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Geodynamics, the Generation and Preservation of Continental Crust

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The trace element signature of Earth's continental crust resembles that of arc lavas, but there are peaks of ages that suggest that continents may have formed during ancient igneous pulses that are difficult to reconcile with supra-subduction zone magmatism. There is increasing evidence that igneous rocks generated in different tectonic settings have different preservation potentials, and so it follows that the tectonic settings in which magmas are generated shapes the long term composition of the continental crust. Recent studies of the Australian Tasmanides (515-230 Ma) have highlighted how the bulk composition of granitic rocks, and their Nd and Hf isotope ratios, vary systematically with periods of extension and compression. These are thought to reflect the repeated opening and closure of sediment-filled back-arc basins behind a long-lived subduction zone. Granitic rocks in this area define striking secular Nd-Hf-18O trends that correlate with the pattern of deformational events and register changes in magma source during tectonic activity. Juvenile magmatic input was enhanced during extensional, back-arc rifting episodes that immediately followed crustal thickening, suggesting a relationship between slab rollback and continental growth. Unexpectedly the volumes of magma generated, and hence of new crust, were greater in the periods of S-type granite magmatism, and interaction between juvenile magma and sedimentary units deposited during a preceding back-arc rifting cycle was integral to the formation of stable continental material. This highlights the importance of back-arc environments for both the generation and differentiation of continental crust. Around 30% of the crust of Australia appears to have been generated and stabilised in these settings over 300Ma.