Geochemistry of the 2.7 Ga Belingwe volcanics, Zimbabwe: Magmatism in the Archean continental large igneous province

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The evolution of the late Archean Belingwe greenstone belt, Zimbabwe is discussed on the geochemistry of the ultramafic to mafic volcanic rocks.

Four volcanic types are observed by petrography and geochemistry from the 2.7 Ga (Ngezi) volcanic sequence. Komatiites and D-basalts are slightly depleted in both isotopic and trace element compositions. Their chemical variations can be explained by simple fractional crystallizations from the ultramafic komatiite. Contrary to this, komatiitic basalts and E-basalts are siliceous and display enriched isotopic and trace element compositions. Their chemical trends are best explained by assimilation fractional crystallization (AFC) from the komatiite. AFC calculations indicate that komatiitic basalts and E-basalts are derived from komatiites contaminated with >25% of crustal materials. Most volcanic rocks in this study can be explained by combinations of crystallization and crustal assimilation of the primitive melt of the Belingwe komatiite melt at single magma composition.

The volcanic stratigraphy of the Ngezi sequence, which is estimated using numbers of trace element compositions of clinopyroxene relicts, shows that the least contaminated komatiite lay between highly contaminated komatiitic basalt layers, and occurred only near the base of the succession. Above these komatiite layers, D- and E- basalt layers distributed alternately. Considerable volumes of komatiitic magmas may have been produced, but they rarely erupted. Komatiite appears to erupt on the surface only at the early stage, when the plume activity may be sufficiently high. As plume activity decreased with time, komatiite magmas may have stagnated to form magma chambers beneath the continental crust. Then, subsequent komatiitic magmas fractionally crystallized and were contaminated with crust to form D-basalts or E-basalts.

The New Mineral Species, Keilite, (Fe,Mg)S

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Keilite, (Fe,Mg)S, is a new mineral species, the Fe-dominant analogue of niningerite, that occurs in several meteorites: Abee, Adhi-Kot, Saint-Sauveur, LEW 88180, RKP A80259, LEW 87119, LEW 88714, Y-791790, Y-791811, Y-86760 and Y-8404. The type material, the Abee enstatite chondrite is preserved in the collections of the Hawaii Institute of Geophysics and Planetology, University of Hawaii, honolulu, Hawaii, U.S.A. (specimen UH 13).

Keilite is cubic, with space group *Fm*3*m*, *a* 5.20Å, *V* 140.6Å^3, *Z* = 4. Keilite and niningerite occur as grains up to several hundred µm across. Because of the small grain-size, most of the usual properties could not be determined. Keilite is metallic and opaque; in reflected light, it is isotropic and gray. Associated minerals are: enstatite, kamacite and troilite.

The average (and range) of 6 chemical compositions of keilite is: Fe 38.75 (36.99-40.14), Mg 10.71 (10.05-11.96), Mn 3.53 (3.37-3.95), Ca 2.21 (.70-2.91), Cr 1.90 (1.84-1.98), Zn 0.25 (0.13-0.31), Ti 0.08 (0.05-0.09), Ni 0.01 (0.00-0.02), Cu 0.10 (0.00-0.31), S 41.68 (41.26-42.23), total 99.22 wt.%. The empirical formula based on total atoms = 2, is: $(Fe_{0.53}Mg_{0.34}Mn_{0.05}Cr_{0.04}Zn_{0.03})_{\Sigma 0.99}S_{1.00}$. The simplified formula is (Fe,Mg)S. FeS : MgS : (Mn,Ca,Cr)S = 53.8 (50.8-56.1) : 34.1 (32.3-37.7) : 12.1 (11.5-13.5).

The chemical composition of the associated troilite is: Fe 59.7. Mg 0.04, Mn 0.2, Ca 0.2, Cr 2.05, Zn 0.03, Ti 0.33, Ni 0.1, Cu 0.11, S 36.94, total 99.52 wt.%, and the empirical formula based on tota toms = 2. is: $(Fe_{0.94}Cr_{0.04}Ti_{0.01})_{\Sigma 0.99}S_{1.01}$. the simplified formula is: (Fe,Mg)S. FeS : MgS : (Mn,Ca,Cr)S = 96.1 : 0.0 : 3.9.

Reflectance spectra in air and in oil (Nikon nD=1.515) for keilite were measured relative to a SiC standard (Zeiss No. 851). The values ($R_{Fe\text{-}rich}$ and $R_{Mg\text{-}rich}$ in air and $R_{Fe\text{-}rich}$ and $R_{Mg\text{-}rich}$ in oil) for COM wavelengths are: (27.2, 26.9; 12.2, 12.0 %) 470 nm, (2.7, 26.1; 11.9, 11.7 %) 546 nm, (26.4, 26.0; 11.7, 11.4 %) 589 nm, (26.0, 25.5; 11.7, 11.4%) 650 nm. The reflectance values of keilite increase with increasing Fe content.