MANTLE METASOMATISM OF PYROXENITE XENOLITHS FROM KAULA ISLAND, HAWAII

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Both garnet-bearing and non-garnet-bearing pyroxenite xenoliths have been discovered from a new locality in the Hawaiian Islands, Kaula Island (Fig. 1). This tiny, 1 km long, remnant of a tuff cone is located 93 km SW of the island of Kauai (Fig. 2). It contains pyroxenite and ultramafic (spinel lherzolite and dunite) xenoliths in a palagonitized, nephelinite tuff. Xenoliths are abundant and fresh. Compared to the garnet pyroxenites from Salt Lake Crater, Oahu (Hawaii), the Kaula xenoliths are less mafic. They contain little or no olivine (<1 vol. %) and their clinopyroxenes (cpx) have lower Mg #s (72-83 vs. 79-89). Both Salt Lake Crater (Helz, 1979) and Kaula pyroxenites contain glass along fractures within and along the margins of cpx. The Kaula glasses are high Al_2O_3 basalts and are quartz to hypersthene normative (Table 1).

Unlike some glass-bearing mantle xenoliths (e.g. Comin-Chiaramonti et al., 1986), the glass compositions in the Kaula pyroxenites cannot be explained by decompressional melting of phases in the xenoliths. Intrusion of the host nephelinite or any combination of host nephelinite and xenolith phases are inadequate to explain the glass compositions. Mass balance calculations require a K-, P-rich component which is missing from the xenoliths.

Jones et al. (1983) suggested mantle metasomatism as a process to explain the composition of similar glasses from mantle xenoliths from Tanzania. In the absence of a suitable alternative model, mantle metasomatism seems the only plausible explanation for the high K and P contents of the Kaula glasses.

The introduction of the metasomatic fluid occurred prior to the incorporation of the xenolith into the host nephelinite, but after metamorphism of the xenolith. The presence of the glass along fractures within cpx suggests that it was related to or followed a deformational event. The most recent deformational event experienced by the mantle under Kaula Island may be its ascent over the Hawaiian arch. Clague (1986) proposed this process as a mechanism to produce Hawaiian post-erosional volcanism (of which the host nephelinite is an example). Thus, the metasomatism of the pyroxenite xenoliths may have occurred _just_ prior to their incorporation in the host nephelinite.

References

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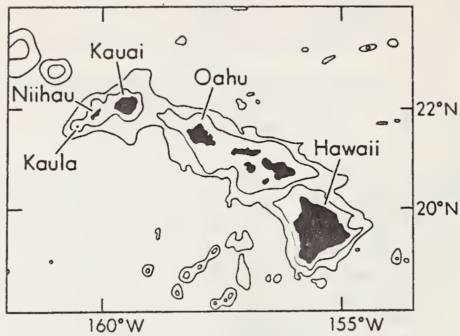

Fig. 1. Bathymetric map of the Hawaiian Islands and nearby seamounts with 1,000 and 2,000 fathom contours. Note oblique trend of Kaula, Niihau and Kauai (NE-SW) to the trend of the Hawaiian Islands (NW-SE).

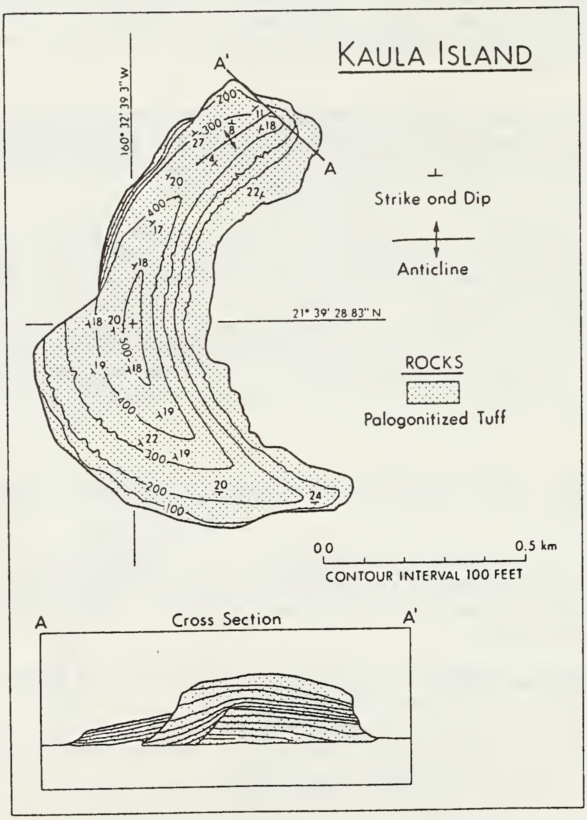

Fig. 2. Geologic map of Kaula Island. Topographic base map from Palmer (1936). Cross section shows depositional anticline exposed at the north end of Kaula Island. Kaula Island consists entirely of palagonitized tuff.

TABLE 1

	Glasses		Host
	KA-110	KA-107	Nephelinite
SiO_2	49.02	47.51	40.95
TiO_2	0.47	1.06	2.83
Al_2O_3	19.70	18.78	12.02
FeO	10.28	12.17	12.78
MnO	0.30	0.29	0.23
MgO	5.27	6.24	12.82
CaO	12.22	11.22	10.84
Na_2O	1.14	1.46	3.76
K_2O	0.44	0.74	1.23
P_2O_5	0.34	0.24	0.86
Total	99.18	99.71	98.32
Q	3.1	0.0	-
Or	2.6	4.4	2.8
Ab	9.7	12.4	-
An	47.7	42.7	12.5
Lc	0.0	0.0	3.6
Ne	0.0	0.0	17.5
Di	9.3	9.7	29.5
Hy	12.9	11.2	-
Ol	0.0	4.3	24.2
Mt	2.0	2.3	2.5
Il	0.9	2.0	5.5
Ap	0.8	0.6	2.0
Mg#[1]	47.7	47.8	67.0

[1] Based on $Fe_2O_3/FeO = 0.15$