EGU21-5272
https://doi.org/10.5194/egusphere-egu21-5272
EGU General Assembly 2021

The Australian Plate and underlying mantle from waveform tomography with massive datasets

Janneke de Laat, Sergei Lebedev, Bruna Chagas de Melo, Nicolas Celli, and Raffaele Bonadio
Dublin Institute for Advance Studies, Cosmic Physics, Dublin, Ireland (delaat@cp.dias.ie)

We present a new S-wave velocity tomographic model of the Australian Plate, Aus21. It is constrained by waveforms of 0.9 million seismograms with both the corresponding sources and stations located within the half-hemisphere centred at the Australian continent. Waveform inversion extracts structural information from surface, S- and multiple S-waves on the seismograms in the form of a set of linear equations. These equations are then combined in a large linear system and inverted jointly to obtain a tomographic model of S- and P-wave speeds and S-wave azimuthal anisotropy of the crust and upper mantle. The model has been validated by resolution tests and, for particular locations in Australia with notable differences with previous models, by independent inter-station measurements of surface-wave phase velocities, which we performed using available array data.

Aus21 offers new insights into the structure and evolution of the Australian Plate and its boundaries. The Australian cratonic lithosphere occupies nearly all of the western and central Australia but shows substantial lateral heterogeneity. It extends up to the northern edge of the plate, where it is colliding with island arcs, without subducting. The rugged eastern boundary of the cratonic lithosphere provides a lithospheric definition of the Tasman Line. The thin, warm lithosphere below the eastern part of the continent, east of the Tasman Line, underlies the Cenozoic volcanism locations in the area. The lithosphere is also thin and warm below much of the Tasman Sea, underlying the Lord Howe hotspot and the submerged part of western Zealandia. A low velocity anomaly that may indicate the single source of the Lord Howe and Tasmanid hotspots is observed in the transition zone offshore the Australian continent, possibly also sourcing the East Australia hotspot. Another potential hotspot source is identified below the Kermadec Trench, causing an apparent slab gap in the overlying slab and possibly related to the Samoa Hotspot to the north. Below a portion of the South East Indian Ridge (the southern boundary of the Australian Plate) a pronounced high velocity anomaly is present in the 200-400 km depth range just east of the Australian-Antarctic Discordance (AAD), probably linked to the evolution of this chaotic ridge system.