An Electrical Resistivity Model of the Southeast Australian Lithosphere and Asthenosphere

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Kate Robertson

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THE UNIVERSITY of ADELAIDE

ABSTRACT

A combination of magnetotelluric and geomagnetic depth sounding data were used to attempt to image the electrical resistivity structure of southeast Australia, to investigate the physical state of the crust and upper mantle. A 3D forward model of southeast Australia comprised of regional sets of broadband and long-period magnetotelluric and geomagnetic depth sounding data, over an area of 440 x 300 km^2, was used to map broad-scale lithospheric properties. Model results show an order of magnitude decrease in resistivity from the depleted continental mantle lithosphere of the Delamerian Orogen in the west, to the more conducting oceanic mantle of the Lachlan Orogen in the east. The decrease in resistivity in conjunction with a 0.1 km/s decrease in P-wave velocity at depths of 50-250 km, suggest a change in temperature (ΔT$\sim$200°C) due to lithospheric thinning toward the east as the likely cause, in conjuction with a change in geochemistry and/or hydration. A high resolution two-dimensional inversion using data from 37 new and 39 existing broadband magnetotelluric stations mapped crustal heterogeneity beneath the Delamerian Orogen in much greater detail. Lateral changes in resistivity from 10-10 000 Ωm occur over the space of a few kilometres. Low resistivity ($\sim$10 Ωm) regions occur at depths of 10-40 km. Narrow paths of low resistivity extend to the surface, coinciding with locations of crustal faults from seismic interpretations. Movement of mantle fluids up these faults, during periods of extension prior to the Delamerian Orogen, may have produced a carbon-rich, low resistivity lower crust, leaving a resistive upper mantle, depleted of volatiles.

KEYWORDS

electrical conductivity, resistivity, magnetotellurics, lithosphere, crust, upper mantle, Delamerian Orogen, Lachlan Orogen, southeast Australia

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