# New data, new insights into the Tasmanian cover

**Mark Duffett**
*Mineral Resources Tasmania*
mark.duffett@stategrowth.tas.gov.au

**SUMMARY**

Tasmania's extensive Jurassic dolerite and Cenozoic basalt cover and the nature of their physical properties have effectively confined mineral exploration to the west and north-east of the State. Largely as a consequence, precompetitive geophysical data acquisition has concentrated around those regions.

In recent years a number of factors have changed this situation. The advent of passive seismic and magnetotelluric techniques have demonstrated ability to identify features beneath the Tasmanian cover that can be connected with geological structures known to have tectonic and possibly metallogenic significance. Additionally, the cover itself has become thought of an exploration target for bauxite, rare earths and most recently natural hydrogen.

Two airborne magnetic and radiometric surveys over a major portion of Tasmania's covered terranes have now been added to the State's existing coverage. In addition to very effective mapping of geological units and structures within Permian to Cenozoic cover sequences, the new data in combination with deeper-penetrating passive methods suggest relationships of cover structures to fundamental basement features.

**Key words:** Tasmania, magnetic, magnetotelluric, passive seismic

## INTRODUCTION

Exploration beyond the exposed richly endowed Paleozoic and Proterozoic terranes of Tasmania has been hampered by the Permo-Triassic sediments, Jurassic dolerite and Cenozoic basalt that together blanket much of the centre and south-east of the State. The dolerite and basalt are particularly problematic for geophysical exploration, being generally magnetic, dense and high velocity. The basalt is often also conductive, as major portions of it are vesicular or otherwise porous, and intercalated poorly consolidated sediments. As a result, both precompetitive and commercial exploration effort has been largely confined to the uncovered areas.

## NEW GEOPHYSICAL DATA

Figure 1 illustrates how much of Tasmania's known mineral endowment is located in the west and north of the state, largely outside the areas of high frequency, high amplitude magnetic response that characterise the dolerite and basalt cover. However the passive seismic results also depicted (Young et al. 2013 and references therein) were important in identifying a major tectonic structure extending south-south-east from the region of the Tamar estuary beneath magnetic cover. This independently confirmed and extended the structure first identified as the Tamar conductivity anomaly by magnetotelluric methods in the 1980s (Parkinson and Hermanto, 1986), and thus demonstrated that significant crustal elements were resolvable beneath the dolerite.

AusLAMP magnetotelluric data in Tasmania (Figure 2; Ostersen 2021) complement and extend the depth resolution of the features identified by the passive seismic data. At 7 kilometres depth, the locus of the Tamar conductivity feature is shifted southwards and abuts the 'granite wall' interpreted primarily from gravity data (Leaman 2012). The implied rheological contrast suggests a potential focus of mineralising fluid flow. By 25 kilometres depth in the inverted resistivity model (Figure 2; Ostersen 2021) the Tamar feature is no longer clearly resolved, however there is an emergent concordance between the 'gold corridor' lineament in NE Tasmania and the 100 ohm-metre strike line, suggestive of a southward continuation of this mineralised trend.

To reduce the risk attendant to exploration of this and other similar extension of mineral potential into eastern and southern Tasmania, approximately 90,000 line kilometres of magnetic and radiometric data have been flown over central and south-eastern Tasmania across two major surveys in 2021 and 2022 (Figure 3). This has increased Tasmania's coverage of contemporary high quality, semi-regional resolution (200 metre line spacing) magnetics and radiometrics by almost a third.

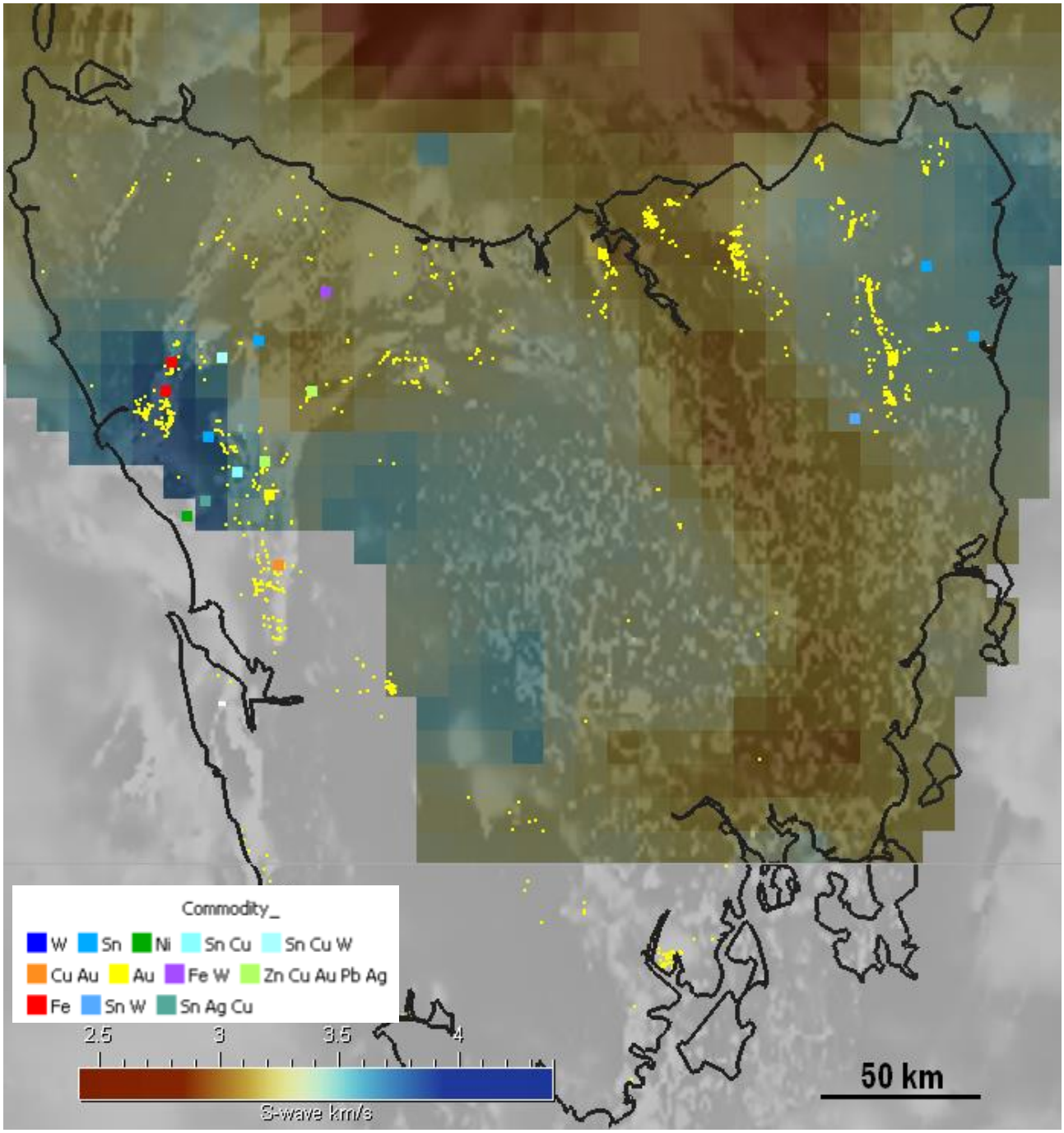


**Figure 1. S-wave velocity at ~1 km depth (Young et al 2013) with total magnetic intensity greyscale overlay. Significant metallic ore deposits denoted by coloured squares, gold occurrence by yellow dots. NB apparent truncation of known mineralisation trends (e.g. the 'gold corridor' in NE Tasmania) by magnetic cover.**

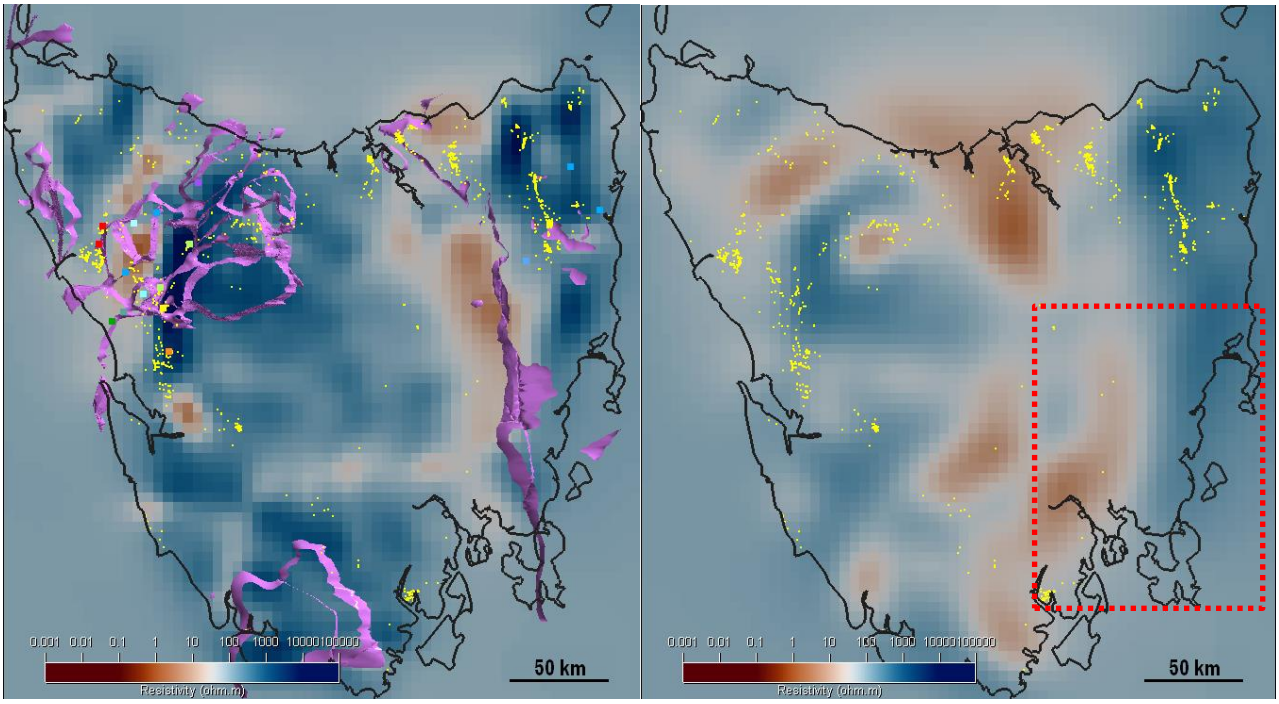


**Figure 2. Resistivity at ~7 km depth (left) and ~25 km depth, after Ostersen (2021). Mineral occurrences as in Fig. 1. Red dashed rectangle indicates approximate location of 2022 airborne magnetic and radiometric survey (Fig. 3).**

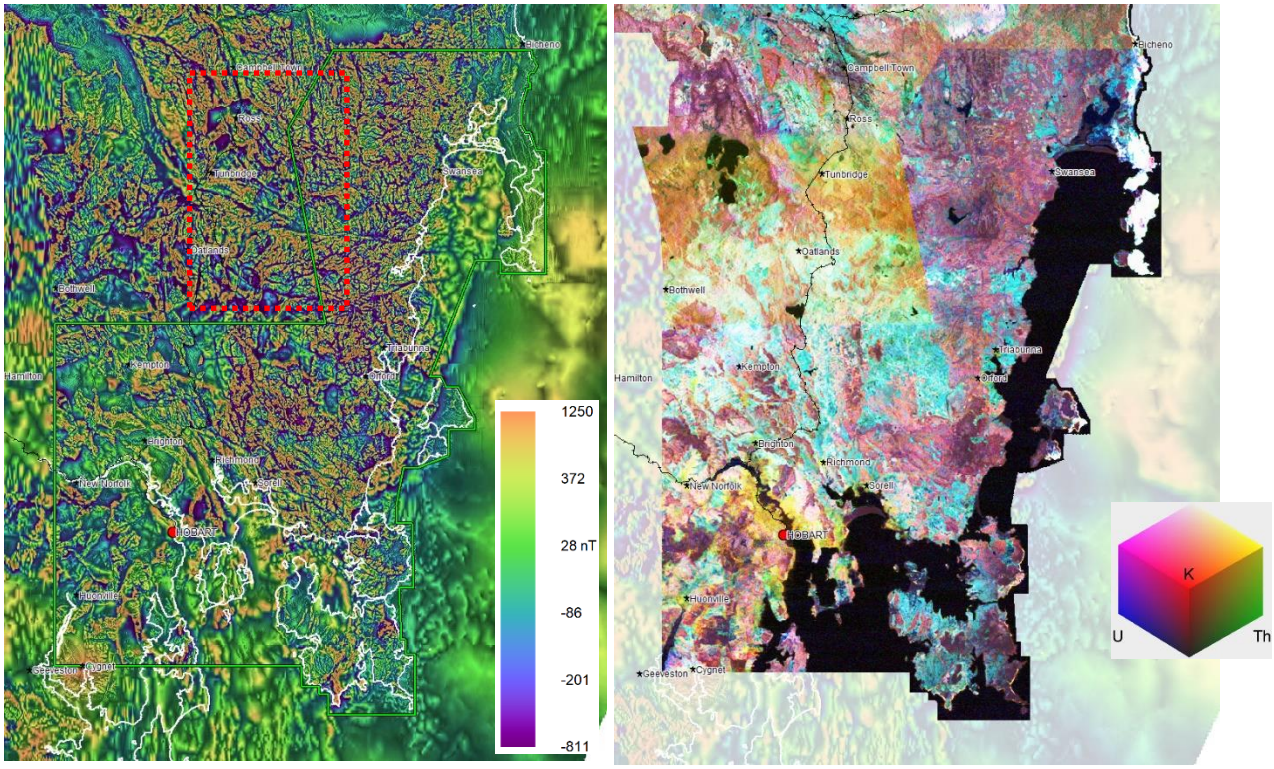


**Figure 3. Total magnetic intensity with tilt angle intensity overlay (left) and gamma radiometric ternary image (right) from 2022 airborne survey, south-east Tasmania. Red dashed rectangle indicates approximate location of 2021 passive seismic survey (Fig. 4).**

## PRELIMINARY OBSERVATIONS

The new airborne data reveal a great deal of internal structure and compositional variation within Tasmania's cover units, particularly the dolerite. Many of these features have not previously been recognised. Especially prominent in Figure 3 are arcuate, convex-south apparent faults that swing more west-east, rather than the NNW grain of the terrain further west. An extract from 2.5 km depth in a higher resolution (2-3 km node spacing) passive seismic survey undertaken in a collaboration between Spa*ark Energy, the Institute of Mine Seismology and Mineral Resources Tasmania suggests a possible control by basement structure on these arcuate faults (Figure 4). Changes in apparent dolerite magnetisation that may be related to grain size and other primary petrological controls on magnetite characteristics.

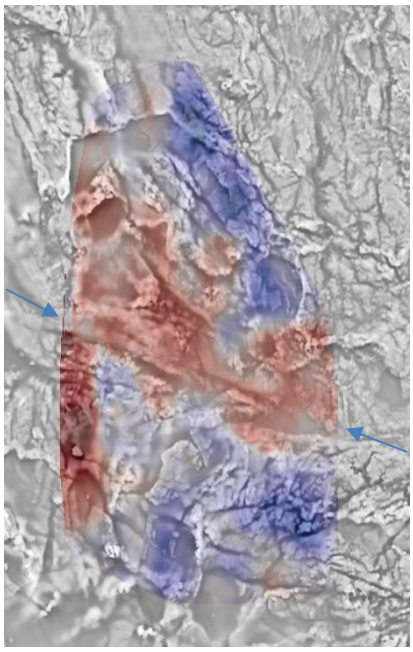

**Figure 4. 2.5 km depth slice of velocity model from passive seismic survey (red low velocity, blue high) suggesting possible control on shallow dolerite-displacing fault expressed in magnetics (greyscale).**

## ACKNOWLEDGMENTS

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