Geophysical Research Abstracts,
Vol. 10, EGU2008-A-11106, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-11106
EGU General Assembly 2008

Microbial biomineralization processes forming Holocene Mg-carbonate stromatolites

A. Spadafora (1), E. Perri (2), C. Vasconcelos (1) & J.A. McKenzie (1)

(1) Geological Institute, ETH-Zurich, 8092 Zurich, Switzerland - (2) Dipartimento di Scienze della Terra - Università della Calabria, 87036 Rende, Italy - (alessandra.spadafora@erdw.ethz.ch)

Recent Mg-carbonate stromatolites form in association with the microbial mat in Lagoa Vermelha (Brazil), a small shallow hypersaline lagoon located about 100 km east of Rio de Janeiro. The stromatolites, although showing diversified fabric characterized by thin or crude lamination and/or thrombolitic clotting, exhibit a pervasive peloidal micro-fabric. The peloidal texture consists of dark micritic aggregates of Mg-carbonate formed by the iso-oriented assemblage of sub-microns trigonal polyhedrons and organic matter remains. Limpid acicular crystals of aragonite arranged in spherulites surround the aggregates. The dark micritic Mg-carbonate, comprising the peloids, shows a consistent presence of organic matter as indicated by strong autofluorescence in comparison with the aragonite crystals. This organic matter is observed as sub-micron flat and filamentous mucus-like structures inside the interspaces of the high Mg-calcite crystals and is interpreted as the remains of degraded extracellular polymeric secretion (EPS). Moreover, many fossilized bacterial cells are strictly associated with both aragonitic and Mg-carbonate mineral phases. They mainly consist of 0.2 to 4 micron in diameter sub-spherical, rod-like and filamentous forms, isolated or in colony-like clusters. The co-existence of fossil EPS and bacterial bodies, associated with the polyhedrons of high Mg-calcite, implies that the organic matter and microbial metabolism played a fundamental role in the precipitation of the minerals that form the peloids. At the same time, the lack of EPS in the aragonitic phase indicates an additional precipitation mechanism. The complex processes that induce mineral precipitation in the modern Lagoa Vermelha microbial mat appear to be recorded in the

studied lithified stromatolites. The bacterial and EPS degradation and calcification, through the precipitation of early Mg-rich ovoidal mineral aggregates, represent the first steps for stromatolitic laminae formation. Sub-micron polyhedral crystal formation of Ca-dolomite and/or very high Mg-calcite results from the coalescence of carbonate nano-globules around degraded organic matter (ESP and/or bacterial bodies) nuclei. Nanoglobules aggregate to form larger ovoidal crystals that constitute peloids. Further precipitation of aragonitic spherulites around peloids could occur when heterotrophic degradation of organic matter by SRB terminates and alkalinity increases. Moreover, many fossilized bacterial bodies associated with spherulitic nuclei of aragonite have been observed, perhaps indicating that subsequent microenvironmental water conditions around the peloids permited the existence and metabolic activities of a different bacterial community that induces aragonite precipitation.

This study is supported by the Swiss National Science Foundation Grant No. 200020-113590.