PALAIOS, 2010, v. 25, p. 618–635
Research Article
DOI: 10.2110/palo.2010.p10-032r

Formation of deglacial microbialites in coral reefs off Tahiti (IODP 310) involving sulfate-reducing bacteria

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Keywords: coral reef, lipid biomarker, last sea-level rise, organomineralization, LA-ICP-MS

ABSTRACT

During IODP Expedition 310 (Tahiti Sea Level), drowned Pleistocene–Holocene barrier-reef terraces were drilled on the slope of the volcanic island. The deglacial reef succession typically consists of a coral framework encrusted by coralline algae and later by microbialites; the latter make up ≤80% of the rock volume. Lipid biomarkers were analyzed in order to identify organisms involved in reef-microbialite formation at Tahiti, as the genesis of deglacial microbialites and the conditions favoring their formation are not fully understood. Sterols plus saturated and monounsaturated short-chain fatty acids predominantly derived from both marine primary producers (algae) and bacteria comprise 44 wt% of all lipids on average, whereas long-chain fatty acids and long-chain alcohols derived from higher land plants represent an average of only 24 wt%. Bacterially derived mono-*O*-alkyl glycerol ethers (MAGEs) and branched fatty acids (10-Me-$C_{16:0}$; *iso*- and *anteiso*-$C_{15:0}$ and -$C_{17:0}$) are exceptionally abundant in the microbial carbonates (average, 19 wt%) and represent biomarkers of intermediate-to-high specificity for sulfate-reducing bacteria. Both are relatively enriched in ^{13}C compared to eukaryotic lipids. No lipid biomarkers indicative of cyanobacteria were preserved in the microbialites. The abundances of Al, Si, Fe, Mn, Ba, pyroxene, plagioclase, and magnetite reflect strong terrigenous influx with Tahitian basalt as the major source. Chemical weathering of the basalt most likely elevated nutrient levels in the reefs and this fertilization led to an increase in primary production and organic matter formation, boosting heterotrophic sulfate reduction. Based on the observed biomarker patterns, sulfate-reducing bacteria were apparently involved in the formation of microbialites in the coral reefs off Tahiti during the last deglaciation.