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Are plumes an appropriate mechanism for Archaean continent creation ?

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New SIMS U-Pb zircon data for the Zimbabwe craton shows significant late Archaean crustal growth between 2.75 and 2.6 Ga. In particular at 2.7 Ga magmatism in the middle and lower crust is coincident with voluminous, craton wide basalt and komatiite eruption, preserved in greenstone belts and interpreted as a former large igneous province of inferred plume origin. In detail, however, this episode of crustal growth involved the reworking of, and addition to, an older (3.5Ga) continental nucleus which makes up the core of the Zimbabwe Craton. Other magmatic events during late Archaean crustal growth at 2.74, 2.67, 2.64 and 2.62 Ga cannot be closely linked with a 'plume event', but rather, are tentatively ascribed to continental margin crustal growth at the edge of the old continental nucleus. Hence in the case of the Zimbabwe Craton at 2.7 Ga, the role of plumes in continental growth is ambiguous and may be more closely linked to crustal reworking than the growth of new felsic crust.

Models for the coupling of the Archaean subcontinental lithospheric mantle (SCLM) and Archaean felsic crust have also invoked a plume process. These models are driven by the close association of Archaean felsic crust with SCLM of the same age. They require the unique, highly depleted, composition of the late Archaean SCLM to be the residue of extensive komatiite extraction from the mantle. This model is rejected here in favour of a basalt-extraction model, which better satisfies geological and geochemical constraints. An appropriate tectonic setting for a basalt extraction model for the origin of the Archaean SCLM is at a hot ridge at which thick, dense Fe-rich basaltic crust is produced, underlain by very thick buoyant SCLM, meaning that the Archaean SCLM originated as oceanic lithosphere. The coupling of thick depleted SCLM with continent-growth provides a mechanism for increasing the buoyancy and enhancing the probability of preservation and implies a process whereby the generation of felsic TTG magmas is closely associated with the creation of oceanic lithosphere. One mechanism which satisfies this process is the production of felsic TTG melts by slab melting in an Archaean subduction zone. Geochemical modelling of the partial melting of thick, Fe-rich tholeiite can produce melts very similar in composition to those found in Archaean felsic crust. These data support the notion of Archaean subduction tectonics and provide a viable model for the creation of continental crust during the Archaean.

In contrast plume models have difficulty in identifying an appropriate basaltic starting materials for the genesis of felsic crust rendering them less appropriate for explaining the coupled felsic crust – thick depleted SCLM association.