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Thermal structure of the Newer Volcanic Province, Western Victoria, Australia from a long period Magnetotelluric (MT) array

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In 2010 and 2011, long-period MT data were collected in a rectangular grid with nominal 300 km x 150 km dimensions in western Victoria, Australia, across the southern end of mid Paleozoic Lachlan and early Paleozoic Delamerian orogeny and Quaternary Newer Volcanic Province (NVP). The aim of this survey is to map electrical resistivity variations in the crust and upper mantle to understand the lithospheric structure and thermal regime of the area.

The observed heat flow values in western and central Victoria ($\sim$85 μWK^3) are well above the world average for Paleozoic rocks. The Quaternary Newer Volcanic Province in western Victoria, the youngest and the most extensive volcanoes (15000 km^2 of basalts) in the intraplate volcanism of eastern Australia, are evidence of a large recent volcanic event. However, the nature and the mechanism(s) of magma production are still debated. Previous teleseismic tomography studies of the region show a reduction of seismic wave speed ($\sim$ 3-4 per cent) at lithospheric depths of $\sim$50-150 km beneath Central Highlands sub-province of the NVP, providing supporting evidence for high elevated temperatures at the upper mantle beneath the NVP and the possible existence of a mantle plume. However, there is no clear age progression of volcanoes consistent with formation from a mantle plume. Our MT data was collected at approximately the same survey sites as existing teleseismic array to constraint the geological structures of the lithosphere of western Victoria and to provide insight into questions related to magma genesis of the NVP.

Preliminary results show that strike analysis using phase tensors are reflecting the strike of the main geological feature of the Moyston fault, the structural boundary between Delamerian and Lachlan orogeny. The induction arrows indicate there is a large conductor beneath the Central Highlands sub-province of NVP relating to periods between 50 s and 1000s, correlating to depths lower than 10 km. This large conductor is correlated with interpreted elevated temperatures at upper mantle depths beneath the NVP observed by teleseismic data. Preliminary two dimensional modelling shows there is a large conductor beneath Central Highlands sub-province of the NVP extended between $\sim$20 km and 120 km. However, the ocean effect and existence of Moyston fault and of a potential plume requires further three-dimensional modelling.