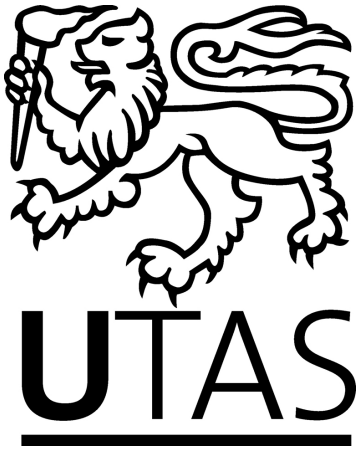

University of Tasmania

School of Earth Science

Non-Linear Tomographic Inversion of Active Source Seismic Data: An Investigation of the Basement Structure of Eastern Tasmania

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Abstract

A genetic algorithm has been developed for the inversion of seismic traveltime data and applied to a tomographic investigation of central-eastern Tasmania. The investigation used four shots and twelve stations across a 100 km east-west section of the post Devonian cover of the Tasmania Basin. This area lies across the inferred but poorly understood contact between the Eastern and Western Tasmanian Terranes, which has proven difficult to image in previous geophysical studies.

The genetic algorithm developed in this project is portable across all parallel and non-parallel Unix-based computing platforms, and interfaces with an existing, advanced, fast marching forward model code. The algorithm was applied both at low resolution with subsequent model refinement by a subspace inversion method in a two-step approach, and at higher resolution to directly invert the data using a one-step approach. The one-step implementation yielded superior exploration of the model space, and sufficient exploitation of the possible solutions when applied to the sparse noisy data acquired during the controlled source investigation. This demonstrates the viability of a one-step Monte-Carlo approach to seismic traveltime tomography in cases of sparse data coverage.

The results of the inversions show a high velocity anomaly at 6 km depth and 147.4 degrees longitude, coincident with a long-wavelength magnetic anomaly, and is interpereted as an ultramafic unit of possible oceanic crustal affinity. This supports both thick and thin-skinned tectonic models with oceanic crust beneath the Eastern Tasmanian Terrane, though the thin-skinned scenario is preferred on the basis of existing gravity data. A model is suggested in which this oceanic unit is part of the allochthonous boninite-tholeiite stack overlying the Western Tasmanian Terrane.

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any tertiary intitution, and to the best of my knowledge and belief contains no material previously published or written by any other person, except where due reference is made in the text of the thesis.

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Many land owners would be more than a little uneasy at the prospect of an honours student with 200 kg of explosives, but Forestry Tasmania and the Southern Midlands Council made their land available for this project, and without their assistance, it would not have been possible. Thanks also to the land owners who allowed me to deploy stations when I turned up on their doorstep unannounced, in particular Steve Rockcliff for his assistance in field maintenance.

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In the honours room, my comrades deserve a mention. Over the last few weeks,

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