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The late Archaean granite paradox

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Late- to post-tectonic granites (*ss*) are an important feature of many Archaean cratons. They are thought to represent the final stabilisation of the craton and reflect a major, crustal-scale melting event. Given that Archaean cratons are largely built of magmas of the TTG suite late tectonic Archaean granites are usually assumed to be melts of TTG crust. However, a number of studies have shown that Archaean TTGs, produced by the partial melting of a mafic source, have relatively low melt fertility – they have low modal proportions of hydrous mafic minerals and a low K_2O content – making them an unsuitable source for granitic melts.

Here we present the results of a case study from the Zimbabwe Craton where the late Archaean Chilimanzi and Razi granites form a major part of the present-day outcrop [1]. Geophysical studies show that they form tabular-shaped, shallow-crustal bodies which formed at between 2600-2630 Ma, and after the main TTG magmatism. Here we resolve the late Archaean granite paradox by examining in detail the geochemistry of the potential granitoid protolith ie. TTGs of the middle and lower crust of the Zimbabwe Craton. We show from isotopic data (elevated mu values and negative e_{Nd}) and trace element data (elevated K, Rb, Th, U, Pb) that Neoarchaen TTG magmatism in Zimbabwe is not entirely juvenile but represents a mix of juvenile melts with recycled older crust [2]. Our geochemical data indicate that the resultant Neoarchaean crust (juvenile TTG + partial melt of older TTG crust) is more fertile than juvenile TTG melts alone and this 'fertile' crust is the candidate source for the late Archaean granites of the Chilimanzi and Razi suites. Our trace element modelling suggests that this melting took place in the middle crust. This finding indicates that late-tectonic Archaean granitoids will only form in areas where the cratonic TTG magmatism incorporates recycled felsic older crust.

[1] Chagondah et al. (2023) S. Afr. J. Geol. [2] Rollinson (2023) Contrib. Min. Pet. 178:1