Petrology, geochemistry and low-temperature alteration of lavas and pyroclastic rocks of the kimberlitic Igwisi Hills volcanoes, Tanzania.

BY

A. Willcox,. I. Buisman,. R. S. J. Sparks,. R.J. Brown,. S. Manya,. J. C. Schumacher,. H. Tuffen

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Abstract

Geochemical data are presented for the kimberlitic Holocene Igwisi Hills volcanoes (IHV), Tanzania, which preserve extra-crater lavas and pyroclastic rocks. Their young age and exceptional preservation enable investigation of kimberlite magma compositions and alteration pathways of kimberlites. The IHV lavas have a variable matrix assemblage dominated by calcite, olivine and a serpentine-like mineral (termed serpentine-X). Minor primary groundmass phases include apatite, phlogopite, monticellite, perovskite and spinel representing late-stage crystalisation. Secondary phases include hydrogarnet, a mixed-layer chlorite–vermiculite–montmorrilonite, minor brucite and low-temperature oxides and clays such as goethite and jamborite. The matrix of pyroclastic rocks is dominated by calcite with fewer groundmass phases. The parental magmas are inferred to have had ~ 21 wt.% SiO_2, ~ 22 wt.% CaO, ~ 23 wt.% MgO and Mg# ~ 70. The IHV are classified as calcite kimberlites. The total volatile concentrations of the primary melt are ~ 14 wt.%, which predominantly consists of CO_2 although the H_2O content is also high. Whole-rock geochemical analyses indicate minor crustal contamination, low-temperature alteration and weathering. Pervasive serpentinisation in both lavas and pyroclastic rocks results from low-temperature alteration induced by the circulation of meteoric waters during cooling. Serpentine-X is potentially a new mineral and is richer in Al_2O_3 and FeO and poorer in SiO_2 than published analyses of serpentine minerals. These compositions are attributed to a 1:2 mixture of serpentine and hydrotalcite. We propose that serpentine-X has replaced a reactive, late stage residual silicate glass, the existence of which helps explain the presence of vesicular scoria (similar to glassy basaltic pyroclasts) and viscous kimberlite lavas.

Keywords

Extrusive kimberlite; Igwisi Hills; Serpentine; Geochemistry; Petrology