Trace element partitioning between 'black smoker' fluids and minerals

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The presence of active seafloor hydrothermal vents enables sampling of 'ore-forming' fluids and corresponding linings of 'black smoker' chimneys, where minerals precipitate directly from high-temperature hydrothermal fluids. If predictable relationships between the trace element contents of 'black smoker' fluids and these minerals can be identified, then trace element contents of chimney linings can be used as proxies for vent fluid composition and may record changes in hydrothermal activity over time.

Here, we present new investigations of trace element partitioning in chalcopyrite along the innermost linings of 'black smoker' chimneys. High-spatial resolution analyses of trace elements in chalcopyrite were carried out by secondary ion mass spectrometry (SIMS) calibrated against picked separates of mineralogically and geochemically homogeneous linings that were analyzed by solution high-resolution inductively-coupled-plasma mass spectrometry (HR-ICPMS). Mineral trace element contents are being compared with chemical (including trace element) analyses of corresponding hydrothermal fluids and calculations of aqueous complexing.

Preliminary results indicate that for most sampled 'black smoker' chimney linings, chalcopyrite in each lining is characterized by homogeneous distributions of Ag and Mn. Several chimney linings contain chalcopyrite that is homogeneous with respect to Co or Zn. In a few samples, chalcopyrite is homogeneous with respect to As or Cd. A small number of the linings are sufficiently homogeneous for use as working standards, and in developing SIMS calibration curves using HR-ICP-MS analyses of picked minerals.

Comparisons between chimney lining and corresponding fluid compositions reveal a strong correlation between the Ag content of chalcopyrite and the Ag:Cu ratio of the hydrothermal fluid, supporting that trace element/carrier element ratios play a dominant role in determining mineral trace element concentration. Positive linear trends, but with significant outliers, are observed between concentrations of Co, Mn, and Zn in minerals and in fluids (ratioed to carrier element). This scatter points to the importance of aqueous complexing at *in situ* conditions affecting partitioning between 'black smoker' fluids and minerals.