

Modeling fluid-rock interaction during greisenization at the East Kemptville tin deposit: implications for mineralization¹

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Interaction between a tin-bearing greisenizing fluid and a leucogranitic rock was modeled in order to evaluate the possible role of alteration induced changes in fluid chemistry in cassiterite deposition. The interaction was modeled using simple titration and multiple-pass fluid flow models with the program CHILLER, modified to permit calculations at 450°C and 4.0 kb. The compositions of the mineralizing fluid and the unaltered leucogranite were based, respectively, on analyses of fluid inclusions and whole-rock chemistry, of samples from the East Kemptville greisen-hosted tin deposit, Nova Scotia. The starting fluid contained 4.85 M Cl, 3.7 M Na, 0.53 M Fe, and minor K, Si, F and Sn, and was at a pH of 3.0, while the leucogranite contained 35 wt.% quartz, 29 wt.% albite, 19 wt.% muscovite and 17 wt.% K-feldspar. In both models, the calculations show that with increasing alteration, K-feldspar was the first mineral consumed, and that this was followed by replacement of albite by muscovite. With further alteration, muscovite was replaced by topaz and pyrrhotite, and cassiterite precipitated in quartz-topaz rocks. In the most altered rocks, only topaz and quartz are present. These changes accurately reproduce those determined for natural samples at East Kemptville. However, only the multiple-pass fluid flow model predicts the changes in fluid inclusion composition. The multiple-pass fluid flow model quantified changes in fluid composition as a function of its interaction with the wall rock and thus enabled us to assess better the factors that controlled cassiterite precipitation. Important conclusions of the model are that the fluid and the rock equilibrated at each stage of the alteration and the water/rock ratio remained constant across the alteration halo. We further concluded that phases precipitated close to the vein in an earlier stage of the alteration were re-dissolved with evolution of the mineralizing system. In particular, re-dissolution of cassiterite caused an increase in the concentration of SnCl⁺ in the fluid. As a result, cassiterite saturated at a lower pH, and the chemical potential of SnCl⁺ increased away from the vein. This could, in turn, explain the low tin grades at East Kemptville. ©1998 Elsevier Science B.V. All rights reserved.

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