Precambrian terranes in West Australia and East Antarctica: seismic structure and implications for continent formation and evolution

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The crustal thickness and seismic S-wave velocity profile of the upper lithosphere are found using energy from distant earthquakes recorded at remote, temporary seismic stations ('receiver function' analysis). Such methods can be used to constrain major structural and compositional characteristics of the continental crust, and delineate the extent of cratonic and orogenic terranes in regions where geological exposure of the surface is limited. They provide an effective alternative to active source seismic techniques for deep crustal targets.

A new, near-comprehensive survey is presented which highlights variations in the structure of the West Australian Craton at the scale of the main terrane groups. Seismic structure is very consistent within several of the individual Archaean terrane groups, most notably the Pilbara, Murchison and Southern Cross. They are underlain by lower crust of low seismic velocity and show a sharp seismic Moho. Significant contrasts are seen between neighbouring terranes, thus, major tectonic units have a velocity profile that is a signature of that terrane or terrane group. We infer that the seismic structure is fixed before craton assembly and preserved through the subsequent collision and accretion of the tectonic units forming the West Australian Craton. Archaean terranes younger than 2.8 Ga do not show the low velocities in the lower crust or the very sharp Moho that is characteristic of the oldest terranes. One explanation is that less reworking of the lithosphere took place after this time.

Reconnaissance-scale determinations of seismic structure have been made in East Antarctica in the Lambert Glacier region, which encompasses the proposed boundary between three of the ancient continents that formed East Gondwana. The only area of extensive rock exposure in central East Antarctica, it uniquely allows the seismic structure to be linked to surface geology. Data was recorded at stations of the SSCUA deployment in remote regions as far south as 75°S. Seismic structure and Moho depth are determined across the region, providing constraints on its tectonic evolution. A significant contrast in crustal depth is found between the Northern and Southern Prince Charles Mountains that may indicate the location of a major tectonic boundary. Baseline seismic receiver structures have established for the Rayner, Fisher and Lambert Terranes that may be used to map the crust beneath the Antarctic ice sheet in future work.