

**A PALEOCEANOGRAPHIC RECORD OF LITTLE ICE AGE AND WARM MEDIEVAL
INTERVAL CONDITIONS IN NORTHERN CHILE? PRELIMINARY DATA FROM
GRAVITY CORES IN BAHIA MEJILLONES (23° S lat.)**

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The coastal desert of northern Chile and Peru, probably the most arid place on earth, owes its lack of precipitation to a singular interaction of oceanic and atmospheric processes. The northbound cold Humboldt Current and the eastern branch of the SE Pacific anticyclonic cell combine their effects to strongly reduce the evaporation of oceanic water and limit the transfer of this humid air onshore. Additional orographic factors reinforce the arid conditions, particularly in the Atacama desert of northern Chile. As the interactive factors that control the extreme aridity may not have varied significantly during the major Quaternary climatic fluctuations, it can be inferred that the coastal regions of northern Chile and Peru have been submitted to similar climatic conditions for most of Quaternary times.

At an interannual time scale, the current climatic system is altered by the El Niño phenomenon which brings heavy rains on the northern Peru coast and more episodically some rain in southern Peru and northern Chile (see Ortlieb, same vol.). Under present-day conditions this recurrent (although not periodic), short-term, oceanographic and climatic anomaly is responsible for most of, if not all, the rainfall that may occur in the coastal desert. The historical record of major rainfall in Peru during the last few centuries, which was used to establish the chronology of former El Niño events, does not provide the most adequate information on climate variability at a decadal/centennial time scale. The relationships between the interannual El Niño anomaly and longer-term past climatic fluctuations, like the Little Ice Age, are not well documented in this coastal region, and remain to be understood. Whether the El Niño system behaved differently, or not, during the Little Ice Age and under present conditions is still a matter of discussion.

The close relationship which links climate and oceanographic conditions in the study area plainly justifies that a closer look be given to potential paleoceanographic records. Firstly because paleoceanographic information may compensate for the scarcity of onshore paleoclimatic data, and secondly because the area offers an excellent opportunity to study the variability of the interaction mode between atmospheric and oceanographic processes in the course of the last centuries/millennia. Earlier studies had shown that marine sediments from the Peruvian continental margin were suitable for high resolution analysis and might be useful for paleoceanographic reconstructions. The laminated sediments are related to the oxygen minimum zone and located at a few hundred meters depth.

Offshore from the centre of the driest part of the Chile-Peruvian coastal desert, we investigated the possibility that marine sediments from Bahía Mejillones provide a record of former oceanic conditions, and subsequently of climatic fluctuations. A series of Phleger cores,

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several decimetre long (up to one meter) were collected. The first results of this co-operative franco-chilean program are encouraging since it was discovered that favourable physico-chemical conditions (hypoxia) are found on the bottom of this bay below a 50 m depth (down to at least 150 m depth) and that bioturbation is very limited. In many cores the dark greenish muds are grossly laminated and the stratification well preserved. The sediments are rich in organic matter, diatoms, foraminifers and fish remains, all material currently under study. Preliminary radiocarbon dating (on bulk sediment) suggests sedimentation rates in the range of 180 to 300 mm/10³ y, between the center and the rim of the 15 km-wide embayment. These rates are high if one considers that, because of the aridity, the fraction of terrestrial material is extremely reduced (mostly of eolian origin).

The laminations and other sedimentologic heterogeneities observed along the cores are interpreted as resulting from variations in the oceanic circulation pattern and in the intensity of the local upwelling system. Relative abundance of planktonic and benthic foraminifers as well as of pelagic fish remains along the cores is used to reconstruct paleoenvironmental conditions (involving both the upper part of the water column and the sea floor). Data from one of the first cores under study tend to indicate that before the installation of the present conditions, the water was colder and had a more "oceanic" character. Before that, is recognized a relatively warm episode (with sardine replacing anchoveta, as observed during present-day strong El Niño events), during which the hypoxia on the sea bottom was intensified. At the base of the 37-cm-high core (age estimate: ca. 1000 AD), the assemblage of bioindicators is roughly similar to that of the core top (present situation).

We interpret that the cold episode might correlate with the Little Ice Age, while the warmer episode might represent the Warm Medieval Interval. If this interpretation is correct, the marine sediments of Bahía Mejillones would reflect, in a quite simple way, the global (or northern hemisphere?) climatic fluctuations of the last ten centuries. We are presently working on the characterization of the three successive oceanographic regimes that were identified in the cores in the lapse of the last millennium. These regimes will be compared with the local oceanographic conditions occurring during El Niño, "normal", and "anti-El Niño" years. Through these comparisons we hope to determine, for instance, whether the Little Ice Age was, or was not, characterized by conditions similar to those of "anti-El Niño" episodes, or at least if "anti-El Niño" events were more common at that time.

These preliminary data clearly need to be cross-checked by further analyses of additional cores. A more precise chronological framework is also required. Nevertheless, as this paleoceanographic information encompassing the last millennium is among the first that are being obtained along the South American Pacific coast, it is felt that they are worth considering in paleoclimatic reconstructions at regional scale. The reconstitution of paleoclimatic scenarios in South America should necessarily involve information on the eastern Pacific Ocean circulation patterns and their variation at distinct time scales.

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