Integrating active and passive seismic methods to constrain crustal architecture

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About 80% of the Australian continent is covered by sediments. In order to improve exploration success in covered terranes, the UNCOVER initiative identified high resolution 3D seismic velocity characterization of the Australian plate as a high priority. To achieve this goal, government and academia have united around the Australian passive seismic Array project (AusArray) which aims to obtain a national half degree data coverage over Australia and an updateable 3D national lithospheric model which grows in resolution as new/more data become available. Here we focus on crustal characterization arising from the deployment of over 150 new broadband passive seismic stations and new deep reflection seismic profiles as part of Geoscience Australia's Exploring for the Future program coupled with datasets collected by academia supported by AuScope and ANSIR. Given the Moho discontinuity is the most prominent seismic velocity contrasts in the lithosphere we start by constraining its topography followed by the bulk composition of the crust and crustal velocity. We use the receiver function method (RF), applied to seismic data from AusArray, supported by active reflection and wide-angle profiles. Our integrated approach allows extrapolation of first order structures identified using high fidelity active seismic methods across 0.5 degree spaced passive seismic arrays bolstered by bulk crustal composition constraints based on Vp/Vs from H-K stacking and supplemented by ambient noise tomography. Our results reveal large Moho topography across northern Australia. For example, along the southern margin of the Mount Isa Province Moho depths vary by over 10 km across distances of less than 100 km. In other areas systematic variations of the Moho correlate well with the lithosphere-asthenosphere boundary and conductors within the crust mapped by surface wave tomography and magnetotelluric studies. Our results show excellent correlation with legacy deep reflection and wide-angle seismic experiments thereby allowing formally identified crustal domains to be confidently interpreted away from these high-resolution profiles using the RF method. Less compacted basins identified using reflection seismic profiles show great agreement with ambient noise imaging of the crust.