Geochemistry and Mantle Source(s) for Carbonatitic and Potassic Lavas from SW Uganda

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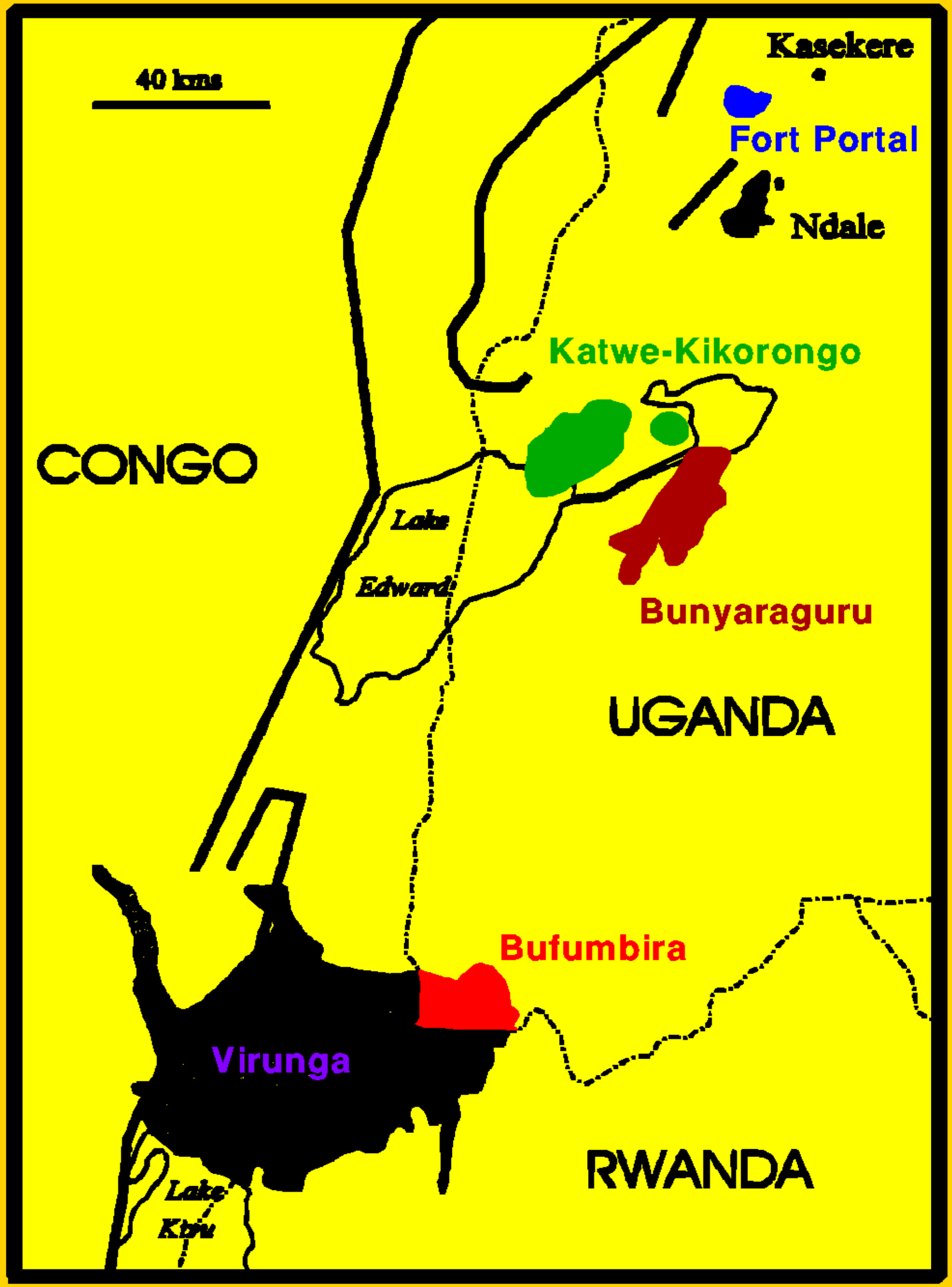
Bunyaraguru

Olivine-bearing tephras & rare lavas. Leucite + augite (ugandite), augite + kalsilite (mafurite) and melilite + leucite (katungite)

Bufumbira

Basanite, leucitite, leucite-phonolite, latite & trachyte



Fort Portal

Extrusive carbonatites

Katwe-Kikorongo

Olivine-melilitite and feldspathoidal cpx-rich tephras & subordinate flows

Fort Portal

Tuff cone

Tuff cone and crater lake

Fort Portal

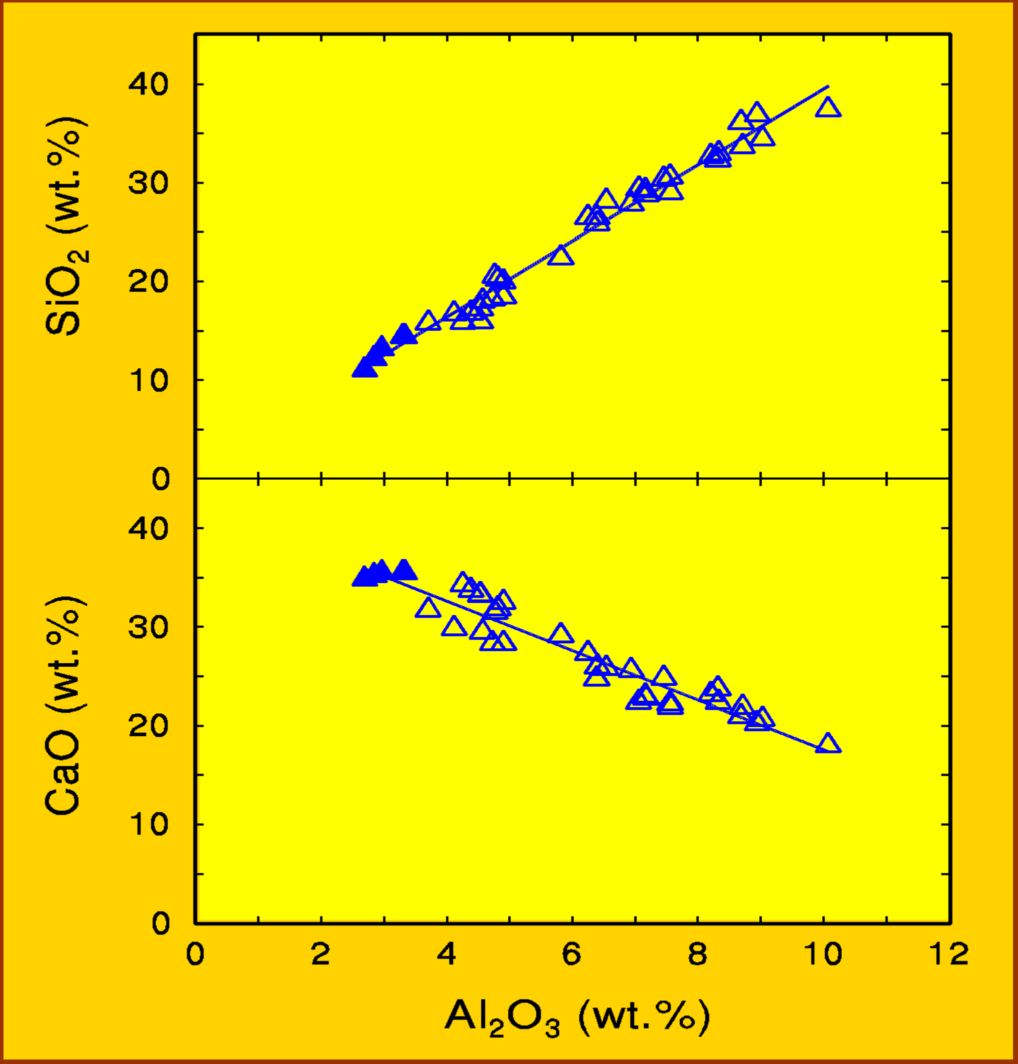
Quarry -
"flaggy" tuff

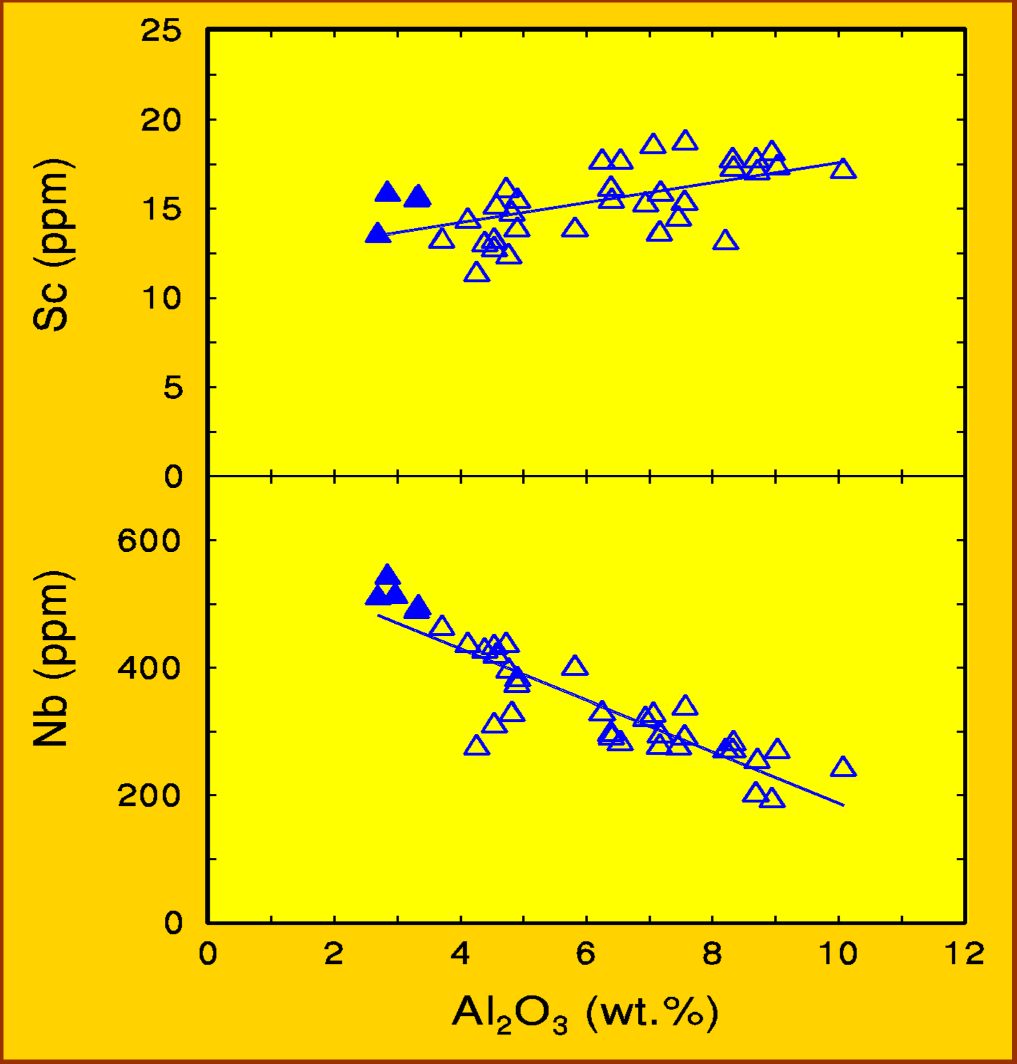
Lapilli-tuff

Ash-tuff

Mixing lines for Fort Portal tuffs and lavas

Extrapolation to Al_2O_3 = 0% yields an estimate of the original composition of the carbonatite magma.





- Crustal xenoliths are ubiquitous in the Fort Portal tuffs and lavas.
- The Fort Portal tuffs and lavas can be regarded as mixtures of carbonatite magma and Precambrian crustal xenoliths.
- Plots of various elements versus Al (or Si) yield straight-lines which represent variable mixtures of crustal xenoliths and carbonatite magma.
- The original composition of the carbonatite magma can be determined by extrapolation to zero wt.% alumina.

Katwe-Kikorongo

Crater

Rim is composed of tuffs and agglomerates

Crater lake

Katwe-Kikorongo

Subaqueous tuffs

Bufumbira

Mgahinga and Sabinio volcanoes

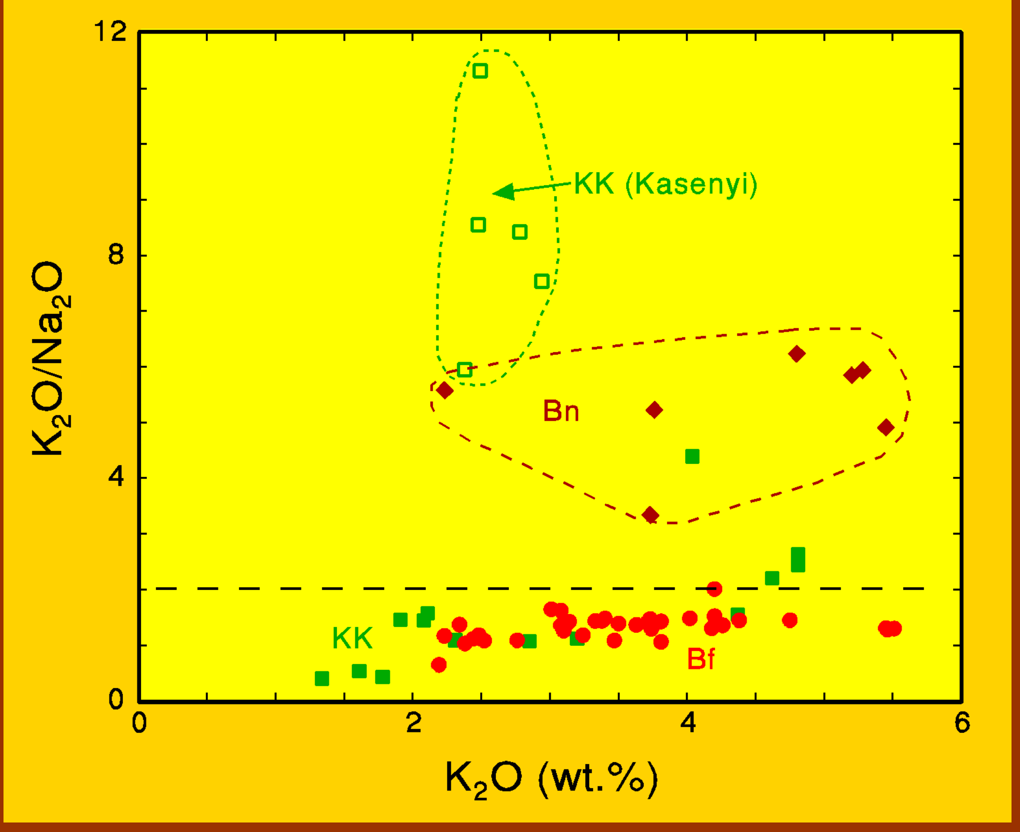
Trachyte plug

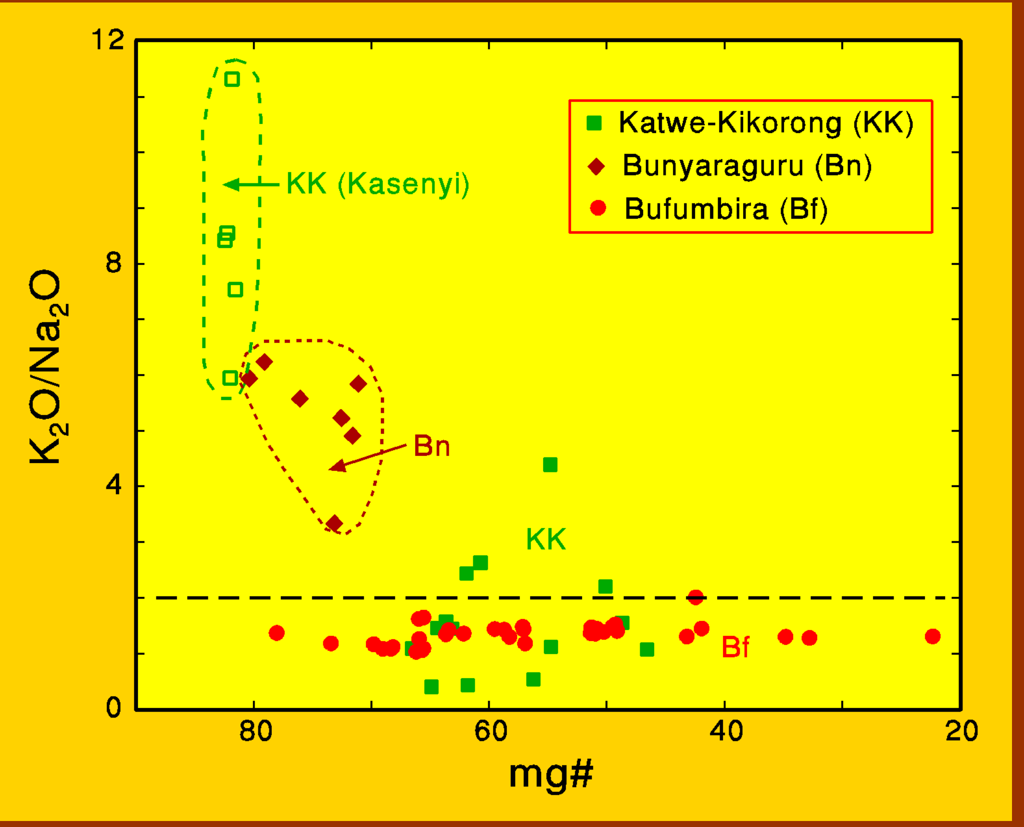
Bufumbira

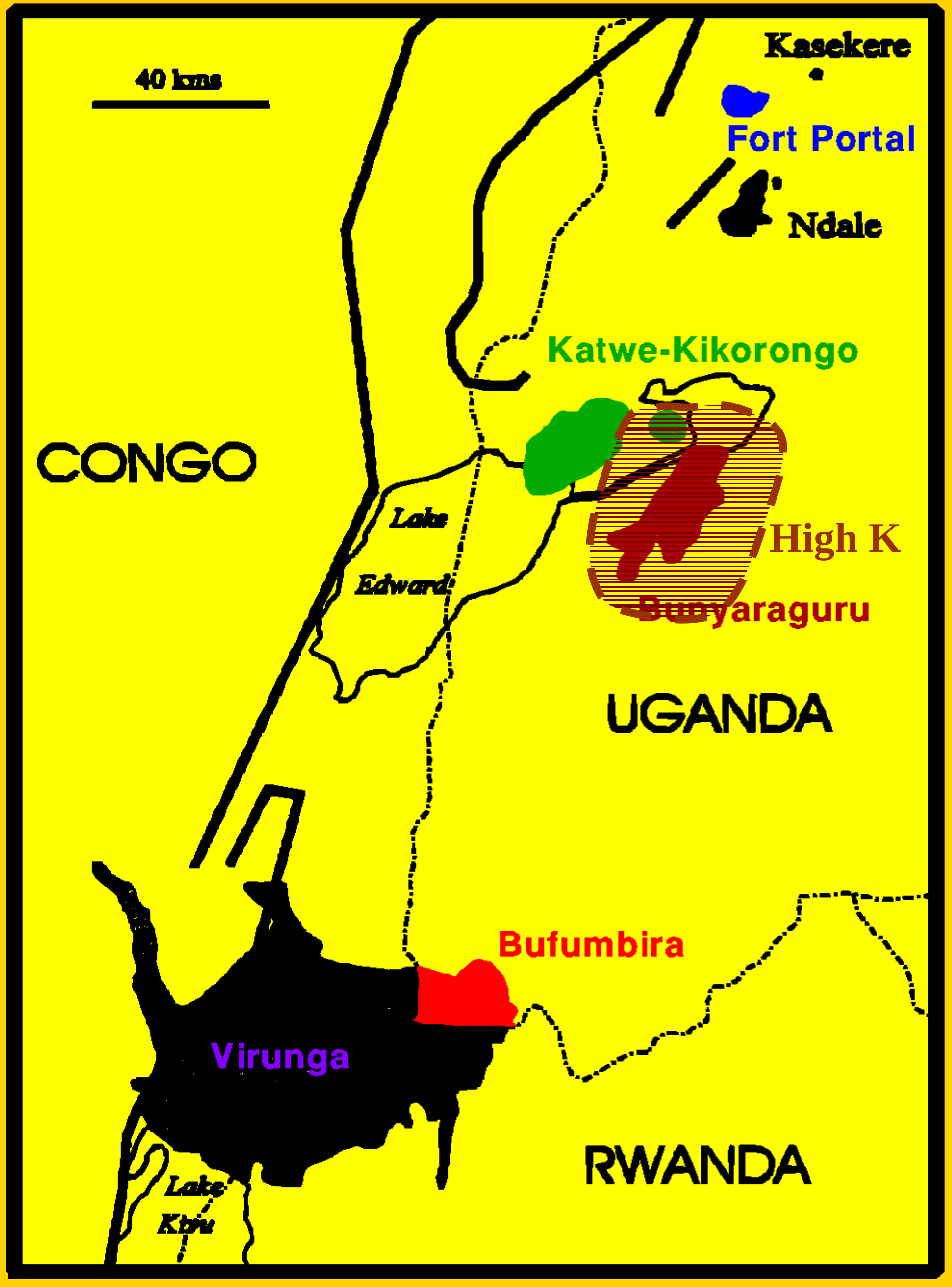
Leucite basalt

Lapilli tephra

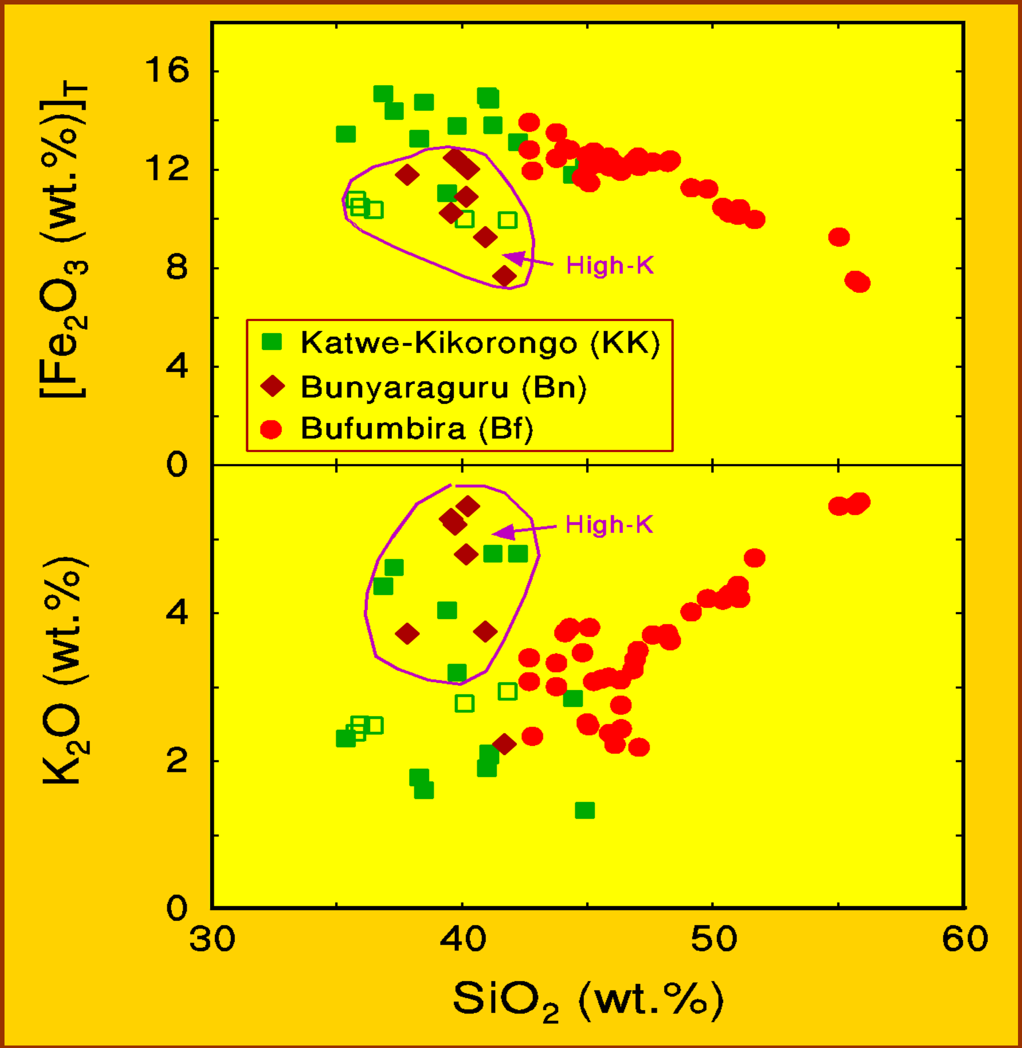
K_2O-Na_2O relationships for Katwe-Kikorongo, Bunyaraguru and Bufumbira. Note the strongly potassic character of the Bunyaraguru and Katwe-Kikorongo (Kasenyi) samples.

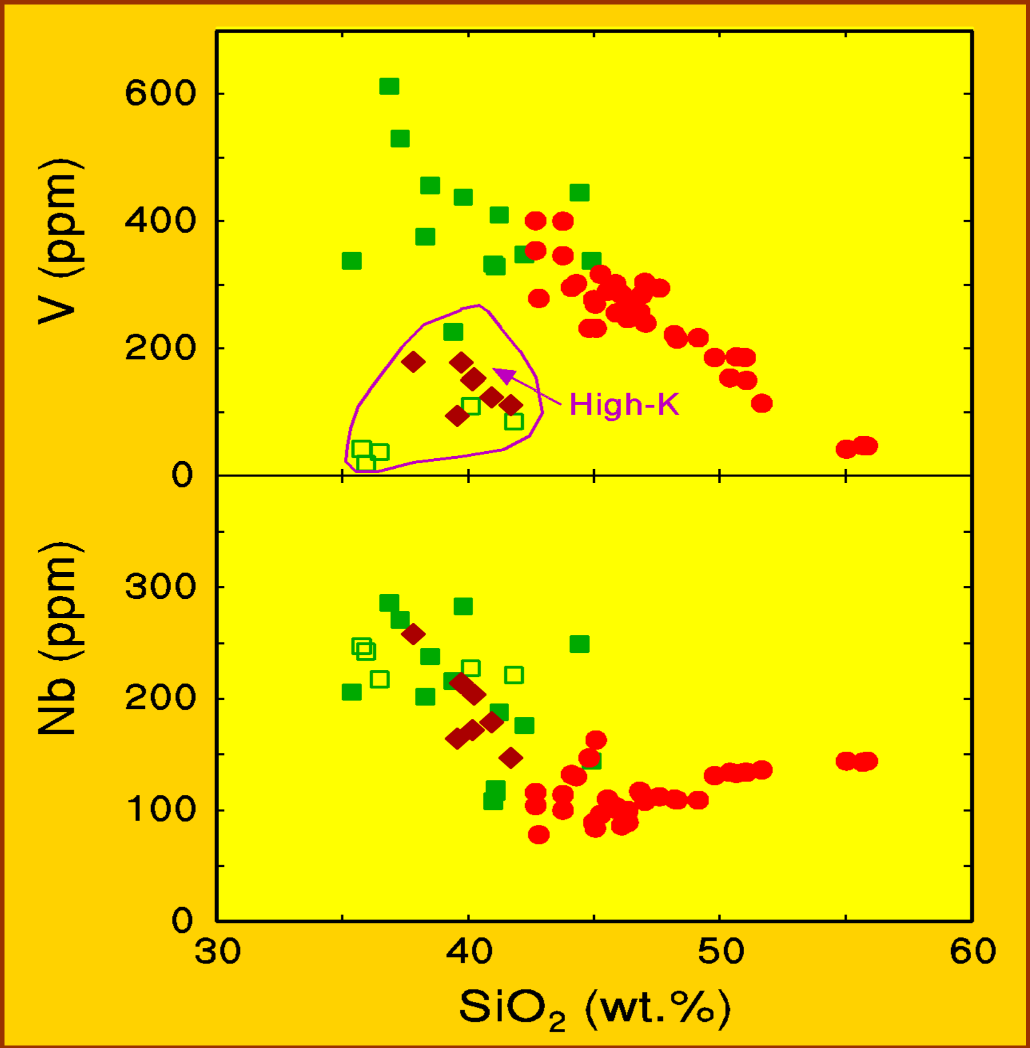




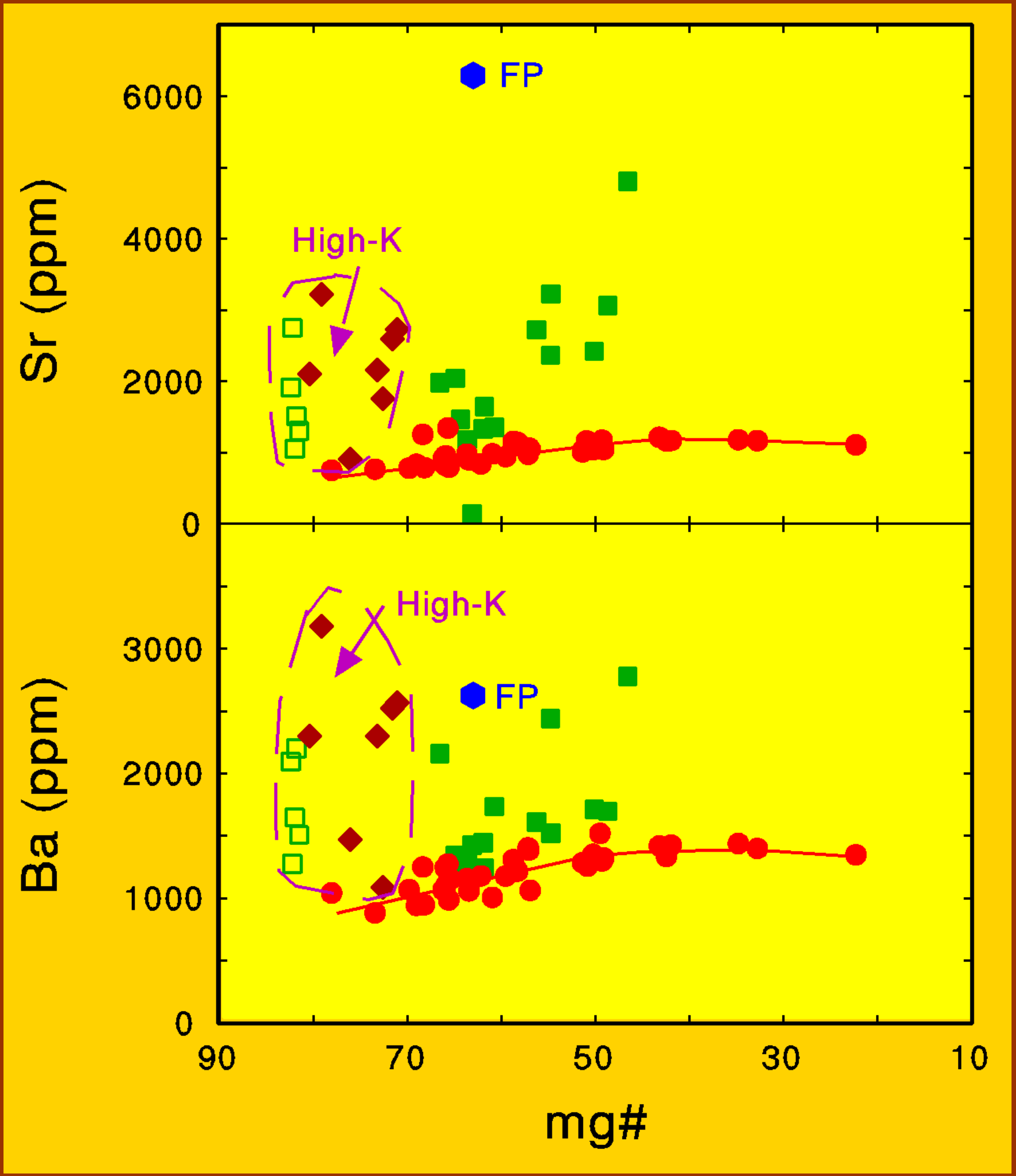

40 kms
Kasekere
Fort Portal
Ndale
Katwe-Kikorongo
CONGO
Lake
Edward
High K
Bunyaraguru
UGANDA
Bufumbira
Virunga
RWANDA
Lake
Kivu

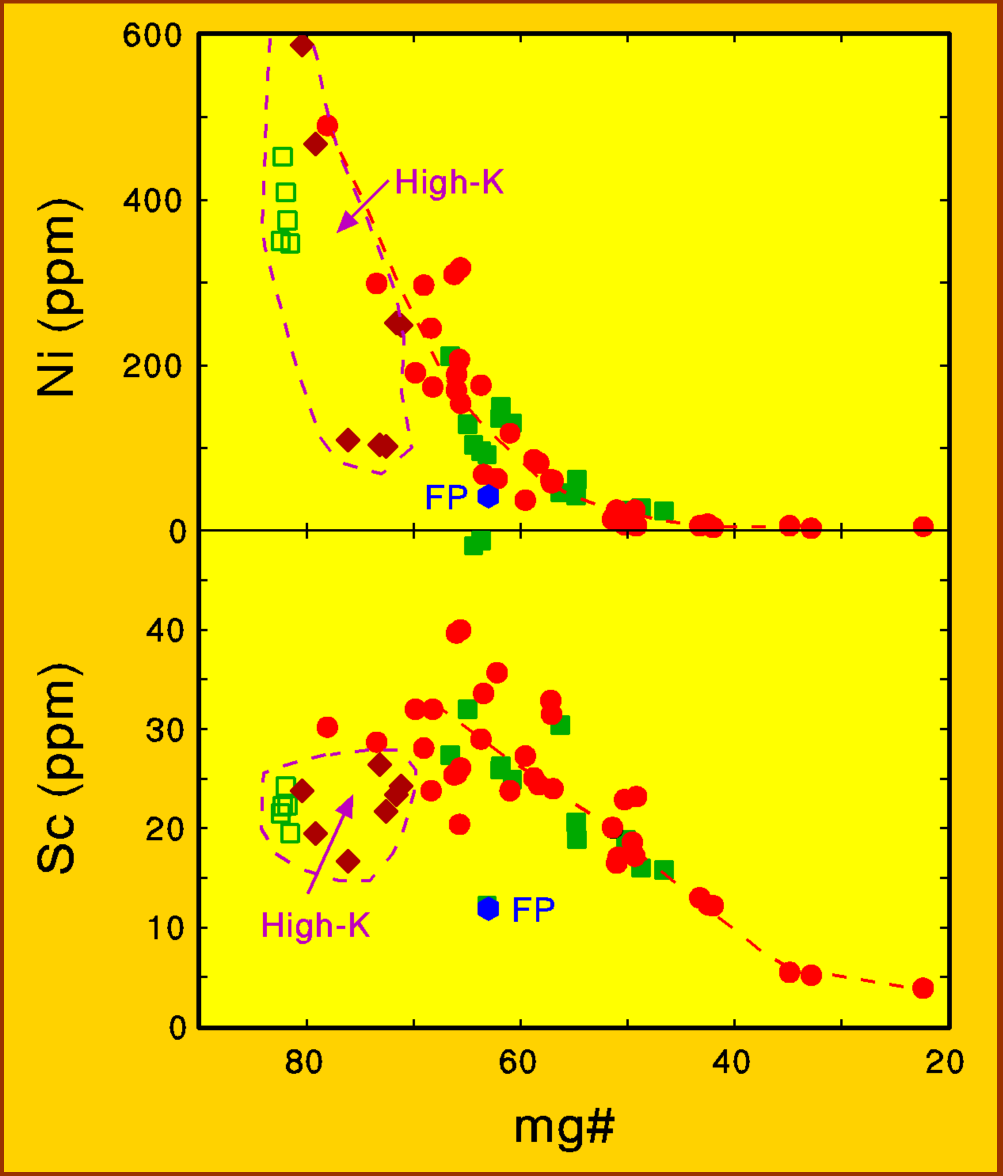
Selected major and trace elements versus SiO_2. Note that the "potassic" samples plot in distinctly different areas from the rest of Katwe-Kikorongo and Bufumbira samples. Declining V with increasing SiO_2 suggests magnetite fractionation.





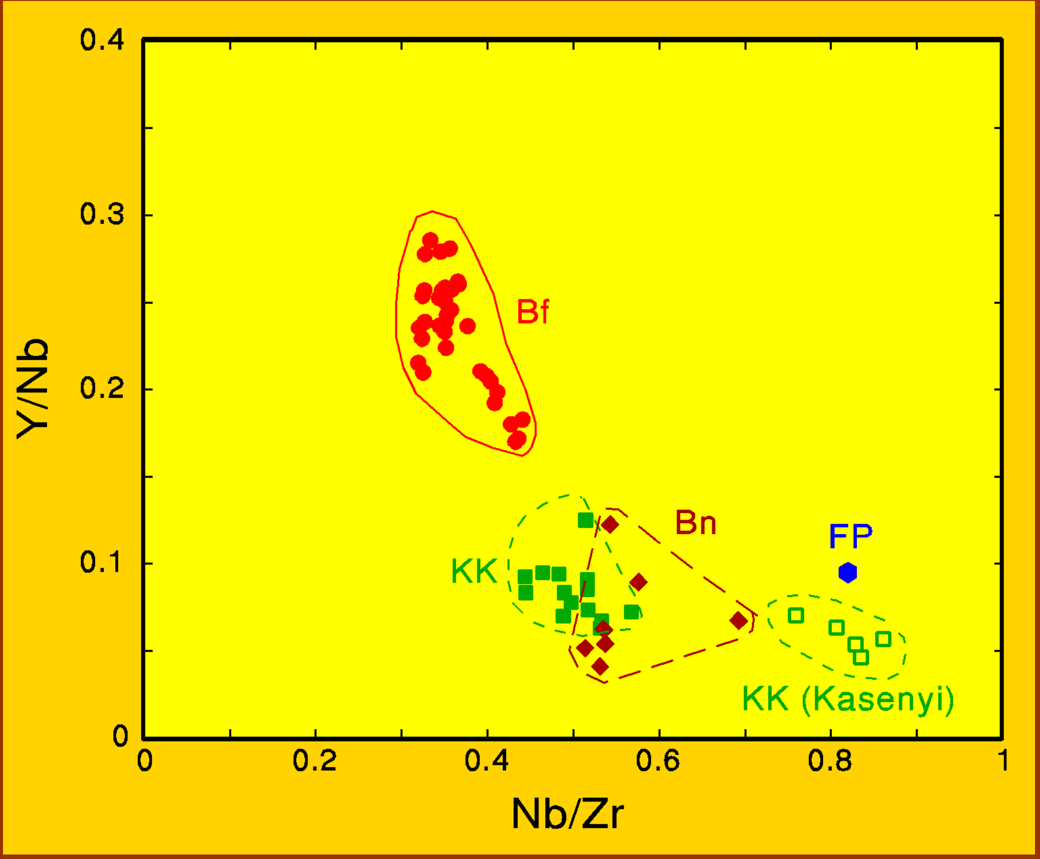
Selected trace element vs mg#. Note that the high-K samples are significantly enriched in Sr and Ba and relatively depleted in Ni and Sc.

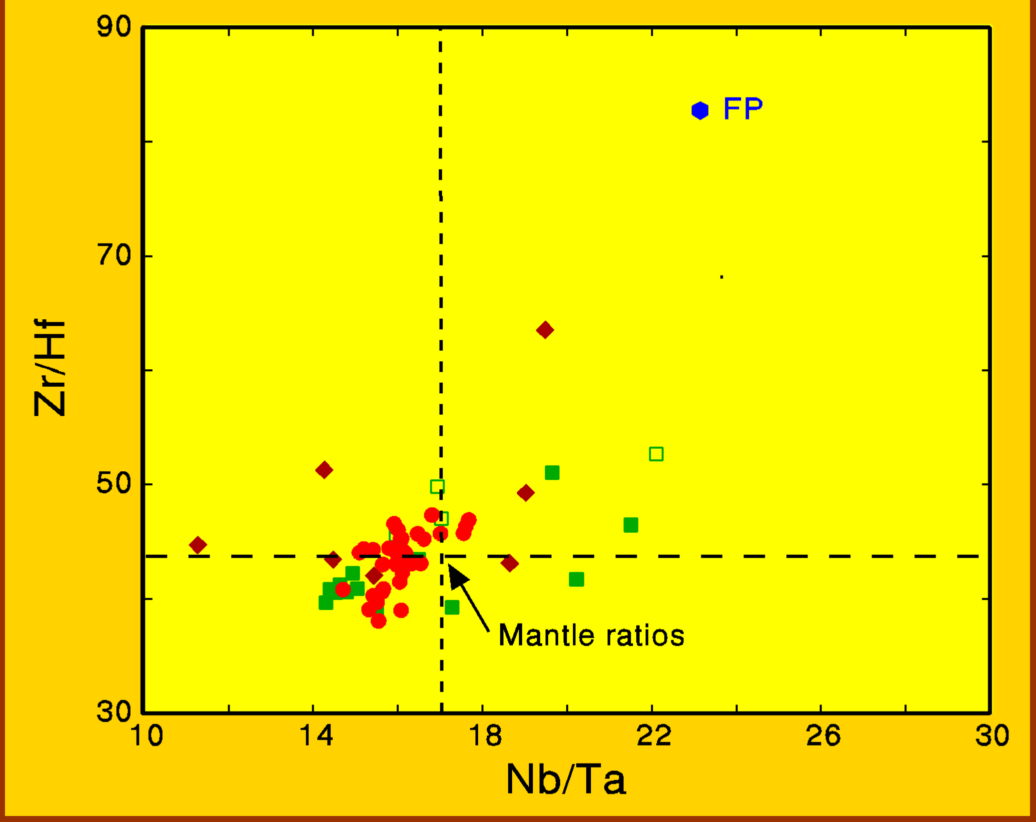




- The high-K volcanics show chemical signatures significantly different from the other volcanics, e.g., higher K_2O, Ba and Sr and lower V, Ni and Sc at similar SiO_2 content and mg#.
- A regular increase in Sr and Ba content, and then a constant concentration, with decreasing mg# indicates that the feldspar minerals were not important fractionating phases.
- The regular decrease in Ni (olivine) and Sc (clinopryroxene) with increasing mg# indicates that these minerals were important fractionating phases.

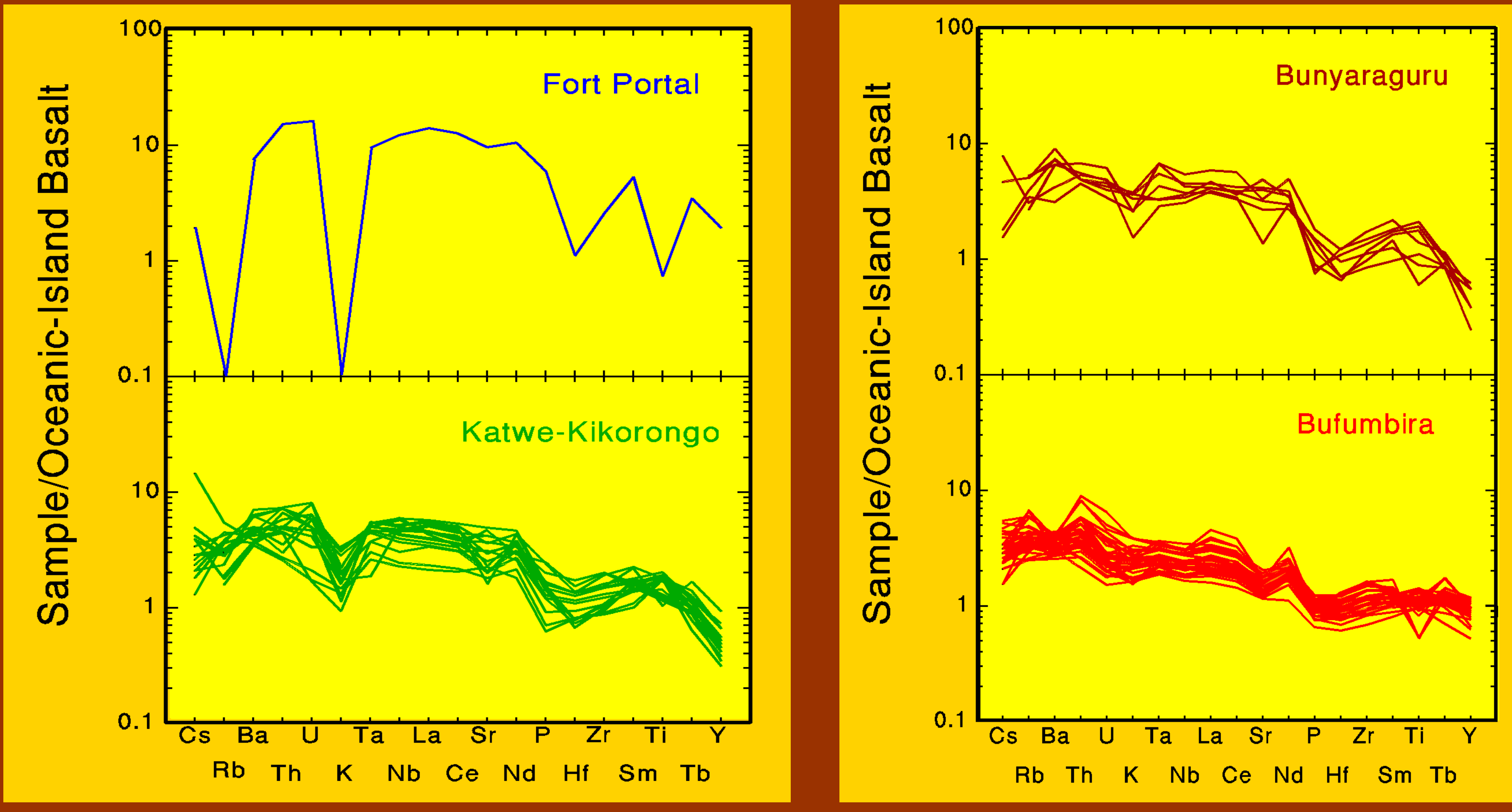
Each volcanic area plots in a distinct region on a Y/Nb vs Zr/Hf diagram suggesting different mantle source regions.



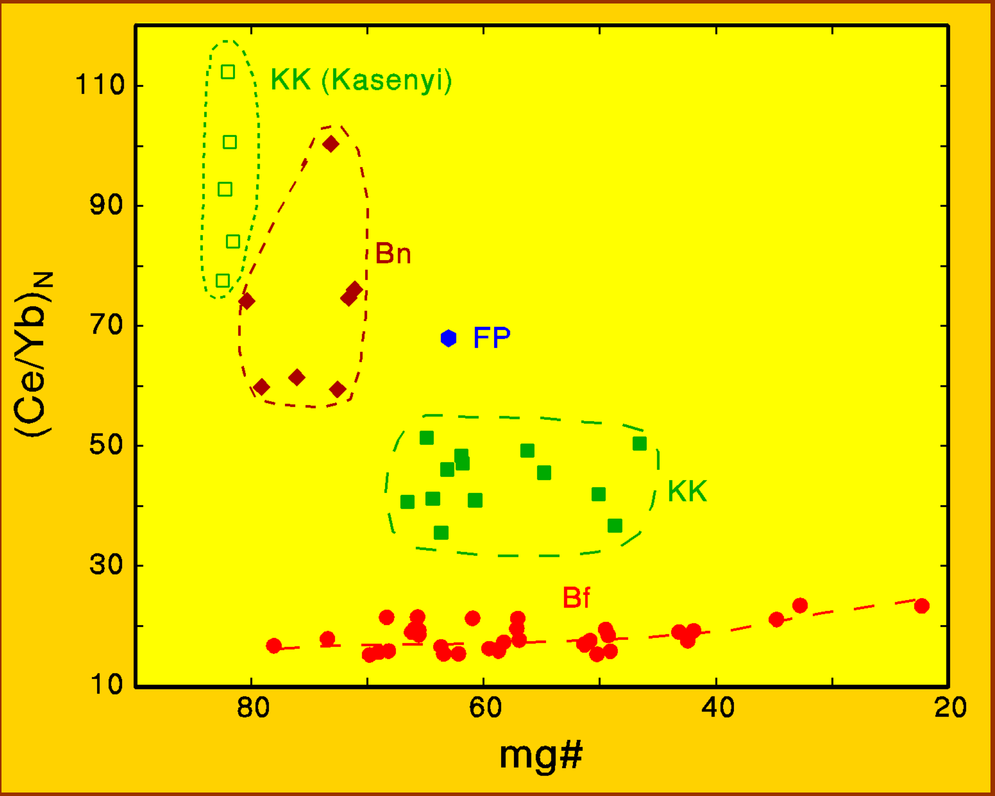


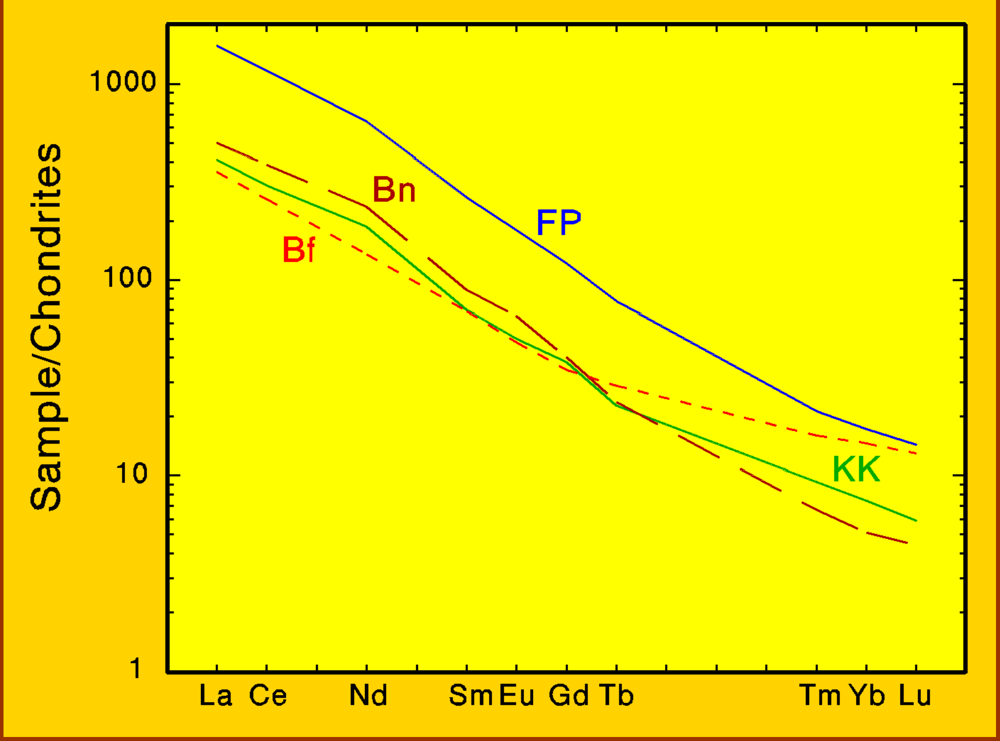
Zr/Hf and Nb/Ta ratios are close to mantle values with the exception of Fort Portal and some of the K-rich samples which show relative Zr and/or Nb enrichment.

OIB-normalized spider diagrams for the various volcanic fields. Note the differences in the slopes for the various spider diagrams.



$(Ce/Yb)_N$ ratios as a function of mg#. The high-K samples have the highest $(Ce/Yb)_N$ ratios suggesting smaller degrees of partial melting. Bufumbira samples show a regular increase in $(Ce/Yb)_N$ with decreasing mg#, a trend typical of fractional crystallization.





Representative REE patterns. Note crossing patterns for Katwe-Kikorongo, Bunyaraguru and Bufumbira which suggest that the melts were derived by variable degrees of melting of a garnet-bearing source.

Conclusions

- The mantle under the western branch of the East African rift system is chemically heterogeneous.
- This mantle has been subjected to variable degrees of metasomatism as represented by the K_2O/Na_2O ratios for volcanics from the various fields.
- Chemical mantle domains can be identified which gave rise to each of the volcanic groups.
- REE data suggest that garnet was important in the source area, and that magma variations are in part due to variable degrees of partial melting.