

Making, keeping, and maybe even losing ancient continental lithosphere

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Archean cratons are areas of continental crust and lithosphere that exhibit long-term stability against deformation. Seismic evidence suggests that cratonic lithosphere may have formed via thrust stacking of proto-cratonic lithosphere. We review this evidence and present numerical simulations and scaling analysis to test this formation hypothesis, as well as to elucidate mechanisms for long term stabilization of ancient continental lithosphere. Geochemical constraints are used to help determine if cratonic roots formed originally from ancient oceanic lithosphere via buoyant underthrusting in a shallow subduction environment or via thrust stacking of arc lithosphere in a collisional environment. Our simulations and scaling analysis suggest that relatively thin or rehydrated cratonic lithosphere may not provide long term stability as the Earth cools over geologic time, which may provide an explanation as to why some cratons are not long-lived.