Mechanism and growth rate of the continental crust

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Many recent studies conclude that plate tectonics started in the mid Archean around 3 Ga. If so, a mechanism other than subduction must have created the granitoids that dominate Archean continental crust. The sagduction hypothesis proposes that the base of thick oceanic crust founders and partially melts to generate granitic magma. Here we evaluate the hypothesis, assuming that: 1) thick oceanic crust is internally differentiated, with hydrated basalt in only the uppermost layers, 2) to generate granitic magma requires that water and basalt is present in the lower part of the crust or is taken deep into the mantle. Our numerical modelling, using a realistic model of a thick, differentiated mafic-ultramafic crust, demonstrates that when the high proportion of intrusions is taken into account, the lower crust is well above dehydration temperatures and essentially dry. Any deformation in thick, differentiated crust is restricted to the lowermost layers of dry infertile mafic-ultramafic cumulates that lack ingredients essential for the generation of granitic magma. Peaks in age spectra for rocks of the continental crust have been related to times of reduced cycling of continental crust back into the mantle, linked to continent-continent collisions and assembly of supercontinents. We propose instead that the peaks record periods of enhanced mantle plume activity that speeded up the rate of subduction and accelerated crustal growth.

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