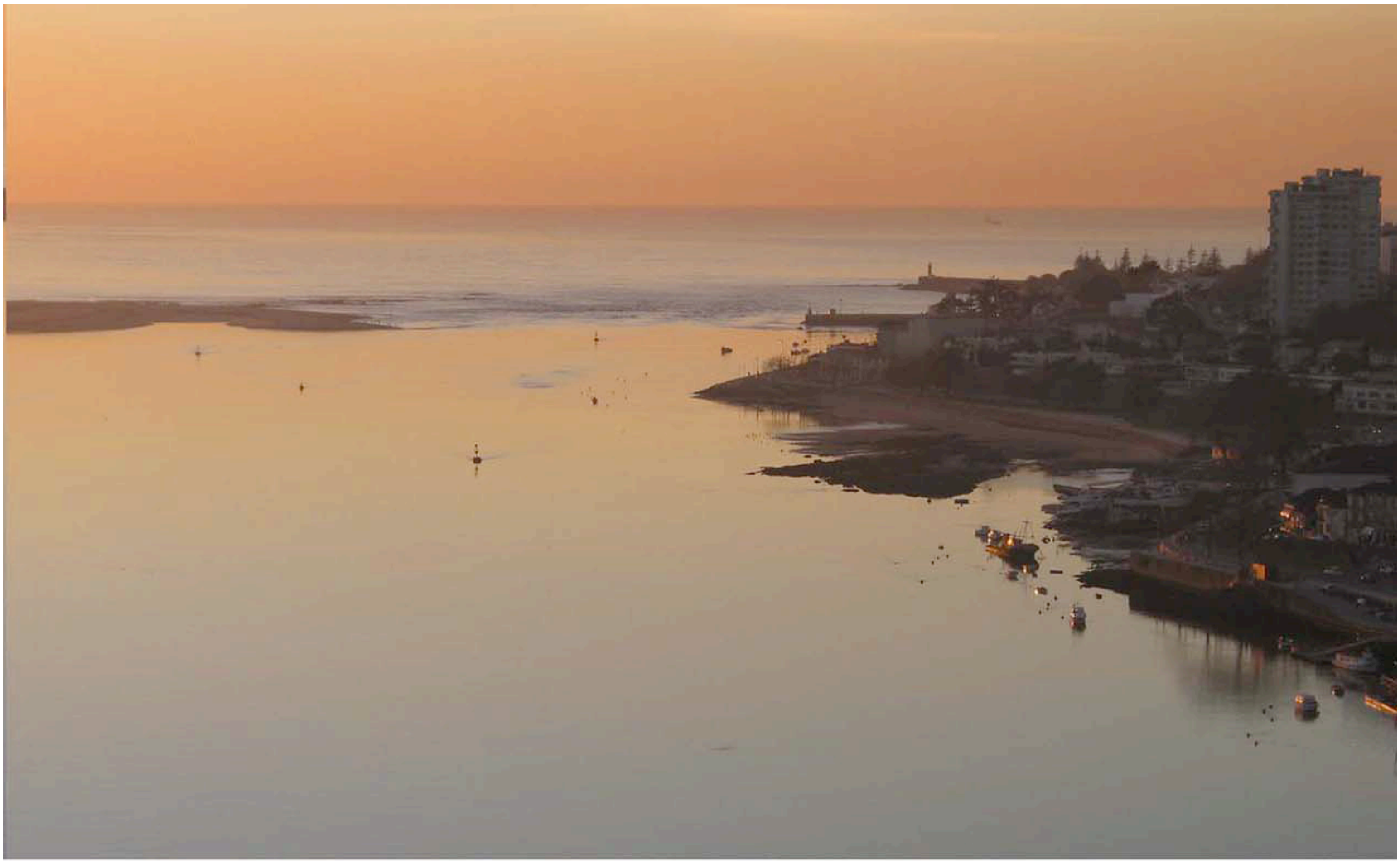


Porto, auditório da Reitoria da UP
19 Setembro 2005

Seminário

Sea level changes

Mudanças globais, variações do nível do mar e dinâmica costeira

PROGRAMA

10:00 Sessão de Abertura

10:30 **Nils-Axel Mörner** (Universidade de Estocolmo) - Sea level changes and coastal evolution; Past records & Future Perspectives.

11:30 Coffee break

12:00 **Ramon Blanco Chao** (U. Santiago Compostela) - Coastal change in the NW Spain since the last interglacial: influencing factors in long to short timescales.

12:30 **Helena Granja** (U. Minho) - Late Pleistocene-Holocene environmental changes (NW coastal zone of Portugal).

13:00 Almoço

15:00 **Assunção Araújo** (U. Porto) – Porto littoral: the influence of tectonics in sea level changes and coastal morphology.

15:30 **Pedro Proença Cunha** (U. Coimbra) - Tsunamis generated by island landslides - the example of La Palma.

16:00 **Ana Ramos Pereira** (U. Lisboa) - Sea level changes and neotectonics - some examples in Portugal (Arrábida and Southwest).

16:30 **Alveirinho Dias** (U. Algarve) – Holocene mean sea-level variations: data precision and compatibility.

17:00 **Mesa redonda**: Global Change – the IPCC and the scientists.

Apoio

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

U.PORTO

Dep. Geografia FLUP

APEQ (Assoc. Port. Estudo Quaternário)

APGeom (Assoc. Port. Geomorfólogos)

APG (Assoc. Port. Geógrafos)

APG (Assoc. Port. Geólogos)

Maria da Assunção Araújo

*Associate Professor, Porto Arts and Humanities Faculty, Via Panorâmica s/n
4150-564, Porto, Portugal; Fax/Tel: +351 226077194
E-mail: m.a.araujo@netcabo.pt*

Porto littoral: the influence of tectonics in sea level changes and coastal morphology.

Abstract

The plotting of relative sea level variations for several stations belonging to the Iberian Peninsula shows different trends. These trends seem to be related with the diastrophism affecting more intensely the Northern and Southern façade of the Peninsula.

Porto is located on the riverside of Douro, the most plentiful river in the Iberian Peninsula, which is deeply entrenched on the littoral platform, close to its mouth. This littoral platform is a quite common feature at Portuguese coastline, surrounding it almost in all its length.

At Porto area the littoral platform contains several outcrops of cenozoic deposits and it is limited to the interior by a generally step relief (marginal relief) which is probably a fault scarp acting mostly after the earlier deposits had been formed

A careful study of those deposits showed up that they are not at all primarily marine as its situation, facing the Atlantic could make us suppose: the marine deposits are disposed only in a narrow fringe lower than 40 m high. The upper deposits have a clear fluvial origin, they go up until 130m and they are clearly disturbed by tectonics.

Apparently, a sub-meridian accident produced the subsidence of the narrow fringe (1-2km maximum width) where the marine deposits are lying. This seems to indicate that the sea retouched this lower block when it subsided along that sub-meridian fault (fig. 1).

The newer, marine deposits can be assigned to at least three levels (around 30m, 20m and from 10 to recent sea level) distinguished by sedimentary criteria. They are not everywhere at the same altitude, but they are disposed in a irregular up and down pattern, with a general trend indicating a subsidence towards the meso-cenozoic basin that evolved like an aulacogen during meso-cenozoic times, and begins at Espinho, 15km south of Porto (Lusitanian basin).

We will focus on the tectonic style and regional tectonic framework that created the differences between 2 places, one of them appears at the north and the other at the south of Porto area.

A aeolian sandstone lying upon a marine deposit (Labruge beach, 15 km north of Douro river mouth, 5m above mean sea level) was TL dated, with a result of 84kaBP. Therefore, the underlying marine deposit must be from last interglacial. In addition, it is possible to correlate other iron-cemented sandstones covering old marine platforms with a similar position, found at several places in this coastline, with the same interglacial.

Admitting the sedimentology-based correlation of marine deposits at the North of Espinho they seem to be balanced to south, in the direction of Lusitanian basin (fig. 2).

At Aguda beach, some 12 km south of Porto the last interglacial marine deposit is laying at a lower altitude, 1m above mean sea, level fossilizing a wide marine platform. Upon it, we found some lagoon deposits. The upper part of them (around 4-5m above msl) was TL dated with a result of ca. 8ka BP.

So, this lagoon deposits are a testimony of continental conditions during last glaciation and/or flandrian transgression.

The lagoon deposit is covered by **another** marine sandstone, about 5 m above msl. Therefore, in this area, there are clear evidences of two marine sea levels with about 120 ka difference of age lying at quite similar altitudes (fig. 3).
In this coastal area, generally the marine deposits dispose themselves in a staircase fashion, the older ones at higher altitudes and the more recent at lower altitudes - which is typical of a slow uplifting area (Cabral, 1995). However, at Aguda, near Espinho, the last interglacial marine deposit is superposed by a flandrian one – and this disposition suggests that the uplifting trend prevailing in the north is replaced by a subsiding one.
At the south of Espinho the marine deposits seem to vanished – may be they are simply buried under the fini-Würmian and Holocene aeolian sands that cover the western part of the littoral platform in that area.
These aeolian sands include a podzol cemented old dune, which seems balanced to the north towards Esmoriz lagoon (see a development at Araújo, 2002 in the next pages).
In conclusion, the marine deposits at the North of Espinho and the würmian/holocene deposits at the South of this city show opposite tectonic trends that seems to define a tectonic depression corresponding approximately to the localisation of Esmoriz lagoon.
At Espinho, coastal erosion began in the middle of nineteen century. We think that the rising of sea level that began after the end of Little Ice Age, together with a possible subsiding trend, may be responsible for the severe erosion endured by this area.

Some bibliography

Araújo, M. A., 1985. O estudo do litoral norte de Portugal (região do Porto); alguns problemas metodológicos. Actas da I Reunião do Quaternário Ibérico, Vol. I, Lisboa, Grupo de Trabalho Português para o Estudo do Quaternário, 269-279.

Araújo, M. A., 1991. Evolução Geomorfológica da Plataforma Litoral da Região do Porto. Unpublished PhD thesis, Faculdade de Letras da Universidade do Porto, 534 p.

Araújo, M. A., 1997. A plataforma litoral da região do Porto: Dados adquiridos e perplexidades. Estudos do Quaternário, Lisboa, APEQ, 1, 3-12.

Araújo, M. A., 2000. Depósitos de fácies continental e marinho na plataforma litoral da região do Porto: importância da tectónica na sua organização espacial. Ciências da Terra, Lisboa, Universidade Nova de Lisboa, 14, 111-122.

Araújo, M. A., 2002. Relative sea level, diastrophism and coastal erosion: the case of Espinho (Portuguese NW coast). Littoral 2002 proceedings, Associação Eurocoast-Portugal, Instituto de Hidráulica e Recursos Hídricos, Faculdade de Engenharia da Universidade do Porto, 2, 125-132.

Araújo, M. A., 2004. O final do Cenozóico na plataforma litoral da região do Porto. Geomorfologia do NW da Península Ibérica, Porto, FLUP-GEDES, 117-138.

Araújo, M. A., Gomes, A., Chaminé, H. I., Fonseca, P. E., Gama Pereira, L.C., Pinto de Jesus, A., 2003. Geomorfologia e geologia regional do sector de Porto-Espinho (W de Portugal): implicações morfoestruturais na cobertura sedimentar cenozóica. Cadernos Laboratorio Xeolóxico de Laxe, Coruña, 28, 79-105

Cabral, J., Ribeiro, A., 1988. Carta Neotectónica de Portugal (escala 1:1000000), Serviços Geológicos de Portugal, Lisboa.

Cabral, J. M. L. C., 1995. Neotectónica de Portugal Continental, Memórias do Instituto Geológico e Mineiro, Lisboa, 31, 265.

Chaminé, H.I., 2000. Estratigrafia e estrutura da faixa metamórfica de Espinho-Albergaria-a-Velha (Zona de Ossa-Morena): implicações geodinâmicas. Faculdade de Ciências da Universidade do Porto. 497 pp. (unpublished PhD Thesis).

Chaminé, H. I., Gama Pereira, L. C., Fonseca, P. E., Noronha, F., Lemos de Sousa, M. J., 2003a. Tectonoestratigrafia da faixa de cisalhamento de Porto-Albergaria-a-Velha-Coimbra-Tomar. Cadernos Laboratorio Xeolóxico de Laxe, Coruña, 28, 37-78.

Costa, J. C. & Teixeira, C., 1957. Carta Geológica de Portugal na escala de 1:50000, Notícia explicativa da folha 9-C (Porto), Serviços Geológicos de Portugal, Lisboa, 38 p.

Daveau, S., 1977. L'évolution géomorphologique quaternaire au Portugal, Recherches Françaises sur le Quaternaire, Paris, INQUA, 50, 11-21

Ferreira, A. B., 1983. Problemas da evolução geomorfológica quaternária do noroeste de Portugal. Cuadernos do Laboratorio Xeolóxico de Laxe, Coruña, 5, 311-329.

Ferreira, A. B., 1993. As Rañas em Portugal: significado geomorfológico e estratigráfico. O Quaternário em Portugal, balanço e perspectivas, Lisboa, Colibri, 7-15.

Granja, H. M., Soares de Carvalho, G., 1995. Sea-Level Changes During the Pleistocene-Holocene in the NW Coastal Zone of Portugal. Terra Nova, Terra Research, 7, 60-67.

Mörner, N. A., 1973. Eustatic changes in last 300 years. Paleogeograp., Paleoclimat., Paleoecol., 9, 153-181.

Ribeiro, A., 1984. Néotectonique du Portugal, Livro de Homenagem a Orlando Ribeiro, Lisboa, Centro de Estudos Geográficos, 1, 173-182.

Ribeiro, A., 2002. Soft Plate and impact tectonics, Berlin, Springer Verlag, 324 p.

Ribeiro, O., Cotelo Neiva, J. & Teixeira, C., 1943. Depósitos e níveis pliocénicos e quaternários dos arredores do Porto (Nota preliminar). Boletim da Sociedade Geológica de Portugal, 3, 95-101.

Ribeiro, O., Lautensach, H., Daveau, S., 1987. Geografia de Portugal. I. A posição geográfica e o território, Lisboa, 334 p.

Somoza, L., Zazo, C., Bardaji, T., Goy, J. L., Dabrio, C. J., 1987. Recent Quaternary Sea Level Changes and Tectonic Movements in SE Spanish Coast, Trabajos sobre Neógeno-Cuaternario, 10, 49-77.

Teixeira, C., 1962. Carta Geológica de Portugal na escala 1/50000: Notícia explicativa da folha 13-A (Espinho), Serviços Geológicos de Portugal, Lisboa, 28 p.

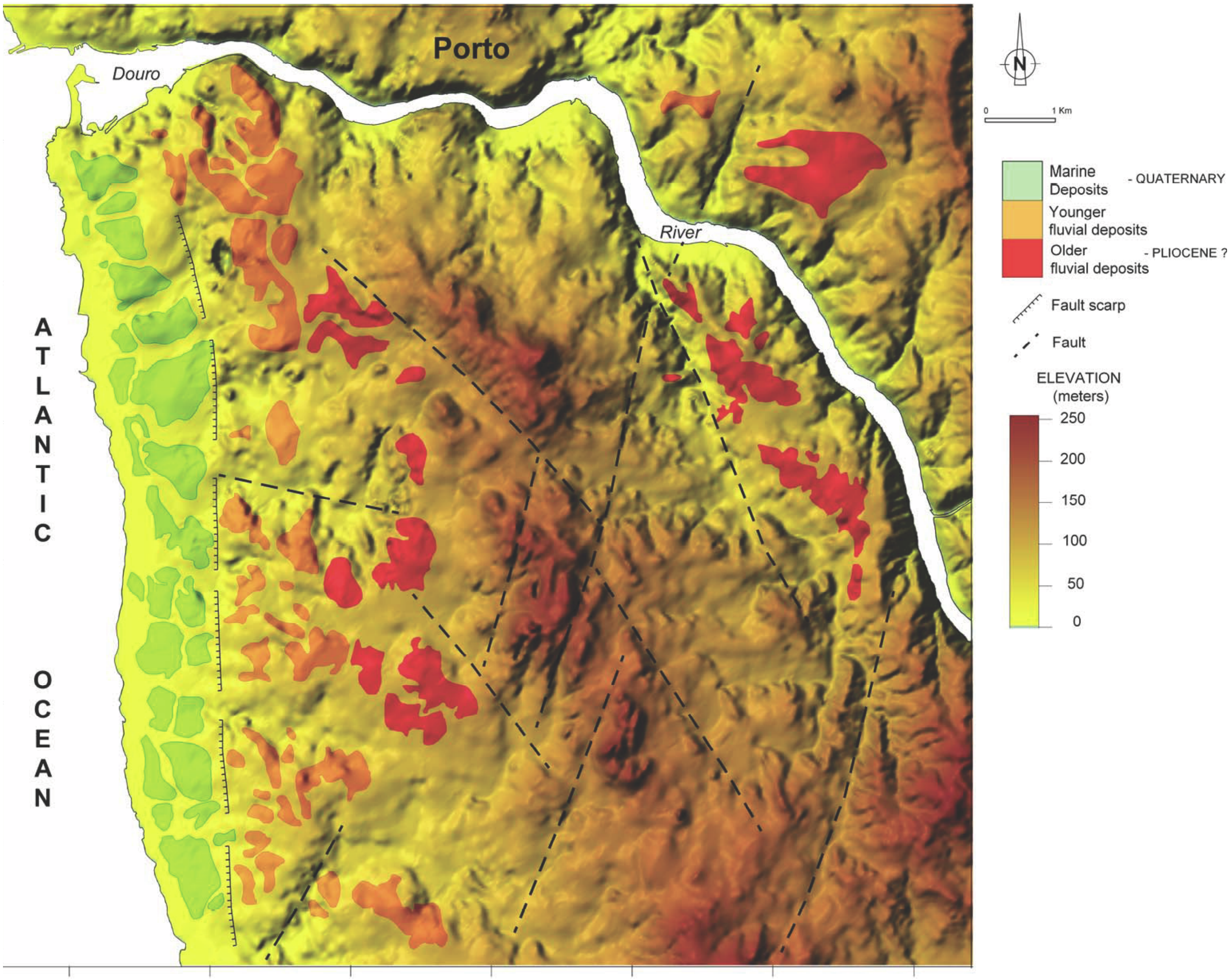


Fig. 1 – Digital Elevation Model (illumination from SW, angle of 45º).

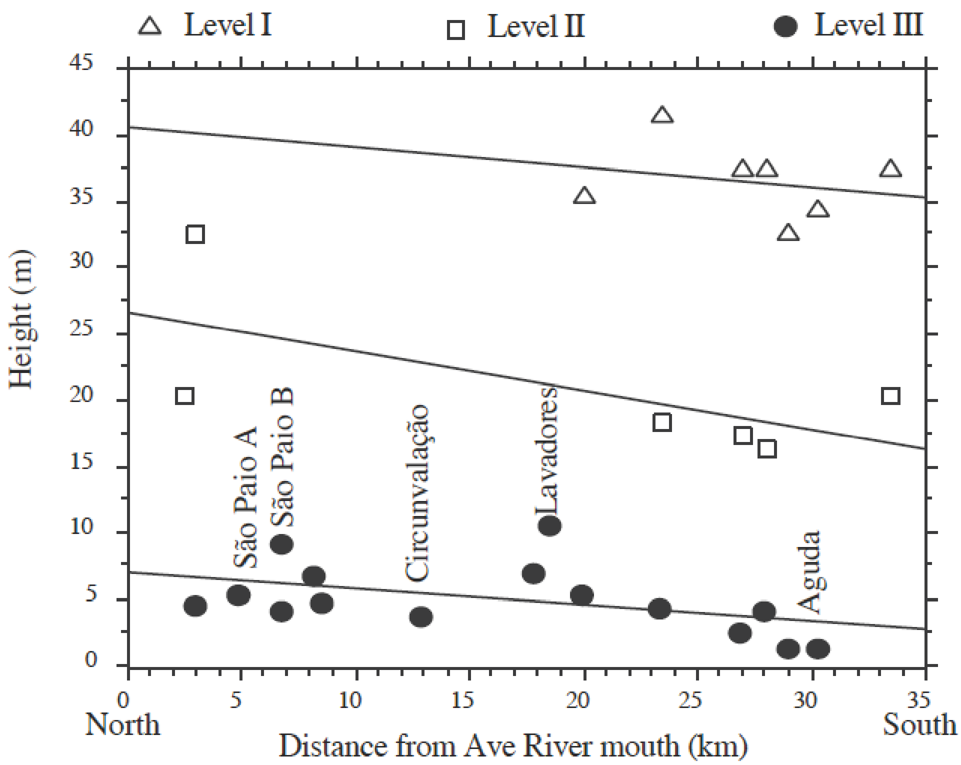
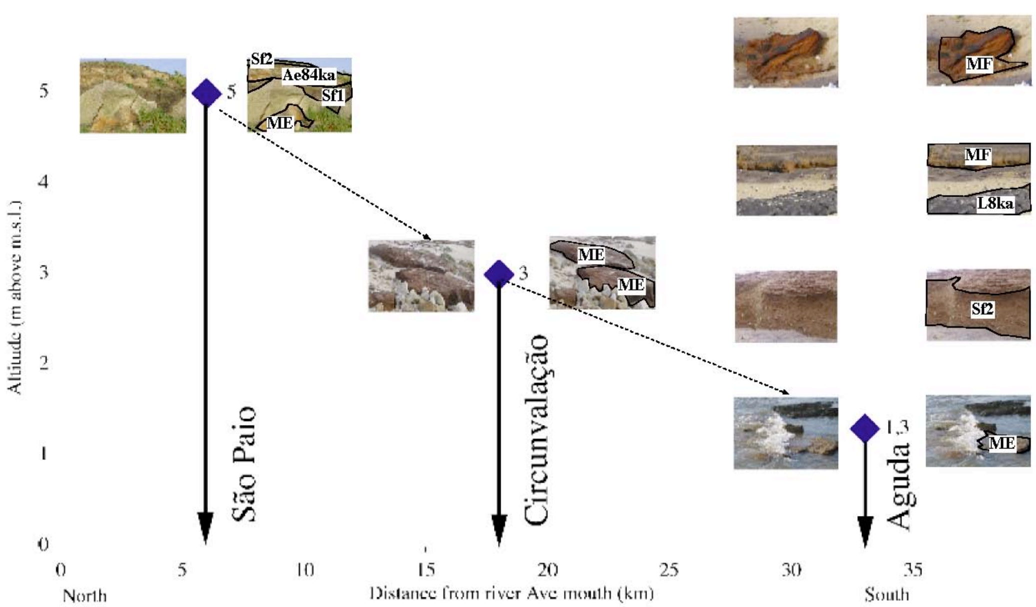


Figure 2 – The height of marine deposits outcrops and its evolution along the studied coastline.



ME - Eemien marine deposit (ca. 125.000 BP); **Sf1** - Solifluidal deposit (<125.000; >84.000 BP); **Ae 84 ka** - Aeolian deposit (ca. 84.000 BP); **Sf2** - Solifluidal deposit <84.000>8.000 BP; **L8ka** - Lagoon deposit (ca. 8.000 BP); **MF**- Flandrian marine deposit <8.000 BP

Deduced balancement of Eemien marine deposits

Fig. 3 - Essay of correlation of the different outcrops referred in the text.