Geophysical Research Abstracts, Vol. 9, 10250, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10250

Early Cretaceous fossil bacteria and biofilms in hydrothermally-supported carbonate chemoherms

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Marine chemosynthetic communities occur in areas where chemically charged fluids vent at the sea floor. In this setting, bacterial oxidation of methane has been thought to be the main driving force for the formation of microbial carbonate mounds that sustain chemosymbiotic invertebrate communities. However, submarine hydrothermal environments may support a large variety of microbial communities.

A newly discovered Early Cretaceous (Late Aptian–Earliest Albian; $\sim$112 Ma) group of vent sites from the Basque–Cantabrian basin of northern Spain shows evidence of shallow water microbial chemoherm formation and chemosynthetic communities. Microbial productivity in the chemoherms were possibly regulated by hydrothermal venting at the sea-floor along active faults created during continental rifting during to the opening of the Bay of Biscay. The best exposed vent deposits extend more than 0.5 km along the synsedimentary fault, hosting tens of isolated or coalescent chemoherms that range from 2–8 m high and 5–20 m wide, and that alternate with carbonate breccias and calcarenites.

Optical microscopy, cathodoluminescence (CL), scanning electron microscopy (SEM) and X-ray diffraction (XRD) analyses have revealed that an assemblage of carbonate stromatolites and Fe-oxide biofilms preserved as hematites (Fe_2O_3) makes the frame of the chemoherms. Direct examination of the microbialite facies with SEM has revealed a variety of morphotypes that suggests that an association of both cyanobacteria and neutrophilic Fe-oxidizing bacteria mineralized as carbonate and Fe-oxide crusts respectively. Calcification of cyanobacteria in the carbonate stromatolitic crusts generated a micropeloidal structure of micrite that is characterized under SEM by the

presence of clusters of coccoids structures and remnants of spherical bacteria. SEM-images of the microbial structures mineralized as iron oxides include isolated and dendritic filamentous structures, spherules and globular bodies surrounded by platy crystals of hematites.