EGU22-2977, updated on 19 Aug 2022
https://doi.org/10.5194/egusphere-egu22-2977
EGU General Assembly 2022

Imaging the full extent of the Australian cratonic lithosphere using waveform tomography with massive datasets.

Janneke de Laat[1], Sergei Lebedev[2], Bruna Chagas de Melo[1], Nicolas Celli[1], and Raffaele Bonadio[1]
[1]Dublin Institute for Advance Studies, Cosmic Physics, Dublin, Ireland (delaat@cp.dias.ie)
[2]University of Cambridge, Cambridge, United Kingdom (sl2072@cam.ac.uk)

Australia has a long a complex geological history, spanning from the early Archean to the present day. Tomographic models can help us better understand the evolution of Australia by imaging the seismic structure of the crust and underlying mantle. We present a new S-wave tomographic model, Aus22, computed using a very large dataset of 0.9 million seismograms. The dataset includes all publicly available broadband data and yields the densest possible coverage across the hemisphere centred at the Australian continent, with sparser coverage elsewhere. Aus22 is computed using a three-step inversion procedure: 1. waveform inversion, 2. tomographic inversion and 3. outlier analysis. The model is validated by resolution tests and, for particular locations with notable differences with previous models, by independent inter-station measurements of surface-wave phase velocities. The new tomography resolves the structure of the Australian Plate and its boundaries in great detail. Cratonic lithosphere underlies nearly all of western and central Australia and shows substantial lateral heterogeneity. The highest seismic velocities are observed in the central-west portion of the continent, including the West and South Australian Craton. The North Australian Craton can be distinguished by a slightly lower seismic velocity, especially in its southern part. The cratonic lithosphere below the North Australian Craton extends northwards offshore through the Gulf of Carpentaria and the Arufa and Timor Sea and terminates at the southern Banda Arc and the New Guinea Fold-and-Thrust Belt, marking the northern boundary of the Australian Plate. The eastern boundary of the cratonic lithosphere is close, in most places, to the geologically defined Tasman Line and provides a new, deep-lithospheric definition of this line. East of this boundary, the lithosphere transitions to thin, warm lithosphere underlying the volcanically active east of the continent. This transition is sharp in the north, where it is located just west of the Georgetown Inlier, whereas an area of moderately thick, transitional lithosphere is present in the south-central part of the continent.