Andalusite-topaz relations in peraluminous granites: preliminary results from an experimental investigation

D. B. Clarke[1], B.Wunder[2], H-J.Förster[2], A.Hahn[2], and D.Rhede[2]

1. Department of Earth Sciences, Dalhousie University, Halifax, NS B3H 3J5 <clarke@dal.ca>¶ 2. GeoForschungsZentrum Potsdam, 14473 Potsdam, Germany

Textural and chemical evidence shows that most andalusite (Al_2SiO_5) in peraluminous granitic rocks is of magmatic origin, and at least some topaz ($Al_2SiO_4(OH,F)_2$) can also crystallize directly from the silicate melt. Highly evolved peraluminous granites normally contain either andalusite or topaz, but rarely both. In some plutons, the evolution from a magma crystallizing andalusite to one crystallizing topaz signals an increase in the chemical activity of fluorine in the magma, and thus represents an important threshold en route to forming some granite-related mineral deposits. In this paper, we attempt to locate the andalusite-topaz transition in T-P-X space, where T = 750-550°C, P = 200 MPa, and X = A/NK (1.1, 1.2, 1.3, 1.4), F (0.0, 0.5, 1.0, 2.0, 3.0, 4.0 wt.%), and H_2O (2, 6 wt.%), and to determine whether the melt-andalusite-topaz relationship is cotectic or peritectic. The experiments use synthetic gels in the system SiO_2-Al_2O_3-Na_2O-K_2O-H_2O-F as starting materials, run times of 2–22 days, and analysis of run products by X-ray diffraction, using Rietveld refinement, and by electron microprobe. Included seeds of andalusite and/or topaz in all runs assist in overcoming kinetic effects. High A/NK favours andalusite or topaz, whereas low A/NK favours muscovite. High T, low F, and low H_2O promote the formation of magmatic andalusite, whereas low T, high F, and high H_2O promote the formation of magmatic topaz. One run (T = 600°C, A/NK = 1.3, F = 4 wt.%, H_2O = 6 wt.%) shows development of topaz reaction rims on andalusite, suggesting that topaz may be the product of a peritectic reaction between early primary magmatic andalusite and late fluorine-enriched melt. Primary (magmatic) textures in some runs resemble those in quartz-muscovite-topaz greisens. In addition, some low-T - high-F runs contain cryolite (Na_3AlF_6), inviting comparisons with cryolite-bearing granites in the Erzgebirge and elsewhere, and with the Ivigtut pegmatitic cryolite deposit in southwest Greenland.