reflectors defining units but many structural reflectors (thrusts and fracture zones of lower velocity), and few such patterns might be identifiable.

Two possible DHIs have been observed, and each involves an association with a lower density medium, presumed to be mid Palaeozoic rocks.
These are located at SP 3380-3420, Line TB01-PB and SP 1540-1760, Line TB02-BA.

The possible feature on Line PB is illustrated in Figure 23.
There are several, horizontal high amplitude responses on the structural crest and these show slight dip contrasts to all surrounding features. Given the three dimensional nature of the structures involved (Figure 20) this character is quite unexpected.
The responses are associated with the intermediate level structure which may involve ultramafics and these materials may be implicated in the generation of the seismic changes.

The possible features on Line BA are much less definite but there are several possibilities in the particular short line section. All lie in the 0.6 to 1.3 seconds range. The sites lie south of Mt Thunderbolt near the edge of the Florentine Valley structures. All responses are relatively subtle but oppose the grain of other reflections. All effects lie within the modelled Palaeozoic section which is considered to dip up to the east toward the base Parmeener unconformity.

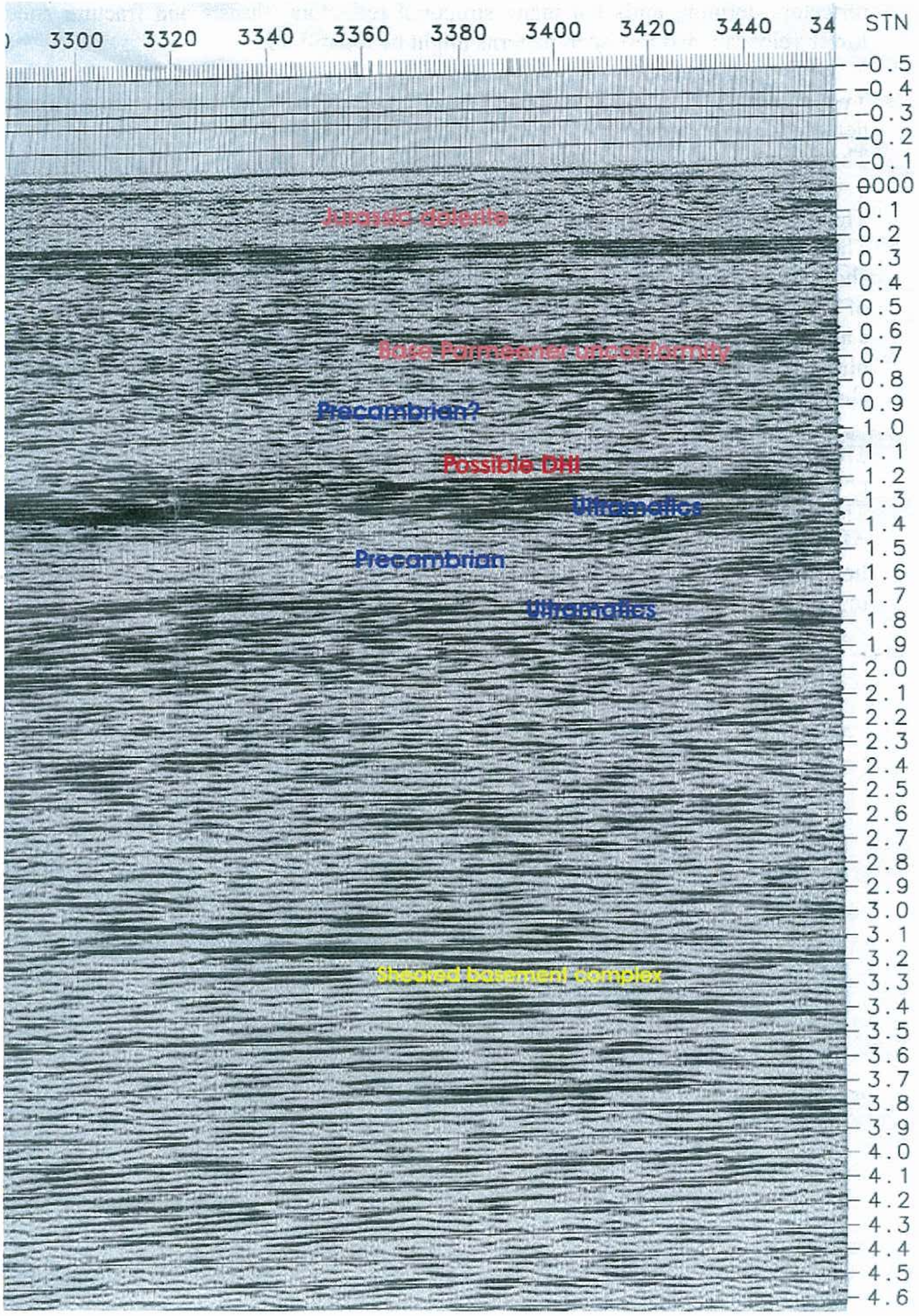

Figure 23: Portion of Line TB01-PB near Bellevue.

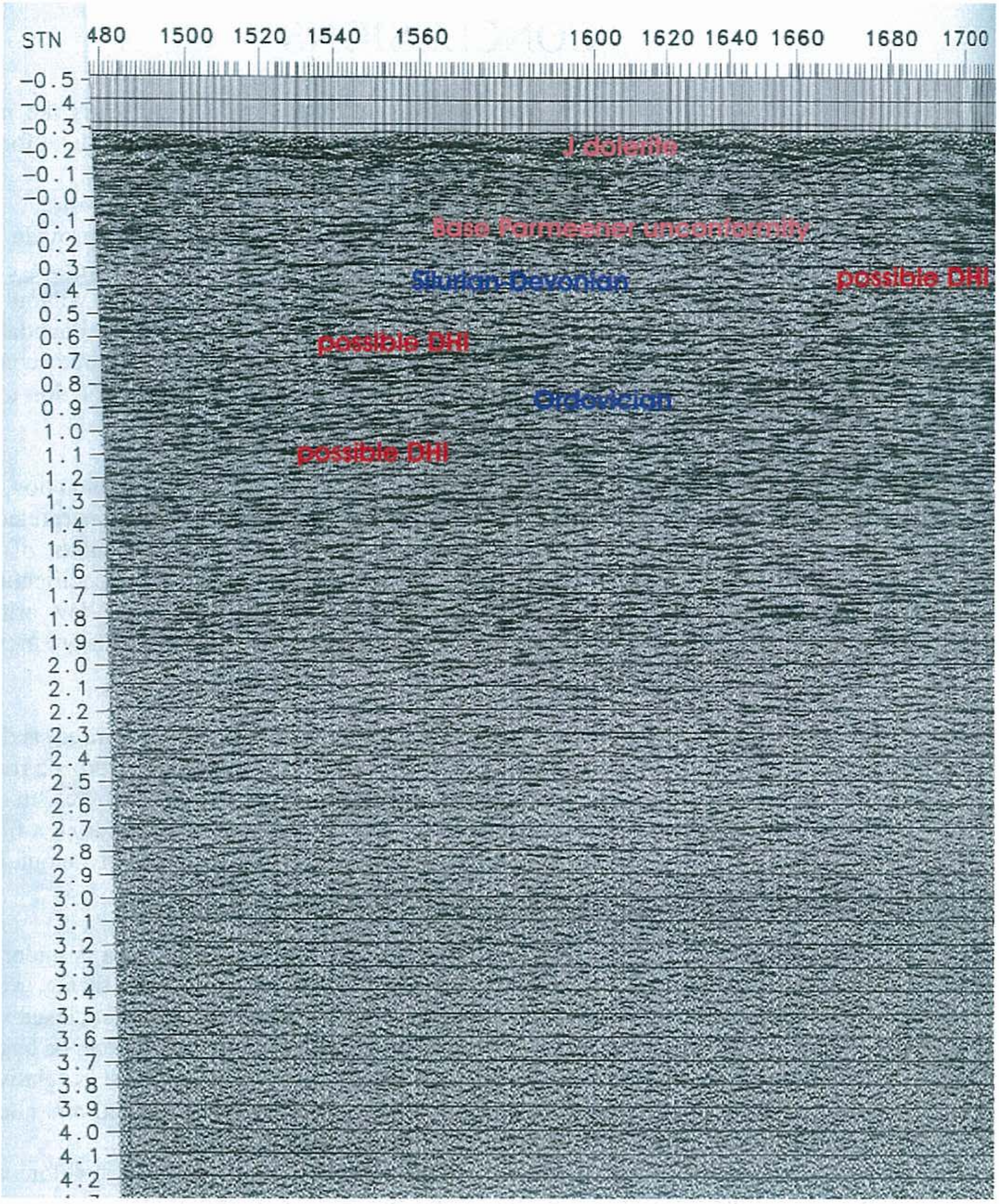

Figure 24: Portion of Line TB02-BA south of Mt Thunderbolt.
Note the cross-grained appearance of this record which may reflect hydrocarbon indicators or a combination of off-line, dipping and diffraction events. Short horizontal effects are clearly anomalous in this situation.

CONCLUSIONS

The principal conclusion drawn from the present study, which represents the most extensive analysis ever undertaken, is that the data available is quite inadequate for the guidance of a substantial exploration program. See Recommendations.

The seismic surveys completed to date are too isolated and unable to provide any comprehensive structural or stratigraphic unity. Segments of these traverses carry interesting suggestions of reflector events but their origin is not identifiable without use of other methods or well control. Most events are thought to be structural boundaries. One well, Hunterston-1, is simply not enough to provide the required control information alone: the area is too large, too complex and too variable for this to be claimed.

Gravity data, which have been used to carry major elements of this interpretation, are variable in quality and coverage and have almost certainly been over-interpreted in western regions. Magnetic data, used to test or verify certain elements of the interpretation, are only able to do so within the constraints of acquisition specifications. This data set is the most consistent regionally and it has been able to allow critical conclusions. These include the deduction that many thrusts and detachments are present and that they involve ultramafics (presumed to be Cambrian in age).

The present integrated interpretation does indicate where data must be acquired, and the nature of that data. If the implications suggested, with respect to mid Palaeozoic rocks, are correct then some useful stratigraphic holes may be drilled. There are other sites, as near Bronte and Steppes, where generally concordant interpretation allows significant variations and such sites should be drilled to establish firm control at clearly anomalous or ambiguous locations.

The interpretation generally confirms earlier views that central Tasmania is underlain by a complex overthrust terrain and that thrusts are both east and west facing. Many include coatings of ultramafics and some arcuate surfaces are completely enclosed with these materials. Precambrian rocks, including dense and dolomitic members, or largely dolomite, dominate the upper crust and siliceous Tyennan style basement is relatively limited in volume. The denser rocks may also be strongly metamorphosed and altered rocks but there is no suggestion of any significant magnetic signature.
Palaeozoic rocks can be traced into the plateau region from the southwest (Florentine valley region), the west (King William) and the north (Golden Valley). Block size, variation and limited lateral extension restricts seismic control and the other data sets can only indicated general presence and basic lithology at present. It is clear, however, that large portions of the included section are relatively low density (2.60 t/m^3 +) and indicates the presence of Silurian and Devonian rocks, perhaps with significant elements of non limestone Ordovician. Large accumulations of Cambrian rocks appear to be absent under much of the region.

This interpretation should be reviewed and models recalculated once new potential field data is available and at least some of the control wells have been drilled.

RECOMMENDATIONS

Some comments were made in Introduction which suggested that the present work would inevitably be limited. Such limitations were directly related to ground inspections of critical structures, and the quality and coverage of gravity and magnetic data. It is also clear that the generally isolated nature of the seismic coverage also retards understanding. The entire interpretation should be reviewed upon completion of these recommendations.

DRILLING

Some drilling is required regardless of acquisition of any other data, or surface evaluations. Some real control and insight into the construction of the basement is essential – and this control must be widespread.

Great South Land Minerals has nominated a number of drilling targets, mainly for stratigraphic purposes. These must be drilled, and to depths of at least 3000 m. This depth is required to ensure that the target zone thickness is properly appraised for future interpretation revision. Besides, the content of the basement to such depths may offer clues as to the source and movement of any hydrocarbons present. The already-drilled deep hole at Hunterston is not deep enough to answer some of the questions which arise from existing seismic data: hence any holes should be drilled to rig capacity and not less than 3000 m (economic depth limit?).

This study suggests that some of the current, nominated well sites are not ideally located. An example of this is offered by Gezer 1. This is clearly off structure, whatever that actually is, and would require greater depth to reach any of the primary reflectors. This site should be shifted several kilometres to the southeast, to Lake Echo. Figure 22, however, shows both sites – and both should be drilled. The nominal Gezer location would establish something of the lithology above the first major reflector and confirm or deny the absence of Palaeozoic rocks near Marlborough. The Lake Echo site is probably close to the crest of reflectors (Figure 20) and would test both the prospectivity and stratigraphy of the region.

Some other suggested sites, which would provide regional control and resolve some ambiguities, are also shown on Figure 22. These are considered the minimum necessary sites to provide appreciation of existing data and support analysis of new data infills.

An additional site near Tarraleah or Wayatinah might also prove of use.

POTENTIAL FIELD DATA

The coverage and quality of magnetic data must be improved. The only practical way to do this is to survey the entire licence area with consistent specification which allow resolution of both shallow source features and basement effects. Such a survey should have a line spacing of the order of 200-400 m maximum (closer is better) and a nominal terrain elevation clearance of 100-150 m. Significant deviations up to 300-400 m are not significant if very local, provided instrumentation fully records clearances. Tie lines of 10-20 km are advised as minimum specification. The higher range of terrain clearance tolerated means that towns and cities can be overflown leading to a seamless final presentation. The specifications also mean that the data can be presented as a detailed map and in continued form at some fixed height, say 1300 m asl. The upward-continued format would be used for basement interpretation and the detailed low level form for Parmeener interpretation.

The coverage and quality of gravity data must also be improved but this is an easier and less costly exercise. Some parts of the area already possess a nominal 1 km observation spacing although the reliability of anomaly values may leave something to be desired. Many regions have a station spacing of more than 7 km, including the zone south of Bellevue, around Thunderbolt, and near Lake Echo. This explains the comments given in Conclusions: some traverses are almost certainly over-interpreted. It is recommended that every track of access which can be driven with a 4WD vehicle in these areas be traversed and observed at 500 m nominal spacing with a modern gravimeter and GPS support. This method will rapidly improve gravity coverage and reliability.

SEISMIC DATA

The present study indicates the problems with existing coverage and also suggests that the seismic coverage planned for 2007 is imperfect. Important structures and stratigraphic sections have been missed, and tie sections not considered. It is important that a net of seismic profiles be acquired since much of the difficulty with the present coverage lies with the isolation of individual traverses and the lack of cross ties. These are especially necessary in the Lake Echo region on the basis of present inferences.

Recommended coverage for the plateau region is suggested on Figure 25.

The data should be acquired using a wide frequency response and should not be filtered or altered in any way prior to processing. All traverses should be acquired with the straightest orientation and should exclude major doglegs wherever possible. Use of roads means that some orientation and elevation problems are inevitable but the proposed continuation of Line AA2, for example, is not advised. This line, essentially north-south, includes an east-west segment of some kilometres. This will degrade results. An alternative arrangement has been suggested in Figure 25 and it involves acquiring the north-south segments as proposed but using a cross traverse to acquire the other portion. This has the advantage of providing a proper and continuous setting for all segments.

Traverse planning must be carefully thought through in order to optimise results. Any seismic survey in Tasmania is very expensive and anything which diminishes the chance of good results should be avoided. Line PB, for example, is little short of a disaster for this reason. This line should have traversed from Bronte to Deloraine, not Bronte to Great Lake to Bothwell. TH should have been Great Lake to Bothwell.

Several other lines have waste segments which add nothing to the data set. It is not an advantage to use every bit of road or road curl just to advance a few hundred metres on orientation. This is evident for lines BA and TL where nothing is gained by taking a hairpin bend and following a different orientation.

Seismic presentations should be labelled for orientation and should be organised in the same way (looking north for east-west lines, and looking west for north-south lines) and shot points should be systematically laid out to achieve this. This is a planning issue but reduces confusion and rotation of data in order to put it in the manner of normal inspection. Part of this problem has arisen at the processing centre which has not been concerned with the finer points of useful, and non confusing, presentation.

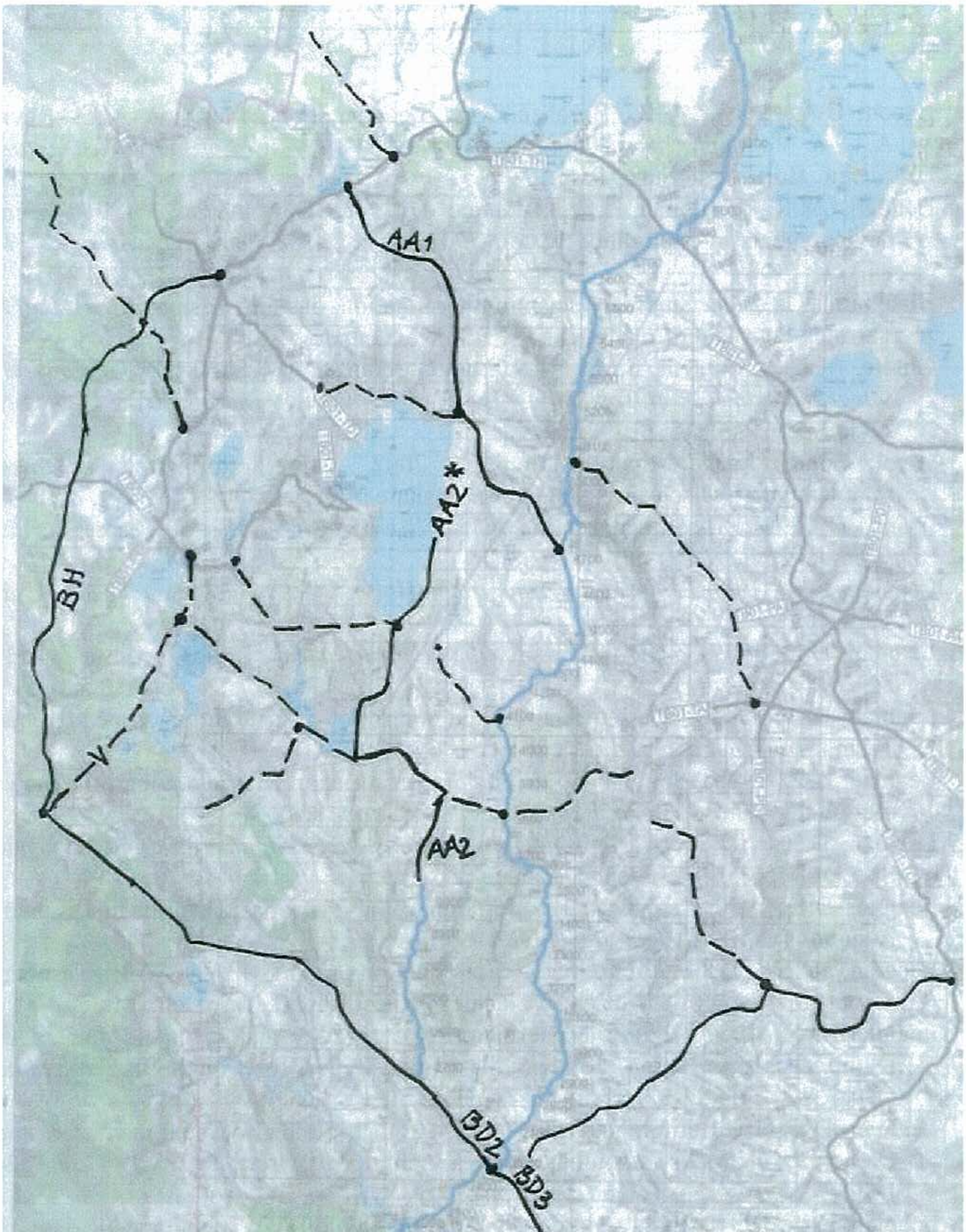

Figure 25: Recommended seismic coverage, central Tasmania.
Existing traverses are shown as coloured, heavy lines on the base map (black = survey TB01, blue = survey TB02). Firm lines on overlay are planned lines for next survey. Broken lines are the minimum recommended coverage required to provide cross ties and basic time maps.
Note AA2 has been planned with a major dogleg. This line should either be acquired in segments or as two parts and much longer cross line as shown.

REFERENCES

Bacon, C.A., Calver, C.R., Boreham, C.J., Leaman, D.E., Morrison, K.C., Revill, A.T., & Volkman, J.K., 2000. *The Petroleum Potential of onshore Tasmania: a review*. Bull. Geol. Surv. Tasm. 71.

Bendall, M.R., Volkman, J.K., Leaman, D.E., & Burrett, C.F., 1991. Recent developments in exploration for oil in Tasmania. *Aust. Petr. Expl. Assoc. J.*, 74-84.

Blackburn, G., 2004. Summary seismic interpretation, onshore Tasmania. SEL 13/98. Terratek Petroleum Consultants Pty Ltd, November.

Clarke, M.J., & Forsyth, S.M., 1989. Late Carboniferous-Triassic, In *Geology and Mineral Resources of Tasmania*, (Eds Burrett, C.F. & Martin, E.L.) Geol. Soc. Aust. Spec. Publ. 15, p. 293-338.

Great South Land Minerals Limited, 2002. Offer information statement. Supplementary Disclosure Document for share offer.

Irving, E., 1956. The magnetisation of the Mesozoic dolerites of Tasmania. Pap. *Proc. Roy. Soc. Tasm.* 90, 157-168.

Leaman, D.E., 1970. *Dolerite intrusion near Hobart, Tasmania.* PhD Thesis, Univ. Tasm.

Leaman, D.E., 1972. *Gravity survey of the Hobart District.* Bull. Geol. Surv. Tasm. 52.

Leaman, D.E., 1975. Form, mechanism and control of dolerite intrusion near Hobart, Tasmania. *J. Geol. Soc. Aust.* 22: 175-186.

Leaman, D.E., 1978a. Some thoughts on dolerite intrusion with particular reference to marginal features. *Unpub. Rept. Dep. Mines Tasm.* 1978/30.

Leaman, D.E., 1978b. *Use of reflection methods in Tasmania.* Part 1. Geophysics Special Report Mines Dept Tasmania, 7.

Leaman, D.E., 1980. Geophysical exploration of the East Coast Coalfields, Tasmania. A summary. *Mines Dept. Rept. 1980/49.*

Leaman, D.E., 1986. Preliminary interpretation report, 1985 West Tasmania aeromagnetic survey. Mt Read Volcanics Project Report, Tas. Dept. Mines.

Leaman, D.E., 1987. Phase 1 interpretation of gravity and magnetic data in the D'Entrecasteaux Region, Southern Tasmania. Report for Conga Oil. Tas. *Mines Dept. Open File 87-2718.*

Leaman, D.E., 1990. Inferences concerning the distribution and composition of pre-Carboniferous rocks in southeastern Tasmania. *Pap. Proc. Roy. Soc. Tasm.* 124, 1-12.

Leaman, D.E., 1991a. Progress report. Interpretation of gravity and magnetic data. EL 1/88 Central Tasmania. Report for Conga Oil by Leaman Geophysics.

Leaman, D.E., 1991b. Initial interpretation, gravity and magnetic data Northern Tasmania. Report for Conga Oil by Leaman Geophysics.

Leaman, D.E., 1992. Finding Cambrian keys: An essay in controversy, prospectivity and tectonic implications. *Bull. Geol. Surv. Tasm.* 70, 124-148.

Leaman, D.E., 1994. Criteria for evaluation of potential field interpretations. *First Break (EAEG),* 12, 181-191.

Leaman, D.E., 1995. Source component display and potential field interpretation. *Explor. Geophys.*, 26, 221-226.

Leaman, D.E., 1996a. Evaluation of AGSO seismic lines T4 and 5, for Great South Land Minerals. *Mines file* 96/3873.

Leaman, D.E., 1996b. Basement lithology interpretation map, prepared for Mineral Resources Tasmania submission to Regional Forest Agreement.

Leaman, D.E., 1997a. Features of Jurassic dolerite intrusions at Cape Surville, Lynwood, Single Hill and Mount Nelson, Tasmania. *Pap. Proc. Roy. Soc. Tasm.* 131: 13-20.

Leaman, D.E., 1997b. Application of magnetic methods to deep basin structures. *Explor. Geophys.*, 28, 97-105.

Leaman, D.E., 2002a. The effective magnetic contrast of the dolerites of Tasmania. *Explor. Geophys.* , 33, 166-171

Leaman, D.E., 2002b. *The Rock which makes Tasmania.* Leaman Geophysics, 216pp

Leaman, D.E., & Richardson, R.G., 1980. Seismic reflection surveys, Clifton Beach, southern Tasmania. *Mines Dept. 1980/50.*

Leaman, D.E. & Richardson, R.G., 1981. *Gravity survey of the east coast coalfields.* Bull. Geol. Surv. Tasm. 60.

Leaman, D.E., & Richardson, R.G., 1989a. *The Granites of west and northwest Tasmania - a geophysical interpretation.* Bull. Geol. Surv. Tasm., 66.

Leaman, D.E., & Richardson, R.G., 1989b. Production of a residual gravity field map for Tasmania and some implications. *Explor. Geophys.*, 20, 181-184.

Leaman, D.E., & Richardson, R.G., 1992. A geophysical model of the major Tasmanian granitoids. *Rep. Dept. Mines Tas.* 1992/11

Leaman, D.E., Baillie, P.B. & Powell, C.McA., 1994. Precambrian Tasmania: a thin-skinned devil. *Exploration Geophysics,* 25, 19-24.

Leaman, D.E., & Webster, S., 2002. Quantitative interpretation of magnetic and gravity data for the Western Tasmanian Regional Minerals Program. *Tas. Geol. Surv. Record.* 2002/15.

McDougall, I., 1964. Differentiation of the Great Lake dolerite sheet, Tasmania. *J. Geol. Soc. Aust.* 11: 107-132.

Richardson, R.G., 1987. An experimental seismic reflection survey on Bruny Island. *Unpub. Rept. Dep. Mines Tasm.,* 1987/53.

Richardson, R.G., & Leaman, D.E., 1981. Fingal Tier seismic reflection traverses 1 and 2. *Mines Dept Rept 1981/6.*

Roach, M.J., Leaman, D.E., & Richardson, R.G. 1993. A comparison of regional-residual separation techniques for gravity surveys. *Exploration Geophysics,* 24, 779-784.

TASGO symposium abstracts, 2001. The Geological Framework of Tasmania. Worshop to finalise TASGO and TASMAP projects under the National Geoscience Mapping Accord. AGSO and MRT.

APPENDIX 1

TABLE OF ROCK PROPERTIES

Density is expressed as contrast with background and reduction density of 2.67 gm/cc

Age and unit	Density gm/cc, t/cu m	Susceptibility cgs	SI
Quaternary	-1.2	0	
Tertiary sediments	-0.7	0	
basalt	0.23	>0.001	>0.01
Jurassic dolerite	0.23	>0.004	>0.05
Triassic	-0.22	0	
Permian	-0.1 to -.13	0	
Siluro-Devonian	-0.1	0	
Mathinna Beds	-0.06 to 0.04	0	
Devonian granite	-0.05-0.07	0	
granodiorite	0.03	~0.0002	~0.0025
Ordovician Gordon Gp	0.07	0	
Denison Gp	-0.07	0	
Cambrian Tyndall/Yolande Gps	0.05-0.07	0.0002	0.0025
Dundas Gp style	0.05-0.07	<0.0002	<0.0025
sundry variations	var	var	
andesites	0.1-0.15	>0.0002	>0.0025
central volcanics	0.06-0.08	~0.0002	~0.0025
porphyry	-0.03<0.05	<0.0002	<0.0025
granite	-0.05/0.02	>0.0005	>0.006
ultramafic	var	>0.01	>0.12
Que style basalts	0.1-0.2	>0.0003	>0.0035
(note many Cambrian units exhibit variations in properties locally when altered)			
Precambrian/Eocambrian			
Crimson Creek Fm	>0.1	>0.001	>0.01
Success Creek Fm	>0.07	0	
Lineament rocks	>0.1	>0.0002	>0.0025
Oonah/Burnie Fm	0.08	<0.0005	<0.006
Forth Complex	0.1	0 var	
Tyennan/Badger/Rocky Cape	0	0	
Cradle Block var	0.1	0	
sundries/amphibolites	0.15	0.0003	0.0035
Massive dolomites	0.17	0	

APPENDIX 2

READING THE MODEL DIAGRAMS

All models have been constructed using the criteria and methodology of Leaman (1994, 1995, 1997b). This means that a family of rock units (see Appendix 1) has been consistently engaged and in ways that are known to occur.
Property ranges lie close to those observed and quoted in Appendix 1 and inferences have been used to deduce which combinations of units may actually be present, and where.

The diagrams themselves are in two parts: gravity and magnetics. The separation has been made for clarity and to indicate which units contribute to the observed or modelled effect. This is rarely apparent in compound plots which attempt to label units with properties used.

In so far as it has been possible, and hardware and software have allowed (there were some curious transformations!), the sections are colour coded and labelled in various sections so that the reader may gain a feel for what is included.
Dark blue = Precambrian dolomite, light blue = relatively dense occasionally dolomitic Precambrian, white = siliceous, possibly Tyennan Precambrian or neutral lithology (2.67 t/m^3). Dark green = Cambrian ultramafics, light green = other Cambrian rocks (volcanic or sedimentary). Red or black have been used for Devonian formations, magenta for Silurian, red for siliceous Ordovician and light red for Gordon Limestone. Devonian granitoids are shown in red.
Undifferentiated Parmeener cover or Permian is usually shown in light grey (occasionally blue), Triassic in green and dolerite in black. Tertiary rocks are not visible (but included in the models) at the scales plotted.

Observed data profiles are the red lines in each case. The blue profile is the calculated (modelled) profile.
The anomaly scale (top left in each diagram) shows the range of scale. Thus 20 mgal represents the entire scale, each tick is then 4 mgal.
The depth scale (bottom left) is scaled in the same way. Thus 9000 m represents the full scale, each tick is 1800 m.
The horizontal scale (bottom right, below "calc shift") is the full range of the diagram. Thus 45000 m represents the length of the section presented, although at least 15000 m more will have been included in calculation to avoid large end effects (but not displayed), and each tick will then represent 4500 m.

The values of "obs shift" and "calc shift" are important since these confirm the consistency of the modelling. The differences between the two numbers should match the base shifts or base levels of the data set. For residual gravity data, assuming the residual separation to be valid, this difference should be zero. For residual magnetic data it will depend on what base value was chosen by the contractor of the survey and its difference from the true IGRF related value at the site. Since the magnetic field is a variable function this number can vary and must be assessed for the survey and data set. The residual field offered on magnetic maps is rarely true, since this subtlety is not appreciated by many, but it is important that it be determined and recovered consistently in modelling or magnetic interpretations become nonsense and ill-determined. In this case an assessment of the data set suggested that the true base value for the survey was 50 to 60 nT higher than the values presented. This difference should, therefore, appear in the shift values. A difference of 50 nT has been considered an adequate match.

Details of the line appear in the lower left corner of each sub plot and the title line of each plot includes some end point detail in the form of shortened AMG coordinates and some description.