Continental Overflow and Archean Tectonics

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Whether Archean tectonics can be fully understood by application of plate tectonic principles has been a matter of some controversy. Two complementary approaches exist for resolving this problem. The first is to attempt to explain everything that is seen in the preserved remnants of Archean crust, using the principles of plate tectonics and modern analogues, and to see if unresolved paradoxes and problems remain. This approach faces the difficulties of interpreting rocks whose enormous age implies that Archean events are seen with difficulty through a mask of Proterozoic and Phanerozoic events. An alternate approach is to examine the dynamical implications of the higher thermal output of the Archean Earth.This higher heat output during the Archean implies a steeper geothermal gradient, in continents as well as in oceanic crust. Recent estimates of lower crustal viscosity suggest that this steeper geotherm must have produced an extremely soft and ductile lower continental crust, and a relatively thin upper brittle continental crust. Given this, pervasive and repeated gravitational collapse of continents onto adjacent ocean basins would preclude the general emergence of continents as land until the mean geothermal gradient had dropped to less than about 30 degrees Celsius per kilometer. Many peculiarities of the Archean can then be attributed to this pervasive and ongoing gravitational collapse: the absence of modern passive margins, rock suites characteristic of the melting of oceanic crust submerged by continental overflow, and mafic magmatism associated with rapid extensional episodes.