Seismic tomography of Western Australia: case study for Pilbara Region

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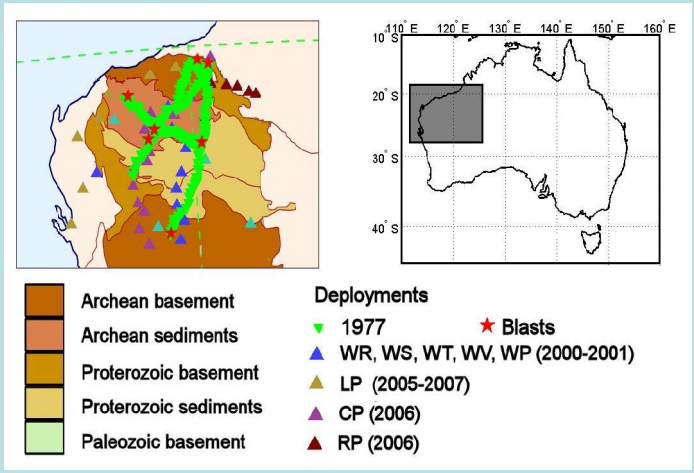
The Australian seismic stations are favourably positioned for investigation of the crustal and deeper structure of the southern hemisphere specially by using the teleseismics from the active belts extending through Indonesia, Papua New Guinea and southwest Pacific. Since 1993, the Australian National University has conducted a set of deployments of portable broadband seismic instruments across the continent with various station spacing. The latest deployments allowed many additional data for research and tomographic analysis.

In this study the tomography results for the northwest of Western Australia (WA) are presented with particular consideration of the Pilbara region - the oldest part of the Australian continent. The main geological features comprise the younger Capricorn basin which separates the older Pilbara craton in the north and the Yilgarn craton in the south.

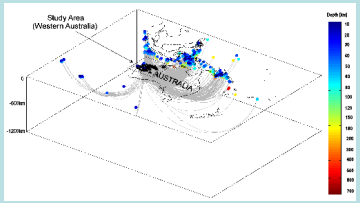
Traveltimes from National Seismic Network stations and arrays in WA were used which recorded some 350 local and distant events in order to image the 3D structure of those geological features. Also data from an earlier 1977 survey in the region based on mining blasts were utilised to constrain the model.

The volume was discretised into cells of 100x100km grid in the area of interest and depth ranges of ten kilometres intervals down to the Moho discontinuity, and 50 to 100km layers afterwards. A novel Fast Marching Method was applied in forward modelling and Checkerboard tests performed for sensitivity of inversion.

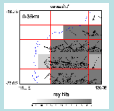
Geology and Seismic Deployments in northwest of WA

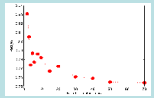


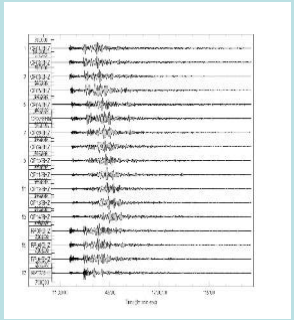
Events, Stations, and ray paths



Rays coverage

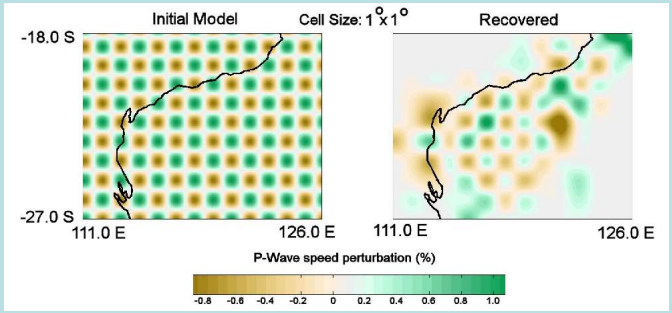






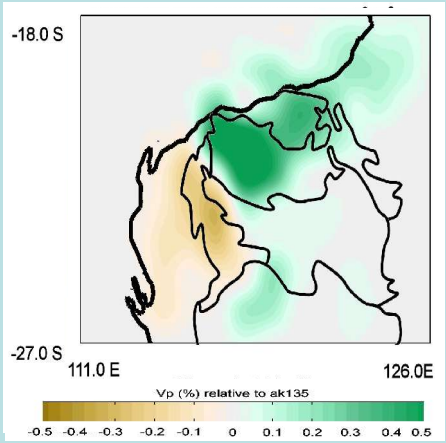
No. of iterations versus rms error

Checkerboard test

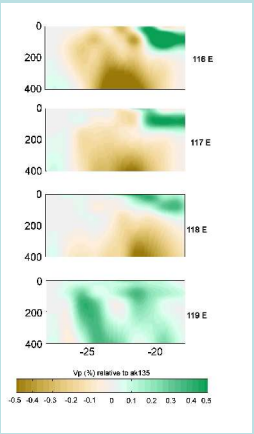


Recordings of M7.5 earthquake which occurred in the Molucca Sea on 21/01/2007

Inversion Results (Averaged top 35km)



N-S Crosssection



These new seismic tomography images are more detailed than previous ones and clearly differentiate between the younger and older geological structures. For the areas with good ray coverage it is even possible to distinguish the provinces inside the basin. The results can help in better understanding of the crustal processes in the northwest of WA and further geophysical investigations of cratons in Australia and worldwide.