K, RB AND BA IN MICAS FROM KIMBERLITE AND PERIDOTITIC XENOLITHS.

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Highly-sensitive electron microprobe analyses were made for Rb and Ba in micas from peridotitic xenoliths in kimberlites, in MARID-suite nodules, in phlogopite megacrysts, and in kimberlite groundmass minerals (Table 1). Special attention was paid to background for Rb L_{α} (Fig. 1); the standard was Corning X-glass (0.49 wt.% Rb_2O, atomic absorption analysis, J. Ito). Fig. 2 summarizes the ranges and mean for K/Rb and K/Ba.

Primary micas from peridotite xenoliths were split into two groups. High-K ones have lower Na, lower BaO (340-880) and higher Rb_2O (320-440) than low-K ones (BaO 1720-4000, Rb_2O 160-260). Phlogopites from the MARID-suite (interpreted as cumulates from kimberlite liquid crystallizing at considerable depth; Dawson and Smith, 1977) have higher Rb_2O than both types of peridotite micas, and the same range of BaO as high-K peridotite micas. Aoki (1974) recorded Rb_2O analyses for MARID micas twice greater than ours, whereas Allsopp and Barrett (1975) recorded ~400-530 for Wesselton "nodule" micas which fall in our range of 340-800 for MARID micas. The very wide ranges for megacryst micas (interpreted as phenocrysts; Smith and Dawson, 1975) overlap those for MARID micas, and our range of Rb_2O encompasses that for Monastery megacrysts (Rb_2O 683-963; Allsopp and Barrett, 1975).

The groundmass of micaceous kimberlites contains very rare, Fe-rich micas (Type I) interpreted as xenocrysts from an intrusive precursor (carbonatitic?), and abundant Type II micas interpreted as late-stage primary crystals (Smith, Brennesholtz and Dawson, see another Ext. Abstr.). Both have very wide, overlapping ranges of Rb_2O and BaO. BaO concentrations tend to be considerably greater than those for the high-K peridotite, MARID and megacryst groups, but similar to those for the low-K peridotite group. Bulk analyses of kimberlite groundmass micas should be determined essentially by Type II micas, and the K/Rb range for Wesselton groundmass mica (Barrett, 1975) is at the low end (110-160) of the range (112-1040) found by us for micaceous kimberlites from several localities. Perhaps some of these micas are partly serpentinized.

Serpentine carries substantial Rb_2O (Table 1) and somewhat less K_2O. A kimberlite with equal amounts of serpentine (K_2O 400, Rb_2O 580) and Type II mica (K_2O 10 wt.% Rb_2O 400) would have K/Rb 93. No other minerals carry substantial K and Rb. Some measured K/Rb values for bulk kimberlite are: Fesq et al. (1975a), 88-217; Barrett and Berg (1975), 93-207; Harris and Middlemost (1969), mean kimberlite 196. Until detailed mineralogical modes are obtained for samples used for bulk analysis, a definitive test cannot be made, but serpentine is apparently an important sink for Rb in kimberlite.

Unfortunately the presence of barite in many micaceous kimberlites rules out simple interpretation of K/Ba ratios of bulk kimberlite in terms of constituent minerals.

Mica and clinopyroxene (see refs. in Ext. Abstr. by Bishop et al.) are probably the significant hosts for K and Rb at depths below ~100km, and it is interesting to check whether total extraction of these minerals into magmas would yield K/Rb ratios which match those for mantle-derived volcanic rocks. Unfortunately the lack of understanding of the different origins of high-K and low K peridotite micas provides a complication, as does possible mica-liquid fractionation (Beswick, 1976).

Values of K/Rb for bulk kimberlites (~90-220) are lower than our values for high-K peridotitic mica (210-300) and low-K peridotitic mica (330-550), but greater than the values for inclusion-bearing diamonds (20-130, mean ~70; Fesq et al., 1975b). Similarly, the values of K/Ba for kimberlites (8-39; Fesq et al., 1975) lie between those for high- and low-K peridotitic micas (112-292 and 22-51) and for diamonds (1.5-2.5; Fesq et al., 1975b). Clinopyroxenes tend to have high values of K/Rb (often over 1,000; Shimizu, 1975). We have not yet evaluated the ranges for secondary micas in peridotites, but aim to obtain data in time for the conference. Rhodes and Dawson (1975) reported K/Rb 83-234 for peridotites from Lashaine, and these relatively low values may result mainly from secondary mica.

The K/Rb ratio of C1 meteorites, probably the best representative of the primordial solar nebula, is $(544 \pm 75)/1.88 \pm 0.36 = 289 \simeq 100$ (Nichiporuk and Moore, 1974; Krahenbühl et al., 1973)which lies inside our range for peridotitic micas.

K/Ba values for Basutoland flood basalts (12-46, mean 25) and dolerites (mean 36) (Cox and Hornung, 1966) overlap with the range for low-K peridotite micas but not with high-K peridotite micas, while the K/Rb values (basalts, 110-680, mean 213; dolerites, mean 435) overlap the entire range for both low- and high-K peridotite micas, but are far outside the ranges for diamond inclusions. Lloyd and Bailey (1975) reported the following average values for 17 Eifel (Germany) lavas (K/Rb 289; K/Ba 22.5) and 23 Uganda lavas (323;22.9).

Oceanic basalts have higher K/Rb (e.g. 330-1780; O'Nions et al., 1976) and a wide range of K/Ba (e.g. 31-412; Kay et al., 1970). These values overlap considerably with those for peridotitic micas, but tend to be higher. Clinopyroxenes (Shimizu, 1975) from inclusions in kimberlite have higher variable K/Rb (160-22,300) and K/Ba (4-1140), perhaps because of contamination. Further work is needed to test whether clinopyroxene-mica-peridotite could yield oceanic basalts by partial melting, and whether other minerals must be considered to explain K,Rb and Ba.

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Table 1. Electron microprobe analyses

Type	N	BaO ppm	Rb_2O ppm	K/Rb	K/Ba
Peridotite, high K	4	340-880(635)	320-440(380)	212-301(254)	112-292(173)
Peridotite, low K	3	1720-4000(3080)	160-260(220)	332-550(420)	22-51(33)
MARID	7	340-800(390)[a]	470-700(580)	145-203(167)	124-286[a](260)
Megacryst	19	130-2070(380)[b]	290-1060(750)	91-319(138)	102-726(398)
Type I groundmass	5	1030-4320(2670)	240-600(470)	137-348(209)	20-88(42)
Type II groundmass	9	470-5780(2450)	90-820(400)	112-1040(351)	16-199(80)
serpentine[c]	-	<50ppm	530-620(580)	0.25-1.00(0.63)	-
amphibole[d]	-	<50ppm	780	60	-

N number of samples. [a]All but one sample have BaO 340-380; K/Ba 248-288. [b]18 samples have BaO 130-970(380) but one megacryst from Peiser mine is very variable (190-2070) and was omitted from the arithmetic mean. [c]olivine pseudomorph, serpentinized mica, accordion types, respectively in 1097A have Rb_2O,K_2O: 620,170; 530,360; 600,660. [d]1160(MARID).

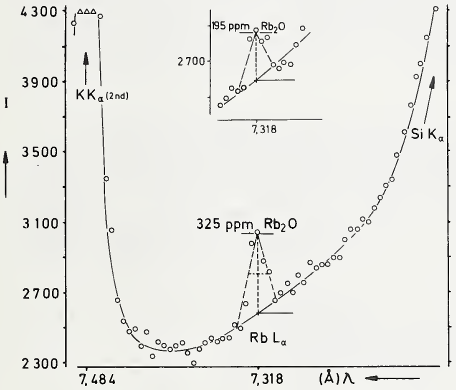

Fig. 1 X-ray counts in 120 seconds vs. λ around RbL_{α} peak for micas with 325 and 195ppm Rb_2O.

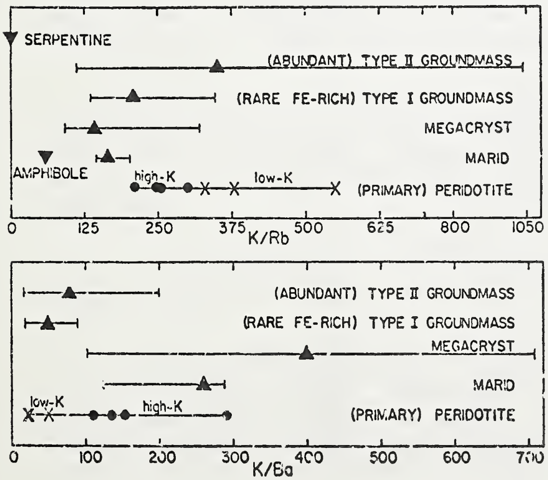

Fig. 2. Ranges and mean of K/Rb and K/Ba for mica (upright triangle) and other minerals (inverted triangle).