carbonates with intercalated volcanics may record the early-stage collision and intercalation of an oceanic plateau that is now preserved as a chain of thrust-stack mountains across the island. The south-directed thrusts preserved in these mountains occur inboard of and coaxial to a line of oil and gas seeps that extend across the island, with the structural loading possibly controlling the locations of the seeps.

Of additional interest, late, high-angle structures, some marked by tectonic breccias of mixed Asian-Australian derivation, mark the northern boundary of at least one of the thrust-stack mountains, implying strong structural control and possible late reworking and/or exhumation along these faults.

Associations of these Australian-derived thrust stack mountains structurally above preserved remnants of oceanic material (MORBs and cumulates) of probable Asian derivation requires further investigation. These oceanic remnants appear to have been emplaced late in the deformation, possibly as late as the Pliocene, and have generated thick fault gauges at their basal contacts.

We present results of our structural studies in East Timor, and their implications for the processes of early-stage collision in young orogenic belts.

Continental materials on Earth by 4.5 Ga from Hf-Pb isotope systematics of the Jack Hills zircons, Western Australia

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There is mounting radiogenic isotope evidence for wholesale differentiation of the terrestrial planets within the first few million years of accretion, as seen for example in the formation of feldspathic meteorite suites and samples from the moon and probably Mars. It thus seems difficult to escape the generation of some differentiated crust on Earth in the Hadean era, especially if early magma ocean scenarios are valid. However mere 'crumbs' of this ancient and potentially sizeable crustal reservoir survive as individual zircon crystals, most notably from the Jack Hills and Mt Narryer regions of Western Australia. These remarkable grains have yielded a treasure trove of information about conditions in the infant Earth, yet fundamental questions remain about the volume, composition and fate of the early crust and its 'depleted' mantle counterpart. The unradiogenic Hf isotope compositions of the Jack Hills zircons hint at the existence of enriched (crustal) reservoirs by at least 4.3 Ga (Y. Amelin et al., 1998, Nature v. 399, p. 252-255; T. M. Harrison et al., 2005, Science, v. 310, p. 1947-1950). However, determination of crust formation ages is hampered by the notoriously complex age dispersions within these grains and the associated difficulty of reliably age-correcting hafnium isotope ratios at the time of zircon crystallisation.

Here, we report an in situ Hf isotope study of the Jack Hills zircons in which the Pb isotope age information was measured concurrently with the Hf isotope ratios. The simple data arrays contrast markedly with the heterogeneity apparent from some earlier studies and provide clear evidence for Earth differentiation at 4.5 Ga, with the production of both continental crust-like material and a mafic crustal reservoir with higher Lu/Hf. The continued re-sampling of this reservoir over 1.5 Ga argues for a substantial stabilised volume of differentiated crust, and, in tandem with oxygen isotope data, supports the existence of Hadean continents.

Isotopic evidence for continental growth during accretionary orogenesis in the Tasmanides, eastern Australia

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The trace element signature of Earth's continental crust resembles that of modern arc lavas, but much of the continental mass apparently formed during ancient igneous pulses that may be difficult to reconcile with subduction zone magmatism. We explore the role of plate subduction in crust generation by considering the tectonic context of whole-rock Nd isotope and zircon Hf-O isotope data from granites of the Australian Tasmanides (515-230 Ma), an accretionary orogen that evolved by alternating back-arc basin opening and closure. Crustal growth in this area is manifest by the emplacement of granitic suites with a sizeable, but latent, basaltic component (30-90%). Nd-Hf-O isotope-time patterns reveal that juvenile input into the granites was enhanced during extensional cycles that followed crustal thickening, cementing a link between slab rollback and continental growth. Interaction between juvenile magmas and supracrustal material deposited during prior back-arc rifting masked the bulk-rock isotope evidence for crust generation, but was integral to the formation of stable felsic crust. Metasedimentary reworking peaked at the inception of slab rollback episodes with the emplacement of peraluminous 'S-type' plutons, but magmatism becoming increasingly juvenile and 'I-type' thereafter as extension and crustal thinning continued. Subduction zone retreat added large tracts of new crust to eastern Australia in <300 Ma, providing an additional perspective on the conundrum of rapid continental growth.