

Micas and columbite-tantalite from some Portuguese granitic aplite-pegmatites

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Different micas occur in granitic beryl-columbite-phosphate subtype aplite-pegmatite veins and sills from the Sabugal area. Subhedral lithian muscovite surrounds relics and penetrates along cleavages of primary muscovite, showing sharp contacts. The lithian muscovite containing higher Fe²⁺, Li and F contents replaces primary muscovite. Radial lithian muscovite from aplite presents lighter areas (richer in Fe²⁺, Li and F) surrounding and penetrating darker areas (richer in Al^{VI}, Al^{IV} + Al^{VI} and OH) in BSE images and showing sharp contacts, suggesting that the former areas replace the latter areas. Primary muscovite and lithian muscovite from aplite and aplite-pegmatite have higher Fe²⁺, Li, Rb and F contents and lower Mg content than primary muscovite from the parent granite and define a trend in the Li-Mg diagram. Very rare lepidolite from aplite-pegmatite surrounds lithian muscovite. In aplite-pegmatite, zinnwaldite penetrates along cleavages and partially surrounds lithian muscovite, suggesting that the former replaces the latter. Locally zinnwaldite and lithian muscovite seem to show different orientations. All contacts are sharp. Rare polythionite partially surrounds lithian muscovite from aplite. The rim has higher Si, Li, Rb and F contents and lower Al^{IV} + Al^{VI} and OH contents than the core. The compositions of the micas studied are well distinguished in Li-R³⁺ + Ti-R²⁺ and Al^{IV} + Al^{VI} versus Fe + Mg diagrams. The lithium micas resulted from the accumulation of F and Li in derivative silicate liquids. Primary muscovite is texturally and chemically identified. Lithium micas have higher Li, F contents and lower Al^{VI}, Al^{IV} + Al^{VI} and OH contents than primary muscovite.

Columbite-tantalite from granitic aplite-pegmatites veins and sills from the Sabugal area occurs associated with K-feldspar, albite, quartz, muscovite and beryl. Columbite-(Fe) is more abundant than columbite-(Mn) and tantalite-(Fe) is rare. Individual crystals of columbite-(Fe) are complexly zoned, showing alternating light BSE contrast zones high in W, Ta, Sn and F and dark BSE contrast zones high in Nb and Ti. Other complexly zoned crystals have col-(Mn) containing higher Nb, Mn contents, and lower Ta, Fe contents and Ta/(Ta+Nb) value than col-(Fe). A zoned columbite-(Fe) crystal shows the lighter zones containing higher Ta, Fe contents and Ta/(Ta+Nb) value and lower Nb content than the darker zones. In this crystal, a partial thin rim of tantalite-(Fe) is the richest in Ta, Sn, Ti, Sc, Fe and Mg contents and Ta/(Ta+Nb) value and the poorest in W, Nb and Mn contents. Columbite-tantalite is a primary phase. Crystals are complexly zoned, showing sharp contacts between zones, with exchange of Nb↔Ta and Fe↔Mn, suggesting that magmatic fluxes may have played a role, but diffusive reequilibration was not very important. The increasing content of fluxing elements like Li, F, B and P increase the solubility of columbite-(Mn). This type of zoning may be due to disequilibrium conditions.

Using a surface precipitation approach to model the continuum between Hg adsorption and precipitation onto *Bacillus subtilis*

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The effect of bacterial cell wall adsorption on the precipitation of mineral phases in supersaturated systems is not well constrained experimentally, although there is circumstantial evidence for enhanced precipitation in these systems with the presence of bacteria. Surface complexation modeling has been applied successfully to model the adsorption of a wide range of aqueous metal cations onto bacterial cell walls. Surface precipitation theory represents an extension of surface complexation modeling that can bridge the continuum between adsorption and precipitation. However, only a small number of studies have examined the effect of bacteria on mineral precipitation reactions in well-controlled experiments, so testing and calibration of the surface precipitation modeling approach is limited for bacterial systems. In this study, we measured the extent of Hg(II) removal from solution, in the presence and absence of non-metabolizing cells of *Bacillus subtilis* in both sulfide-free and sulfide-bearing systems under a range of concentrations from undersaturation to supersaturation with respect to solid phase HgO and HgS, respectively. Initial Hg molalities ranged from 10⁻⁵ to 10⁻² m at pH 4.5; ionic strength was buffered by conducting the experiments in 0.01 M NaClO₄, and the wet mass of bacteria used in each biotic experiment was held constant at 5 g/L. Sulfide-free experiments were conducted aerobically with a two-hour equilibration period. Sulfide experiments were conducted with varying concentrations of Na-sulfide under anaerobic conditions. Samples from both types of experiments were filtered and analyzed for aqueous Hg by a Hydra II AF Mercury Analyzer following the ASTM International standard test method for mercury in water.

The biotic systems exhibited enhanced Hg(II) removal relative to the abiotic controls in undersaturated conditions, likely due to Hg(II) adsorption onto cell wall functional groups. However, under the highest Hg concentrations studied in the sulfide-free system, the bacteria inhibit precipitation, maintaining high concentrations of Hg in solution. We use surface precipitation modeling to account for the range of Hg removal that we observed in the sulfide-bearing system, yielding equilibrium constants that can quantitatively account for Hg adsorption and precipitation with a single set of parameters. This approach offers promise for modeling the fate and distribution of aqueous metals in geologic systems with a wide range of saturation state conditions.