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Experimental Study of Culture Media of a Bacteria from Dry Environment

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Studying the geochemical and mineralogical signatures of bacterial activity in dry environments is of interest for weathering studies under desert conditions, as well as for detection and characterization of life in extreme environments, including extra-terrestrial materials. In this work, our aim was to characterize the mineral phases retrieved from culture experiments made under different physical and chemical conditions on micro-organisms collected from desert environments, in order to detect potential mineralogical bio-signatures. We used the strain TTB310 belonging to a new species closely related to Acidovorax. This bacteria was isolated from Tataouine (Tunisia) desert soil (Gillet et al, 2000) and is well suited to our study as it was observed in association with pyroxene dissolution pits and calcite precipitation. To get a better understanding of the involvement of strain TTB310 in calcite precipitation, this strain was cultured on solid media enriched in calcium carbonate. Resulting rosettes of calcite were prepared for TEM investigations. Some calcite crystals were shown to display a 10Å superstructure on (2-21), which might be related to the bacterial activity. The strain was also cultured in a TSB/10 liquid medium containing 20 g/l of a very fine orthopyroxene powder (<10μm) at 30 C. Incubation lasted from 1 day to several months. Mineralogy of bulk samples was investigated with X-ray diffraction and Rietveld refinement procedures. TEM and SEM observations of bacteria and minerals were also performed. The cultures show the coexistence of rod-shaped and ovoid-shaped individuals of the same strain, which have different interactions with minerals: the ovoid-shaped organisms form biofilms embedding submicron pyroxenes and secondary alteration phases. Drying experiments of strain TTB310, followed by cultures, were carried out, demonstrating that strain TTB310 can resist to extreme drying. Morphological and ultra-structural modifications associated to such stress conditions were studied by TEM : morphological modifications of the bacteria occur and important densities of polyphosphate granules are observed as a result of stress conditions. Precipitation of crystallographically oriented sylvite and halite crystals is reported in the cell walls. These characteristics are compared to that observed in the meteorite rosettes. Some differences are observed (e.g. size), leaving open the question of the factors leading to the formation of ultra-small nanobacteria under desert conditions.

Gillet P., Barrat A., Heulin T., Achouak W., Lesourd M., Guyot F., Benzerara K., *EPSL*, **175**, 161-167, (2000).