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Unstable tectosphere and the evolution of continents

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The longevity of continental tectosphere has usually been attributed to its depleted character. As indicated by their high Mg numbers (˜91-94), cratonic peridotites are believed to be the residue of high-degree melting, which results in intrinsic chemical buoyancy. More importantly, melt depletion dehydrates residual mantle, and this dehydration could substantially strengthen depleted mantle because mantle rheology is very sensitive to the trace amount of water. Thus, the high-degree of melting, which is responsible for the creation of tectosphere, may explain its longevity at the same time, and quite a few numerical studies have been conducted in the past to verify this notion. Previous modeling efforts are, however, rather monotonic; they all end up with saying that tectosphere must be stiff enough to survive long enough and it can be stiff enough because of melt depletion. The longevity of tectosphere may not be such a simple issue. First of all, cratonic peridotites are not a simple residue of mantle melting. They have high Mg numbers but are also characterized by excess Si. Second, cratonic crust, which resides on tectosphere, is also not a simple product of one-time mantle melting. Its composition is andesitic, not basaltic. The generation of cratonic crust could well be fundamentally related to the origin of tectosphere(though these two issues have rarely been discussed together in terms of dynamics), and if this is the case, the longevity of tectosphere can be better formulated as the net production of continents through creation and destruction. In this talk, I will review relevant geological, geophysical, and geochemical data, and present a new research direction toward a unified understanding of the origin and evolution of continents.