Geophysical Research Abstracts
Vol. 19, EGU2017-12945-2, 2017
EGU General Assembly 2017

Mineralogy of the Banganapalle lamproite, India, and spinel zonation as a record of chemical evolution during crystallisation

Satya P Kumar (1), Suresh C Patel (1), Subramanian Ravi (2), and Kamal L Pruseth (3)

(1) Department of Earth Sciences, I.I.T. Bombay, Powai, Mumbai, 400076, India (spkumariitb@gmail.com), (2) Geological Survey of India, Bandlaguda, Hyderabad, 500068, India, (3) Department of Geology and Geophysics, I.I.T. Kharagpur, 721302, India

The Mesoproterozoic Banganapalle Lamproite Field of southern India comprises four lamproite dykes which have intruded the Tadpatri Shale of the Cuddapah platformal sedimentary sequence. Mineralogical study of the dyke no. 551/110/4 shows that the rock has an inequigranular texture with megacrysts and macrocrysts of possibly olivine which are completely pseudomorphed by calcite and quartz due to pervasive hydrothermal and/or duteric alteration. Phenocrysts and microphenocrysts of phlogopite are highly chloritised with occasional preservation of relicts. The groundmass is dominated by calcite with subordinate amounts of phlogopite (completely chloritised), diopside, apatite, rutile and spinel. Other minor phases in the groundmass include titanite, allanite, monazite, zircon, barite, carboceranite, pyrite, pyrrhotite, chalcopyrite, galena, sphalerite, heazlewoodite, and pentlandite.

Spinel occurs in three textural types: (i) xenocrysts showing homogeneous composition; (ii) phenocrysts and microphenocrysts with continuous compositional zoning from the core to the rim; and (iii) groundmass crystals with distinct growth zones marked by discontinuous compositional zoning from the core to the rim. Four growth zones (zones I–IV) of spinel are recognized. Phenocrysts and microphenocrysts are designated as zone I spinels which have 55.0-65.7 wt% Cr_2O_3, 2.7-7.2 wt% Al_2O_3, <0.4 wt% TiO_2, and record a decrease in Al/(Al+Cr) from the core to the rim. Zone II spinels either occur as overgrowth rims on xenocrystal and zone I spinels or form cores to zone III rims in discrete grains, and have higher TiO_2 (1.2-3.6 wt%), lower Al_2O_3 (1.2-2.9 wt%) and similar Cr_2O_3 (55.0-63.8 wt%) contents compared to zone I spinels. Zone III spinels either occur as overgrowth rims on xenocrystal and zone II spinels or form cores to zone IV rims in discrete grains, and contain higher Al_2O_3 (5.7-10.2 wt%), lower Cr_2O_3 (45.9-56.0 wt%) and similar TiO_2 (1.6-3.4 wt%) compared to zone II spinels. Overgrowth rims of zone II and zone III spinels locally exhibit oscillatory zoning with characteristics of diffusion controlled magmatic growth. Zone IV spinels are marked by low Cr_2O_3 (17.4-25.5 wt%) and Al_2O_3 (1.6-2.0 wt%), and high Fe_2O_3 (28.8-35.4 wt%) and TiO_2 (4.0-7.1 wt%) contents. Xenocrystal spinels are distinguished from magmatic spinels by high Al_2O_3 content (11.3-22.4 wt%) and uniform composition of individual grains. The wide range of composition and the zonation pattern of magmatic spinels suggest that the mineral was on the liquidus through most part of the lamproite crystallisation. The abrupt changes in composition between the zones indicate hiatus in crystallisation and/or sudden changes in the environmental conditions, resulting from crystallisation of associated minerals and periodic emplacement of certain elements into the magma.

Diopside occurs in groundmass segregations and has low contents of Na_2O (<0.77 wt%), Al_2O_3 (<1.2 wt%), Cr_2O_3 (<0.25 wt%) and TiO_2 (<1.7 wt%), although higher values of TiO_2 (up to 3.0 wt%) are locally encountered. Phenocrystal phlogopite has Mg/(Mg+Fe^{2+}) ratios in the range of 0.76-0.83, and a Cr-rich composition (3.2-3.6 wt% Cr_2O_3) that indicates its crystallisation at mantle pressures. Co-precipitation of this phlogopite with phencocrystal spinel can explain the observed Al-Cr zoning in the latter.