

## Compositional evolution of phlogopite in TK4 lamproite, southern India

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The Proterozoic, diamondiferous TK4 lamproite of southern India is a hypabyssal intrusion, composed of macro- and micro-phenocrysts of phlogopite and diopside set in a groundmass of diopside, phlogopite, calcite, fluorapatite and chromite. Richterite occurs rarely as inclusion in phlogopite phenocrysts. Phlogopite shows wide compositional variation between the following end-member molecules: phlogopite-biotite [ $K_2(Mg,Fe)_6Si_6Al_2O_{20}(OH)_4$ ], octahedral site deficient Ti phlogopite [ $K_2(Mg,Fe)_4TiSi_6Al_2O_{20}(OH)_4$ ], eastonite [ $K_2(Mg,Fe)_5AlSi_5Al_3O_{20}(OH)_4$ ] and kinoshitalite [ $Ba_2(Mg,Fe)_6Si_4Al_4O_{20}(OH)_4$ ]. Compositional zonation of the phenocrysts reveals four stages of phlogopite crystallisation. Zone I phlogopite, which is relatively Cr-rich (1.1–2.1 wt%  $Cr_2O_3$ ) and Fe-poor (4.5–5.5 wt%  $FeO^T$ ), is overgrown by zone II phlogopite with 0–1.0 wt%  $Cr_2O_3$  and 5.3–9.5  $FeO^T$ . Both the zones show broadly similar values of  $TiO_2$  (3.1–5.8 wt%) and BaO (<1.1 wt%). Zone III phlogopite overgrows either zone I or II and has lower  $TiO_2$  (<2.9 wt%) and higher BaO (1.5–4.1 wt%) contents. The Fe-content of zone III (5.8–7.6 wt%  $FeO^T$ ) is higher than that of zone I, but similar to that zone II. Zone IV phlogopite mantles on zone III and is Ba-poor (0.4–0.8 wt% BaO) and Fe-rich (7.1–9.5 wt%  $FeO^T$ ). Both the zones III and IV are Cr-poor (<0.1 wt%  $Cr_2O_3$ ) and are compositionally similar to groundmass phlogopites. Zone II records a decreasing trend of Cr-activity which is attributed to co-crystallisation of phlogopite and chromite. Zone I phlogopite formed prior to the chromite crystallisation, whereas zones III and IV formed after the melt was depleted in Cr due to chromite precipitation. The Ba-rich composition of zone III phlogopite indicates a period of Ba-enrichment in the magma. The wide range of composition and the zonation patterns in phlogopites suggest that the mineral was on the liquidus throughout the lamproite crystallisation.