LASHAINE, TANZANIA XENOLITHS: A NEW COLLECTION

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A previously-unstudied collection of xenoliths from Lashaine, Tanzania consists predominantly of peridotites and pyroxenites, and includes a few samples of mica- and amphibole-rich rocks. The dominant rock type is non-garnetiferous peridotite (lherzolite and wehrlite), with spinel clinopyroxenite and garnet wehrlite subordinate. Spinel-websterite and garnet-clinopyroxenite are less abundant. Two samples are nearly all phlogopite (87%), and one other rock is kaersutite peridotite.

Among the lherzolites, either clino- or orthopyroxene is dominant in the mode. The dominant phase usually forms large grains that appear to have exsolved the subordinate phase, which occurs as small, marginal grains. Occasionally, the exsolved phase may still be enclosed by the dominant phase. One analysed garnet-lherzolite contains 5 phases: orthopyroxene (En_{93}) is the dominant pyroxene, the garnets are pyropic; in addition to olivine (Fo_{90}) and minor clinopyroxene, there is chromite and secondary Mg-Al spinel. Of the 20 thin sections studied, 3 evidently contained garnets, which now are cloudy patches of alteration minerals including clays, serpentines, and secondary spinels. Few of the non-garnetiferous peridotites actually contain spinel; the opaque phase probably is titan-magnetite, and in some samples ilmenite and magnetite are partially exsolved.

Among pyroxenites, several of the spinel-bearing varieties contain a pink-to-green pleochroic (hypersthenic?) pyroxene, and one garnet-pyroxenite contains plagioclase, in probable melt areas. One rock of especial interest is composite, comprising dunite-wehrlite-websterite zones. In this rock the olivnes are chemically zoned, while pyroxenes are zoned in some other peridotites and pyroxenites.

About 90% of all the rocks in the collection contain micas (phlogopite), either as selvages and veins or as interstitial flakes or clusters of flakes. Notably, none of the garnet-rich rock types studied in thin section contain micas of either habit.

The textures of these rocks are dominantly allotriomorphic-granular, with fewer porphyroclastic and rare mosaic types. Allotriomorphic-granular textures frequently are overprinted by porphyroclastic texture; the mosaic-textured rocks contain a few relic porphyroclasts.

Nearly all rocks, whether strained or not, are modified by a later partial melt episode that generally is confined to interstitial areas, and is especially well-developed at the edges of clinopyroxenes. In all observed cases, interstitial micas did not form as a result of the melt event, but were melted by it. However, several sections contain red-brown phlogopite as thin rims around grains of opaque minerals (?Ti-magnetite or spinel). This is obviously due to reaction, and may be related to melting, but in all other rocks studied the genetic relation between micas and other phases is unclear. The phlogopites frequently are overgrown by darker phlogopite rims. In rocks with porphyroclastic overprinting, interstitial mica grins are often bent and have migratory extinction. In veins, very coarse mica grains (up to 10 mm) appear to have recrystallized in a process of strain recovery.

Phlogopite compositions generally are similar to those reported by Dawson and Smith (1973): 3-5 wt. % TiO_2, 13-15% Al_2O_3, 18% MgO, 9% FeO and 8-9% K_2O. The darker overgrowths probably contain higher Mg and Ti, in accord with results reported by Boettcher, et al. (this symposium). This is contrary to the hypothesis of Reid, et al. (1975), that their single phlogopite with very high Ti represents a primary mica.

Bulk analyses were performed on fifteen samples, and electron microprobe analyses were carried out for all phases in four selected sections. According to the bulk analyses, this collection has greater chemical variability than that studied by Dawson and colleagues. Figure 1 compares several chemical parameters of the new collection to those of Rhodes and Dawson's (1975) peridotites. Lashaine nodules can be classified into two main peridotite categories: 1. a group comprising garnetiferous and non-garnetiferous types characterized by a narrow range of Mg-Fe ratio (Mg/Mg+Fe .92-.94) and low K_2O (0.0-0.07 wt. %). with large variability in other oxides, especially SiO_2, Al_2O_3, CaO and Na_2O. This group may be subdivided on the basis of Al_2O_3 content (Figure 1b), 2. the group of higher-Fe peridotite (Mg/Mg+Fe .71-.85) that is also characterized by higher K_2O (0.09-0.38%) and smaller variations in the content of other oxides (SiO_2, Al_2O_3 and Na_2O); CaO is highly variable (0.06-3.3%), reflecting a broad range of pyroxene contents in these predominantly clinopyroxene-rich peridotites.

Figure 1a includes pyroxenites of the new collection; their Al_2O_3 contents range from 2.71% to 4.90%, K_2O 0.08-0.36% and CaO 5-17%. The single sample of kaersutite-peridotite corresponds to an Fe-rich peridotite, low in SiO_2 but rich in Al_2O_3 (6.1%, not plotted). In thin section, this rock exhibits textures that strongly suggest conversion of clinopyroxene to amphibole.

The single composite sample is not a simple layered rock. A fragment of pyroxenite is detached from the main mass and surrounded by dunite. The texture of the dunite contrasts with that in the websterite. Olivines in the (cpx-bearing) dunite are strongly zoned: cores Fo_{74-76}, rim_{80-84}. There is a marked Fe gradient across the wehrlite into the websterite, where olivines are Fo_{70}. Analogous phase-chemical changes characterize the clinopyroxenes: Mg/Mg+Fe in dunite is .69-.75, in wehrlite .65, and in websterite .63-.66; there are marked gradients at the dunite-wehrlite and wehrlite-websterite contacts. The orthopyroxenes of the websterite are iron-rich: Mg/Mg+Fe= .59. These rock types are all characteristic of the Al-augite ultramafic group (Wilshire and Shervais, 1975), and the structural, textural and chemical relations suggest that the websterite was intrusive into the dunite; the wehrlite is intermediate chemically and texturally between dunite and websterite, and may represent a zone of mobile components.

The chemical and petrographic data accumulated from this collection point to metasomatism and local intrusion as important influences in the formation of these rocks. Minerals with clearly secondary chemical and textural characteristics can be found in most rock types. At one or many stages in the formation of these samples the environment seems to have been open to mobile chemical components, possibly resulting in large variations in Fe and Al_2O_3 among the peridotites. The Lashaine rocks seem to be evidence of the chemical activity within the mantle, rather than representatives of "primary" or "residual" mantle.

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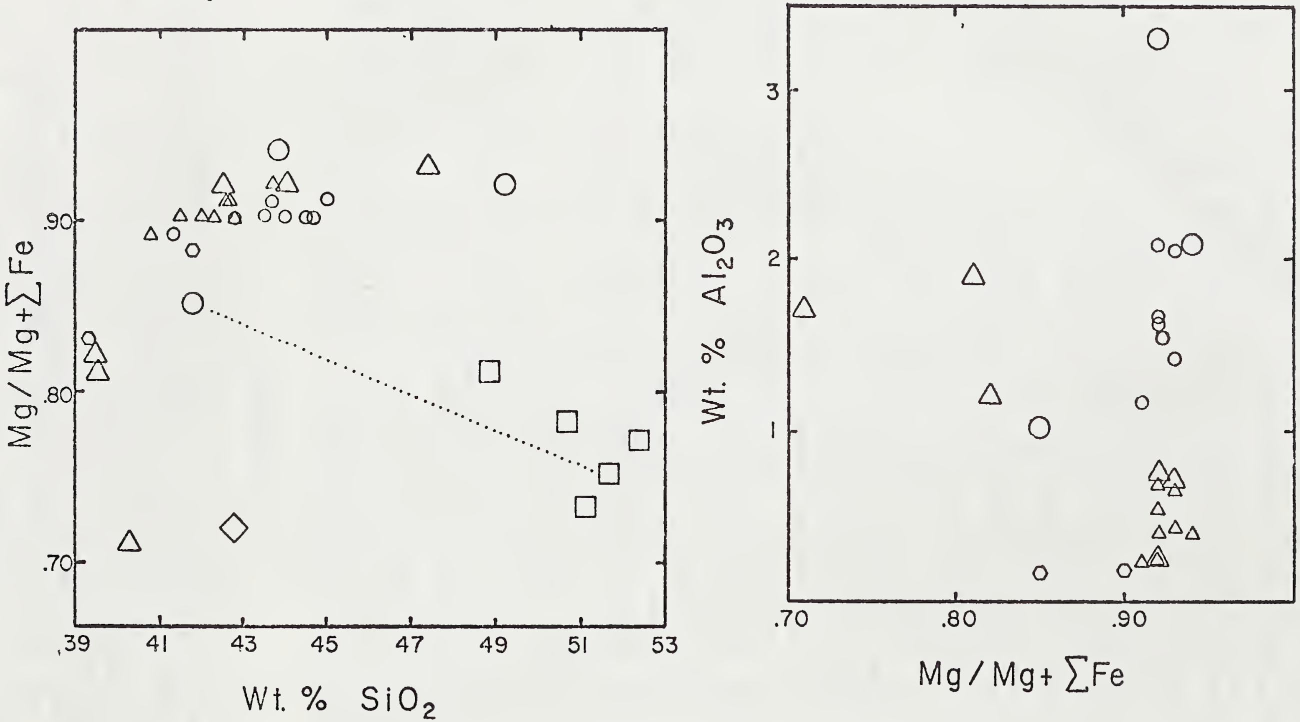
FIGURE 1

a. SiO_2 vs Mg-Fe ratio, includes all analysed Lashaine rocks.

b. Al_2O_3 vs Mg-Fe ratio, Lashaine peridotites



Small symbols are analyzed samples of Rhodes and Dawson, 1975; large symbols are analyses from this report: circles, garnet peridotite; triangles, garnet-free and spinel peridotite; hexagons, 'intermed. Fe' peridotite (Rhodes and Dawson, 1975); diamond, kaersutite peridotite; squares, pyroxenite.