Raising the continental crust

CAMPBELL IAN H. [1]* AND DAVIES D. RHODRI[1]

[1]RSES, Australian National Univ., Canberra, ACT 0200, Australia (*correspondence: ian.campbell@anu.edu.au)

The changes that occur at the boundary between the Archean and Proterozoic eons are arguably the most fundamental to affect the evolution of the continental crust. The principal component of Archean continental crust is granite-greenstone terranes (GGTs), with granites always dominant. The greenstones consist of a lower sequence of submarine komatiites and basalts, which erupted onto pre-existing tonalite-trondhjemite-granodiorite (TTG) crust. The basaltic rocks pass upwards first into evolved volcanic rocks, such as andesites and dacites, and then into reworked felsic pyroclastic material and immature sediments. This transition coincides with widespread emplacement of granitoids and stabilisation (cratonisation) of the continental crust. Proterozoic supracrustal rocks, on the other hand, are dominated by extensive flat-lying platform sequences of mature sediments, which were deposited on stable cratonic basements. Basaltic rocks are appreciably less important than in the Archean. Experimental evidence shows that TTGs are produced by melting wet basalt at pressures greater than 1.2 GPa, leaving a complimentary dense eclogitic reservoir in the continental roots, which we suggest, acted as ballast to the early continents. Ubiquitous continental pillow basalts in Archean lower greenstone sequences require the early continental crust to have been sub-marine whereas the appearance of sedimentary rocks, at higher stratigraphic levels, requires it to have emerged above sea level by the time of sedimentation. We argue that the rise of the continental crust, the onset of sedimentation, widespread melting of the continental crust, and cratonisation form a continuum that is the direct result of delamination of the dense eclogite roots, triggered by the arrival of the mantle plumes at the base of the lithosphere that produced the komatiites and associated basalts.