

Microbially induced formation of copper minerals

HEIKE BOSTELMANN^{1*}, CARLA ZAMMIT¹, GORDON SOUTHAM¹

¹The University of Queensland, St Lucia, Queensland 4072, Australia (*correspondence: h.bostelmann@uq.edu.au)

Low grade copper ores are a key target for bioleaching technology, made difficult by complex interactions and the passivation of mineral surfaces. During the bioleaching of sulphides, intermediate products of sulphur oxidation, such as thiosulphates and polysulphides, will accumulate in the system and can then interact with the surrounding material. To better understand how microbiota affect copper mineralogy under complex weathering conditions, e.g. in the presence and influence of native copper, an experimental system using sulphur oxidising bacteria grown on different sulphur sources was set up, to which pure copper was later added.

The setup containing thiosulphate leached pure copper, and the presence of bacteria led to the formation of a distinct succession of copper mineral precipitates. Platy sulphides forming “porous” hemispheres encased the copper pieces and were in turn surrounded and overlapped by cuprite crystals and acicular copper phosphates (Fig. 1). The same sequence of compounds also coated the glass walls of the vessel, with the phosphates additionally occurring as “free” grains, i.e. either detached from the sample surface or formed separately.

In contrast, though the abiotic control also formed copper oxides, the crystals were one to several orders of magnitude larger than those of the biotic system, and the system lacked phosphates altogether. Furthermore, the “free” grains were comprised of several minerals that were morphologically distinct from those formed on the substrate, likely containing sulphates (based on EDS). Systems with bacteria grown on elemental sulphur rather than thiosulphate resulted in significantly reduced copper mobilisation, with the abiotic control having no effect over the same time period.

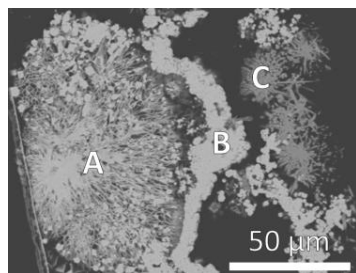


Figure 1: Scanning electron micrograph of a cross section showing copper sulphide hemispheres (A) surrounded by cuprite (B) and copper phosphates (C).