

**Final Report, 2012**

**SEL 45/2007 (Orford)**

**19<sup>th</sup> November 2011 - 18<sup>th</sup> November 2012**

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## Summary

*KUTh Exploration Pty Ltd (KUTh) holds two Special Exploration Licences in Tasmania for Category 6 minerals (geothermal substances). The principle target of KUTh's work on these tenements is the location of high-temperature Hot Rock geothermal resources suitable for development as Enhanced Geothermal System (EGS) power generators. This report covers the period 19/11/2011 – 18/12/2012 on tenement SEL 45/2007 and is the final report to be lodged for this licence which expires on 18/12/2012.*

*No work has been undertaken on the licence area in the current annual reporting period. Work previously completed on the licence during KUTh's 5-year tenure includes shallow heat flow drilling.*

*The combined results of work completed to date indicate that the potential for geothermal resource development within the tenement area is low.*

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# 1 Introduction

KUTh Exploration Pty Ltd (KUTh) is a geothermal explorer and is the holder of two current geothermal exploration licences in Tasmania. The principle target of KUTh's work is the location of high-temperature Hot Rock geothermal resources suitable for development as Enhanced Geothermal Systems (EGS) power generators. This report covers work completed in the period 19/12/2011 – 18/12/2012 on KUTh's tenement SEL 45/2007. This is the final Annual Report lodged for this tenement which expires on 18/12/2012.

## 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 45/2007 (Figure 1). The tenement was granted for a period of five years to search for geothermal substances (Category Type 6) on 19 December 2007. The licence originally comprised 1,811 km<sup>2</sup>, however, two thirds of this area was relinquished in 2010 and it now comprises 420 km<sup>2</sup>. Tenure details of SEL 45/2007 are tabulated below.

Tenement Type	SEL
Number	45/2007
Commodity	Geothermal
Licensee	KUTh Exploration P/L
Operator	KUTh Exploration P/L
Area	420km <sup>2</sup>
Date Granted	19/12/2010

Table 1: Tenure details for SEL 45/2007.

## 1.2 Location and access

SEL 45/2007 is located along the south-east coast of Tasmania adjacent to the southern boundary of SEL 26/2005. Access to the tenement is limited via a number of formed roads, minor roads, farm and forestry tracks.

## 1.3 Topography and vegetation

SEL 45/2007 comprises areas of coastal hinterland with moderate to high relief and is dominated by native eucalypt forest and forest plantations.

## 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 have 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.



**Figure 1:** KUTH Energy tenement boundaries (red) including restricted areas (grey) and roads (orange). The red star indicates the location of shallow heat flow drilling in SEL 45/2007. Grid squares 25 x 25km; MGA 94 Zone 55.

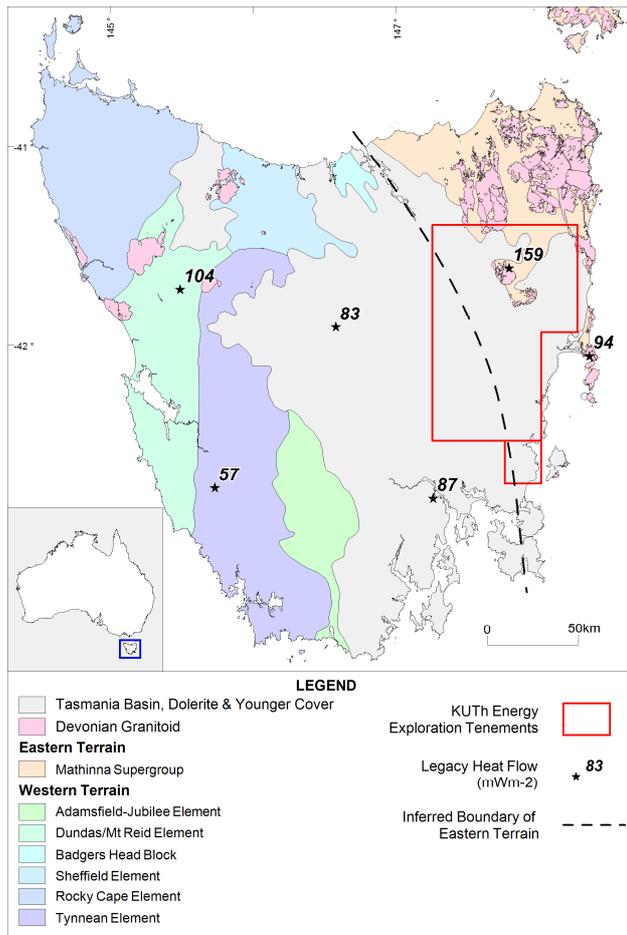
Both Western and Eastern Terrains host Devonian granite, the most extensive intrusions being the slightly older batholiths in the East (Burrett & Martin, 1989). Exposures of Devonian-aged granite in the far north-east of the state are known to include highly-fractionated high-heat-producing (HHP) granites 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. Outcrops of granitic rock are observed along the south-eastern coastline including at Maria Island to the east of the tenement area.

## 2 Previous Exploration

No geothermal exploration work has been undertaken across this area prior to KUTH's tenure. Existing geological mapping across the tenement indicates that basement sequences, inferred from gravity mapping and nearby coastal exposures to include Devonian granitoid, are obscured by younger cover comprising the Parmeener Group (Permo-Triassic sediment), Jurassic Tasmanian Dolerite, minor tertiary basalt, tertiary sediment and recent unconsolidated alluvium/colluvium.

## 3 Work Completed in the Current Annual Reporting Period

No work was undertaken on SEL 45/2001 in the reporting period.



**Figure 2:** Regional geology of Tasmania showing the major crustal elements. Legacy heat flow data are as summarised by Cull (1991).

## 4 Summary of Work Completed During the Tenure

### 4.1 Shallow Drilling and Heat Flow Estimation

A shallow drill hole for heat flow determination was drilled to total depth (TD) of 252.7m in 2008 (see location map, Figure 1). Collar information for the hole is summarised in Table 2 and full details provided in Appendix 2. The hole was drilled vertically to ~250m depth; an RC pre-collar was drilled to 102m and a diamond tail completed to TD. A complimentary program of geothermometry and sampling for thermal conductivity was completed by contractors Hot Dry Rocks Pty Ltd in December 2009 and estimated heat flow values were returned March 2009.

Hole Name	Easting	Northing	RL (m)	Completion	Depth (m)
Rheban	572790	5279433	79	1/7/2008	252.7

**Table 2:** Collar location data for the Rheban drill hole. Hole was drilled vertically; coordinates are MGA94 Zone 55.

#### 4.1.1 Drilling

Drilling was undertaken by Gerald Spaulding Drillers Pty Ltd of Devonport. Two rig types were used, a TH 62 percussion drill rig for pre-collar and a G & K 1000 diamond drill rig for the diamond tail. The pre-collar was cased with 125mm Class 12 PVC and grouted to prevent aquifer damage. On completion of diamond drilling 40mm Class 9 PVC was emplaced from surface to total depth to act as a guide for the thermal probe and was dummy probed to ensure that it was open and clear. A capped, lockable lid was fixed onto HWT casing at the

top of the hole which was then left for approximately 2 to 3 months to equilibrate before final temperature logging was undertaken.

Chips from the percussion rig were collected every 3m and logged, photographed and archived. HQ core was placed in trays with up to 1m from each tray wrapped in "Gladwrap" to retain moisture for thermal conductivity measurements. The core was then transported to the MRT core shed where it was logged, photographed and archived. Drilling encountered lithologies from (Table 3). Geological logging codes are provided in Appendix 1, a detailed geological log and chip and core photographs in Appendix 2.

Site preparation required for drilling was minimal although sumps were required for the diamond drilling. On completion of drilling, the site was rehabilitated, taking care to ensure that rock, clay and soil were put back in the approximate order to which they had been excavated. Topsoil containing seed-bank was then placed on top.

Hole name	From (m)	To (m)	Geological unit
Rheban	0.0	252.7	Jdl

**Table 3:** Geological summaries of the Rheban hole. Refer to Appendix 1 for logging codes.

#### 4.1.2 Down-hole temperature logging

The Rheban hole was logged by Hot Dry Rocks Pty Ltd using a wireline thermistor probe, a thermometer that relies on changes in electrical resistance to measure temperature changes. Down-hole temperatures were recorded at 1 metre increments to a resolution of 0.001°C. The hole was logged twice with a preliminary run ~5 weeks after drilling followed by a final run ~4 months after drilling. A summary of final and stable temperatures recorded at depth is provided in Table 4. Full results are presented as tables of temperature recorded per metre down-hole and as graphs of geothermal gradients in Appendix 2.

Hole Name	Bottom hole temperature (°C)	Depth (m)
Rheban	21.8	225

**Table 4:** Bottom of hole temperatures recorded in the Rheban hole.

#### 4.1.3 Thermal conductivity measurements

Measurements of thermal conductivity were undertaken on core samples by Hot Dry Rocks Pty Ltd. Sampling was designed using the interim temperature log and a visual assessment of the downhole geology. Each sample comprised a segment of core ~10cm long from which three disks between 1 – 3cm were cut. Cut disks were polished, evacuated via vacuum pump and submerged in water prior to measurement in a divided bar instrument. Values of wet thermal conductivity were recorded in W/mK at a standard temperature of 30°C to a precision of +/- 2°C. The uncertainty for each sample was derived from the uncertainty of the individual disk measurements.

A summary of thermal conductivity measurements from the Rheban hole is given in Table 5 and full results are presented in Appendix 2.

Hole Name	Dominant lithology	Thermal conductivity (W/mK)
Rheban	Jdl	2.05 – 2.23

**Table 5:** Thermal conductivity ranges for the dominant lithology of Rheban hole. Refer to Appendix 1 for logging codes.

#### 4.1.4 Surface heat flow estimation

Heat flow is determined as a product of temperature gradient and thermal conductivity. Estimations of surface heat flow ( $\text{mWm}^{-2}$ ) from the Rheban hole provides an indication of the heat flux at this point on the surface of the Earth. Thermal data derived from the Rheban hole were input into one-dimensional (1D) conductive heat flow modelling software by Hot Dry Rock Pty Ltd and heat flow for each bore was estimated by comparison of modelled (predicted) and observed temperature values. Results of the heat flow modelling process are summarised in Table 6 below and are presented in full in Appendix 2.

The surface heat flow determined at Rheban is of high quality with good model fit and uncertainty <1%.

Hole Name	Confidence	Surface HF ( $\text{mW/m}^2$ )	Error ( $\text{mW/m}^2$ )
Rheban	High	94	0.5

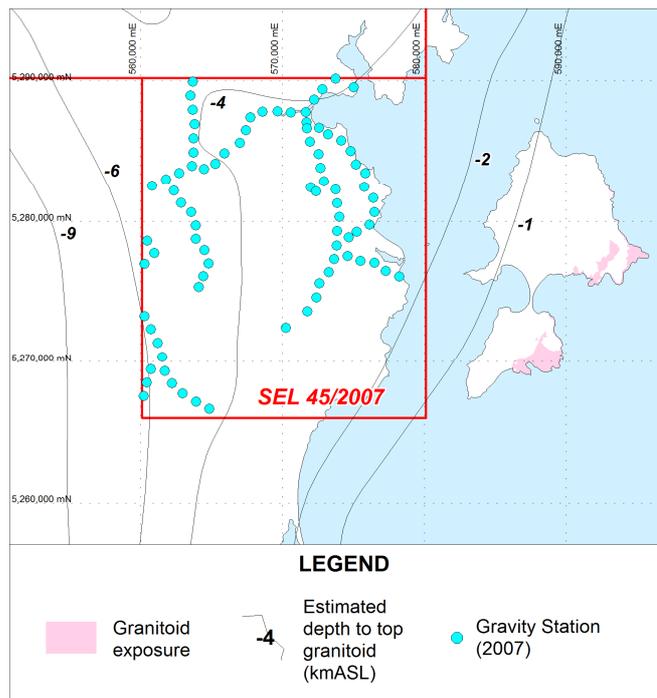
**Table 6:** Estimated surface heat flow value from Rheban drill hole.

#### 4.2 Gravity survey

A total of 86 new gravity survey points were recorded along roads and tracks across the tenement area in 2007 (Figure 3). The survey was undertaken on behalf of KUTH by Solo Geophysics & Co. Gravity data were acquired using a LaCoste & Romberg Model G #556 gravity meter and positioning was controlled using a Leica 1200 dual frequency RTK for survey applications and a Garmin GPS60 for local activities. The RTK survey resolution was better than 0.05m for both horizontal and vertical measurements.

Data acquired during the survey were processed to account for tidal variation, base and daily drift, latitude and Bouger calculation. Final values were derived by the standard AGSO isogal65 formula. A single Bouger density of 2.67gms/cc was required for terrain correction. These data are currently available within the MRT open-file gravity database and are summarised in Appendix 3.

Interpretation of gravity data was undertaken by Dr David Leaman in 2007. Results of this gravity modelling incorporating the broader Tasmanian dataset confirmed the prediction of buried granitoid in the vicinity of SEL 45/2007 (Figure 3).



**Figure 3:** Location of 2007 gravity stations, granite outcrop and depth to buried granite contours predicted from 2007 data interpretation.

## 5 Discussion

Review of the legacy geological data across SEL 45/2007 supports the presence of insulating Mesozoic sediments atop faulted Precambrian basement units. Granite bodies have been predicted at drillable depth within these rocks and moderate to high heat flow identified in the Rheban drill hole may suggest some potential for a deep-seated (>4km) hot-dry-rock style geothermal play. However, there are no indications of in situ permeability at depth and recent gravity interpretations (Leaman, 2012) now suggest granite at unfavourably shallow depths of 2 - 3km. Terrain, access, market and environmental considerations are also unfavourable and are expected to hinder development of any possible resource. Regionally, the Rheban area compares unfavourably with hotter, potentially permeable targets located on SEL 26/2005 to the north and extension of the current licence term has not been recommended.

## 6 Environment

There are no outstanding environmental or rehabilitation issues across SEL 45/2007. Ground disturbances during the tenure were limited to site preparation for a single shallow borehole. All disturbances related to the drilling survey were fully rehabilitated following completion of the hole.

## 7 Expenditure

Details of final expenditure on SEL 45/2007 in the year 2011-2012 are captured in Table 7 below.

	<b>SEL 45/2007</b>
<b>Geoscience Costs</b>	\$
Geology	167
Geochemistry	
Geophysics	
Remote Sensing	
<b>Drilling &amp; Gridding</b>	
Gridding	
Drilling	
<b>Land Access Costs</b>	
<b>Rehabilitation Costs</b>	
<b>Feasibility Study Costs</b>	
<b>Other Costs</b>	882
<b>Administrative Costs</b>	
<b>TOTAL</b>	1049
<b>TOTAL ALL YEARS</b>	328,555

**Table 7:** Expenditure on KUTH tenement SEL 45/2007 in the year 2011-2012.

## 8 Conclusion and Recommendations

The combined results of work completed to date on SEL 45/2007 indicate that the potential for geothermal resource development within the tenement area is low. Renewal of the licence area is not recommended.

## 9 References

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## 10 Keywords

Geothermal exploration; HDR (Hot Dry Rock); EGS (Enhanced Geothermal System); High Heat Producing (HHP) granite.