Bacterial colonisation of copper sulphides

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The interaction of bacteria with chalcopyrite in bioleaching systems is poorly understood, but key to understanding processes controlling and enhancing copper solubilisation. This study investigated the colonisation and growth of a consortium of acidophilic iron and sulphur oxidising bacteria (*A. ferrooxidans, L. ferrooxidans and A. thiooxidans*) on different sulphides, representing a well characterised system (pyrite), easily leached material (bornite-chalcocite ore) and a difficult bioleaching target (chalcopyrite). In order to determine the necessity of attachment and colony formation for culture survival and growth, sample chips with a polished surface were suspended in the bacterial consortium for one day, then transferred to fresh media for growth, in order to create a limited window for colonisation and a challenging growth environment. Samples were then removed at regular intervals and analysed using scanning electron microscopy to determine and examine growth patterns on the mineral surfaces.

Both the pyrite and the bornite-chalcocite ore supported colony formation. The pyrite samples exhibited preferential attachment of cells to natural surfaces, with almost no attachment to the polished surface, whereas the ore possessed colonies on all bornite-chalcocite surfaces, and evenly scattered individual cells on the non-sulphidic minerals in the ore. In contrast, the chalcopyrite sample did not result in the growth of microcolonies, though cells were evenly distributed over the entire specimen. All three systems formed precipitates on the mineral surfaces; iron phosphates on pyrite and chalcopyrite, and copper phosphate on the bornite-chalcocite ore. All systems had viable cell counts two orders of magnitude higher than the original inoculum by the end of the experiment.

The lack of iron both in solution and in the precipitates formed on the bornite/chalcocite ore sample indicate a preferential leaching of chalcocite, with no significant solubilisation of bornite. An increase of copper in solution, coupled with high bacterial counts in the fluid phase showed that colony formation on the surface of chalcopyrite is not essential for bacterial growth, suggesting that copper solubilisation from this mineral is likely due to a biogenically catalysed chemical leach rather than direct biooxidation of the mineral.