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Beryl stability in local hydrothermal and chemical environments in a mineralized granite

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ABSTRACT

The temperature and chemistry of hydrothermal fluids control the breakdown and formation of beryl in rocks of appropriate bulk composition. In rocks of the Triberg granitic complex in the Schwarzwald, Germany, late-magmatic to hydrothermal greisen fluids interacted with beryl-bearing pegmatites and the leucogranitic host rocks over a range of temperatures, but the greisen overprint was not pervasive. As a result, it is possible to examine the effects of the greisen fluids on beryl stability and the host granitic rock over a range of temperatures. Replacement of primary (pegmatitic) beryl resulted in the formation of secondary beryllium minerals. At high temperature (~550 °C), gem-quality aquamarine was precipitated in vugs with alteration halos of albite, muscovite, cassiterite, and fluorite. At lower temperatures (~250 °C), blue anhedral beryl replaced potassium feldspar in granite adjacent to fractures. At slightly lower temperatures (~220–230 °C), pegmatitic beryl was replaced by kaolinite ± bertrandite ± phenakite.

Calculated activity and phase diagrams suggest that precipitation of secondary beryl depends chiefly on variations in the ratio Na/K in the fluid. These same fluids were responsible for the albite and white mica formation in the surrounding granite. Further, the effective fluid-to-rock ratio determines the progress of the alteration reactions, which in turn determines the ability of the fluid to precipitate beryl. On the basis of fluid-inclusion measurements and the activity-diagram calculations, a pH of about 5 (at ~550 °C and 4% NaCl equivalent) was estimated for the fluids that caused the mineralization.