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Microbialites : a major component of the last deglacial reef sequence from Tahiti

(IODP Expedition #310).

Environmental significance and sedimentological roles.

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The last deglaciation was characterized by a rapid sea-level rise and abrupt climatic changes with probable coeval alteration of ecological conditions, including bathymetry, light intensity, terrigenous flux, nutrient concentrations etc. The reconstruction of depositional environments based on biological successions and sedimentary sequences provides some insight into the environmental changes that reefs had to face during the last deglaciation. Among biological indicators of environmental changes, microbial fabrics, referred as “microbialites”, first described in the last

deglacial reef sequence from Tahiti [1 to 3], are of pivotal interest in such reconstructions because of their widespread occurrence in Late Pleistocene to Holocene reef frameworks from many areas (see review in [4]).

600 m of reef cores with an exceptional recovery were retrieved from 37 holes by drilling the successive reef terraces along transects ranging from 40 to 117 m water depth in three regions distributed around Tahiti (Faaa, Tiarei and Maraa) during the IODP Expedition #310 “Tahiti Sea Level” [5 to 7]. Those archives represent therefore an unique opportunity to investigate the distribution in time and space of microbialites in reef sequences in order to better understand their environmental significance and their sedimentological roles in reef development during the last deglaciation.

The occurrence of microbialites at all depths in the last deglacial reef sequence and within all coralgal frameworks identified indicates that they developed in various parts of the reef tracts, thus reflecting contrasting scenarios of microbialite development. They developed in open primary reef cavities, perhaps some distance within the reef frameworks, and their abundance is clearly subordinate to the internal structure of the various coralgal frameworks. However, they commonly appear as major structural and volumetric components, locally forming up to 80% of the reef rock in loose frameworks dominated by branching *Porites*.

Microbialites generally comprise a suite of fabrics, including two end-members represented by laminated fabrics (« stromatolite »-like fabrics) and dendritic accretions (« thrombolite »-like fabrics) commonly associated in compound crusts, probably reflecting differences in the composition of the involved biological communities and/or in biomineralization processes during the accretion of the crusts.

Microbialites form surface crusts corresponding to a late stage of encrustation of the dead parts of coral colonies, or more commonly, of related encrusting organisms (coralline algae and crustose foraminifers), implying that some time elapsed prior to the formation of the microbialites and that there was generally no direct space competition between coralgal and microbial communities. This is also reflected by the age differences between corals and overlying microbialite crusts previously reported in dredged samples and in Papeete drill cores [3]. At the top of reef sequences, microbialites generally form the ultimate stage of a biological succession indicating a deepening sequence, whereby shallow water corals and associated encrusting organisms are replaced by deeper water assemblages of coralline algae and crustose foraminifers before the accretion of microbialite fabrics, the precipitation of phosphatic-iron- manganese crusts, and the deposition of planktonic micritic limestones [3].

The widespread development of microbialites in the last deglacial reef sequences may characterize periods of environmental degradation related to the rapid sea-level rise and abrupt climatic changes. The reported biological successions suggest changes in water quality, and especially an increase in nutrients related to surface fluxes and terrestrial groundwater seepage and/or continuous upwelling of nutrient-rich deeper waters during sea-level rise (see also [3 and 4]). Environmental changes, such as those leading to eutrophication, might have provided ideal conditions for microbial communities to develop biofilms and induce distinctive biomineralization processes. Bacteria isolated from the microbial communities occurring in modern biofilms observed in drill cores indicate that anoxic conditions and anaerobic microbial processes probably dominated during carbonate precipitation. This observation is reinforced by the presence of pyrite, which is commonly associated with laminated microbialite fabrics. Interpretation of the modern environmental conditions of microbialite formation may provide a model that can be used to interpret fossil counterparts.

The rapid lithification of the microbialite crusts, as deduced from a suite of sedimentological features, implies that their widespread occurrence in many Quaternary reef tracts may have significantly altered sediment transport from reef margins to slope environments. Ongoing studies are expected to increase our knowledge regarding the timing and processes of microbialite formation, their environmental significance and their sedimentological roles in reef development during the last deglaciation.

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References

[1] Montaggioni L.F. & Camoin G.F., 1993, Geology, 21, 149-152.

[2] Camoin G.F. & Montaggioni L.F., 1994, Sedimentology, 41, 655-676.

[3] Camoin G.F. et al., 1999, Sedim. Geol., 126, 271-304.

[4] Camoin G.F. et al., 2006, Sed.Geol., 185, 277-295.

[5] Camoin, G.F., Iryu, Y., McInroy, D., & the Expedition 310 Project Team, 2005. IODP Sci. Prosp., 310. http://www.ecord.org/exp/acex/310SP.html

[6] Expedition 310 Scientists, 2006. Tahiti Sea Level: the last deglacial sea level rise in the South Pacific: offshore drilling in Tahiti (French Polynesia). IODP Prel. Rept.,

310. doi:10.2204/iodp.pr.310.2006

[7] Camoin G.F., Iryu Y., McInroy D., and the Expedition 310 scientists, in press. Proc. IODP, 310 : College Station TX (Integrated Ocean Drilling Program Management International, Inc.).