Molybdenite deposition in Bingham Canyon deposit: Role of sulfur, redox and pH chemistry in magmatic-hydrothermal fluids

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The Bingham Canyon porphyry deposit shows a distinct metal zonation of 1) shallow Cu-Au mineralization (Cu-stage) and 2) deeper Mo mineralization (Mo-stage) occurring in a separate vein set that truncates earlier Cu-Au veins.

In deep low-grade Cu-stage quartz veins, we found high concentrations of Cu, S, and Mo in the fluids, whereas in low-grade Mo-stage veins, we found rather lower Cu, but similar concentrations of S and Mo, compared to the input fluids of the Cu-stage. Sulfur concentrations in intermediate density (ID) type inclusion in deep low-grade Cu-stage samples are similar to their Cu concentration, whereas ID-type inclusions in low-grade Mo-stage veins have S contents in excess over their Cu content. Compared to the P-T conditions of the Cu-precipitation stage (90-260 bars and 320-430 °C), the Mo-precipitating fluids extended to higher pressures and temperatures of 140-710 bars and 360-580 °C.

Mass-balance calculation and vapor/brine partitioning data indicate that the mass of vapor phase exceeded that of brine by about 9/1 and more than 70% of Mo, Cu, and S (by mass) were deposited by the vapor phase in both mineralization stages.

High Mo contents (max. 0.0054 Mo/Na in ID; 380 μg/g Mo in brine) in the hydrothermal fluids were maintained from the early Cu-stage to the late Mo-stage, suggesting that Mo concentration in the fluids may not be the decisive factor for the separate Cu & Mo precipitations in Bingham Canyon deposit. Instead, the metal separation may be explained by a reduction in redox and a pH increase in the fluids from evolving source region. This is indicated by 1) the stoichiometry of chalcopyrite and molybdenite precipitation reactions, 2) a difference in the Fe/Mn ratio in fluids of the two (Cu and Mo) veining stages, 3) incipient muscovite alteration along high-temperature molybdenite veins, and 4) an increasing vapor/brine partition for Mo.

We suggest that the early Cu-stage fluids were slightly oxidized, allowing efficient Cu-Fe sulfides precipitation and thereby consume much of the dissolved S. By contrast during the later Mo-stage, the fluids were more reduced and acidic, thereby allowing selective saturation of molybdenite as the first precipitating sulfide.

Uranium interactions with bacterial communities from contaminated soils in Chernobyl

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Following the Chernobyl accident in 1986, vegetation, contaminated soil and other radioactive debris were shortly buried *in situ* in trenches. The present work describes the analysis of the structure of the bacterial communities that have been evolving in this environment for more than 20 years. Comparison of the diversities found in soil samples exhibiting contrasted radionuclides content is a prerequesite to point out the potential role of microorganisms in radionuclide migration in soils.

Bacterial communities were examined using a genetic fingerprinting method that allowed a comparative profiling of the samples (DGGE), with universal and group-specific PCR primers. Our results indicate that a long term exposure to radionuclides did not lead to extinction of bacterial diversity in Chernobyl soils.

A collection of aerobic and anaerobic culturable isolates was also assembled. A phylogenetic analysis of 250 heterotrophic aerobic isolates revealed that 5 phyla are represented: *Beta-, Gammaproteobacteria, Actinobacteria, Bacteroidetes* and spore-forming *Firmicutes*, the last being largely dominant [1].

Eleven representative fast-growing strains, related to diverse genera, were exposed to uranium. In each case, bacteria/uranium interactions exhibited different kinetics, suggesting that underlying mechanisms (biosorption, accumulation, precipitation) could be different.

[1] Chapon *et al.* (2011) *Applied Geochem* (under revision)