



Organic insights into the bioprecipitation of carbonates in photosynthetic biofilms. A case study from La Laguna de Chiprana hypersaline lake (Spain).

Jérémy Jacob, Pascale Gautret, Christian Défarge, Patrick Albéric, Patrick Baillif, Nathalie Lottier

► To cite this version:

Jérémy Jacob, Pascale Gautret, Christian Défarge, Patrick Albéric, Patrick Baillif, et al.. Organic insights into the bioprecipitation of carbonates in photosynthetic biofilms. A case study from La Laguna de Chiprana hypersaline lake (Spain).. International Meeting on Organic Geochemistry, Sep 2007, Torquay, United Kingdom. pp.P184-TU. insu-00188033

HAL Id: insu-00188033

<https://insu.hal.science/insu-00188033>

Submitted on 15 Nov 2007

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

ORGANIC INSIGHTS INTO THE BIOPRECIPITATION OF CARBONATES IN PHOTOSYNTHETIC BIOFILMS. A CASE STUDY FROM LA LAGUNA DE CHIPRANA HYPERSALINE LAKE (SPAIN)

Jérémy JACOB, Pascale GAUTRET, Christian DEFARGE, Patrick ALBERIC, Patrick BAILLIF and Nathalie LOTTIER.

ISTO, UMR 6113 CNRS - Université d'Orléans, Bâtiment Géosciences, 45067 Orléans, Cedex 2, France.

Within complex systems such as microbial mats formed in benthic environments, calcium carbonates are often associated with photosynthetic biofilms. This biocalcification regulates CO₂, calcium and alkalinity in hydrosystems and is therefore highly sensitive to environmental and anthropogenic triggers. Deciphering biocalcification mechanisms is therefore a prerequisite for understanding present and past biogeochemical cycles. The photosynthetic activity of cyanobacteria could explain the presence of biocarbonates in biofilms (Ludwig et al., 2005), although the metabolic activity of sulfate-reducing bacteria can also be invoked (Dupraz and Visscher, 2005). Moreover, carbonates precipitation could be mediated by extracellular polymeric substances (EPS) or by macromolecules in dissolved organic matter (Gautret et al., 2006).

The CYANOCARBO project (ANR, France) aims at elucidating the mechanisms of biocalcification through a multidisciplinary approach combining ecophysiology, microbiology, biochemistry, biogeochemistry and micropetrography, performed on the photosynthetic biofilms presently developing in La Salada de Chiprana hypersaline lake (Northern Spain). Our contribution to this project focuses on the typing of biochemicals (amino-acids, carbohydrates and lipids) extracted from various components of the system (interstitial water, sheaths and tissues), coupled with elemental (Ca, Mg, Fe, S, Na, K) and microscopic (photonic and electronic) analyses. Three sites were selected with regard to the predominant community that develops at the surface. They comprise an anoxygenic photosynthetic bacteria (*Chloroflexus*-like) and two cyanobacteria (*Lyngbya* sp. and *Microcoleus chthonoplastes*). For each site, three short cores of few centimetres long and ca 1 cm² surface were drilled in order to test the heterogeneity of the material and/or the reproducibility of analyses. The dissection of individual layers that compose each microbial mat was realized under microscope, on the basis of morphological and microstructural considerations. Water soluble (EPS1) and cell-bound (EPS2) EPS were recovered, purified (MicroSep© 3kD) and analysed for amino acid and carbohydrate content. The low molecular weight fraction and the insoluble material were reserved for elemental and lipid analyses.

SEM analyses show several carbonate precipitates differing in both microstructure and composition (Ca and Ca/Mg) intimately associated with an abundant and diversified organic material. Elemental analyses performed on the insoluble material show distinct distributions of Ca, Mg, Fe, S, Na and K. The distributions of amino-acids and carbohydrates in EPS1 and EPS2 and of sterols in insoluble materials are highly variable within each site as a result of microspatial heterogeneities. We are currently investigating any relationship linking the biochemical signature to mineralogical assemblages and exploring any seasonal variation. This will allow us assessing the dominant processes that control bio/organic carbonatogenesis in these original systems.

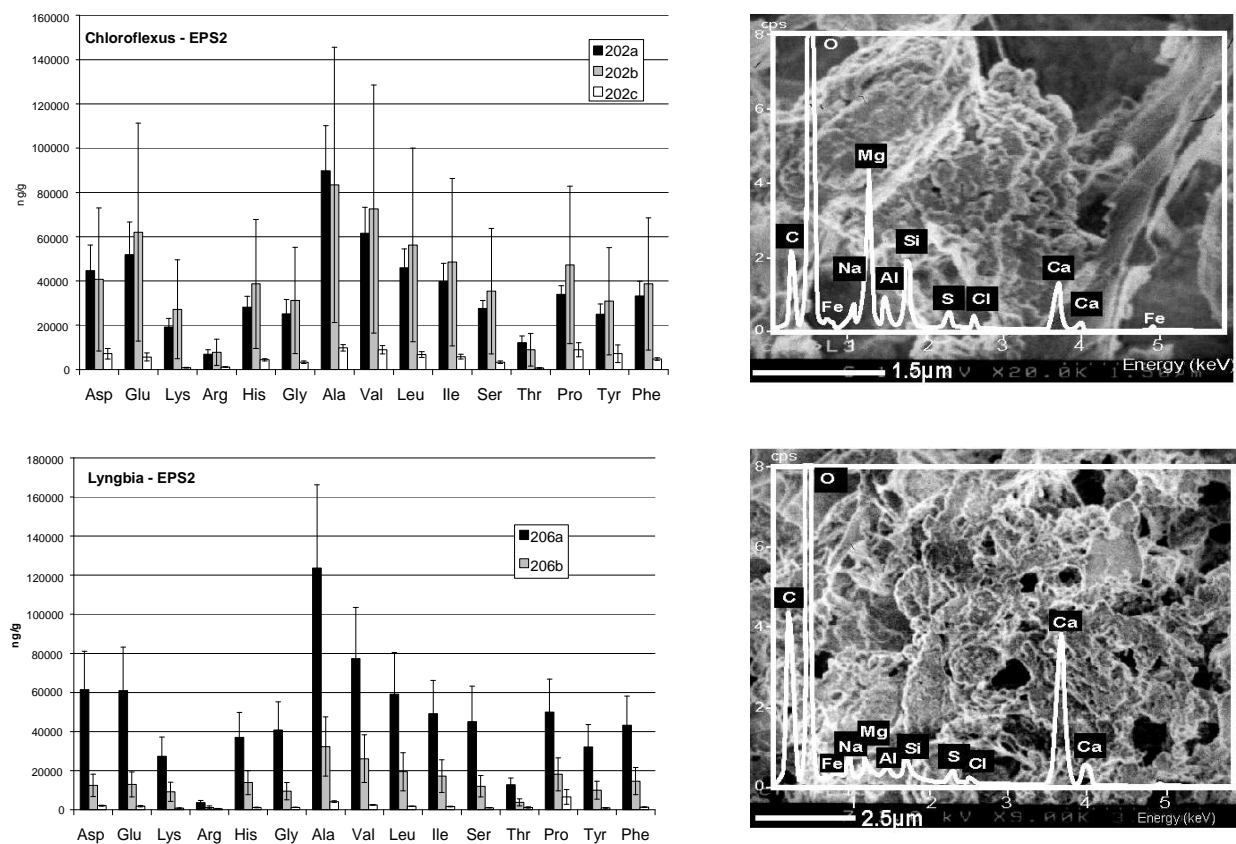


Figure 1. Distributions of amino acids associated with microbial sheaths within the different layers of the 202 (*Chloroflexus*-like dominated) and 206 (*Lyngbya* dominated) mats and cryoSEM pictures illustrating the diversity of associated mineral assemblages.

REFERENCES

- Dupraz, C., Visscher P., 2005. Microbial lithification in marine stromatolites and hypersaline mats. *Trends in Microbiology* 13, 429-438.
- Gautret, P., De Wit, R., Camoin, G., Golubic, S., 2006. Are environmental conditions recorded by the organic matrices associated with precipitated calcium carbonate in cyanobacterial microbialites? *Geobiology* 4, 93-107.
- Ludwig, R., Al-Horani, F.A., de Beer, D., Jonkers, H.M., 2005. Photosynthesis-controlled calcification in a hypersaline microbial mat. *Limnology and Oceanography* 50, 1836-1843.