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# Holocene ostracods of Pederneira (Nazaré, Portugal), a structurally-segmented infilled lagoon

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The Pederneira infilled lagoon is located in the W Portuguese coast (39°34'N; 9°01'W) and is segmented in 3 sectors, communicating through narrow, geologically-controlled gorges developed in Jurassic limestone. This study presents a reconstruction of Holocene palaeoenvironmental changes recorded in sediments from one core (NZS2, top at +4.25 m mean sea level-msl) taken from its innermost sector, where extensive silting favoured the development of a flat alluvial plain.

The 29.3 m-long core was analysed for ostracods, sedimentology and geochemistry. For ostracods 10 $cm^3$ samples were wet-sieved (63 $\mu$m mesh) and all valves and carapaces identified (1 individual = 1 carapace or 1 valve). Organic matter (OM) and $CaCO_3$ were determined by loss on ignition and gasometric method, respectively. Al, Si, S, Cl and Br contents were obtained by EDXRF spectrometry at ITN (Portugal). Five AMS $^{14}C$ ages were determined at Beta Analytic Inc., USA.

Ostracods are well represented along the core (more than 6500 individuals). Most of the species are marine littoral to shallow sublittoral, some being phytal (e.g., *Loxoconcha rhomboidea*, *Xestoleberis labiata*, *Semicytherura sella*), others preferring sandy to silty or muddy substrates (e.g., *Pontocythere elongata*, *Urocythereis britannica*, *Carinocythereis whitei*). However, the most abundant species are the brackish forms *Loxoconcha elliptica* and *Cyprideis torosa*. Interpretation of the ostracod assemblages (preservation, species abundance, diversity, dominance and age structure) allowed the identification of 4 major ecological zones, corresponding to sediment units with contrasting textures and compositions (cf. Moreira et al. 2010 for geochemistry; Fig. 1):

**Zone I/Unit I** (-25.05 to -17.14 m) is barren of ostracods. The sediment, deposited until 9550 cal BP, consists of sand/muddy sand, low in OM and free of bioclasts, with high contents in Si and low in Al and palaeosalinity proxies. This indicates a fluvial environment distant from marine influence.

**Zone II/ part of Unit II** (-17.14 to -3.88 m) was further divided in 3 ecological sub-zones:

**Sub-zone IIA/lower section of subunit IIA** (-17.14 to -9.20 m) yielded very few valves, generally of juveniles of brackish and littoral marine species frequent in outer

estuaries, most of them transported. The sediment is organic mud/slightly sandy mud with variable proportion of bioclasts. The high contents in Al and lower Si suggest enrichment in filossilicates. Palaeosalinity elements occur and increase upward. This subunit represents the development of an estuary after 9550 cal BP and during about 2000 years, retaining the earliest signature of marine invasion at the bottom.

**Sub-zone IIB/upper section of subunit IIA** (-9.20 to -5.35 m) – ostracods are mostly represented by scarce populations, with many reworked adult and juvenile valves of *L. rhomboidea*, *Aurila convexa*, *Basslerites berchoni*, *Leptocythere pellucida* and *C. whitei* and brackish forms almost disappear. Sediment remains organic and muddy but increases in $CaCO_3$ and palaeosalinity proxies. This subzone is interpreted as an estuarine environment open to marine influence.

**Sub-zone IIC/lower part of subunit IIB** (-5.35 to -3.88 m) – abundant forms of both marine (frequently associated with algae) and brackish ostracods. *L. elliptica*, *L. rhomboidea*, *X. labiata*, *S. sella*, *S. robertsi*, *Leptocythere macallana*, *P. elongata* and *U. britannica* are the most representative species, frequently autochthonous; several (> 20) other marine species are transported, represented by few valves, generally of juveniles. The sediment is still essentially muddy, the variations in the Si and Al profiles reflecting rapid textural changes; the OM, $CaCO_3$ and palaeosalinity indicators remain high, the Br content reaching a maximum value.

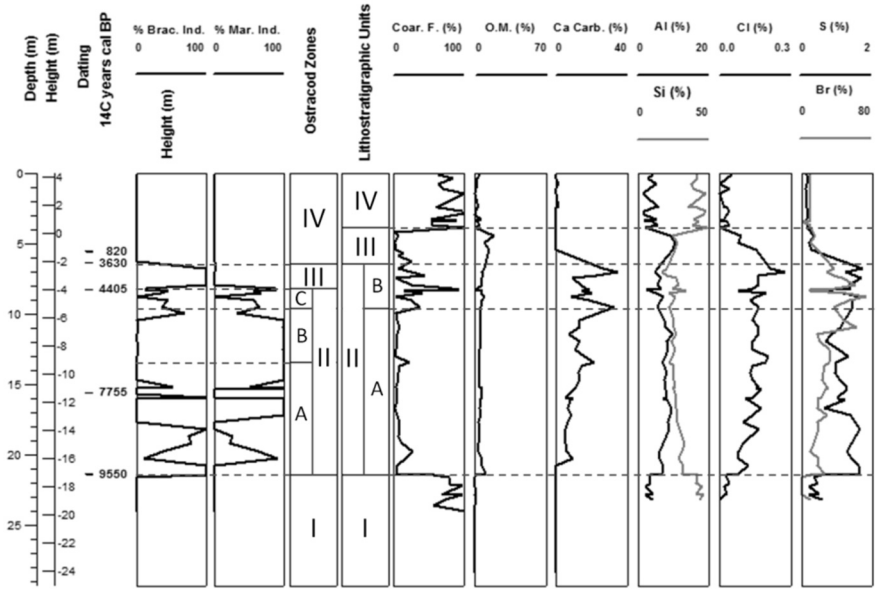


*Fig. 1:* Ostracod zones and lithotratigraphic units. Left: % distribution of the ecological ostracod groups (brackish and marine). Right: profiles of textural (% > 63 μm), compositional attributes (% OM; % $CaCO_3$) and selected elements (Si and Al – texture; S, Cl, Br – palaeosalinity). Radiocarbon ages (cal BP) at the middle point of the 2σ interval.

This sub-zone records the strongest marine signal, particularly in its top, compatible with the increase in open marine conditions of the former estuarine environment.

**Zone III/upper part of subunit IIB** (-3.88 to -2.14 m) – very abundant (sometimes > 400 individuals/sample) brackish *L. elliptica* and *C. torosa*, well-preserved, with adults and juveniles, mostly autochthonous. *Cytherois fischeri* also occurs moderately represented at the base. In the top, *Sarscypridopsis aculeata* (1 valve) and *Heterocypris salina* (1 valve) occur (indicating very low salinity to freshwater conditions), washed into this essentially brackish-water setting. The surface of *C. torosa* valves gradually becomes more punctuated upcore, suggesting a drop in salinity. The sediment is mud/sandy mud, high in OM and carbonate. The contents in Si and Al are similar to underlying sediment, but Si decreases to the top as a consequence of dilution by shell debris. The levels of the palaeosalinity elements remain high, with Br decreasing to the top. Zone III accumulated between c. 4400 and 3600 yrs cal BP, corresponds to an essentially brackish, more restricted environment, that became progressively less saline to the top.

**Zone IV/Units III and IV** (-2.14 to +4.25 m), is barren of ostracods and lack biogenic carbonate. Unit III consists of peat/organic mud, whereas Unit IV shows minerogenic and coarser detrital facies (sands/muddy sands) low in OM. The Si and Al profiles are in agreement with variations in both OM and texture. The palaeosalinity signal decreases across Unit III and in Unit IV becomes similar to Unit I. Zone IV records the progradation of fluvial sediments over the former flooded space, initially as a marginal facies (Unit III) evolving to the present day alluvial plain (Unit IV).

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## Reference

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