

Coexisting monazite and allanite in peraluminous granitoids of the Tribeč Mountains, Western Carpathians

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ABSTRACT

Monazite, a typical light rare-earth element (LREE) mineral of S-type granitoids in the Western Carpathians, was found in the peraluminous biotite granodiorite-tonalite in the Tribeč Mountains commonly containing polymineralic inclusions. These inclusions are dominated by anhedral allanite, although allanite also occurs rarely as discrete grains not enclosed by monazite. The monazite studied here is relatively homogeneous and characterized by high Th contents with proportions of huttonite (ThSiO₄) and brabantite [CaTh(PO₄)₂] up to 14.6 and 9.3%, respectively. The discrete allanite grains are highly aluminous with a composition consistent with the peraluminous type of host rock. However, allanite included in monazite is extremely variable in LREE, Al, Fe, and Mg contents. This variation is interpreted to result from entrapment of allanite (+ melt) in monazite before local equilibrium was attained. The change from allanite to monazite as the stable LREE-rich phase is related to an overall decrease in Ca concentration caused by the onset of plagioclase crystallization. The early precipitation of allanite was possible because of the high LREE concentrations in the melt. The crystallization temperature of allanite must have been higher than monazite saturation (>856–845 °C and 798–790 °C for two analyzed samples). The Zr saturation temperature based on zircon solubility and REE thermometry based on monazite solubility reflect an increase in temperature from the edge to the center of the pluton, which coincides with an increase in the huttonite content in monazite. The primary LREE assemblage is accompanied by small grains of late huttonite(?) replacing monazite and brabantite replacing allanite.