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An association of primary analcime and calcite in phonolite

THE phonolite in question is from the South Turkana region of the Kenya rift valley. The local succession includes basalt, trachyte, and phonolite lavas and pyroclastics, and ranges in age from Miocene to Pleistocene (Webb, 1971). Above a basal group of Miocene basalts are a group of phonolite shield volcanoes, in which are numerous flows of phonolite bearing nepheline and analcime. Such lavas are greenish-black, have a smooth flinty fracture, and are sometimes flow-banded. They form flows up to 30 m thick, and extend up to 2 km from their source. Small phenocrysts of greasy nepheline and glassy feldspar are visible in hand specimen, and the groundmass mafics are evenly distributed, apart from the flow-banding, corresponding to the Losuguta type of phonolite (Prior, 1903, pp. 235–41).

In thin section, the nepheline phenocrysts are sometimes seen to be altered to fibrous zeolite. The feldspar phenocrysts show only Carlsbad twinning, but X-ray studies indicate that they have the composition of anorthoclase.

The groundmass is commonly fine-grained, so that nepheline and feldspar are indistinguishable. Aegirine, aenigmatite, and a blue-green alkali amphibole occur as small mossy shreds and clusters. The flow-banding referred to above is seen to be due to the segregation of the groundmass minerals into alternating mafic-rich and mafic-poor layers. Occasionally a mafic-poor layer develops laterally into a lens up to 10 mm long and 1½ mm thick, consisting of completely isotropic analcime, into which project stumpy alkali-feldspar euhedra. Such lenses are continuous with the groundmass, and are thought therefore not to be vesicles. In one specimen, 5/437, an analcime lens was seen to have a core of calcite, occurring as a mosaic of distinct grains showing cleavage but not twinning. The lava is extremely fresh, as regards both phenocrysts and groundmass, and it is inferred from this, from the evidence that the lenses are not vesicles, and from the absence of calcite elsewhere in the thin section, that both the calcite and the analcime are primary minerals.

It is considered that the analcime lenses represent a liquid residuum, which can accumulate locally during late flow movements. Such a residuum, although rich in potential analcime, contains also enough silica for the continuing growth of alkali-feldspar, which nucleates on the walls of the lenses and grows inwards towards the liquid. At a critical point of silica undersaturation, the liquid precipitates analcime, and finally calcite. It is considered that the latter increases in concentration with the continuing precipitation of lime-poor minerals (aegirine, alkali-feldspar, nepheline, etc.), until locally it reaches its point of saturation late in the crystallization sequence.

Evidence that analcime could be a final liquid residuum is shown in an alkali-silica diagram, fig. 1, in which are plotted phonolites from this group of lavas, and analcime, calculated as pure $NaAlSi_2O_6.H_2O$. The latter lies on the trend through the phonolites, and it is possible then that at some stage late in the crystallization of the rock, an analcime residuum develops.

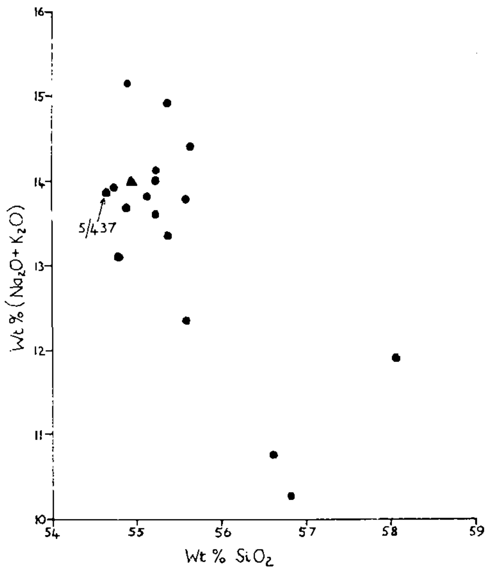

FIG. 1

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Classification of K-feldspar polymorphs by X-ray means

RECENTLY, Parsons and Boyd (1971) have discussed a relationship between K-feldspar order and igneous rock composition. Like many earlier workers they used the 131 reflections of the K-feldspars to estimate structural state. Feldspars were crudely classified on the basis of the appearance and relative intensities of the 131 reflections