



## **Sea-level rise, climatic changes and reef development during the last deglaciation.**

### **Preliminary results from the IODP expedition 310 “Tahiti sea level”.**

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The timing and course of the last deglaciation (19,000-6,000 calendar years BP - cal. yr BP [1]) are essential components for understanding the dynamics of large ice sheets [2] and their effects on Earth's isostasy [3,4] as well as the complex relationship between freshwater fluxes to the ocean, thermohaline circulation and, hence, global climate during the Late Pleistocene and the Holocene. Furthermore, the last deglaciation is generally seen as a potential recent analog for the environmental changes that our Planet may face in the near future as a consequence of the ocean thermal expansion and the melting of polar ice-sheets related to the greenhouse effect.

Coral reefs are sensitive recorders of past sea-level and environmental changes. Their accurate dating by mass spectrometry is of prime importance to the understanding of the mechanisms driving glacial-interglacial cycles during Quaternary times. Due to their growth within a narrow depth window, coral reefs represent excellent sea-level indicators. High-resolution records of past global changes (especially temperature and salinity changes) are stored in the geochemical and physical parameters of annually-banded massive corals and can be used to examine ocean/atmosphere vari-

ability. Changes in other environmental parameters such as light conditions, water energy and nutrient levels are usually reflected in variations in the composition of reef communities, as reef-dwelling organisms are sensitive to subtle ecological changes affecting their environment.

The study of coral reef records of last deglacial events is therefore of prime importance : 1) to constrain the timing and amplitude of rapid sea-level changes, 2) to reconstruct abrupt climatic and environmental changes, and 3) to evaluate the impact of those changes on coral reef development.

Because the amplitude of the last deglacial sea-level rise was at least of 120 m (e.g. Barbados [5], Bonaparte Basin [6] and review in [7]), the relevant reef and sediment archives are mostly stored on modern fore-reef slopes where they can be investigated only by dredgings, submersible sampling and offshore drilling. The scarcity of available and useful data, due to the difficult accessibility of those archives, is responsible for the continuing debates concerning both the general pattern of the last deglacial sea-level rise and the timing and amplitude of abrupt climatic and environmental changes that occurred during that time window.

Tahiti is a volcanic island characterized by slow and regular subsidence rates and located at a considerable distance from the major former ice sheets and corresponds, therefore, to an ideal site to obtain an unbiased continuous record of last deglacial events. Drilling operations carried out on the modern reefs off Papeete [8 to 12] and dredgings around the island [13] have demonstrated the occurrence of distinctive levels of relict reefs and confirmed the significance of these features as unique archives of abrupt last deglacial sea-level rise and climate and environmental changes.

The Integrated Ocean Drilling Program (IODP) Expedition #310 “Tahiti Sea Level” (october-november 2005; [14 to 16]) aimed to recover most, if not all, of the coral reef record of the last deglacial sea-level rise by drilling the successive reef terraces from a dynamically positioned vessel (*DV/DP Hunter*). More than 600 m of reef cores, including 30 m of massive corals, with an exceptional recovery were retrieved from 37 holes along transects ranging from 40 to 117 m water depth in three regions distributed around the island (Faaa, Tiarei and Maraa). Borehole logging operations in 10 boreholes provided continuous geophysical information about the drilled strata.

The general scientific objectives of the expedition were threefold :

- To establish the course of the last deglacial sea-level rise ;
- To define sea-surface temperatures and salinities variations during the last deglaciation when solar insolation, sea-level, and atmospheric CO<sub>2</sub> levels were

different from today.

- To analyze the impact of sea-level and environmental changes on reef development during the last deglaciation.

The primary objectives of Expedition 310 required a multidisciplinary approach involving the use of geochemical and biochemical techniques, paleomagnetic analyses, and detailed investigation of lithological and biological assemblages.

The preliminary geochemical results obtained on pristine shallow-water corals and on massive coral colonies suitable for paleoclimate studies coupled with the analysis of the temporal and spatial distribution of coral reef systems demonstrate that the objectives of the expedition are expected to be fulfilled.

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