KIMBERLITES AND THEIR ULTRAMAFIC XENOLITHS FROM WESTERN KENYA

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Three western Kenya kimberlites, Y1B1, Y1B3 and YA17, were found in the Nyanzian greenstone belt to the north of Winam Gulf by exploration-drillings. The localities are as follows; Y1B1 Hole, 34°11.2'E, 0°4.7'S, Y1B3 Hole, 34°14.0'E, 0°3.1'S and YA17 Hole, 34°30.9'E, 0°9.5'N. Though the western Kenya kimberlites were intruded into the Archean rocks of $(2.71 \pm 0.34) \times 10^3$Ma(Yanagi et al., 1981), their exact age of intrusions can not be defined. However, owing to alignment of these western Kenya kimberlite-localities parallel to Kavirond Rift, these kimberlite magmatism may be correlated with the rifting followed by Tertiary to Recent volcanic activities.

The drill-cores are about 140 to 220 metres long and are composed of a very thin soil layer, laminated tuffaceous silt and sand and yellow-green to dark green kimberlites. Two or three thin horizons concentrating ultramafic xenoliths were found and are sometimes overlain by weakly laminated kimberlite poor in xenoliths.

Y1B1 kimberlite: Macrocrysts are olivine, pyroxene, phlogopite and small amounts of amphibole, opaque minerals and non-chromian garnet. The matrix is composed of cryptocrystalline serpentine, opaque minerals, perovskite, calcite, titaniferous andradite and saponite. Small-sized autoliths were found commonly in thin sections.

YA17 kimberlite: Macrocrysts are olivine, natrolite and/or thomsonite and small amounts of phlogopite and opaque minerals. The matrix is composed mainly of saponite, diopside, natrolite, thomsonite, opaque minerals, calcite and small amounts of perovskite, titaniferous andradite, pectolite, amphibole, cancrinite and apatite. Druses or veins of natrolite and/or thomsonite were found, commonly associated with calcite and diopside.

Y1B3 kimberlite: The drill-core specimens are intensely weathered. This kimberlite is mineralogically similar to YA17 kimberlite rather than Y1B1 kimberlite.

Ultramafic xenoliths: Garnet-free harzburgite, dunite and phlogopite-bearing hornblendite were found. Harzburgite and dunite contain secondary-textured amphibole, phlogopite and opaque minerals.

Chemical compositions of major and trace elements of western Kenya kimberlites and their ultramafic xenoliths are shown in Table 1. Y1B1 kimberlite from the deep part of the drill-core shows lower K_2O and Na_2O contents than those from the shallow part. YA17 kimberlite shows fairly low K_2O and high Na_2O contents. High CaO and CO_2 contents of the shallow part of Y1B1 kimberlite are derived clearly from calcite. High contents of Rb, Sr, Y, Zr, Nb, Pb and Ba and low contents of Co and Ni are characteristically shown for the shallow part of the Y1B1 drill-core. The chemical features of major and trace elements of YA17 kimberlite are similar to those of the shallow part of the Y1B1 drill-core. These differences in major and trace elemental abundances may result from low temperature alteration at the saponite stage.

The source of macrocrysts of olivine, phlogopite and amphibole in western Kenya kimberlites will be discussed by comparison with the chemistry of these minerals in ultramafic xenoliths. Relatively low NiO and CaO contents together with wide spread in MgO/(MgO+FeO) ratios are considered to be diagnostic of olivine phenocrysts.

Three compositional types(I, II, III) of phlogopite are identified especially owing to their TiO_2 and Cr_2O_3 contents as shown in Fig. 1. Type I phlogopites are poor in TiO_2 with variable contents of Cr_2O_3, FeO and Al_2O_3, type II rich in TiO_2 and FeO with relatively high Al_2O_3 and low Cr_2O_3 contents, and type III rich in TiO_2, Cr_2O_3 and Al_2O_3 with relatively high FeO contents. Since the phlogopites of type I and type II are similar in chemistry to phlogopites from ultramafic xenoliths, these phlogopite macrocrysts are considered to be discrete ultramafic rocks. Type III phlogopites including the rim part of zoned phlogopites may have crystallized in the kimberlite magma.

Amphibole macrocrysts comprise titanian edenite, edenite, edenitic hornblende, magnesio-katophorite and richterite. All of these amphiboles are considered to be discrete ultramafic rocks, owing to their chemistry similar to those in ultramafic xenoliths together with metasomatic ultramafic microxenoliths; titanian edenite in hornblendite, edenitic hornblende in harzburgite, magnesio-katophorite in dunite and edenite, magnesio-katophorite and richterite in the metasomatic ultramafic microxenoliths.

The values of $\delta^{13}C_{PDB}$ and $\delta^{18}O_{SMOW}$ of the calcite macrocryst and the matrix carbonate of the yellow-green kimberlites(shallow parts of the drill-core) are slightly heavier than those of the matrix carbonate of dark green kimberlite(deep parts of the drill-core). This suggests some meteoric-hydrothermal water interaction during the diatreme emplacement. These values of the western Kenya kimberlites are heavier than those of the kimberlites from other localities(Kobelski, B. J. et al., 1979).

References

Kobelski, B. J., Gold, D. P. and Deines, P. O., 1979, Variations in stable isotope compositions for carbon and oxygen in some South African and Lesothan kimberlites. In Boyd, F. R. and Meyer, H. O. A.(ed.): Kimberlites, diatremes, and diamonds: Their geology, petrology, and geochemistry. Proceedings 2nd International Kimberlite Conference 1, American Geophysical Union. pp. 252-271.

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Table 1. Chemical compositions of western Kenya kimberlites.

(wt.%)	1	2	3	4	5
SiO_2	30.10	35.49	39.33	41.48	41.86
TiO_2	1.60	0.73	1.72	0.05	0.02
Al_2O_3	3.95	2.42	5.25	0.80	0.48
Fe_2O_3	7.34	6.00	6.59	1.74	0.84
FeO	4.05	5.34	5.40	5.56	6.29
MnO	0.22	0.20	0.20	0.12	0.12
MgO	21.39	33.68	17.70	44.24	46.56
CaO	11.68	3.49	11.58	0.49	0.25
Na_2O	1.33	0.47	3.36	0.26	0.17
K_2O	2.03	0.30	0.94	0.14	0.06
P_2O_5	0.74	0.18	0.70	0.01	0.00
$H_2O(+)$	3.73	6.46	4.18	2.54	1.43
$H_2O(-)$	2.24	2.20	3.12	1.36	0.67
CO_2	8.75	2.54	0.73	0.45	0.34
Total	99.15	99.50	100.80	99.24	99.09

(ppm)					
Cr	630	626	610	1800	1000
Co	45	66	43	76	84
Ni	475	980	330	1900	2000
Cu	0	0	0	0	0
Zn	66	60	74	36	34
Br	0	0	0	0	0
Rb	29	3	26	0	0
Sr	900	230	610	26	12
Y	20	5	17	0	1
Zr	185	65	150	11	7
Nb	29	0	2	0	0
Mo	2	2	3	1	1
Pb	12	7	7	3	3
Th	12	7	8	1	1
Ba	485	196	740	27	6
Ga	5	2	7	2	6

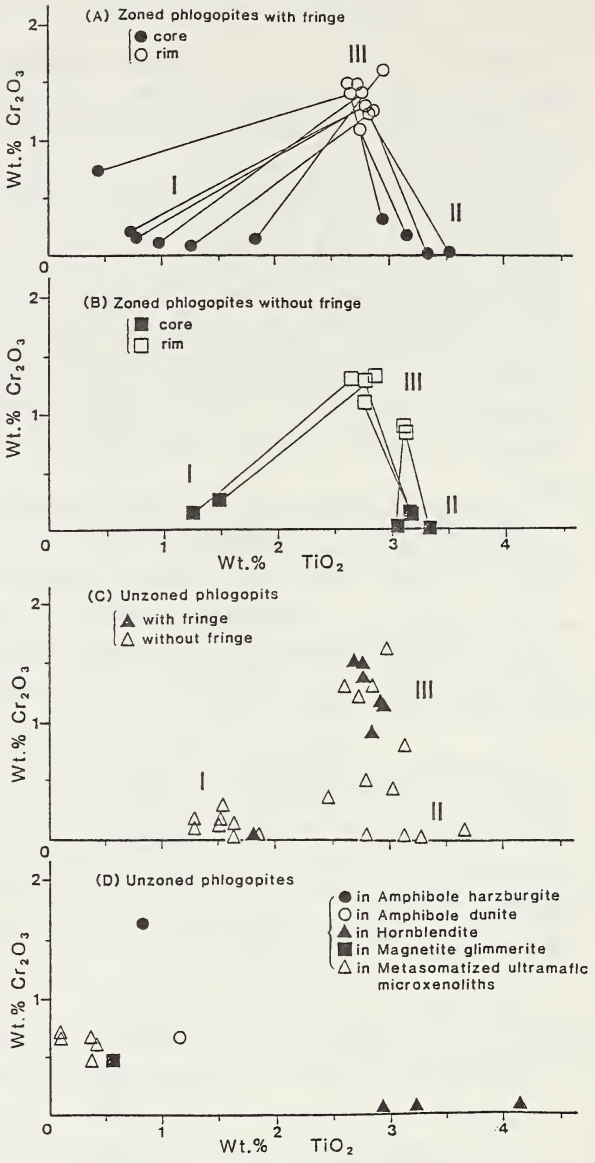

Fig. 1. Cr_2O_3 vs. TiO_2 for phlogopites in the western Kenya kimberlites and their ultramafic xenoliths.

1:Yellow-green YlBl kimb.(shallow part), average of 2 samples.

2:Dark green YlBl kimb.(deep part), average of 5 samples.

3:Dark grayish green YA17 kimb.(shallow & deep parts), average of 5 samples.

4.Harzburgite in YlBl kimb.

5.Harzburgite in YA17 kimb.