Geophysical Research Abstracts, Vol. 7, 04960, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04960

Calcification of cultured marine cyanobacterial mats: an example from Øresund, Denmark

J. Kaźmierczak(1), M. Kühl(2), T. Fenchel (2), B. Lacka (3), K. Malkowski(1), S. Kempe (4), B. Kremer (1) C. Kulicki (1)and M. Kuzniarski (3)

(1) Institute of Paleobiology, Polish Academy of Sciences, Warszawa, Poland, (2) Marine Biological Laboratory, Copenhagen University, Denmark, (3) Institute of Geological Sciences, Polish Academy of Sciences, Warszawa, Poland, (4) Institute for Applied Geosciences, University of Technology, Darmstadt, Germany (jkaztwarda.pan.pl / Fax: (+4822) 620 62 25 / Phone: (+4822) 6978 887)

Calcium carbonate precipitates from microsensor-monitored marine cyanobacterial mats from Nivå Bay (Øresund, Denmark), cultured for over three years in closed-system conditions at the Marine Biological Laboratory of the Copenhagen University in Helsingør[1,2], are presented. Two modes of calcium carbonate precipitation have been observed within the mats[3,4]: (i) formation of sub-micrometer-sized morphs of Mg-calcite in the mucilage near the basis of the living cyanobacterial layers, and (ii) production of a variety of mixed Mg-calcite/aragonite morphs (anhedral and subhedral grains, hemispheres, dumbbells, and aggregates of dagger-like and rhombic platy crystals) in the zones of activity of purple sulfur bacteria in the death cyanobacterial biomass. These observations are supported by the results of stable carbon isotopes measurements of the $CaCO_3$ precipitates showing ^{13}C values about $2‰$ heavier for calcium carbonate grains generated in the living surficial cyanobacterial zone (due to photosynthetic uptake of lighter carbon) as compared with grains generated in the zones of decaying cyanobacterial biomass (due to input of lighter carbon from the decomposition of the cyanobacterial biomass). Saturation indices calculated with respect to calcite, aragonite, and dolomite inside mats show high supersaturation values across the $CaCO_3$-producing microbial zones. These high values are clearly related to much higher, as compared with the mat ambience, pH and carbonate alkalinity levels generated inside the mat by the metabolising microbiota and to an increased amount of Ca^{2+} and Mg^{2+}stored in vivo in the cyanobacterial sheaths and extracelllar poly-

mer substances (EPS), and, during their decomposition, liberated to the mats interiors. The $CaCO_3$ precipitates produced by the studied cyanobacterial mats are similar to $CaCO_3$ morphs originated in experiments with bacterial cultures and bacterially decomposed cyanobacterial biomass emplaced in Ca-rich media[5], proving universality of such process[5,6].

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