Geophysical Research Abstracts
Vol. 18, EGU2016-3351, 2016
EGU General Assembly 2016

Lithospheric discontinuities beneath Australia: interaction of large-scale and fine scale structure

Brian L. N. Kennett (1) and Kazunori Yoshizawa (2)

(1) Research School of Earth Sciences, Australian National University, Canberra ACT, Australia (brian.kennett@anu.edu.au), (2) Department of Earth and Planetary Sciences, Faculty of Science, Hokkaido University, Japan (kazu.yoshizawa@mail.sci.hokudai.ac.jp)

Understanding the complex heterogeneity of the continental lithosphere involves a wide variety of spatial scales and the synthesis of multiple classes of information. Seismic surface waves and multiply reflected body waves provide the main information on broad-scale structure, and bounds on the extent of the lithosphere-asthenosphere transition (LAT) can be found from the vertical gradients of S wavespeed. Information on finer scale structures comes though body wave studies, including detailed seismic tomography and P wave reflectivity extracted from stacked autocorrelograms of continuous component records. With the inclusion of deterministic large-scale structure and realistic medium-scale stochastic features there is not a need for strong fine-scale variations. The resulting multi-scale heterogeneity model for the Australian region gives a good representation of the character of observed seismograms and their geographic variations and matches the observations of P wave reflectivity. The presence of reflections in the 0.5–3.0 Hz band in the uppermost mantle suggests variations on vertical scales of a few hundred metres with amplitudes of the order of 1%. There are some indications of a change of reflection character in the lower part of the lithosphere in the transition to the asthenosphere. In some parts of central Australia there is a reasonable tie between a change in reflectivity and other information on mid-lithospheric discontinuities.

Individual seismic probes illuminate different aspects of the heterogeneity, but the full spectrum has to be taken into account to understand the properties of apparent discontinuities and their geodynamic implications. Once fine-scale structure is taken into consideration it becomes apparent that wave interference plays a very important role in determining the nature of apparent discontinuities seen with lower frequency probes such as S wave receiver functions. Changes in the character of fine-scale heterogeneity can themselves produce apparent discontinuities.