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ORAL PRESENTATIONS | CONCURRENT SESSION PRESENTATIONS

Clays and micro-organisms

Sulfide weathering processes mediated by microfungi

Pietro Marescotti[1], Grazia Cecchi[1], Simone Di Piazza[1], Gabriella Lucchetti[1], Mauro Giorgio Mariotti[1], Mirca Zotti[1]
[1]*DISTAV, University of Genova, Genova, Italy*

This study aimed to experimentally investigate the interactions, the bioalteration, and the biocorrosion of sulfides mediated by three microfungi (Trichoderma harzianum group, Penicillium glandicola, P. brevicompactum) isolated within the open-air waste-rock dumps from Libiola mine (Liguria, Italy). Unaltered samples of pyrite-mineralizations from the same waste-rock dumps were ground and sieved into size fraction of 150-63 ↔m which resulted composed by single crystals of pyrite (>80 wt%), with minor quartz and trace amount of chalcopyrite. The mineral bioalteration tests were carried out for six weeks using Czapek-Dox agar medium (CZA). In each plate, four pyrite crystals or crystal fragments were set into the solid medium. After one week, pyrite grains were almost completely covered by mycelia of the three different fungi. The samples were examined, before and after the experimental procedure, using plane-polarized optical microscopy (transmitted- and reflected-light) and environmental scanning electron microscopy (ESEM-EDS). The ESEM analyses were performed in low-vacuum mode for the micromorphological analyses to characterize the evolution of the mineral-fungi interactions during the different experimental steps. After six weeks covered by mycelia, the pyrite grains were collected and analyzed revealing that the surface of pyrite crystals was strongly corroded in all experimental tests.

ESEM images underlined how pyrite alteration was strictlty associated with biological patterns (curves, rounded cracks, and sinuous traces). Corrosion patterns and etching pits were not related to specific crystallographic planes or weakness, but were randomly distributed on the crystal surfaces, in particular in correspondence of the fungal hyphae attachment. Moreover, in the same temporal interval, the control experiment performed in abiotic conditions did not show any dissolution evidences thus suggesting that in absence of fungal interactions the pyrite weathering did not occur or was much slower.

The experimental results evidenced the active role of fungi in the pyrite crystal weathering and suggested that sulfide alteration was not only the consequence of the interactions between metabolites secreted by fungi and minerals, but there was also a possible bio-mechanical role of hyphae in corrosion through penetration, boring, and burrowing along weak crystal planes or microfractures.

Finally, the evidences of biocorrosion led to evaluate the important role of fungi in the iron and sulfur cycles in sulfide-bearing materials, since fungal alteration systematically triggers sulfide to sulfate oxidation, causing local gypsum and Fe-oxyhydroxides precipitation within mycelium structures