storms range from 5.25 to 7.80 m but the amplitude rises to 6.22 to 9.19 m when a 225 yr recurrence interval is considered. Maximum measured tidal ranges (astronomical plus meteorological/barometric) reach 3.86 to 4.30 m. These data support the idea that sea level during storms (water/wind set up) can rise high enough to surpass, or at least breach, the spit barriers, flood the sheltered lowlands behind them, and deposit layers of sediments derived from the sea in the inner parts estuaries and lagoons. However, the preservation potential of EWE deposits can be very low owing to later reworking by permanent, ubiquitous currents and waves (CLIFTON, 1988; EINSELE ET AL., 1996; DAWSON & STEWART, 2007).

Most surveys of EWEs in the area concentrated on the marshlands of Guadalquivir (LARIO ET AL., 1995; LARIO, 1996; LARIO ET AL., 2001; RUIZ ET AL., 2004, 2005; CÁCERES ET AL., 2006), Tinto-Odiel (LARIO, 1996; RUIZ ET AL., 2007; MORALES ET AL., 2008), and Guadalete (LARIO ET AL., 1996; LARIO, 1996; DABRIO ET AL., 1999; LUQUE ET AL., 2001, 2002) estuaries, and some areas on the south-eastern coast of the Gulf of Cadiz (LUQUE, 2002; WHELAN & KELLETAT, 2003, 2005; ALONSO ET AL., 2004; LUQUE ET AL., 2004), (Fig. 1, Table 2). These studies described the sedimentary record of high energy events in the Gulf of Cadiz and concluded that most of them were tsunamigenic; following this conclusion, recurrence intervals were deduced (MORALES ET AL., 2008; RUIZ ET AL., 2008b). The reported sediments are usually interbedded in estuarine or spit barrier sedimentary units that act as effective sedimentary sinks, likely to preserve geomorphological features that witness the palaeoenvironmental changes.

2.1. Doñana spit barrier and Guadalquivir estuary and marshlands

Three phases of high energy events have been identified in the Guadalquivir marshlands. The lower, oldest episode (phase 1, ca. 5310 calBP) is represented by fine sediments with fragmented shells that RUIZ ET AL. (2005) and CÁCERES ET AL. (2006) interpreted as the result of breaching of the spit and accumulation of chenier deposits.

During the second phase (4500 to 3700 calBP), several episodes of breaching of the spit (LARIO ET AL., 1995; LARIO, 1996) with noticeable input of marine water into the estuary (LARIO ET AL., 1995; LARIO, 1996; RUIZ ET AL., 2005) have been reported and related to storms. Chenier deposits and fine sediments accumulated in the estuary by the end of this phase, when a tsunamigenic event caused erosion of the underlying lagoon sediments and former (phase 1) chenier deposits (RUIZ ET AL., 2005; CÁCERES ET AL., 2006).

Several high-energy events that occurred during the time span of the third phase (2500 to 2000 calBP) have been identified, and are briefly discussed below.

A sandy layer with erosional base occurs interbedded between estuarine clay deposits. Sands are rich in marine shells and show high magnetic susceptibility. This layer has been interpreted as produced by an event of erosion and breaching of the spit during a tsunami ca. 2600-2500 calBP (LARIO, 1996; LARIO ET AL., 2001, 2002), on the basis of correlation with an earthquake recorded in the seismic catalogue (GALBIS, 1932).

Other sandy layers have been related to episodes of erosion and breaching of the spit barrier in the interval 2700-2400 calBP, and interpreted in different ways. LARIO ET AL. (1995) and LARIO (1996) assigned these to severe storm surges during episodes of climatic instability, in the absence of analogues in the seismic catalogue. A similar sandy to silty layer with marine and estuarine fauna accumulated in the estuary during the interval 2400-2200 calBP has been interpreted as the result of erosion and breaching of the Doñana spit during a high-energy event (RUIZ ET AL., 2004) or a tsunami (CÁCERES ET AL., 2006).

RUIZ ET AL. (2004) drilled a core from the inner marshland and found an interval of assumed chenier deposits. They interpret a storm deposit followed upwards by two tsunami events, the younger one dated between 2700 and 2210 calBP. The sedimentological and palaeontological evidences supporting a tsunamigenic origin for these layers is not fully conclusive (Table 1). Similar layers of chenier deposits have been interpreted as high energy events, but it was not possible to decide whether they were generated by tsunamis or storm surges (RUIZ ET AL., 2004). These same authors describe more chenier deposits aged around 2000 calBP and assign them to a high-energy event of unknown nature. On the other hand, CÁCERES ET AL (2006) assigned layers with same age and with marine fauna and evidence of erosion of estuarine deposits to a tsunami event using correlation with the seismic catalogue.

New revisions (RUIZ ET AT., 2008a) include all these layers in a single tsunami event that occurred ca. 2400-2350 calBP.

A younger layer of bioclastic sandy silts with erosional base was dated ca. 1500 calBP and correlated with a tsunami cited in the GALBIS (1932) catalogue by RUIZ ET AL. (2006), but subsequent research places this event at 1700 calBP (RODRÍGUEZ-VIDAL ET AL., 2008).

2.2. Punta Umbría spit barrier and Tinto-Odiel estuary and marshlands

The oldest high-energy event of marine origin recorded in the Tinto-Odiel estuary is a layer of bioclastic sand with erosional base dated ca. 5705 calBP, and interpreted as storm surges (RUIZ ET AL., 2007). Later, the growing spit was breached around 2700-2400 calBP and the drainage network within the estuary underwent a deep reorganization; LARIO (1996) interpreted these changes as promoted by storm surges.

MORALES ET AL. (2008) cited five high-energy events from ca. 2500 calBP to the present, but provided sedimentological and palaeontological data for the two most recent only (HEL-1 and HEL-2). These were correlated with the 1755 AD (Lisbon earthquake) and the 1531 AD tsunamis respectively, both included in the GALBIS (1932) catalogue.

The youngest layer (HEL-1 = High Energy Level-1), correlated with the Lisbon tsunami, is more than one metre thick and consists or multiple layers/laminasets and parallel lamination or cross bedding that resemble those described in MORTON ET AL. (2007) and SWITZER & JONES (2008).

The erosional base, accumulations of shells, mud layers and absence of current-generated sedimentary structures in the older layer (HEL-2) stand against a storm surge origin. In addition, the occurrence of a goethite crust draping the erosional base, just below the accumulation of mollusc shells suggests that erosion was not caused by the same event. Furthermore, the proposed radiocarbon ages seem most controversial because the authors used a reservoir date for calibration that is different from the one commonly used in most papers. This implies that the ages obtained are, probably, youngest than those obtainable if the other (usual) method was employed. On the other hand, the 1531 AD event is documented as a strong earthquake felt in Lisbon, but there is not a reference in GALBIS (1932) of a tsunami sweeping the Gulf of Cadiz. Therefore, this event can be probably related to the 1755 AD tsunami.

2.3. Valdelagrana spit barrier and Guadalete estuary and marshlands

Two layers of coarse sandy sediments with fragmented marine shell remains, and increased magnetic susceptibility have been recognized and dated as ca. 7000 calBP and ca. 5600 calBP. They were assigned to high-energy events of presumed storm origin (LARIO, 1996).

Other episodes of breaching of the Valdelagrana spit barrier and reorganisation of the estuarine drainage pattern have been invoked between 2700 and 2400 calBP, an interpreted as the result of high energy events (LARIO, ET AL., 1995; LARIO, 1996; DABRIO ET AL., 2000).

Deposits of a tsunami ca. 2300-2000 calBP have been described by LUQUE ET AL. (2002). These are washover fans with three superposed fining-upward units, each with erosional bases, abundant marine fauna (both macro and micro), and some mud clasts eroded from the estuarine marshes. These features are considered as conclusive evidences of a tsunamigenic origin, and there is good correlation with historical chronicles (LUQUE ET AL., 2002, Table 1).

Similar deposits, with three or four fining-upward sequences, some decimetres in thickness, have been describes in sites nearby and ascribed to the 1755 AD Lisbon tsunami using historical data and maps (LUQUE ET AL., 2001). Historical maps show that the latter tsunami induced geomorphological changes in the Valdelagrana spit and the sheltered marshlands (DABRIO ET AL., 1999).

2.4. Conil-Algeciras coast.

A 20 cm thick layer of coarse, bioclastic sand found in Bolonia Bay has been dated 2150-1825 calBP and correlated with a tsunami recorded in the GALBIS (1932) catalogue (ALONSO ET AL., 2004). In Algeciras Bay, an 80 cm-thick layer of fining upward, bioclastic (including algae) sands with fragments of Roman ceramics occurs at ca. 2 m a.s.l. (ARTEAGA & GONZÁLEZ, 2004). This layer erodes older aeolian dune deposits, but interestingly enough, is located between well-dated Roman archaeological levels that allowed calculating an age ca. 50 AD for the event. The deposit has been interpreted as tsunamigenic.

There are other deposits in the south-western Gulf of Cadiz that have been ascribed to the 1755 AD Lisbon earthquake and tsunami. In Trafalgar Cape, large imbricate boulders have been linked to this tsunami (WHELAN & KELLETAT, 2003, 2005; ALONSO ET AL., 2004) although no precise age control has been provided yet. Other example occurs near Tarifa as washover fans (ALONSO ET AL., 2004; GRACIA ET AL., 2006). One more case study is the site of Conil de la Frontera, where a major event destroyed the fishermen's settlement of Conilete and deposited large washover fans. The association with the 1755 AD tsunami is supported by historical maps and written reports that described the event and flooding of the area (LUQUE ET AL., 2004).

Recent revision of these sites by REICHERTER ET AL. (2008) provided evidence of high energy events that were interpreted as tsunamigenic, but research is still on-going and there is a deficiency of chronological data that prevents reaching more solidly grounded conclusions.

3. Discussion and conclusions.

Geomorphological and sedimentological features generated by extreme wave events (EWE) are common along the coasts of the Gulf of Cadiz, and have been assigned to either tsunami or storm surges. After more than 20 years of research some authors concluded that distinguishing coastal deposits generated by tsunamis and storm surges remains a major challenge and no single criterion can be called to identify conclusively the origin of deposits; instead, a conjunction of features and criteria at various scales (trenches, transects, regional data) seems to be the most reliable option for this purpose (summarized in SWITZER, 2008). Following this reasoning, the historical, geomorphological and sedimentological data gathered in the Gulf of Cadiz suggest the common occurrence of EWE in the area throughout the Holocene but they are not always conclusive enough to decide unambiguously whether tsunamis or storms were the real cause.

The main extreme wave events recorded in the Gulf of Cadiz during the Holocene (Table 2) are briefly discussed below:

- **ca. 7000 calBP**. EWE recorded in Valdelagrana spit barrier system (LARIO, 1996). Some data such as, for example, increased magnetic susceptibility, suggest a tsunami event, but neither conclusive data nor contemporary evidences in other areas of the Gulf of Cadiz have been reported so far.
- **ca. 5700-5300 calBP**. EWE in Valdelagrana and Punta Umbría spit barrier systems at ca. 5700-5600 calBP, and interpreted in both cases as storm-generated. Similar deposits reported in Doñana have been assigned to a tsunami at 5300 calBP (LARIO, 1996; RUIZ ET AL., 2005; CÁCERES ET AL., 2006; RUIZ ET AL., 2007).

  The described sedimentary features are not conclusive for tsunamis, but there is evidence of major EWEs that swept broad areas of the SW Iberian coast causing dramatic geomorphological changes and leaving deposits in some places.

  We suggest that all these deposits may correspond to the same event and that the disparity in age results from using different taxa for radiocarbon dating, added to the low number of radiocarbon samples analyzed and the use of the same reservoir effect in diverse environments.
- **ca. 4500-4100 calBP**. Large EWE reported from Doñana marshlands and recorded as a marine layer intercalated in the inner marsh deposits of the estuary. The event caused major geomorphological changes (breaching and erosion) in the Doñana spit barrier. The sedimentary record does not allow distinguishing between tsunami and severe storm as the cause of this EWE (LARIO ET AL., 1995; LARIO, 1996; RUIZ ET AL., 2005; CÁCERES ET AL., 2006).

- **ca. 3900-3700 calBP**. A EWE has been described and interpreted as a tsunami event. Despite the problems of radiocarbon dating discussed above, it is concluded that this is an independent event because it eroded the deposits of the former EWE (4500-4100 calBP). The magnitude of the EWE could be smaller than the previous, but its effects might be over-magnified because the spit was already badly damaged. In any case, the record of this EWE seems to be more local, as it has not been reported from other areas of the Gulf of Cadiz (RUIZ ET AL., 2005; CÁCERES ET AL., 2006).
- **ca. 2700-2200 calBP**. A number of cites refer to a EWE of this range of ages in many places alongshore (Punta Umbría, Doñana, Valdelagrana...) (LARIO ET AL., 1995; LARIO, 1996; DABRIO ET AL., 1999;LARIO ET AL., 2001, 2002; LUQUE ET AL., 2002; RUIZ ET AL., 2004; CÁCERES ET AL., 2006; RUIZ ET AL., 2008A). The effects of the EWE: breaching of spit barriers, introduction of sandy layers with marine bioclasts in the inner estuaries, and chenier development suggest either tsunami or storm surges as the responsible agent. However, the occurrence of washover fans with two or three superimposed fining upward sedimentary units containing shells of marine molluscs, rip-up clasts, and mud cups strongly suggest a tsunamigenic origin (Table 1 and references herein). Widespread occurrence of EWE features along the coast and other effects of regional extent, such as the reorganization of the back barrier drainage patterns of estuaries (e.g. Tinto-Odiel), coupled to historical evidence of a tsunami in GALBIS' (1932) catalogue support this assumption. Age discrepancies for this presumably single event are probably due to flaws in the radiocarbon dating method, or even to the coincidence of a tsunami during a period of climatic instability and strong storms surges that increased the effects of the EWE.

In any case, correlation with published catalogues of historical earthquakes (GALBIS, 1932; CAMPOS, 1991) is very often imprecise because a single tsunami can produce separate features, vertically-superposed fining upward sequences or coarse-grained units, likely to be considered of different ages, assuming that they were deposited by separate events. On the other hand, it is also possible that a given event was assigned to different ages in separate localities (GALBIS, 1932); for instance, the events reported between 245 and 209 BC were compiled from diverse sources (MOREIRA DE MENDOÇA, 1758) and may perfectly well correspond the same event but assigned erroneously to different ages in separate localities.

- **ca. 2000 calBP**. The occurrence in Doñana of chenier deposits of this age suggests a EWE; the basal erosion surface, marine fauna and correlation with the GALBIS (1932) catalogue of historical earthquakes support the interpretation as tsunami.

The same event has been invoked in Bolonia Bay (ALONSO ET AL., 2004) to interpret layers of bioclastic sand, and Algeciras Bay (ARTEAGA & GÓNZALEZ, 2004), where sedimentary features point more definitely to the tsunamigenic nature of the event; however, given the preliminary nature of the late case-study it is more cautious to refer provisory to a EWE. It must be also considered that, although GALBIS (1932) reports a tsunami at 60 BC, both him and the original compiling author (MOREIRA DE MENDOÇA, 1758) indicate that the tsunami was only felt in the Atlantic coast of Portugal and Spain (Galicia), with no reports from the Gulf of Cadiz.

Finally, the oldest tsunami deposits reported from Valdelagrana spit barrier may also fit in this time period.

- **ca. 1500 calBP**. Bioclastic sandy silts drilled in Doñana marshlands have been interpreted as tsunamigenic following correlation with the seismic catalogue (RUIZ ET AL., 2006) and probably it is the same 1700 calBP event (RODRIGUEZ VIDAL ET AL., 2008). However, considering that the sedimentological data are inconclusive, and the local occurrence of these deposits, this layer may represent a EWE with limited impact only.

- **1755 AD Lisbon earthquake and tsunami**. There is an ample historical documentary record of the effects of this EWE in over 30 sites along the south-western Spanish shores, and its geological effects on the Gulf of Cadiz have been reported (CAMPOS, 1991; MARTÍN SOLARES, 2001; LUQUE, 2002). However, there is not widespread sedimentary record of this event (LUQUE ET AL., 2001, 2004; LUQUE, 2002). Historical maps and written documents support the tsunamigenic interpretation of the sedimentary units deposited during this event in Valdelagrana (LUQUE ET AL., 2001). These sequences can be used also as reference to identify tsunami deposits in other areas or study sites.

There are reports of the geological impacts of the 1755 Lisbon tsunami in Tinto-Odiel estuary (MORALES ET AL., 2008), Valdelagrana spit and Guadalete estuary

(DABRIO ET AL., 1999, LUQUE ET AL., 2001), and Conil (LUQUE ET AL., 2004). Other sites where date control of the EWE is less certain have been cited along this coastal segment in Trafalgar (WHELAN & KELLETAT, 2003; ALONSO ET AL., 2004) and Tarifa (ALONSO ET AL., 2004).

In conclusion, at least seven EWEs capable of inducing widespread, dramatic geological, geomorphological and sedimentological changes have hit the SW coasts of the Iberian Peninsula in the last 7000 yr, leaving recognizable, but difficult to interpret, features. It is uncertain whether these EWEs were produced by tsunamis or storm surges. Additional uncertainties result from the assumed ages (if radiocarbon is not available) or even the validity and accuracy of the measured radiocarbon ages, if the sampled shell remains belong to different species of molluscs, or the reservoir effect is inadequately managed.
In any case, it is tempting to calculate recurrence periods for EWEs, and a periodicity of 1200-1500 yr for destructive events seems to emerge. However, when calculating recurrence periods, it is inadequate to assign all the regionally recorded EWEs (even the local ones) to tsunamis.
Analyses of the relationships between the recorded EWEs and high-energy marine/coastal processes at various scales, e.g. those forced by prolonged climatic instability yield more realistic outputs. In fact, the Klaus extratropical cyclone that affected south-western Europe in January 2009 revealed that extreme marine climate conditions can be actually reached in the Gulf of Cadiz, and also proved that destructive EWEs in the area can be triggered by extreme climatic systems.

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Tables caption:

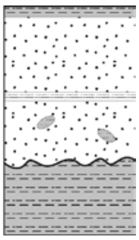
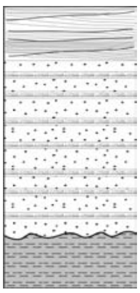
Table 1. Sedimentological, geomorphological and palaeontological features of EWE generated by tsunamis and storms (adapted and modified from ANDRADE, 1992; NANAYAMA ET AL., 2000; KORTEKAAS, 2002; GOFF ET AL., 2004; LUQUE ET AL., 2004; TUTTLE ET AL., 2004; DOMINEY-HOWES ET AL., 2006; KORTEKAAS & DAWSON, 2007; MORTON ET AL., 2007; SWITZER, 2008; SWITZER & JONES, 2008).

Table 2. Synthesis of EWEs recognized in the SW coast of Spain, with references.

Figure caption:

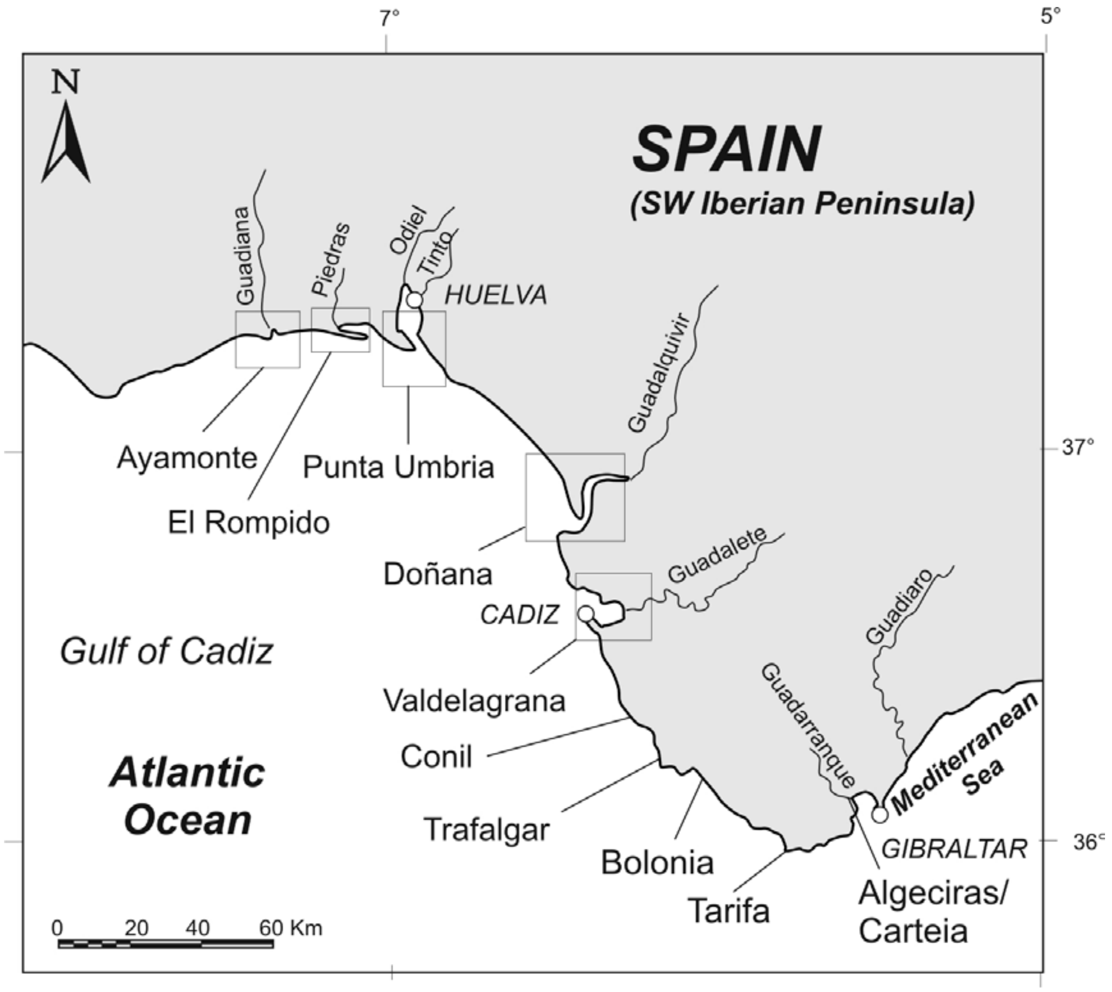
Figure 1. Location map and sites cited in text.

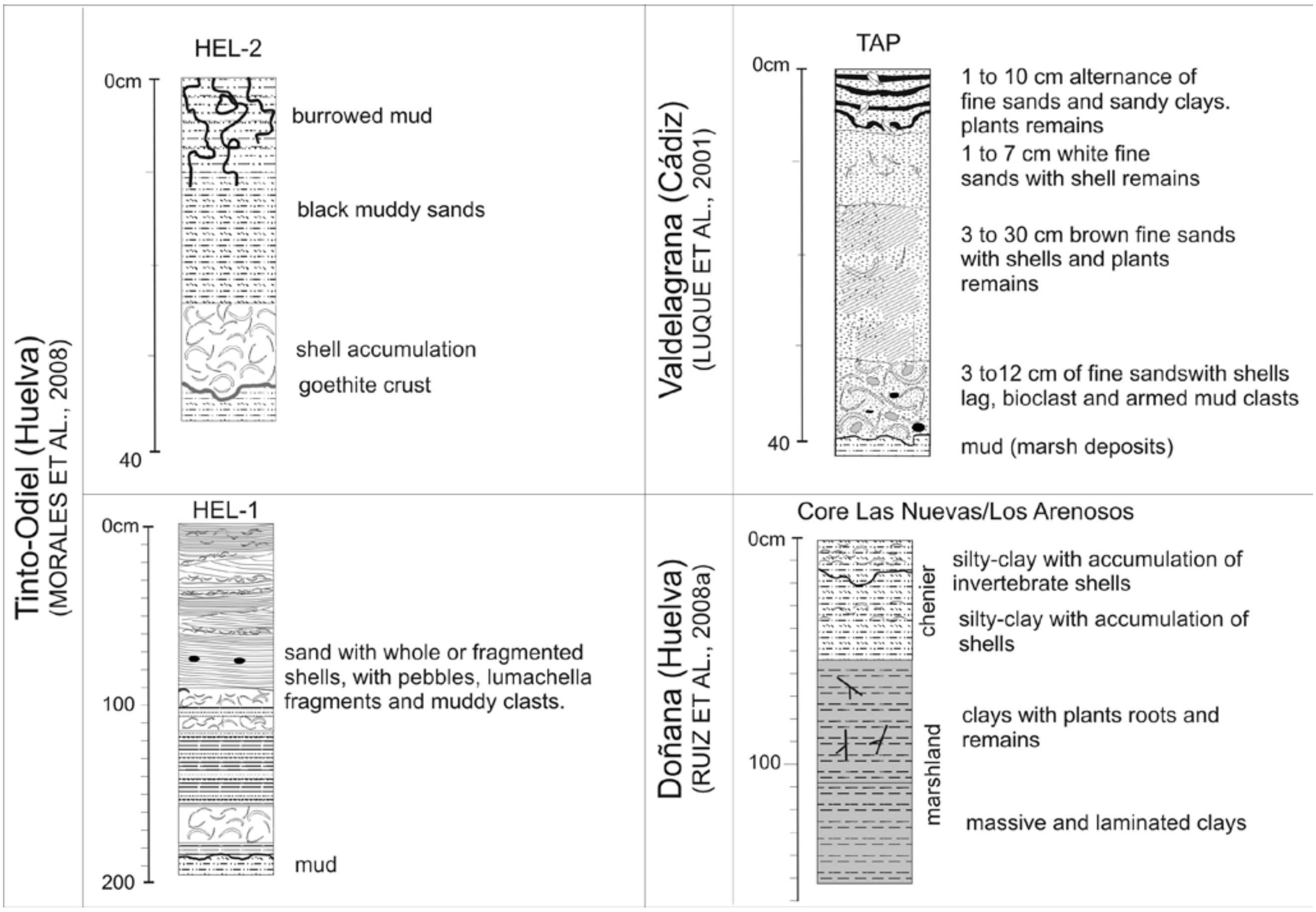
Figure 2. Synthetic sequences of EWE interpreted as tsunamis. In Tinto-Odiel HEL-2 has been correlated with 1531 AD tsunami and HEL-1 with the 1755 AD Lisbon tsunami. The Doñana sequence has been interpreted as a tsunami dated between 2700-2000 calBP. Using Table 1 and sequences proposed by MORTON ET AL. (2007) these three deposits should be attributed to storms, or only EWE, because they lack unambiguous characteristics of tsunami genesis. The Valdelagrana synthetic sequence (TAP cores) corresponds to the washover fans correlated with the 1775 Lisbon tsunami. The sequence appears 3 to 5 times repeated vertically in the Cadiz area. The sedimentary features are characteristic of tsunamigenic deposits (Table 1).

Tsunami	Storm
washover fans associated with breaching of spit bars thining inland fine deposits in a landward direction from the shore erosional basal contact large boulders marine species present presence of shell valves or fragments mixture of marine and estuarine/brackish species plants remains	
Large inland extent More than one fining upward sequence, sometimes homogeneous One to three subunits of massive to fining-upward, very coarse to fine grained sand (LUQUE ET AL., 2004, TUTTLE ET AL.,2004), four layers (NANAYAMA ET AL., 2000) Intraclast (rip-up) from underlaying material -- Basal load structures Bidirectional imbrication Poor sorting -- Rare presence of sedimentary structures (current/wave generated) ------------------- Changes in the drainage pattern --- Increase in magnetic susceptibility Increase in geochemical elements indicating marine origin Marine fauna well preserved Mud intraclast Mud laminae Mud cap at surface -- Mud rip-up clast common in lower part or in the mud cap	Relative smaller inland extend One fine upward sequence or homogeneous Not cited Not cited Unidireccional imbrication Better sorting Presence of sedimentary structures (laminar stratification) Interbeded and laminated coarse, medium and fine grain sand with delta foreset croos-stratification and subhorizontal planar stratification, channels (TUTTLE ET AL., 2004) Not cited Not cited Not cited Marine fauna poorly preserved Mud rip-up clast rare or absent Not cited No mud cap
Typical tsunami sequence (after MORTON ET AL., 2007)  mudcap lamina sets maybe separated by thin mud layers or heavy mineral laminae often normally graded rip up clasts 5-25 cm thick sharp lower contact	Typical storm sequence (after MORTON ET AL., 2007)  mudcap rare may have planar or trough cross bedding, climbing-ripple cross lamination planar stratification many laminae and laminasets 25-200 cm thick sharp lower contact

Age	Sedimentological / geomorphological features	Reference	Original authors interpretation	Data support/problems
Punta Umbría spit barrier/ Tinto-Odiel marshland				
5705 calBP	Sands with micro- and macro- marine shells	(RUIZ ET AL., 2007)	Storm, not tsunami	
2700-2400 calBP	Spit barrier breaching and reorganisation of the back-barrier drainage system	(LARIO, 1996)	Storm surge	
2000 calBP-act. 1531 AD 1755 AD	Five HEL (High Energy Levels) characterized by erosional bottom, shell accumulation and sand, muddy-sand deposits	(MORALES ET AL., 2008)	Tsunamis	Probably 1755 AD tsunami record (HEL-2) and a younger storm record (HEL-1).
Doñana spit barrier / Guadalquivir Marshland				
5310 calBP	Fines deposit with shell fragments, breaching of the spit barrier, cherniers development	(RUIZ ET AL. 2005, CÁCERES ET AL., 2006)	Tsunami	Correlation with other authors
4500-4200 calBP	Spit barrier breaching	(LARIO ET AL.,1995; LARIO, 1996)	Storm surge	
4200-4100 calBP	Deposits with marine fauna in the estuary	(RUIZ ET AL. 2005)	Tsunami & storms	Correlation with other authors
4200-4100 calBP	Cheniers development and fine-grained deposits	(CÁCERES ET AL., 2006)	Tsunami	Correlation with other authors
3900-3700 calBP	Cheniers development and spit barrier breaching + erosion the lagoon and in old cheniers deposits	(RUIZ ET AL. 2005, CACERES ET AL., 2006)	Tsunami	Correlation with other authors
2600-2500 calBP	Sand layer with marine fauna between estuarine deposits, erosional base, high magnetic susceptibility. Spit barrier erosion	(LARIO, 1996; LARIO ET AL., 2001, 2002)	Tsunami	Historical seismic catalogue Conjunction of sedimentological features
2700-2400 calBP	Spit barrier erosion and breaching	(LARIO ET AL., 1995, LARIO, 1996)	Storm surges	Climatic instability
2700-2210 calBP	Cheniers sedimentation	(RUIZ ET AL., 2008A)	Tsunami	Correlation with seismic catalogue
2400-2200 calBP	Silt and sand with marine and estuarine fauna. Spit barrier breaching	(RUIZ ET AL., 2004)	High energy event	
2400-2250 calBP	Spit barrier erosion and breaching	(CÁCERES ET AL., 2006)	Tsunami	Correlation with other authors or seismic catalogue
ca.2000 calBP	Cherniers development	(RUIZ ET AL., 2004)	High energy event	
2020-1990 calBP	Erosion of the lagoon deposits, input of marine fauna and cherniers accumulation	(CÁCERES ET AL., 2006)	Tsunami	Correlation with other authors or seismic catalogue
1560-1510 calBP	Bioclastic sandy silts above erosive surface	(RUIZ ET AL., 2006) (cited as 1700 calBP by RODRIGUEZ VIDAL ET AL., 2008)	Tsunami	Historical seismic catalogue
Valdelagrana spit barrier/ Guadalete marshland				
ca.7000 calBP	Input of coarse sediment (sands), marine shell fragments and increase in magnetic susceptibility	(LARIO, 1996)	Storm	
ca.5600 calBP	Input of coarse sediment (sands), marine shell fragments and increase in magnetic susceptibility	(LARIO, 1996)	Storm	
2700-2400 calBP	Spit barrier breaching and reorganisation of the back-barrier drainage system	(LARIO ET AL., 1995; LARIO, 1996; DABRIO ET AL., 2000)	High energy event	
2300-2200 calBP	Washover fans, repeated fining upward sequence (2 to 3 times), marine shell fragments, armed mounted clasts, erosional lower limit	(LUQUE ET AL., 2002)	Tsunami	Concluding characteristics of the deposits
1755 AD	Washover fans, repeated fining upward sequence (3 to 4 times), marine shell fragments, armed mounted clasts, erosional lower limit.	(LUQUE ET AL., 2001)	Tsunami	Concluding characteristics of the deposits. Dated by historical documents and historical maps
1755 AD	Breaching of spit barrier and washover fans	(DABRIO ET AL., 1999)	Tsunami	Dated by historical documents and maps
Conil-Algeciras coast				
2150-1825 calBP	Bolonia. Coarse sand with bioclasts	(ALONSO ET AL., 2004)	Tsunami	Correlation with the Baelo Claudia earthquake
ca.50 AD	Carteia, Algeciras. Coarse sandy layer, fining upward sequence, mounted clast, bioclasts, calcareous rhodolites, erosional lower limit	(ARTEAGA & GONZÁLEZ , 2004)	High energy event, probably a tsunami	Dated by roman archaeological remains context. Sedimentary characteristics close to those of tsunami deposits
1755 AD?	Trafalgar cape. Large rock blocks orientated and imbricated	(WHELAN & KELLETAT, 2003; ALONSO ET AL., 2004; WHELAN & KELLETAT, 2005)	Tsunami associate to the 1755 Lisbon earthquake	No accurate chronology
1755 AD?	Los Lances beach, Tarifa. Washover fans	(ALONSO ET AL., 2004)	Tsunami associate to the 1755 Lisbon	No sedimentological data No accurate chronology

			earthquake	
1755 AD	Conil. Washover fans	(LUQUE ET AL., 2004)	Tsunami associate to the 1755 Lisbon earthquake	Dated by historical documents and maps





Tinto-Odiel (Huelva)
(MORALES ET AL., 2008)
HEL-2
0cm
40
burrowed mud
black muddy sands
shell accumulation
goethite crust
HEL-1
0cm
100
200
sand with whole or fragmented shells, with pebbles, lumachella fragments and muddy clasts.
mud
Valdelagrana (Cádiz)
(LUQUE ET AL., 2001)
TAP
0cm
40
1 to 10 cm alternance of fine sands and sandy clays. plants remains
1 to 7 cm white fine sands with shell remains
3 to 30 cm brown fine sands with shells and plants remains
3 to12 cm of fine sandswith shells lag, bioclast and armed mud clasts
mud (marsh deposits)
Doñana (Huelva)
(RUIZ ET AL., 2008a)
Core Las Nuevas/Los Arenosos
0cm
100
chenier
marshland
silty-clay with accumulation of invertebrate shells
silty-clay with accumulation of shells
clays with plants roots and remains
massive and laminated clays