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# Polybaric critical melting with high melt retention explains the compositions of Barberton komatiites

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Komatiites are highly magnesian volcanic rocks characteristic of the Archean. They are divided in three types: Al-depleted, which have low Al/Ti, relatively high concentrations of incompatible elements and depleted HREE; Al-undepleted komatiites, with chondritic Al/Ti and slightly depleted LREE; and Al-enriched komatiites, with high Al/Ti, low concentrations of incompatible elements and extremely depleted LREE. The oldest well-preserved examples are found in the Barberton greenstone belt in South Africa (3.5-3.3 Ga). All three komatiite types are found in the belt, commonly within the same stratigraphic unit. Based on a comprehensive petrological and geochemical study, we propose a new melting model for their formation. The basis of the model is the observation, from published experimental studies, that at great depths ($\sim$13GPa), the density of komatiitic liquid is similar to that of solid peridotite. Under such conditions the komatiite liquid does not escape from the source. As the source (probably a mantle plume) ascends through the mantle, the pressure decreases and the density difference increases, making the escape possible. We modelled the formation of komatiite assuming a progressive decrease of the proportion of liquid retained in the source. The Al-depleted komatiites form first at about 13GPa at conditions close to equilibrium melting when a large proportion of liquid (30%) was retained in the source and where the residue contained a high proportion of garnet (20%). Al-undepleted komatiite forms at intermediate depth after exhaustion of residual garnet and after most of the liquid had escaped the source. Al-enriched komatiite forms at shallow depths and pressure (5-10 GPa) from the highly refractory source left after extraction of up to x% liquid. This model reproduces the chemical characteristics of all komatiite types in the Barberton belt and can probably be applied to komatiites in other parts of the world.