Rapid Pyrite Biomineralization and Phosphate Release by Hyperthermophilic Archaea

F. GUYOT[1], A. GORLAS[2]

[1]IMPMC, Muséum National d'Histoire Naturelle, 75005 Paris France. (francois.guyot@mnhn.fr)
[2]I2BC, Univ Paris Saclay, 91405 Orsay Cedex France. (aurore.gorlas@i2bc.paris-saclay.fr)

The hyperthermophilic Archaea *Thermococcales* are major isolates from sulphidic acidic oceanic hydrothermal vents. These cells live close to hydrothermal fluids rich in iron, sulfur and transition element metals; they thus are appropriate for studying and modeling interactions between microbes and minerals in acidic and saline environments. Pyrite FeS_2 is known as a major mineral and metal host in those and many other natural settings. This phase has so far surprisingly very rarely been observed as a direct result of microbial activity. Here, we demonstrate fast (within hours) formation of framboidal-type pyrite at 85°C on the *Thermococcales* cells. Both the observation of zero valent intracellular sulfur vesicles and thermodynamic modeling suggest that polysulfides are reaction intermediates. Polysulfides and zero valent sulfur react with iron phosphates which precipitated inside or in the immedidate vicinity of the cells, forming respectively greigite (Fe_3S_4) on extrapolymeric substances [1] and pyrite within former cells, thus releasing bioavailable phosphate. We suggest that this mechanism is one of the main controls of microbial ecosystems that thrive in acidic and saline environments with important implications for their mineral contents and metal speciations.

[1] Gorlas A., Jacquemot P., Guigner J.M., Gill S., Forterre P. and Guyot F. (2018) PloS ONE 13(8)