Microbial S geochemistry in acidic environments: Integrated geochemical and soft X-ray spectromicroscopic characterization

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Bacterial S Recycling: The Roles of Fe(III) and S^0

The importance of microbial activity for S oxidation and associated acid generation in mine environments is well known, but remains poorly characterized [1, 2]. In particular, no study has evaluated the combined impact of varying Fe(III) and O_2 conditions relevant to acid mine drainage (AMD), which often contains high [Fe(III)]. Further, one of the key microbial S intermediates in the overall oxidation of reduced S species to SO_4^{2-} is elemental S (S^0), which may be internally stored as S globules [3]. However, the occurrence of S^0 in overall microbial S reaction arrays is not well characterized. The objectives of this study were thus to: (1) evaluate in batch experiments, the S pathways catalyzed by a variety of environmental AMD enrichments and pure strains under AMD relevant, varying Fe(III) and O_2 concentrations; and (2) characterize cell associated S globules as well as externally produced S precipitates using soft X-ray spectromicroscopy (STXM; CLS, Saskatoon). The combined experimental and XAS results show that disproportionation is a key process involved in microbial S reaction arrays which is accelerated by Fe(III), with direct implications for acid generation and metal transport in mine systems. This presentation will highlight the utility of combining microbial geochemistry with XAS based characterization techniques for a fuller understanding of the processes involved.

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$^{40}Ar/^{39}Ar$ UV laser dating, EBSD and EMP analysis of 1040-940 Ma metamorphic/deformation/cooling events recorded in Sibao Orogen white micas, South China

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The Tianli Schist is the largest meta-sedimentary complex of the eastern portion of the Grenville-aged Sibaon Orogen in South China, and is linked to the assembly of the Neoproterozoic supercontinent Rodinia. These well-preserved mica-bearing samples were subjected to: (1) Electron Backscattered Detection (EBSD) mapping to characterise the deformation fabrics, (2) electron microprobe (EMP) analyses to discern subtle chemical differences between three white mica populations, and (3) $^{40}Ar/^{39}Ar$ ultra-violet (UV) laser spot dating of specific white mica and biotite fabrics. This combined approach includes EBSD mapping of white micas, which has previously been hampered by difficulties in preparing the samples and issues with mis-indexing of these monoclinic minerals.

The results yield a series of texturally- and chemically-defined $^{40}Ar/^{39}Ar$ ages that can be tied to an initial 1042 ± 7 Ma Grenville metamorphic event and three subsequent deformation/cooling episodes at 1015 ± 4, 968 ± 4 and 942 ± 8 Ma (all 2 σ). The high-resolution 1042 ± 7 Ma $^{40}Ar/^{39}Ar$ Grenville metamorphic age is consistent with a Tianli Schist $^{207}Pb/^{206}Pb$ SHRIMP detrital zircon Pb-loss age of 1029 ± 24 Ma (2σ) [1], and a previous Sm-Nd mineral isochron age of 1034 ± 24 Ma from the nearby Zhangshudun ultramafic complex [2].

The multi-faceted EBSD and EMP approach towards characterising the metamorphic and deformation fabrics in the Tianli Shist has broadened our understanding of the interpretation of the metamorphic/deformation/cooling $^{40}Ar/^{39}Ar$ ages preserved in the white micas.

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