Geochemistry of 2.7 Ga Belingwe volcanics, 
Zimbabwe: implications for the tectonic setting and 
the evolution of the late Archean greenstone belt

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The Belingwe greenstone belt, one of the best-studied areas, is controversial on its tectonic setting, 
whether it is autochthonous or allochthonous. As most Archean greenstone belts are, the Belingwe greenstone 
belt is composed of mainly tholeiitic basalt and komatites occur small amount only near the basement of the 
sequence. Studying these basalts is significant to discuss the origin of komatites. The least altered samples 
were selected from 2.7 Ga volcanic sequences, and major and trace element compositions and isotopic ratios 
of Nd and Pb were determined for bulk rock, clinopyroxene and plagioclase.

<100 μm garnet xenocrysts were discovered in a komatiite. Their major element compositions (Gra20 
Pyp35 Alm45) and trace element ratios [(Sm/Yb)N ~0.2] suggest that they are lower crust origin. This 
discovery indicates that komatiite was erupted through a continental basement and that the 2.7 Ga volcanic 
sequence is autochthonous.

Volcanics in this region were divided into four types, petrologically and geochemically. (La/Sm)N of 
komatites, komatiitic basalt, D-basalt and E-basalt are ~0.7, ~1.5, ~0.8 and 1.2-1.6, respectively. Trace 
element compositions of clinopyroxenes are equilibrium with those of whole rocks, suggesting that the 
variations of these volcanics have been formed before pyroxene crystallized, but not after the alterations. 
Since komatiitic basalts and E-basals have high μ1 values (~8.5 and 9.0, respectively) and low initial Nd 
isotropic ratios [εNd(2.7Ga) ~0.5 and ~0.5, respectively], and komatites and D-basals have low μ1 values 
(~8) and high initial Nd isotopic ratios [εNd(2.7Ga) ~2.5], the chemical variations are produced by different 
degree of contaminations of an older crustal materials. The REE patterns and contents of D-basalt can 
be reproduced by melting the same source for komatiite; it needs ~8-26% degree of partial melting, while they 
can be also obtained by ~45-80% crystallization of primary komatiitic magma. Major element variations of 
the D-basals show that it is more reasonable to be formed by crystallization of komatiitic magma at 1 to 5 
kbar. Degrees of crystallizations and contaminations of basalts increase stratigraphically upward, indicating 
that more evolved and more contaminated basalts erupted at the later stage.

Belingwe komatiite may immediately erupt through continental crust without major contaminations and 
fractionations at the early stage when the plume activity is high enough for komatiite to be erupted to the 
surface. Some of komatiitic and basaltic magmas may be contaminated with an older crustal material, and 
komatititc basalt and E-basalt were formed. Large amount of komatiitic magma may pond at a magma 
chamber and may crystallize to form voluminous D-basals.

Keywords: Geochemistry, Archean greenstone belt, komatiite, crustal assimilation