

Environmental changes in the Moulay Bouselham lagoon (Morocco) during the last 7 000 years using a multiproxy approach

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The aim of this research is to reconstruct Holocene environmental changes in Moulay Bouselham lagoon using a multi-proxy approach to the study of sediments of two short cores: biological (e.g., pollen, foraminifera and diatoms), physicochemical (isotopes, chemical composition) and sedimentary (grain size, clay minerals). The research highlights the role of climatic variations and human interference in the evolution of this lagoon.

The results show that at the beginning of the Holocene this area corresponded to a wide coastal bay, including the surface of Moulay Bouselham present-day lagoon and Merja Ras Ed-Dora. The dating's obtained in the base of the sediment cores range from 6790-6640 BP (end of the Atlantic and early Sub-boreal). Sand predominates in this section of the cores, with low content of organic matter and high content of bioclasts. *Ammonia tepida* is the predominant species but *Haynesina germanica*, *Quinqueloculina seminula*, *Cibicides lobatulus*, *Criboelphidium oceanensis* and *Miliolinella sobrotunda* are also present. At the base, foraminifera assemblages show a relative abundance of *Planorbulina mediterranea*, *Rosalina anomala*, *Rosalina irregularis*, *Miliolinella subrotunda* and *Cibicides lobatulus*. These are typical of a shallow environment with normal marine salinity.

During the sub-boreal period (6640-4520 BP), a sandy barrier developed and the lagoon evolved to a brackish lagoon with low salinity. Sedimentation is homogeneous, the content of silt and clay is high (90%), calcium carbonate content is usually lower than 20% and the organic material exhibited the highest values (> 10%). *Ammonia tepida* is also the dominant species but *C. oceanensis* and *H. germanica* are secondary.

The lagoon was closed in drier conditions and has gradually filled by sediments coming from the watershed, represented by an illite-chlorite association. The lagoon evolved to a *sabkha*. We must emphasize the role of deforestation caused by the Romans (2100 BP) in that period; it increases soil erosion in the sedimentary flux increases to the basin and promotes the infill of the lagoon. During the middle Ages, the lagoon evolved to a semi-closed gulf, communicating by one tidal inlet with the ocean, which was deep enough for navigation. Between 1350 and 250 BP, the sedimentological interpretation shows that muddy deposits were set up by low currents with very low or simple settling in a quiet environment. These levels reflect the closure of the inlet of the lagoon, probably accentuated by the establishment of the Delta Drader isolating the northern part of the lagoon. Arid climatic conditions have led to a reduction of inputs of Drader River.

The top part of the core is marked by the presence of fine sandy sediment, poorly sorted with a negative skewness. This level is characterized by abundant foraminifera association with low diversity (*Ammonia tepida*, *Criboelphidium oceanensis* and *Haynesina germanica*) which corresponds to a brackish lagoon deposit. Currently, the lagoon is reduced to half; it is separated from Merja Ras Ed-Dora which is completely transformed into an agricultural area since the early 20th century. Finally, the Nador Canal construction (1953) accelerated filling of the Moulay Bouselham lagoon.