

An Electrical Resistivity Model of the Southeast  
Australian Lithosphere and Asthenosphere

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## 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<sup>2</sup>, 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 ( $\Delta T \sim 200^\circ\text{C}$ ) due to lithospheric thinning toward the east as the likely cause, in conjunction 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  $\Omega\text{m}$  occur over the space of a few kilometres. Low resistivity ( $\sim 10 \Omega\text{m}$ ) 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

## Table of Contents

|  |           |
|--|-----------|
| <b>Introduction</b>  | <b>7</b>  |
| <b>Lithospheric Resistivity</b>                                  | <b>9</b>  |
| <b>Previous Results From Seismic Studies</b>                     | <b>10</b> |
| <b>MT Theory</b>   | <b>11</b> |
| MT Distortion and Phase Tensor Theory . . . . .                  | 13        |
| Geomagnetic Depth Sounding . . . . .                             | 15        |
| <b>Geological Background</b>                                     | <b>16</b> |
| <b>Observations and Results</b>                                  | <b>18</b> |
| 3D Regional Modelling . . . . .                                  | 18        |
| 3D Forward Model . . . . .                                       | 18        |
| Crustal scale MT . . . . .                                       | 22        |
| Data Acquisition . . . . .                                       | 22        |
| Data Processing . . . . .  | 23        |
| Responses, Strike and Dimensionality . . . . .                   | 23        |
| Phase Tensor Analysis . . . . .                                  | 25        |
| 2D Inversion . . . . .   | 27        |
| Occam 2D Model with Seismic Interpretation . . . . .             | 27        |
| Sensitivity analysis . . . . .                                   | 29        |
| Occam 2D Response Curves . . . . .                               | 29        |
| <b>Discussion</b>  | <b>30</b> |
| 3D Forward Model . . . . .                                       | 30        |
| 2D Inversion . . . . .   | 31        |
| Comparison of MT with Seismic Interpretation . . . . .           | 31        |
| Possible Causes of Mid-Lower Crustal Low Resistivities . . . . . | 31        |

|   |           |
|---|-----------|
| Electrical Resistivity in Southeast Australia | 5         |
| Geological Implications . . . . .             | 32        |
| Crustal and Mantle Heterogeneity . . . . .    | 33        |
| <b>Conclusions</b>                            | <b>34</b> |
| <b>Acknowledgments</b>                        | <b>35</b> |
| <b>References</b>                             | <b>35</b> |
| <b>Appendix A</b>                             | <b>39</b> |
| <b>Appendix B</b>                             | <b>40</b> |

## List of Figures

|     |   |    |
|-----|---|----|
| 1.  | Elliptical representation of the phase tensor . . . . .   | 15 |
| 2.  | Geological map of southeast Australia with MT and GDS station locations . . . . .   | 16 |
| 3.  | Cross-section of P-wave velocity structure beneath the Delamerian and Lachlan Orogens, with electrical resistivities for forward model included . . . . .   | 19 |
| 4.  | Induction arrows of two forward models at 0.01 Hz; One with a west-east decrease in resistivity across velocity boundary between Delamerian and Lachlan Orogens, one unchanging across boundary . . . . . | 21 |
| 5.  | Pseudosection of TE and TM modes, indicating data quality and static shift effects . . . . .  | 24 |
| 6.  | Geoelectric strike . . . . .  | 25 |
| 7.  | Phase tensor pseudosection . . . . .  | 26 |
| 8.  | Phase tensor ellipses over a total magnetic intensity map . . . . .   | 27 |
| 9.  | Occam smooth 2D inversion of all data points of the Southern Delamerian transect, SD01' . . . . .   | 28 |
| 10. | Phases and apparent resistivity values for stations SD01, DB24C, DB30C and SD38 . . . . .   | 30 |
| 11. | Appendix A-Station information spreadsheet . . . . .  | 39 |
| 12. | Appendix B-Processing information spreadsheet . . . . .   | 40 |