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The role of magmatic and hydrothermal processes in the evolution of Be-bearing pegmatites: Evidence from beryl and its breakdown products

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Abstract

Beryl and euclase crystals from the Mina do Santino and the Jacú pegmatites in the Borborema Pegmatite Province in northeastern Brazil contain several generations of melt and fluid inclusions, which allow interpretation of *P-T-X* conditions responsible for beryl crystallization and for alteration of a primary pegmatitic mineral assemblage to a mixture of hydrothermal minerals (euclase, bertrandite, kaolinite, and quartz). Primary melt and fluid inclusions hosted by beryl were trapped simultaneously. However, their homogenization temperatures are significantly higher (870–900 °C) than the values previously reported for pegmatitic systems (<712 °C) and should be treated with caution. An isobaric drop of temperature resulted in the exsolution of a fluid. A low-salinity CO_2-enriched phase and a saline water-rich phase were trapped in pseudosecondary inclusions in beryl at a pressure of 2.1–2.7 kbar and temperature of 390–480 °C. Cooling of the country rocks below 400 °C caused a ductile-to-brittle transition and allowed infiltration of cold groundwater, which further decreased the temperature in the system to 190–240 °C. At the same time, the pressure dropped from a lithostatic (2.1–2.7 kbar) to a hydrostatic value (0.57–0.73 kbar). Consequently, minerals deposited under magmatic conditions (feldspars and beryl) became unstable and a newly formed hydrothermal mineral paragenesis (euclase, bertrandite, kaolinite, and quartz) overprinted the earlier one. The hydrothermal fluids responsible for the alteration differ from the earlier-exsolved fluids in having a lower salinity, lower homogenization temperature, the absence of CO_2, and the presence of CH_4.

Keywords: Mina do Santino, Jacú pegmatite, beryl, euclase, bertrandite, kaolinite, quartz, hydrothermal alterations, fluid and melt inclusions