SUBCONTINENTAL LITHOSPHERE BENEATH KATWE-KIKORONGO, S.W. UGANDA

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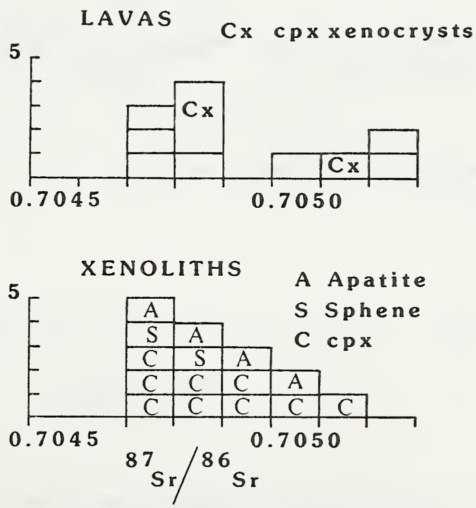
Recent K rich mafic volcanics of the western branch of the East African rift system contain hydrous pyroxenites with variable amounts of phlogopite, amphibole, apatite, sphene, perovskite, Fe-Ti oxides and calcite. This study concentrates on the volcanic products and xenoliths from two adjacent craters in the centre of the Katwe-Kikorongo volcanic field, S.W. Uganda, which lies immediately to the north of Lake Albert. Our aim is to ascertain if the xenoliths, which show evidence of both magmatic and metasomatic textures, represent old metasomatised mantle (Lloyd and Bailey, 1975) or are high P/T cumulates from the host magmas.

Highly undersaturated rocks such as the olivine melilitites and clinopyroxene rich kalsilite-nepheline-leucite bearing assemblages in the western rift are notoriously susceptible to low temperature alteration (Taylor et al. 1984). In an effort to minimise the effects of alteration the volcanic rocks were crushed by hand and secondary xeolites and carbonate carefully removed. The majority of rocks prepared in this way contain less than 1% H_2O indicating they are relatively unaltered. In addition clinopyroxene separates were obtained from the few porphyritic lavas to enable us to determine the isotope systematics on unequivocally fresh material. However it should be noted that the clinopyroxenes are always highly zoned and may be surrounded by a reaction zone of melilite, implying a possible xenocrystic origin. Isotope analyses of xenolith material was only carried out on mineral separates.

Certain lava samples were split into 2 prior to preparation. The extraction of xeolites and carbonate reduces the measured $^{87}Sr/^{86}Sr$, e.g. S23161 0.70531 to 0.70453. Significantly, "cleaned" whole rock samples with H_2O contents greater than 1% yield $^{87}Sr/^{86}Sr$ ratios greater than 0.7052. These apparently altered samples will not be considered further in the discussion. Apatite-clinopyroxene and sphene-clinopyroxene mineral pairs establish the xenoliths to be in Sr and Nd isotope equilibrium. The exception is the carbonate which, although having high trace element contents suggesting a magmatic origin $(La)_N = 645$, has a relatively radiogenic $^{87}Sr/^{86}Sr$ ratio of 0.70563 indicating a minor crustal contribution. Fig. 1 demonstrates that the $^{87}Sr/^{86}Sr$ ratios

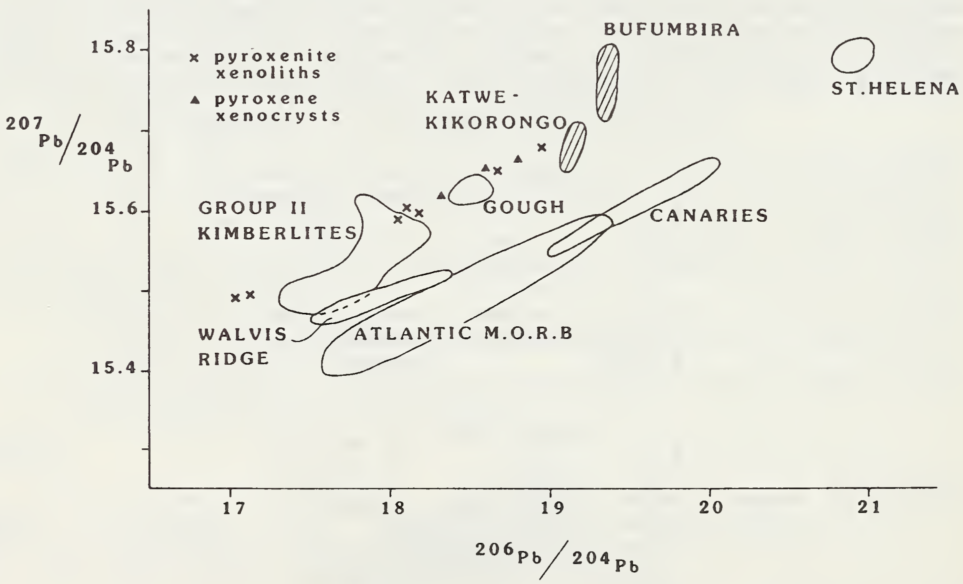
FIGURE 1 $^{87}Sr/^{86}Sr$ histogram for lavas and xenoliths



of the lavas encompass those of the xenoliths and show a significantly greater range. The $^{143}Nd/^{144}Nd$ ratios of the lavas are more radiogenic, >0.51261, than the xenoliths 0.51255 to 0.51261. The xenoliths and lavas therefore plot close to the Bulk Earth value on a Sr-Nd isotope diagram being more radiogenic in terms of $^{143}Nd/^{144}Nd$ than the nearby Virunga volcanic field (Vollmer and Norry, 1983). Clinopyroxenes separated from the lavas are not in Sr/Nd isotope equilibrium with their hosts. Significantly the $^{87}Sr/^{86}Sr$ ratios of the lavas are not consistently more radiogenic implying that the disequilibrium is not simply a consequence of low temperature alteration of the host. REE patterns of clinopyroxenes from the xenoliths and lavas are comparable $(Ce/Yb)_N$ 1 - 1.4. Perhaps more relevant are the highly variable clinopyroxene-host partition coefficients La; 0.19 - 0.47 Yb; 0.23 - 0.78 strongly suggesting that the clinopyroxenes have not all equilibrated with their host magmas and hence that they are xenocrysts originating from disaggregated xenoliths.

The lavas show limited Pb isotope variation, $^{206}Pb/^{204}Pb$ 19.09 - 19.19, but are notable for their relatively radiogenic $^{207}Pb/^{204}Pb$, 15.65 - 15.7., and $^{208}Pb/^{204}Pb$, 39.58 - 40.03, ratios. The data define steeply inclined arrays on Pb/Pb isotope diagrams (Fig. 2) being slightly less radiogenic than the K rich mafic volcanics from Virunga (Vollmer and Norry, 1983). In terms of Sr, Nd and Pb isotope ratios the Katwe-Kikorongo volcanics are less extreme than the Bufumbira rocks. Unlike the Virunga suite, we do have combined major and trace element data and hence can be certain from their high Ni, Cr and MgO contents and low SiO_2 that the Katwe-Kikorongo volcanics have suffered limited fractionation and crustal interaction subsequent to equilibration with their ultrabasic, and presumbaly, mantle source. The suite shows enriched trace element characteristics (5% K_2O, Zr/Nb = 2, Rb/Sr 0.05 - 0.08 and $(La/Yb)_N$ = 100) comparable to group I and II kimberlites but not as extreme as lamproites.

FIGURE 2 $^{207}Pb/^{204}Pb$ vs $^{206}Pb/^{204}Pb$ isotope diagram.



In marked contrast to the lavas, and their Sr and Nd isotope ratios, the xenoliths display significant Pb isotope variation, $^{206}Pb/^{204}Pb$ 17.0 - 19.0, and on Pb/Pb isotope diagrams form linear arrays displaced to significantly more radiogenic $^{207}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$ than, for example Atlantic MORB (Fig. 2). In addition $^{206}Pb/^{204}Pb$ ratios range to values less radiogenic than MORB and Group II kimberlites (Sun, 1980; Smith, 1983, Fraser et al. 1986). Clinopyroxene from the lavas plot among the xenolith data confirming their xenocrystic origin. The linear array defined by the xenoliths. and the xenocrysts, equate to an age of approximately 1300 My. Due to the partially carbonated nature of the xenoliths, whole rock U/Pb ratios have not been determined. However, u values of the clinopyroxenes increase significantly along the array 1->100. Acceptance of the 1300 My age as of geologically significance implies stabilisation of the subcontinental lithosphere during the regional Kibaran crust forming event. Consideration of the Nd isotope systematics of the xenoliths suggest that they can only have been LREE enriched, to their present degree, for an absolute maximum of 900 My. We therefore conclude that, although the xenoliths containan old component with a relatively high u, the Pb/Pb linear arrays hold no direct age significance and represent, at least in part, mixing arrays.

The subcontinental lithosphere beneath this 5 sq km region of the Katwe-Kikorongo volcanic field is isotopically very heterogeneous and has major and trace element chemistry (K_2O 3.5%, Sr >1000 ppm, Ba >1000 ppm and $(La/Yb)_N$ >50) capable of producing K rich mafic volcanics, such as lamproites and olivine melilites, even at relatively high degrees of partial melting i.e. >10%. We have shown that the hydrous pyroxenite xenoliths did not originate as high P/T cumulates from their host volcanics, nor do they represent the source materials for these volcanics. Significantly the type of xenolith, magmatic or metasomatic texture, has no control as to their position on the Pb-Pb arrays. We propose that the hydrous pyroxenitic mantle originated from an alkaline magma (basanite), residual fluids from which, caused the observed metasomatism. The xenoliths are therefore analogous to Type II spinel lherzolites. The Katwe-Kikorongo volcanics are derived from similar pyroxenite material, possibly deeper in the subcontinental lithosphere, that lie on an extension of the Pb-Pb mixing arrays. The mantle derived component of the Virunga volcanism originated from an equivalent source.

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