Geophysical Research Abstracts, Vol. 7, 02565, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02565

The last deglacial sea level rise in the South Pacific :

offshore drilling in Tahiti (French Polynesia) – I.O.D.P. Expedition “Tahiti sea level”

1 G. F. Camoin(1) and Y. Iryu (2)

2 CNRS-CEREGE B.P. 80 F-13545 Aix-en-Provence cedex 4, France (gcamoin@cerege.fr).

(2) Institute of Geology and Paleontology, Tohoku University, Aobayama, Sendai 980-8578, Japan (iryu@dges.tohoku.ac.jp).

Coral reefs are sensitive recorders of past sea level and environmental changes. Their accurate dating by mass spectrometry is of prime importance for the determination of the timing of deglaciation events and thus for the understanding of the mechanisms driving glacial-interglacial cycles. The most useful coral reef records of past sea level changes are related to the last deglaciation and the last interglacial period, approximately 125 ka ago.

The history of sea-level and sea surface temperature variation associated with the last deglaciation is of prime interest to understand the dynamics of large ice sheets and their effects on Earth’s isostasy. So far, the only sea-level record that encompasses the whole deglaciation is based on offshore drilling of Barbados coral reefs (Fairbanks, 1989 ; Bard *et al.*, 1990) which overlie an active subduction zone and was located close to the former ice sheets during the Last Deglaciation « near field » ; Peltier, 1991). Vertical tectonic movements in such areas may be large and are often discontinuous,

implying that apparent sea level records may be biased by variations in the rates of uplift. Hence, there is a clear need to study sea level changes in tectonically stable regions or in areas where vertical movements are slow and/or regular. Furthermore, the eustatic function is best estimated from sea level data collected far from the former ice margins (« far field » ; Peltier, 1991) where the the influence of glacio-isostatic rebound is minimized.

The I.O.D.P. Expedition « Tahiti sea level » (Camoin, Iryu, McInroy *et al*.) seeks to establish the course and effects of the last deglaciation on the subsiding volcanic island of Tahiti (subsidence rates : 0.25mm.yr-1 ; Bard *et al*., 1996), at a considerable distance from former ice sheets.

The scientific objectives of the Expedition are :

A - To reconstruct the general pattern of sea-level rise during the last deglaciation events in order : 1) to establish the amplitude of the maximum lowstand during the Last Glacial Maximum ; 2) to assess the validity, the timing and amplitude of meltwater pulses (so-called MWP-1A and MWP-1B events; c. 13,800 and 11,300 cal. yr BP ; Fairbanks, 1989 ; Bard *et al*., 1990) which are thought to have induced reef-drowning events (Blanchon and Shaw, 1995) and to have disturbed the general thermohaline oceanic circulation and, hence, global climate ; 3) to test predictions based on different ice and rheological models.

B - To identify and to establish patterns of short-term paleoclimatic changes that are thought to have punctuated the transitional period between present-day climatic conditions following the Last Glacial Maximum in order to get a better knowledge of : 1) the regional variation of sea surface temperatures in the south Pacific; 2) the climatic variability and the identification of specific phenomena such as El Nino-Southern Oscillation (ENSO); 3) the global variation and relative timing of post glacial climate change in the southern and northern hemisphere.

C - To analyse the impact of sea-level changes on reef growth, geometry and biological makeup, emphasizing : 1) the impact of glacial meltwater phases (identification of reef drowning events); 2) the morphological and sedimentological evolution of the foreslopes (highstand vs lowstand processes); 3) the modeling of reef building; 4) environmental changes during reef development.

The scientific goals of a high resolution 3D seismic tomography study (Ancillary Project Letter by Kenter *et al.*) that may be developed after the drilling cruise are : (1) to provide the geometric evolution of the reef system in time and space to validate and anchor the sea level reconstruction; (2) to improve the methodology of seismic imaging of coralgal reefs; and (3) to advance the understanding of the heterogeneity

of the pore system and its associated acoustic properties.

The recovery of the whole post glacial reef sequence implies to drill the successive reef terraces that occur seaward of the living barrier reef. Studies and surveys on Tahiti (Camoin *et al.*, 2003; Camoin *et al.*, in press) have demonstrated the occurrence of successive reef terraces at various depths, 100m, 90m, 60m and 40-50m which correspond to drilling targets.

Based on the results of the previous scientific drillings (Montaggioni *et al.*, 1997 ; Camoin *et al.*, 1999 ; Cabioch *et al.*, 1999) and surveys (Camoin *et al.*, 2003; Camoin *et al.*, in press), it is proposed to drill a transect of holes in three areas around Tahiti: offshore Papeete-Faaa (Site TAH-01A), Tiarei (Site TAH-02A) and Maraa (Site TAH-03A). The involved water depths range from 40 to 310 m with one exception concerning the drilling of a keep up reef in the Tiarei area (water depth : 25 m).

References

Bard, E., Hamelin, B. and Fairbanks, R.G. (1990) - U-Th ages obtained by mass spectrometry in corals from Barbados: Sea-level during the past 130,000 years. Nature, 346, 456-458.

Bard, E., Hamelin, B., Arnold, M., Montaggioni, L.F., Cabioch, G., Faure, G. and Rougerie, F., 1996a. Deglacial sea-level record from Tahiti corals and the timing of global meltwater discharge. Nature, 382, 241-244.

Blanchon, P. and Shaw, J. (1995) - Reef-drowning during the last deglaciation: evidence for catastrophic sea-level rise and ice-sheet collapse. Geology, 23, 4-8.

Cabioch, G., Camoin, G. and Montaggioni, L.F. (1999) - Post-glacial growth history of a French Polynesian barrier reef (Tahiti, central Pacific). Sedimentology, 46, 985-1000.

Camoin, G., Cabioch, G., Gautret, P. and Montaggioni, L.F. (1999) - Nature and environmental significance of microbialites in Quaternary reefs: the Tahiti paradox. Sedimentary Geology, 126, 271-304.

Camoin, G., Cabioch, G., Hamelin, B. and Lericolais, G. (2003) – Rapport de mission « SISMITA ». Unpublished.

Camoin, G., Cabioch, G., Eisenhauer, A. and Braga, J.-C. (in press) - Environmental significance of microbialites in reef environments during the Last Deglaciation. Sedimentary Geology.

Fairbanks, R.G. (1989) - A 17,000-year glacio-eustatic sea-level record: Influence of glacial melting rates on the Younger Dryas event and deep-ocean circulation. Nature,

342, 637-642.

Montaggioni, L., Cabioch, G., Camoin, G., Bard, E., Ribaud A., Faure G., Déjardin, P. and Récy, J. (1997) - A 14,000 years of continuous record of reef growth in a mid-Pacific island. Geology, 6, 555-558.

Peltier, W.R., (1991) - The ICE-3G model of late Pleistocene deglaciation: construction, verification, and applications. In: R. Sabadini (Editor), Isostasy, Sea-level and mantle rheology. NATO ASI, C, 334, Kluwer, Amsterdam, pp. 95-119.