SEISMIC TOMOGRAPHY OF WESTERN AUSTRALIA: CASE STUDY FOR PILBARA REGION

C.Sinadinovski, A.Abdulah and B.L.N.Kennett[1]
[1] - Research School of Earth Sciences, Australian National University,
Canberra ACT 0200, AUSTRALIA

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 (ANU) has conducted a set of deployments of portable broadband seismic instruments across the continent with various station spacing. The latest instrumental 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 (Fig.1). Data from the latest ANU deployments and an earlier 1977 survey in the region based on mining blasts were utilised to constrain the model (Drummond, 1981).

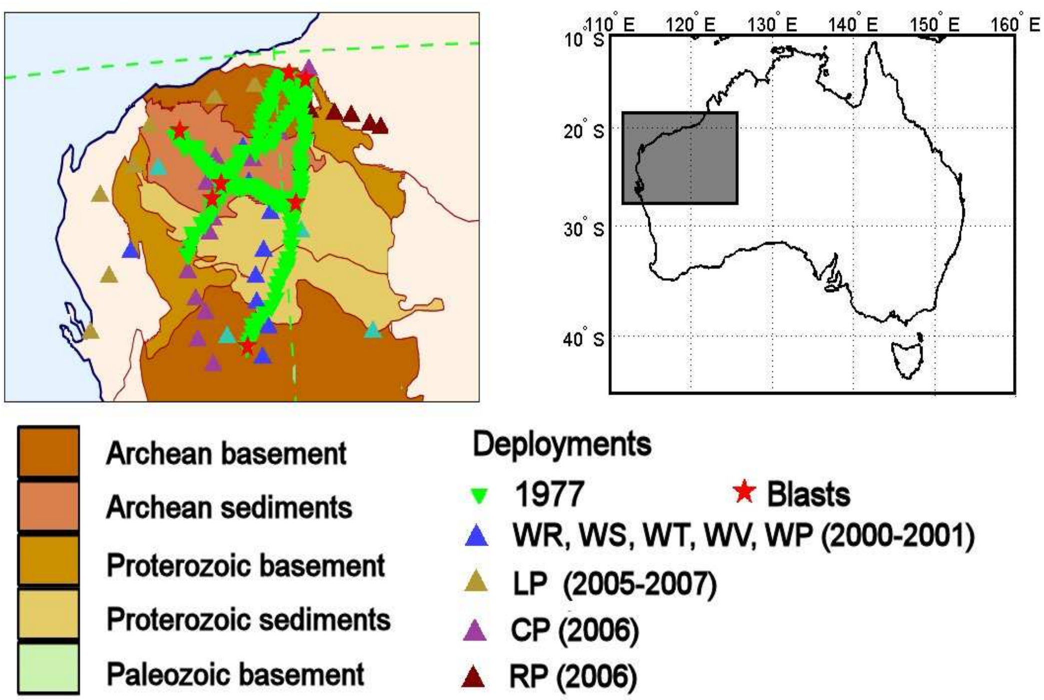

Figure 1: Geology and Seismic deployments in northwest of WA

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 the geological features (Fig. 2).

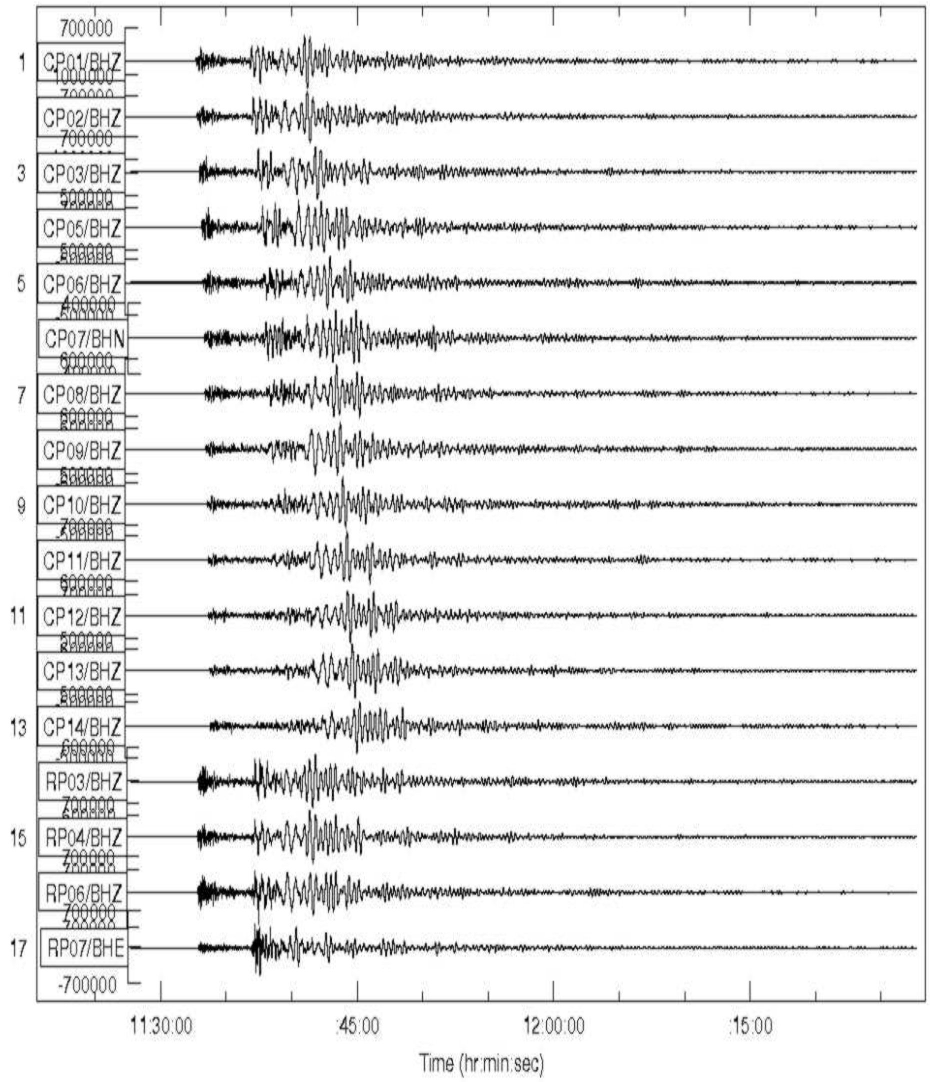

Figure 2: Recordings of the M7.5 earthquake which occurred in the Molucca Sea on 21/01/2007

The volume was discretised into cells of 100x100km grid in the area of interest and finer depth ranges (of ten kilometres intervals) down to the Moho discontinuity, and 50 to 100km layers afterwards. The ray paths and angular coverage for the events and recording stations are presented in figure 3.

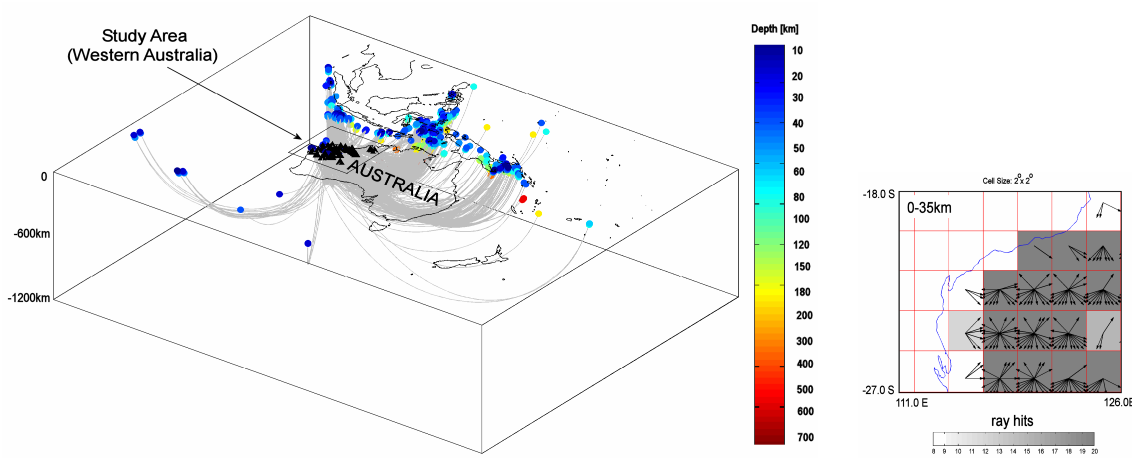

Figure 3: Source-receiver ray-paths and rays coverage per cell

A novel Fast Marching Method was applied in forward modelling and Checkerboard tests (Fig. 4) performed for sensitivity of inversion (Rawlinson and Sambridge, 2004). It was found that with the given source-receiver combinations it is possible to recover the initial model after a few iterations.

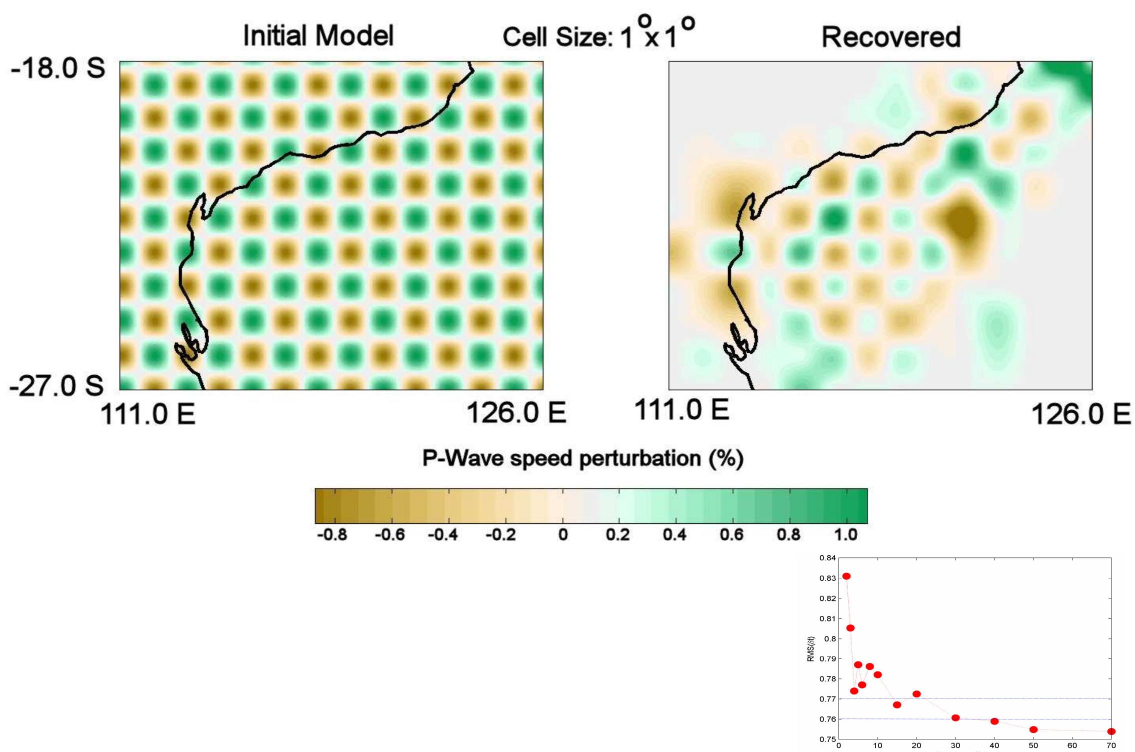

Figure 4: Checkerboard test and root-mean-square errors deviation

These new seismic tomography images are more detailed than previous ones and clearly differentiate between the younger and older geological structures (Fig. 5). For the areas with good ray coverage it is even possible to distinguish the provinces inside the basin. The N-S cross-sections are good indication of the depth to Moho discontinuity.

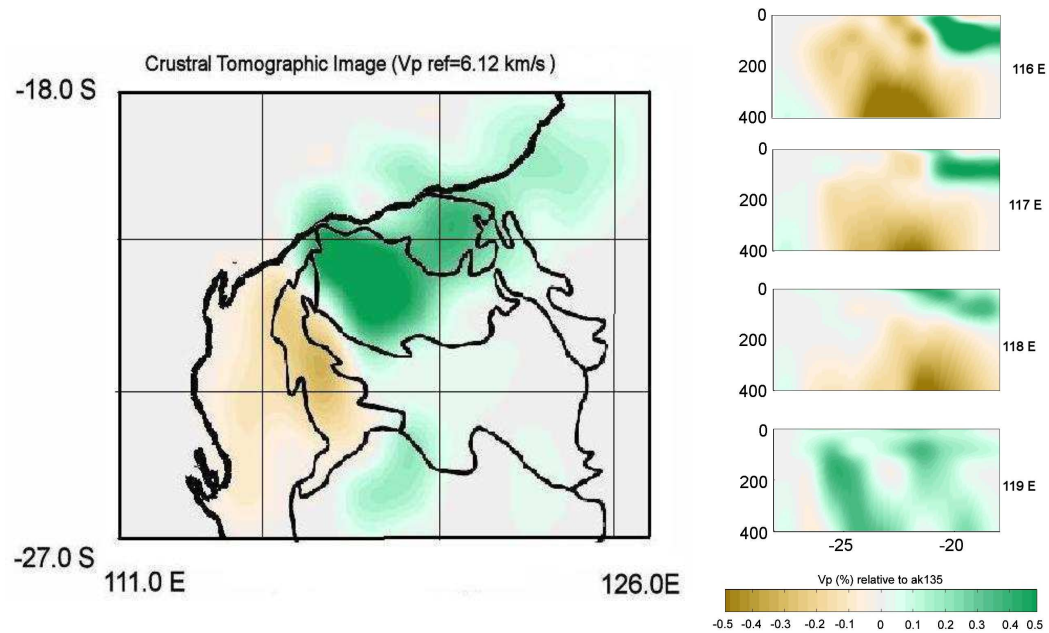

Figure 5: Tomography results (averaged top 35km) and N-S cross-section

The latest instrumental deployments allowed many additional data for research and tomographic analysis (Sinadinovski *et al.,* 2007). These new 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.

References

Drummond, B.J. (1981). Crustal structure of the Precambrian terrains of north-west Australia from seismic refraction data, *BMR Journal of Australian Geology and Geophysics 6,* pp. 123-135.

Rawlinson, N. and Sambridge, M., 2004. Multiple reflection and transmission phases in complex layered media using a multistage fast marching method, *Geophysics,* **69,** 1338-1350.

Sinadinovski, C., Abdulah, A., and Kennett B.L.N. (2007). Western Australia Seismic Wave Speeds Tomography Study. European Geophysical Union Assembly, Vienna, April 2007.