PERALKALINE PLUTONIC MAGMATIC ROCKS OF THE CARBONATITE VOLCANO OLDOINYO LENGAI.

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Coarse-grained blocks in the nephelinitic and phonolitic tuffs and agglomerates of the active carbonatite volcano Oldoingy Lengai, Tanzania, include xenoliths of metasomatic crustal and mantle rocks (fenites and olivine-mica-pyroxenites) and igneous cumulates (Dawson, 1989). The igneous suite comprises jacupirangites, alkali pyroxenites, ijolites and nepheline syenites; there are also blocks of sovite, sanidine-calcite rock and nepheline wollastonitite. Most rocks have cumulate textures, though a few nepheline syenite, ijolite and wollastonitite specimens have a crescumulate texture suggesting derivation from dykes or contacts; with the exception of the jacupirangites, many specimens are cellular and cemented by vesicular intergranular glass.

Mineralogically, the suite consists of clinopyroxene, nepheline, titanomagnetite, pyrrhotite (all rock types), Ti-andradite and wollastonite (in ijolites), perovskite and phlogopite (in ijolites and jacupirangites), sanidine, eucolite and titanite (in nepheline syenites). The pyroxenes have resorbed cores, and oscillatory-zoned overgrowths, indicating a complex crystallisation history but overall show a trend from diopsides in jacupirangites and resorbed cores in ijolites, to aegerine- and hedenbergite-rich types in nepheline syenites and overgrowths in ijolites; the trend indicates increasing $Fe^2/(Fe^2+Mg)$ and increasing $Fe^3/(Fe^2+Fe^3)$ in the more alkali-rich syenites. Nephelines are in the range Ne_{70-80} Ks_{14-22} Qz_{2-12}, the only noticeable differences between rocks being higher Qz in syenite nephelines; Fe_2O_3 concentrations are mainly in the range 1-2 wt% but 5.2 wt.% is found in nepheline in a nepheline-wollastonite-glass vein. Garnets are Ti-andradites (schorlomite+andradite = ~90% of total), containing <1% MgO and <0.1 wt% Cr_2O_3, and many have light-coloured rims containing less TiO_2, FeO, and MgO, but higher SiO_2, Fe_2O_3 and MnO than dark coloured cores; Na_2O is present in small but persistent amounts (0.20-0.37 wt%). The micas are Ti-phlogopites; the most magnesian (mg .86) occurs in reaction rims around xenocrystal olivine, whereas the most iron-rich (mg .58) is groundmass mica in ijolite. Wollastonite is $CaSiO_3$ except for around 1 wt.% FeO. The "magnetite" is magnesian magnetite-ulvospinel with around 20% Fe_2O_3 molecule in solid solution; the phase in jacupirangite is more magnesian and aluminous than that in ijolite or nepheline syenite. The syenite feldspars are mainly sanidine (Ab_{15-32}, Or_{67-85}) though almost pure albite (Ab_{99} Or_1) occurs in one specimen; the sanidines contain up to 0.83 wt% Fe_2O_3. Intergranular glasses are enriched in SiO_2, total FeO, MnO, Na_2O and K_2O relative to bulk rocks. Perovskites have significant concentrations of FeO (up to 1 wt.%), Na_2O (up to 1.2 wt.%) and Nb_2O_5 (up to 2.2wt.%) LREE (up to 5 wt% in jacupirangite perovskite). The apatites contain up to 0.5 wt.% REE. Titanite contains up to 0.3 wt.% REE,

significant ZrO_2 (up to 1.2 wt.% and Na_2O up to 2.2 wt.%. REE partitioning is perovskite >apatite >titanite. Compared with corresponding phases occurring as phenocrysts in the nephelinite-phonolite lava suite (Donaldson *et al.* 1987) those in the plutonic suite show some differences, e.g. the volcanic feldspars are Or_{43-57} Ab_{39-53}, nepheline extends to more potassic compositions (Ks_{26}) but most are compositionally similar, in particular the zoning in pyroxenes and garnets.

Bulk chemical analyses show that the overall suite is silica-undersaturated and highly evolved with agpaitic indices (Na + K/Al) ranging from 0.50 (jacupirangite)) to ~ 1 (ijolite) and 1.78 (eucolite nepheline syenite). They contain high concentrations of LILE, and the light REE concentrations are high both absolutely and relative to heavy REE, particularly in perovskite-apatite-rich jacupirangite. Calcite carbonatite is enriched in Sr (6200 ppm) and Ba (9000 ppm). Chemically the ijolites and nepheline syenites are richer in CaO, TiO_2, total Fe and MgO but lower in Al_2O_3, K_2O and Na_2O than nephelinites and phonolites of equivalent SiO_2 content, reflecting the higher modal contents of perovskite, pyroxene and apatite relative to nepheline and feldspar in the plutonic rocks. Perovskite-magnetite-pyroxene fractionation of parental ijolite can give rise to jacupirangite and nepheline syenite.

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