



Annual Report 2013

SEL 26/2005 (Seventh Annual Report)

8th July 2012 to the 7th August 2013

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Power down under

Summary

KUTh Exploration Pty Ltd (KUTh) currently holds Special Exploration Licence (SEL) 26/2005 in Tasmania for Category 6 minerals (geothermal substances). The principle target of KUTh's work on the tenement is the location of high-temperature Hot Rock geothermal resources suitable for development as Enhanced Geothermal System (EGS) power generators. This report covers work completed in the year 8/7/2012 – 7/8/2013 and is the seventh Annual Report lodged for SEL 26/2005. Previous work conducted on this tenement has identified two inferred geothermal resources at Lemont in the central Midlands and Fingal in the northeast.

Delays in the proposed deep exploratory drill program have limited the annual expenditure on this tenement. No field work was conducted on SEL 26/2005 in the reporting year.

KUTh continues to actively pursue funding options for the Lemont Project through Federal Government renewable energy grant schemes.

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1 Introduction

KUTh Exploration Pty Ltd (KUTh) is an Australian geothermal explorer and is the holder of the Tasmanian geothermal exploration licence SEL 26/2005. The principle target of KUTh's work in Tasmania is the location of high-temperature Hot Rock geothermal resources suitable for development as Enhanced Geothermal Systems (EGS) power generators.

This annual report covers work completed in the period 8/7/2012 – 7/8/2013 on tenement SEL 26/2005 and is the seventh Annual Report lodged for this licence.

1.1 Tenement Status

KUTh Exploration Pty Ltd (KUTh) is a subsidiary of KUTh Energy Ltd and is the sole holder and operator of SEL 26/2005 (Figure 1) for geothermal substances (Category Type 6). Tenure details of SEL 26/2005, which was renewed for a second five-year term in 2011, are provided in Table 1.

Tenement Type	SEL
Number	26/2005
Commodity	Geothermal
Licensee	KUTh Exploration P/L
Operator	KUTh Exploration P/L
Area	7570km ²
Date Granted	7/08/2006
Date Renewed	7/08/2011
Expiry	6/08/2016

Table 1: Tenure details for SEL 26/2005.

1.2 Location and access

SEL 26/2005 includes much of central Eastern Tasmania, extending across the north and south Midlands areas and along the coast from Orford in the south to an area west of Scamander in the north (Figure 1). A number of highways traverse the area and provide access along with minor roads, farm and forestry tracks. Numerous areas are excluded from SEL 26/2005, including National Parks, Commonwealth land, a gas pipeline easement and various small historic and other features.

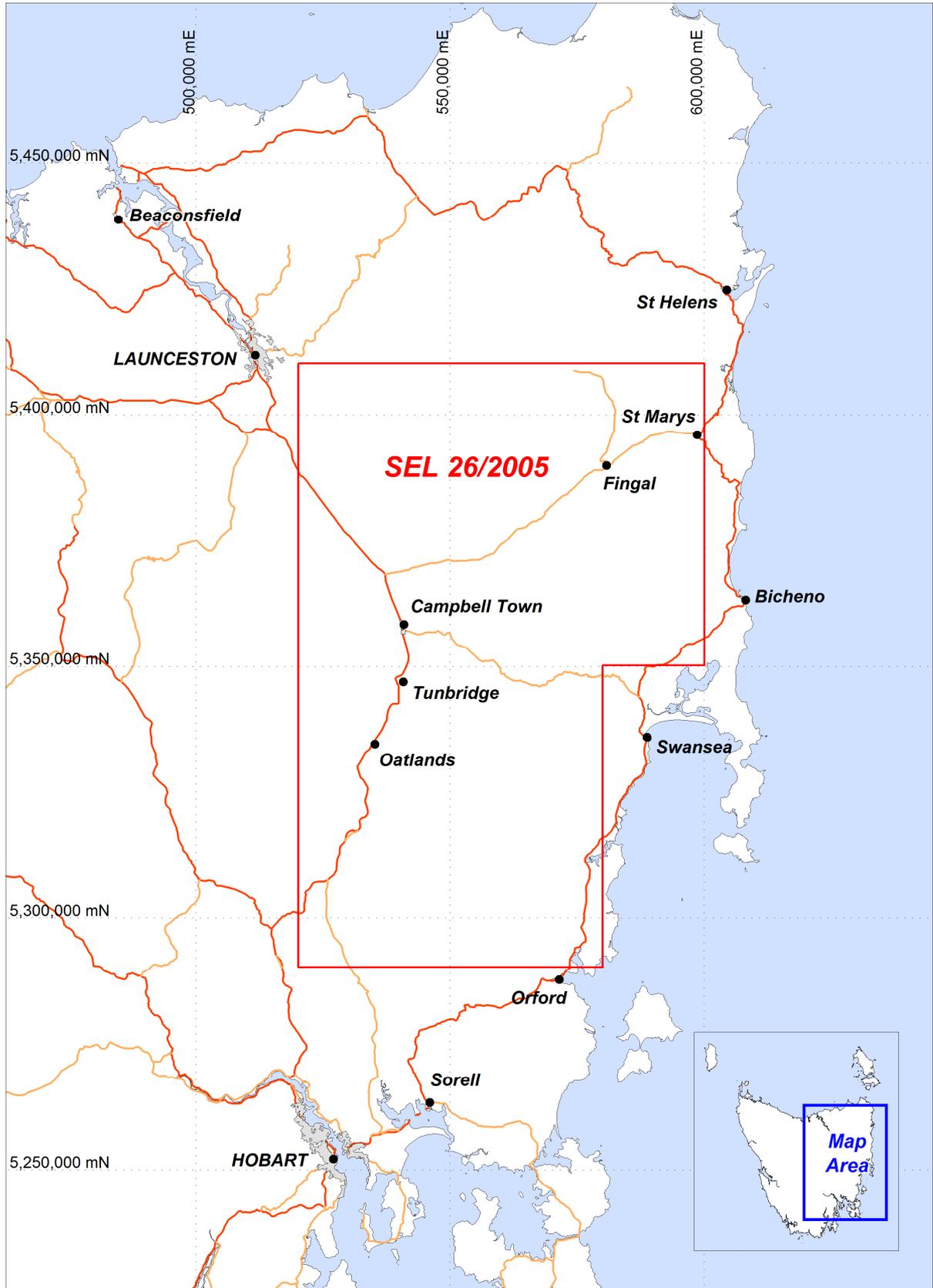


Figure 1: Location map of SEL 26/2005 (red) in relation to major roads (orange) and population centres. (Note this map does not indicate the location or extent of licence exclusions).

1.3 Topography and vegetation

Topography varies significantly across the tenement area and ranges from flat to undulating coastal and inland plains, to steep granite and dolerite ranges and tors. The maximum elevation range across the tenement area is greater than 1km, rising from sea level at the coast to peaks including Ben Lomond (1573m). Vegetation is dominated by dry eucalypt forest and developed pasture although considerable variation is present across the topographic range. Pockets of alpine moorland, wet eucalypt forest, native grassland and scrub, wetland and coastal scrub may be found at various locations across the tenement.

1.4 Geological setting

Tasmania is divided into two basement terrains located in the west and east of the State (Figure 2). Distinguished by age, lithology and deformation these two regions are 'believed to have been juxtaposed at a NNW trending dislocation' inferred to coincide with the Tamar Valley region in central Tasmania (Burrett & Martin, 1989). The Western Terrain comprises variably deformed and metamorphosed Pre-Cambrian basement, the now-deformed Cambrian volcanics and sediments of the Dundas Trough and Mt Read Volcanic Belt and the Ordovician-Silurian shelf sediments of the Wurrawina Supergroup. In the East, deformed low-grade meta-sediments of the Ordovician – Devonian Mathinna Supergroup comprise deep water turbidite deposits that are analogous to the ubiquitous Tasminide flysch of mainland eastern Australia. Similarities in the deformation and depositional style of the Mathinna Supergroup and mainland Tasminide units has led to numerous attempts to correlate the two, the Mathinna being compared variably to the Melbourne Trough and the Tabberabbera Zone of central and eastern Victoria (Powell & Baillie, 1992; Reed, 2001).

Across much of the state, basement is concealed by up to 1km of flat-lying Permian-Triassic sediments of the Tasmania Basin and the extensive thick (>300m) Jurassic dolerite sills which intruded these during Gondwana break-up. Mesozoic and Tertiary cover, including extensive dolerite, shale, silt and some coal formations, totally obscure the contact between the Pre-Cambrian Western and Palaeozoic Eastern terrains, which is inferred to underlie the tenement area.

Both Western and Eastern Terrains host Devonian granite, the most extensive intrusions being the slightly older batholiths in the East (Burrett & Martin, 1989). Exposures of Devonian-aged granite in the far north-east of the state are known to include highly-fractionated high-heat-producing (HHP) granites as part of three major suites (Figure 2; Burrett & Martin 1989). To the south and west of this area, the exposed granite plunges beneath cover which potentially provides the insulation necessary for a classic Hot Dry Rock or Enhanced Geothermal System (EGS) target. Complicating this picture is the presence of a known electrical conductivity anomaly initially observed in the northern Tamar Valley area and referred to as the Tamar Conductivity Zone (TCZ) (Figure 2; Hermanto, 1992). Coinciding broadly with the boundary of the East and West terrains, the TCZ has been interpreted an indicator of fluid in fractured permeable zones (Hermanto, 1992). Intersection between the TCZ and buried HHP granites may thus imply the presence of an existing fracture-permeable geothermal system in Eastern Tasmania.

2 Previous Exploration

KUTh Exploration is the first operator to undertake commercial geothermal exploration work in Tasmania. Legacy geothermal data available in this area are limited to a few early heat flow measurements recorded across the state in the 1950 – 1960s and early 1980s (Figure 2; Cull 1991). Although sparse and of variable quality, these data indicate the presence of high heat flows associated with Devonian granite in the north-east of the state. Heat production data from these granites are available from Collins et al, 1981, and include values of up to $60 \mu\text{W}/\text{m}^3$ for granites at the Royal George Mine.

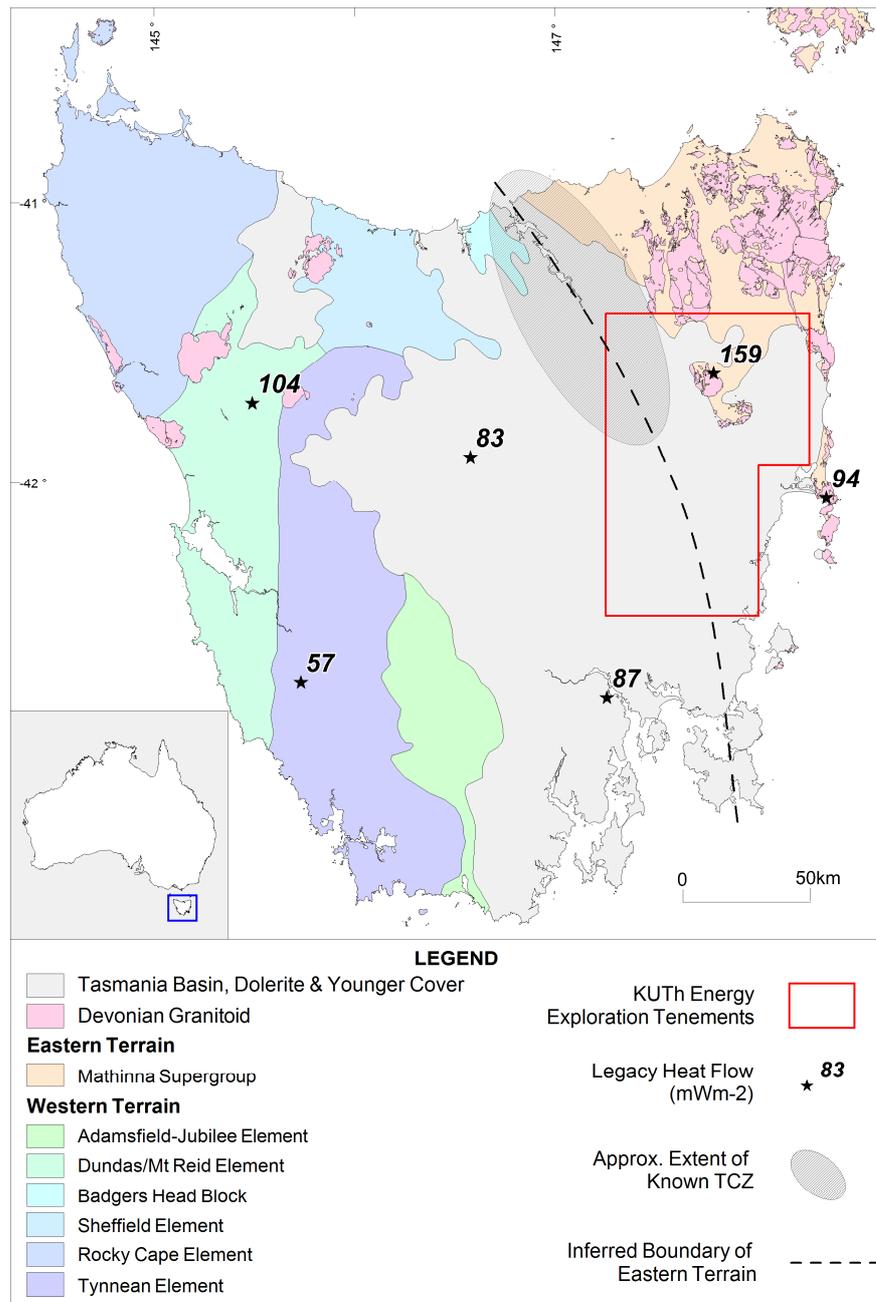


Figure 2: Regional geology of Tasmania showing the major crustal elements. Legacy heat flow data are as summarised by Cull (1991). Also shown is the approximate extent of the known TCZ prior to recent MT survey work.

The presence of the Jurassic dolerite across much of the tenement area has limited exploration for most commodities in this region. With the exception of small areas around Storeys Creek and Fingal in the north-east of the tenement, relatively few drill holes have been cut. Stratigraphical holes at Tunbridge and Ross provide the deepest information from the central tenement area but are both <1km deep. Attempts by KUTH in 2006 – 2007 to undertake a surface heat flow measurement program in existing core holes failed due to a lack of suitable historic open holes.

2.1 Potential Field Geophysics

Available legacy geophysical data include aeromagnetic and gravity coverages. Data quality was patchy leading to an early decision by KUTH to undertake infill gravity and aeromagnetic survey work across the south-east of the tenement area (Ward *et al.*, 2008; Goh & Holgate 2009; Holgate, 2011). Data derived from gravity survey work completed in two campaigns in 2007 and 2010 were provided to Dr David Leaman who used it to update the Tasmanian mantle-source model of Leaman and Richardson (2003). This updated model was then used to refine predicted depth to top granite (Figure 3).

An infill aeromagnetic survey was conducted in 2009 (Goh & Holgate, 2009). The results of this work are summarised in Figure 4 and are interpreted to indicate the presence of major crustal features (lineaments) within the Central Midlands area.

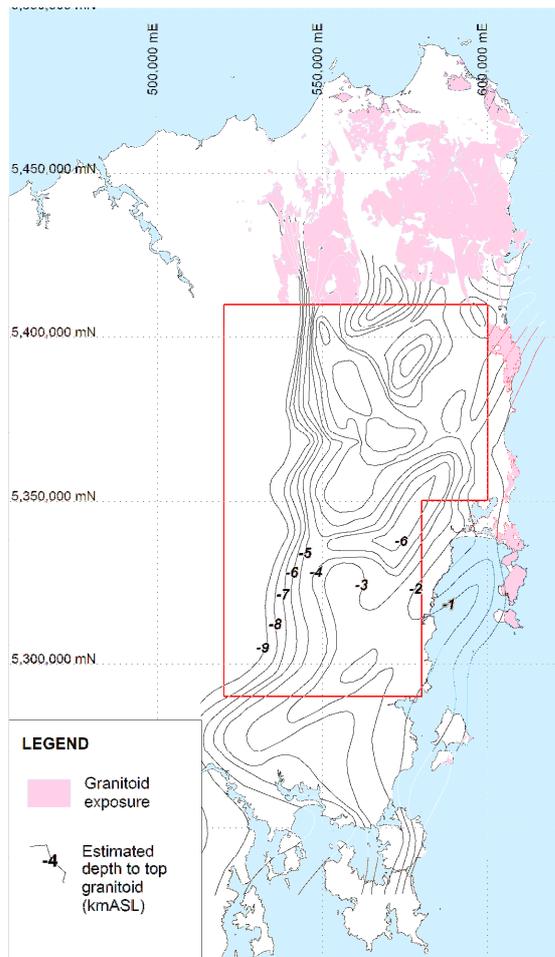


Figure 3: Map of granite outcrop with predicted depth (km above sea level) to top granitoid contours as interpreted by Leaman (2012).

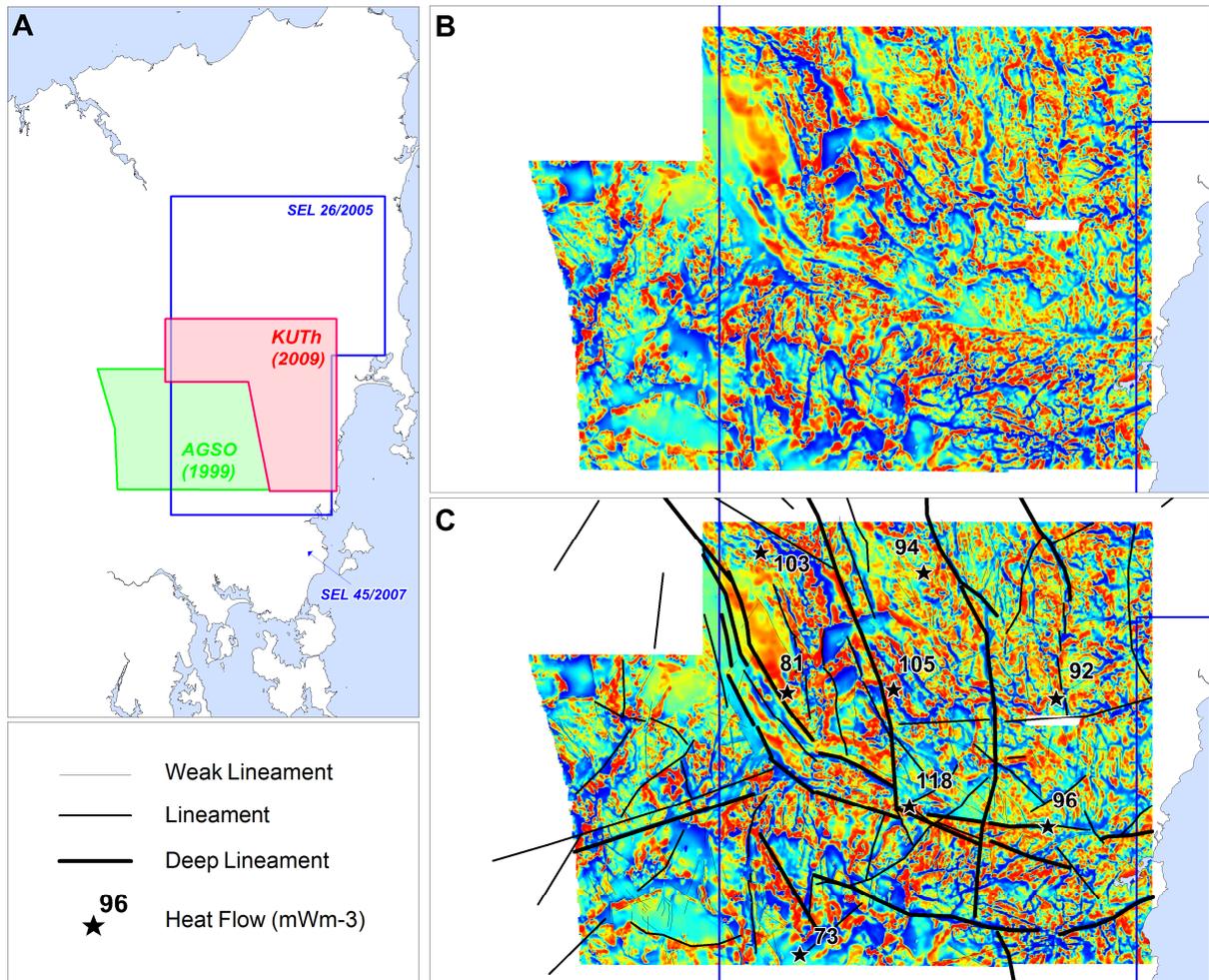


Figure 4: KUTh aeromagnetic data acquisition (a) location plan (b) Total magnetic intensity image and (c) interpreted lineaments.

The majority of magnetic lineaments identified under the survey area are interpreted as the signature of fault or fracture systems. Regionally, magnetic structure is dominated by a large, arcuate feature extending from the northwest to the eastern side of the survey area. This feature, which is interpreted to represent a major fracture zone, is also evident in gravity data and digital elevation models (Figure 5). The presence of this trend in both gravity and upward continued magnetic data supports the suggestion that it is a relatively major feature, penetrating to depth in basement. The fact that it is also strongly apparent in the DEM implies that it is likely to have been subject to post-Jurassic reactivation, most likely as part of a regional Tertiary rifting event that has been identified throughout much of this area (Burrett & Martin, 1989).

2.2 Rock Property Data

The company has established a significant rock thermal conductivity database for eastern Tasmania sourced variably from its own shallow drill program, academic partnerships and targeted legacy core sampling (Goh & Holgate 2009; Holgate & Goh 2010; Holgate, 2011).

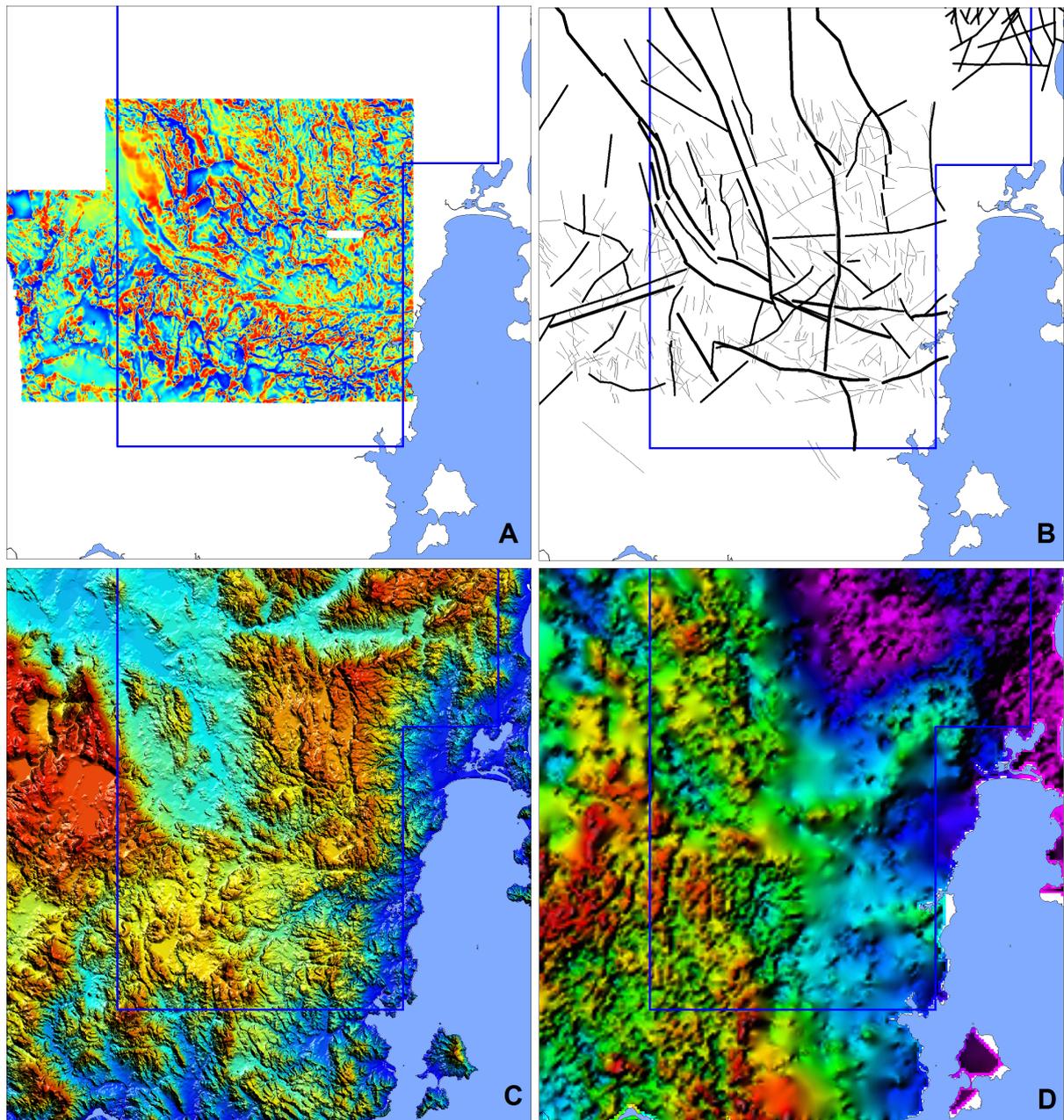


Figure 5: Map images of the Midlands area showing the KUTH tenement boundaries (blue) superimposed on (a) total magnetic intensity from combined KUTH/AGSO aeromagnetic surveys; (b) interpreted magnetic lineaments; (c) digital terrain image; and (d) residual Bouguer gravity anomaly (determined using the MANTLE07 model of Leaman, 2008).

2.3 Heat Flow Determination and Resource Estimation

Between 2007 and 2009 KUTH undertook a program of shallow drilling to enable systematic estimation of surface heat flow across the tenement area (Figure 6; Goh & Holgate, 2009). This work resulted in the identification of several significant thermal anomalies (where heat flow is $>90\text{mWm}^{-2}$) that display a good spatial correlation with the predicted location of buried granite (Figures 3 & 6). The largest observed anomaly extends $\sim 4000\text{km}^2$ across the central portion of SEL 26/2005 and includes three zones of very high heat flow ($>100\text{mWm}^{-2}$) at Lemont and Macquarie in the Midlands and at Fingal in the far north-east. The largest and strongest of these thermal anomalies is that observed at Lemont.

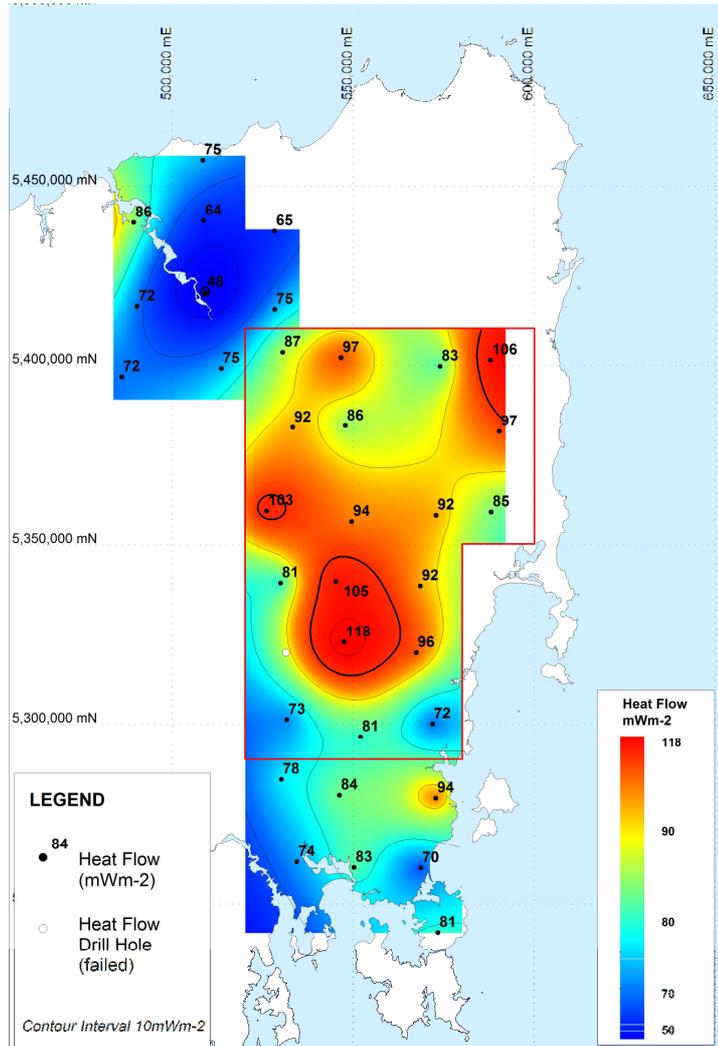


Figure 6: Results of KUTh Energy shallow heat flow drilling program across SEL 26/2005 (now partially surrendered).

Following on from this work three-dimensional (3D) conductive thermal modelling of the Lemont area was undertaken in 2009 using a combination of legacy and newly acquired geological and geophysical data. The results of this work (reported in Goh & Holgate 2009) inferred a contained heat resource of around 260,000PJ_{th} within a 1019km³ reservoir located between 3 – 5km depth in the Lemont area (Figure 7). Temperatures predicted within the resource are up to 200°C at 5km depth. Geothermal Plays initially identified at Lemont included a granite-related Hot Dry Rock target in the east and a less well defined but slightly hotter target in the west. Significantly, the conductive model inversion was found to be unable to account for the presence of extreme heat flow values in the western resource areas without the addition of a previously unrecognised geological unit. A non-unique conductive solution comprising an additional body of rock of either high heat production or high thermal conductivity (termed ‘Unit A’) was required in this area to enable model fit. This Unit may represent a previously unrecognised lithology (e.g. granitoid) or structure (highly foliated sediment). Alternatively, the additional heat flow into the western resource area could be the result of the advective movement of heat by fluids along localised permeable pathways. One or more of these scenarios could significantly influence the geothermal play model envisioned for this area.

In 2010 a second inferred resource estimation was completed at Fingal in the north-east of the State. Previously reported in Holgate & Goh (2010) this work inferred a contained heat resource of around 101,000PJ_{th} within a 384km³ reservoir located in granite between ca.3 – 5km depth (Figure 7). Temperatures predicted within the resource are up 220°C at 5km depth. The geothermal play identified at Fingal is exclusively a granite-related Hot Dry Rock target.

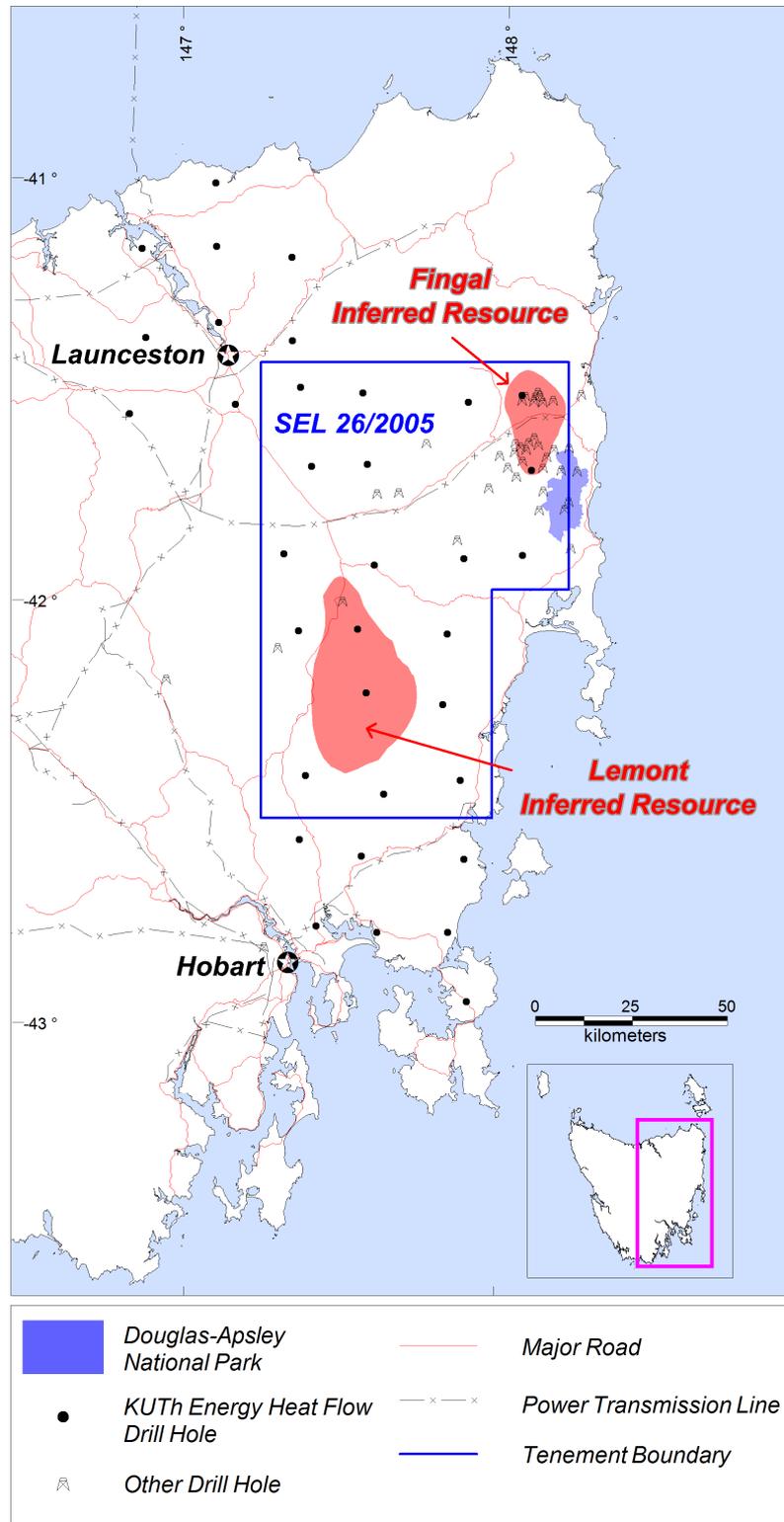


Figure 7: Location Map of Inferred Geothermal resource areas in SEL 26/2005.

2.4 Magnetotelluric Studies

Studies of magnetotelluric (MT) field data identifying a possible conductive anomaly in Northern Tasmania date back to the mid-1970's and are summarised in Hermanto (1992). This work consistently indicated the presence of a broad zone of anomalously high electrical conductivity, the *Tamar Conductivity Zone* or *TCZ*, approximately parallel to the NW trending axis of the northern Tamar Valley, and extending for some distance to the south (Figure 2). The TCZ was observed at depth beneath Mesozoic cover but no direct information was available regarding the nature or detailed structure of the geology associated with it. However, it was concluded that 'the most likely cause of the high conductivity anomaly was a combination of the presence of high conducting fluids and graphite in pores, cracks, and or fractured rocks' implying the potential for fracture permeability associated with this feature (Hermanto, 1992).

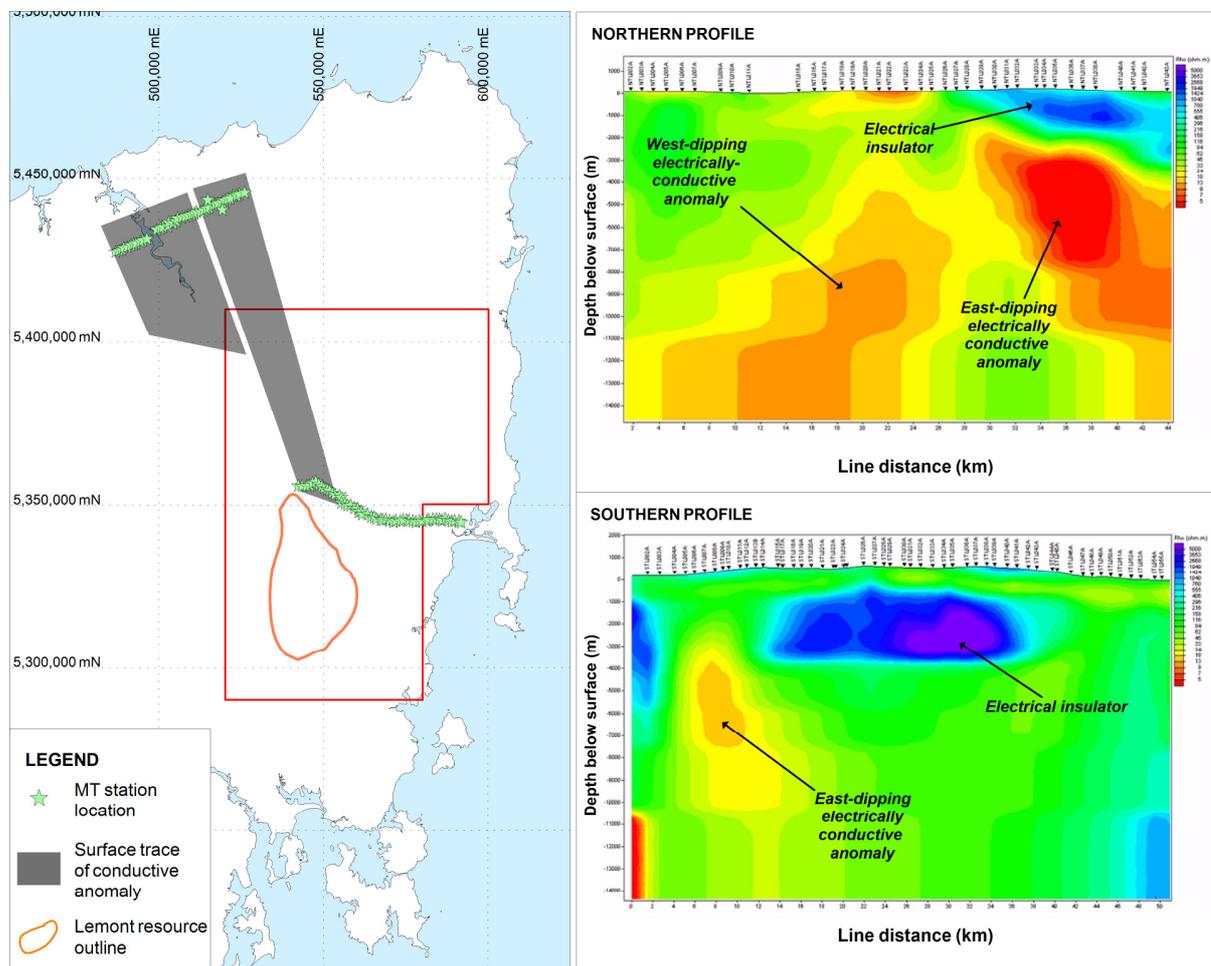


Figure 8: Results of the 2008 reconnaissance MT survey. Station locations (left) and 2D model results for northern (right, top) and southern lines (right, bottom). Models are inversions of TM and TE shifted data. Resistivity is range 5ohm.m (red) to 6000ohm.m (purple), maximum depth below surface is 14km, station spacings are ~1km, line distance northern line = 44km, southern line = 50km.

Between 2008 and 2010 KUTh successfully completed three programs of new MT data acquisition across the TCZ. The first, in 2008/2009, was designed to test the existence of

the anomaly and involved the acquisition of new MT data along two east – west profiles in the far north and central Midlands areas of SEL 26/2005 (Ward *et al.*, 2008; Goh & Holgate 2009). The results of this work are summarised as 2D models in Figure 8. Large east and west-dipping electrically-conductive basement features consistent with the known characteristics of the TCZ were successfully identified in the northern section line. Significantly, an equivalent east-dipping electrically conductive structure was also observed towards the western end of the southern line. This feature, which is interpreted as an extension of the TCZ, is open along strike immediately to the north of the high heat flow anomalies at Lemont and is of considerable interest given its interpretation as a geophysical signature of fluid-bearing fracture-permeable rock.

To further evaluate the southern extension of the TCZ, an expanded MT/TerraTEM survey was undertaken across SEL 26/2005 in 2009 and was followed by a third program of infill MT data acquisition in 2010. Data acquisition on the expanded array was designed to enable 3D MT modelling across the central Midlands area and resulted in the collection of 201 new stations arranged along three profile lines and a surrounding spaced grid (Figure 9). The results of this work were processed using 3D inversion modelling by WesternGeco EM (Geosystem). These data clearly indicate the presence of the TCZ within the resource area. Unexpectedly, the electrically conductive zone was observed to diverge in strike from NW/SE to EW immediately beneath the resource area (Figure 10).



Figure 9: Location map of the 2010 3D MT/TDEM survey array across KUTh Energy’s Tasmanian tenements. Blue stars represent stage 3 (2010) MT stations, red stage 1 and 2 (2008/2009) MT stations. The white outline in the central tenement area indicates the surface extent of the Lemont Inferred Geothermal Resource. Background Image ©Google Earth.

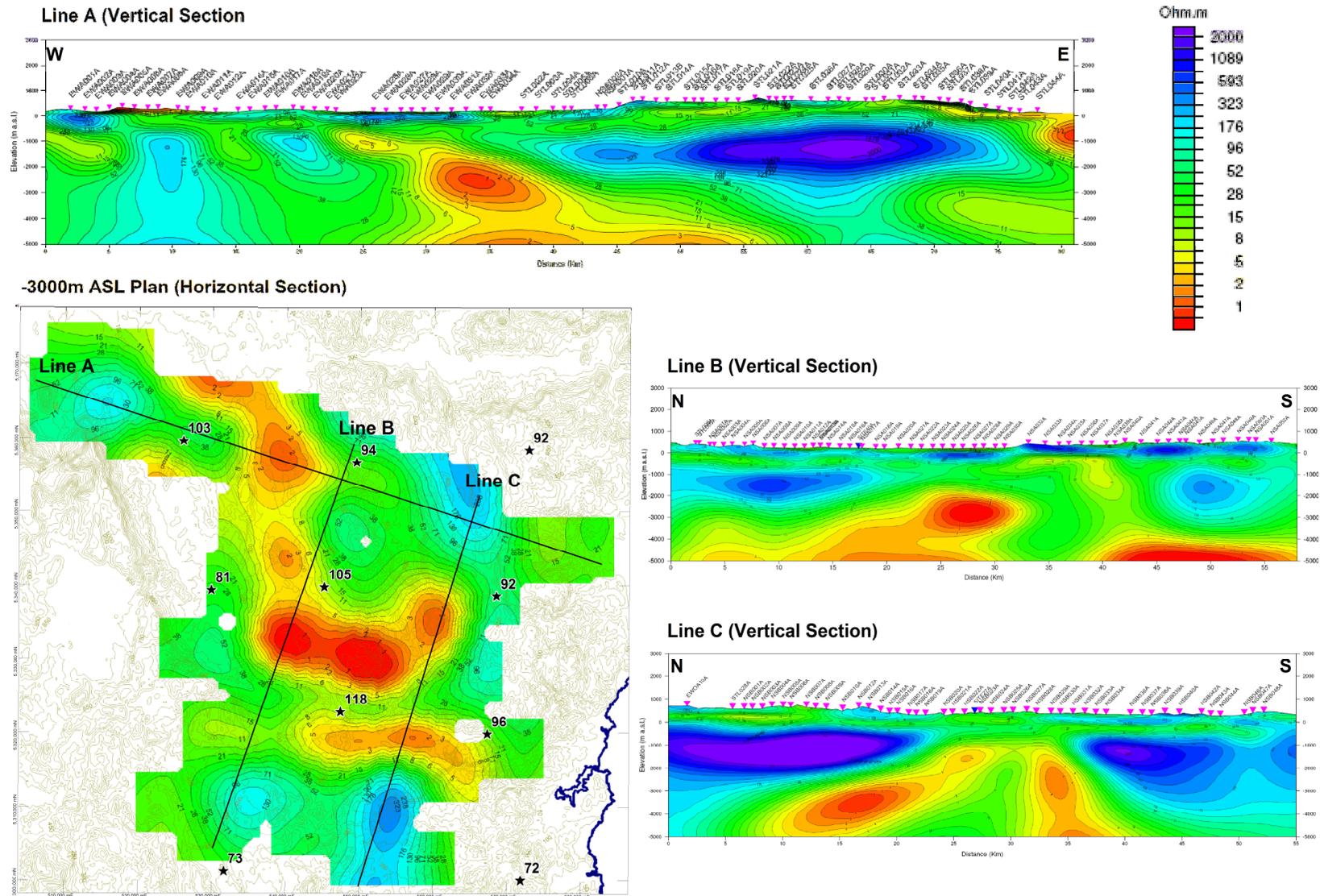


Figure 10: Selected results from the 2010 3D magnetotelluric survey presented as resistivity images. All images share the same scale (shown); warmer colours indicate increased electrical conductivity. Vertical section lines are as located on the -3000m ASL Plan. Vertical exaggeration of these sections is 2:1. The location of surface heat flow values (mWm^{-2}) from KUTH's shallow heat flow program are shown on the plan as black stars. Details of the modelling process are provided in Holgate & Goh (2010)

Visualised in 3D, the southern extension of the TCZ appears to be an east-dipping NW/SE striking planar structure in the NW of the infill survey area. To the south it diverges sharply to strike EW beneath the centre of the Lemont resource area. Two planar EW striking structures are observed in this area, a shallowly north-dipping anomaly in the north and a moderately southerly-dipping anomaly in the south. Vertical sections through these features indicate an inverted v-shaped electrically-conductive anomaly is laterally extensive beneath this area. The apogee of this structure is projected to lie beneath the anomalously hot Lemont bore hole (surface heat flow 118mWm²). In all cases areas of high electrical conductivity are found to be basement features, commencing around 2km depth.

The striking spatial coincidence of apparently deep fractured zones (interpreted from gravity and aeromagnetic data), electrically conductive MT anomalies and anomalously high heat flow within the Lemont region has led to the development of a new conceptual play model for this area. Originally conceived as a relatively high temperature, low permeability Hot Rock prospect, Lemont now appears to host what may be a Naturally Fractured Hot Rock play (Figure 11) with potential for warm/hot fluids at depth along zones of fracture permeability. Following completion of the geophysical acquisition programs it has been determined that further definitive testing of this play model will require deep drilling.

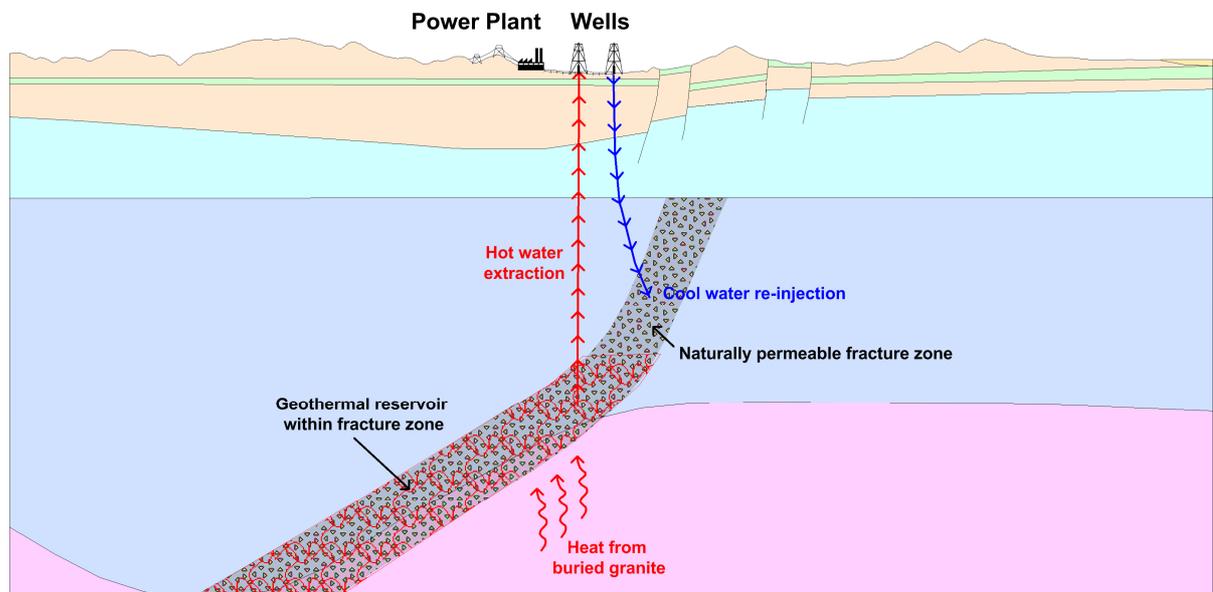


Figure 11: Diagrammatic illustration of Naturally Fractured Hot Rock play concept, Lemont, Tasmania.

2.5 Stress Modelling and Seismic Hazard

2D numerical fault stress-state modelling was undertaken across the NFHR play at Lemont (Holgate, 2011). Fracture location and orientation data based upon geophysical models were combined with stress data derived from an earthquake focal mechanism determined on a local earthquake (Holgate & Goh, 2010). The results of this work again indicated potential for permeable fracture systems at depth in this area.

In 2010, work was completed on a preliminary assessment of the natural earthquake hazard in NE Tasmania as a first step in the establishment of a seismic risk mitigation plan for geothermal development at Lemont and Fingal (Holgate, 2011).

3 Work Completed

No field work was undertaken on SEL 26/2005 during the reporting period.

4 Research & Collaboration

Research and collaborative projects with KUTh support underway or completed during the reporting period are:

4.1 Ambient Seismic Energy Technique 2 (ASET2)

Work on the ASET2 project, a collaborative ARC-linkage partnership between KUTh and the UTAS led by Dr Anya Reading, Senior Lecturer in Geophysics at the UTAS completed in February 2012. Preliminary results of the project were reported in *Holgate* 2011. Final results are expected to be released as publications in selected scientific journals in the near future.

4.2 NICTA Geothermal Data Fusion

KUTh is currently in process of finalising terms to share exploration results and data from its Tasmanian tenure with National ICT Australia as part of that organisation's Geothermal Data Fusion project. This project, which is funded under the Australian Government's *Emerging Renewables Program*, aims to solve problems of geothermal exploration data mining through development of software that will enable companies and government decision makers to better understand what makes a good geothermal site, and where the best target sites for geothermal resources are.

4.3 UC Palaeoclimate Study

KUTh is also currently in process of finalising terms to share exploration results and data with the University of Canberra to assist with the development of a PhD project that aims to determine whether or not the company's Tasmanian borehole temperature data may be used to discern palaeotemperature fluctuations and, if so, to use these data to construct a palaeotemperature record for the State.

5 Environment

Work conducted on the tenements in 2012/2013 resulted in no ground disturbances and hence no environmental or rehabilitation work has been required.

6 Discussion

Throughout the year KUTh has continued to pursue funding options for its Lemont project in the central Midlands. To this end liaison with the Australian Renewable Energy Agency (ARENA) has led to the drafting of a funding application to be submitted to the existing *Emerging Renewable Program*. The company has also taken steps to enter into collaborative agreements with the NICTA as part of an existing ERP grant project.

At the time of writing work on the Lemont ERP submission remains ongoing, however, recent increased uncertainty in the Federal political sphere has in turn resulted in increased uncertainty regarding the timing of elections and forward policy directions that may, or may not, influence both the timing and success of this application.

In view of the ongoing delays to the Lemont Project, KUTh successfully applied for an expenditure variation on SEL 26/2005 in December 2012. Current annual expenditure for the 2012 – 2013 year exceeds the commitment made at this time. However, KUTh freely acknowledges that continued ongoing delays to the Lemont work program may impact upon the company’s ability to meet its forward expenditure commitment of A\$100k in 2013 – 2014. However, in the light of the current over-spend, and the environment of uncertainty surrounding Government programs, the company will retain current commitments pending further review of the funding environment toward the end of the calendar year.

7 Conclusion and Recommendations

Work completed to date has successfully defined a number of significant targets for geothermal development in Eastern Tasmania. 3D geothermal modelling infers an aggregated Geothermal Resource of >350,000PJ_{th} at two sites at Lemont in the Midlands and Fingal in the northeast. Drill targeting and prioritisation has identified Lemont as the primary play. In the face of unavoidable delays, planning remains underway for deep drilling in these areas.

The proposed forward work program for the next year on SEL 26/2005 is:

Activities	Expenditure
<ul style="list-style-type: none"> Proposal and funding application to ARENA ERP 	\$100,000
<i>Assuming funding success, then,</i>	
Lemont Project Stage 1	
<ul style="list-style-type: none"> Project planning Finalise drill partner and define drill technology trial Review permitting requirements Confirm collaborative partnerships Preliminary data gathering (as required by project R&D collaborators) 	

8 Expenditure

Details of expenditure across the 12-month period are captured in Table 3 below.

	SEL 26/2005
Geoscience Costs	\$
Geology	28,619
Geochemistry	
Geophysics	
Remote Sensing	
Drilling & Gridding	
Gridding	
Drilling	
Land Access Costs	1,233
Rehabilitation Costs	
Feasibility Study Costs	
Other Costs	47,899
Administrative Costs	1,056
TOTAL 12/13	78,807
Total Expenditure (7 years)	3,854,059

Table 2: Expenditure on KUTh tenements SEL 26/2005 in the reporting period.

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10 Keywords

Geothermal exploration
 Geothermal resource
 East Tasmania
 HDR (Hot Dry Rock)
 HFR (Hot Fractured Rock)
 EGS (Enhanced Geothermal System)
 High Heat Producing (HHP) granite
 Tamar Conductivity Zone (TCZ)
 Magnetotelluric
 Gravity