Paleoarchean felsic magmatism: A melt inclusion study of 3.45 Ga volcanic rocks from the Barberton Greenstone Belt

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Archean felsic magmatism spatially and temporally associated with the Barberton Greenstone Belt (BGB) of Southern Africa can be broadly subdivided in an early (≥3.2 Ga), Na-rich series that formed the tonalite-trondhjemite-granodiorite (TTG) series, and a generally later (~3.1 Ga), K-rich series akin to modern granites [1].

Felsic volcanic rocks in the BGB are less abundant than their intrusive counterparts, and are mostly strongly deformed. The 3.45 Ga old Buck Ridge Volcanic Complex (BRVC; [2]) contains the least deformed felsic volcanic rocks in the BGB. However, widespread alteration (silicification, K-metasomatism) of these rocks involved strong mobilisation of major and some trace elements [3].

Quartz-hosted melt inclusions have been used to obtain information on the unaltered melt composition. Whole-rock compositions of the least altered samples bear strong resemblance with coeval TTG intrusions, and can be modeled as a mixture of modal phenocrysts (Na-plagioclase, quartz, Fe-Ti oxide, apatite) and melt as indicated by melt inclusion analyses, thus suggesting a cogenetic relationship between the BRVC and TTG intrusions. This is also confirmed by whole-rock concentrations of fluid-immobile trace elements. Further, melt inclusions have moderate Cl contents (≤0.7 wt.%), low F and low S (≤0.12 and ≤0.02 wt.%, respectively). The moderate Cl and low F/Cl suggest a sea water contribution to the melting protolith [4]. These characteristics are interpreted as due to melting of source rocks that have undergone sea floor metamorphism, although in an Archean context this does not have immediate tectonic implications.