TR20_119-132

12. River Derwent magnetic survey, John Garrow Light - Bridgewater.

D.E. Leaman

Limited magnetic surveys in the Derwent Estuary have proved useful in locating key features (*e.g.* Leaman, 1975*a*) or in indicating the distribution of magnetic materials (*e.g.* Leaman, 1975*b*, 1977*b*). Such minor introductory surveys (prior to 1974) had shown that significant anomalies (750-1000 nT) persisted well into the estuary from the shore and were relatively unaffected by the cover of water or silt. It was decided that a detailed survey of the whole estuary would be useful and this survey was commenced in January 1974 and continued until May 1975, whenever time or weather permitted. A preliminary interpretation of the incomplete survey was given in Leaman (1977*a*) where the value of the survey was shown in providing a rapid geological sketch.

The survey commenced with a series of trials to evaluate the type of suspension needed for the instrument. While earlier surveys (Leaman, 1975*a*, 1975*b*) were undertaken on large, stable wooden boats with a crude, simple wire suspension which relied on the weight of the instrument to maintain verticality, all subsequent work was to take place using a small aluminium boat. Since boat motions would be more severe a sophisticated suspension was required if an accuracy of better than 50-100 nT was to be maintained. The instrument, a McPhar H700 fluxgate magnetometer, has a sensitivity of 10-20 nT. After a number of tests a wooden gimbal device capable of free or friction damped motion was constructed, which in excellent conditions allowed a precision of 10-25 nT and in fair conditions about 100 nT. In general all surveys were halted if the reproducibility of results varied by more than 50-100 nT and on most traverses undertaken for the present work the cut-off value has been 50 nT.

The results of the survey were plotted on four 1:10 000 scale maps and have been reduced to the 1:25 000 scale used for the interpretation. The maps cover the following areas:

Area 1: John Garrow Light - Tasman Bridge (fig. 29).
Area 2: Tasman Bridge - Elwick Bay (fig. 30).
Area 3: Elwick Bay - Old Beach (fig. 31).
Area 4: Old Beach - Bridgewater (fig. 32).

All results are plotted as contour maps with a contour interval of 250 nT. The base station for the entire survey is located at Rosny Point with a value of -2100 nT and principal accessory base stations at Macquarie Point, Prince of Wales Bay and Austins Ferry. All values are relative to the base station which has an absolute value of approximately 63 000 nT (total field). The relative values of the accessory tie stations are listed below and are with respect to the base value stated above as 63 000 nT.

Accessory Tie Station	*Anomaly (nT)*
Marieville Esplanade beach ramp	-1900*
Regatta Ground - Domain ramp	-2300
North side end Regatta jetty	-700
East end Bellerive Beach	-1450*
Buckingham rowing club ramp, New Town Bay	∿-1600*
Rock ledge, Church Point	-2300
North side wall Prince of Wales Bay ramp	-1940
HWL pebble beach - fence line, Mt Direction	-2250
HWL centre Austins Ferry ramp	1820
N side ramp, pole line, Austins Ferry ramp	-1050
Rose Bay pipe base, Rosny survey	-3100

Accessory Tie Station	*Anomaly (nT)*
Victoria Esplanade base, Rosny Survey	1800

*Values uniform over a wide area.
Most values vary according to exact position.

Checks of base levels throughout the survey period have enabled removal of most diurnal, annual or other long term variations although significant short term variations may remain. Any obvious inconsistencies have been re-checked and the density of traverses is such that it is unlikely that major deviations are unrecognised.

Traverse location has not been wholly the result of precise survey. In the Selfs Point-Bedlam Walls region all traverses were intercept navigated by survey and positions are considered accurate to within 25 m. However, in all other areas positions were marked by transit intercepts with sightings being made on at least three occasions in each traverse. Up to eight or ten transits have been made on longer traverses or where currents were a problem (especially near Bedlams Walls and the Tasman Bridge). Position accuracy is thus variable but is generally better than 30-45 m for all wide reaches of the river north of Macquarie Point, better than 25 m for narrow reaches and perhaps 100 m south of Wrest Point-Kangaroo Bluff. In the latter region all transit sightings are distant and the accuracy as determined from repeated readings and plottings is generally about 75-100 m.

Detailed discussion and interpretation is provided for each of the four areas but some general comments may be made. On the scale of the present survey there are few direct correlations between field intensity and depth of water apart from variations very close inshore. In many instances anomalies strike into the river and few gradients or peaks correlate directly with bathymetry (*e.g.* fig. 33). This is an important observation since it allows some direct deductions to be made about anomalous bodies. The interpretations given are predominantly qualitative since the survey must be regarded as a basically uncontrolled first order exercise. When the magnetic properties of the various rock types are better understood more detailed surveys and evaluations will be possible.

MAGNETIC PROPERTIES OF KNOWN ROCK TYPES

The following summary details present knowledge about the materials adjacent to the river and which are likely to form river bed, bedrock or magnetic 'basement'. It presumes that, in a general way, all in-river rock types are represented onshore.

Permian sedimentary rocks

A mixed sequence of sandstone, siltstone, mudstone and limestone which is generally not anomalous. The intensity of remanent magnetisation and the volume susceptibility are very low.

Triassic sedimentary rocks

Two sequences of sandstone and mudstone form the series; one quartz rich, the other feldspathic and containing rock fragments. Comments similar to the Permian sequence apply with the possible exception of the feldspathic series which may possess slightly more intense remanence.

Jurassic dolerite

A petrologically and magnetically variable rock with intense remanent

magnetisation and high volume susceptibility (Irving, 1956). A detailed evaluation of the properties of this rock will appear in a future report. Basic data:

Susceptibility: 1-40 x 10^{-3} SI depending on weathering.
Remanence: A/M intensity 4-70 x 10^{-1}
Dip and declination -85° at 325°

Tertiary basalt

The range of properties of the basalt are considered to be greater than for the dolerite. This conclusion is based on experience elsewhere in Tasmania; the variation depends on the degree of weathering. All basalts in the Hobart area are deeply weathered and susceptibilities are normally expected to be less than for the dolerite.

Tertiary sediments
River sediments } Non-anomalous. See Permian rocks.

The sign convention employed throughout is the global, rather than Southern Hemisphere, notation which means that the more negative anomalies are related to the more positively and normally magnetised materials.

AREA 1. JOHN GARROW LIGHT-TASMAN BRIDGE

The results and interpretation for this area are shown in Figure 29. Several features are apparent.

(1) A strong ridge of anomaly from piers 4, 5 south to Macquarie Point.
(2) The central portion of the river between the bridge and Rosny Point is non-anomalous.
(3) Strong ridges of anomaly pass off-shore into Kangaroo Bay, the river and Montagu Bay from Rosny.
(4) A broad swell of anomaly extends south-east from Battery Point.
(5) The main expanse of the estuary is relatively non-anomalous although variations up to 400 nT are noted.

The spine of anomaly on the western side of the river and striking N-S from the bridge is quite surprising. Apart from the section adjacent to the Regatta ground and the termination off Macquarie Point it passes from a portion of the river in which magnetic bedrock (dolerite) is buried beneath more than 260 m of Tertiary sediment, river silt and water (Trollope *et al.*, 1966). There is no apparent dimunition in anomaly intensity and the southern section is due to dolerite. Triassic sandstone occurs in Rose Bay and at Macquarie Point where the field is more than -1500 nT. Changes in water depth also produce no definite correlations with field intensity. It may be concluded that the spine of anomaly is related to dolerite and that in those regions where it is more than -1500 nT dolerite is absent.

Figure 33 presents magnetic and bathymetric profiles across the river south of the Tasman Bridge. In each case there is a general lack of correlation between intensity and water depth (plus silt thickness where known - section A-B). Section C-D shows clearly the effect of the presence or absence of the dolerite (especially near C (Macquarie Point)). Two possible interpretations are provided for the separate anomaly offshore. If the deductions presented in Figure 33 are combined with the known distribution of lower contacts onshore the possibility of a small feeding dyke cannot be overlooked since the dolerite dips west to south-west from Rosny and east from

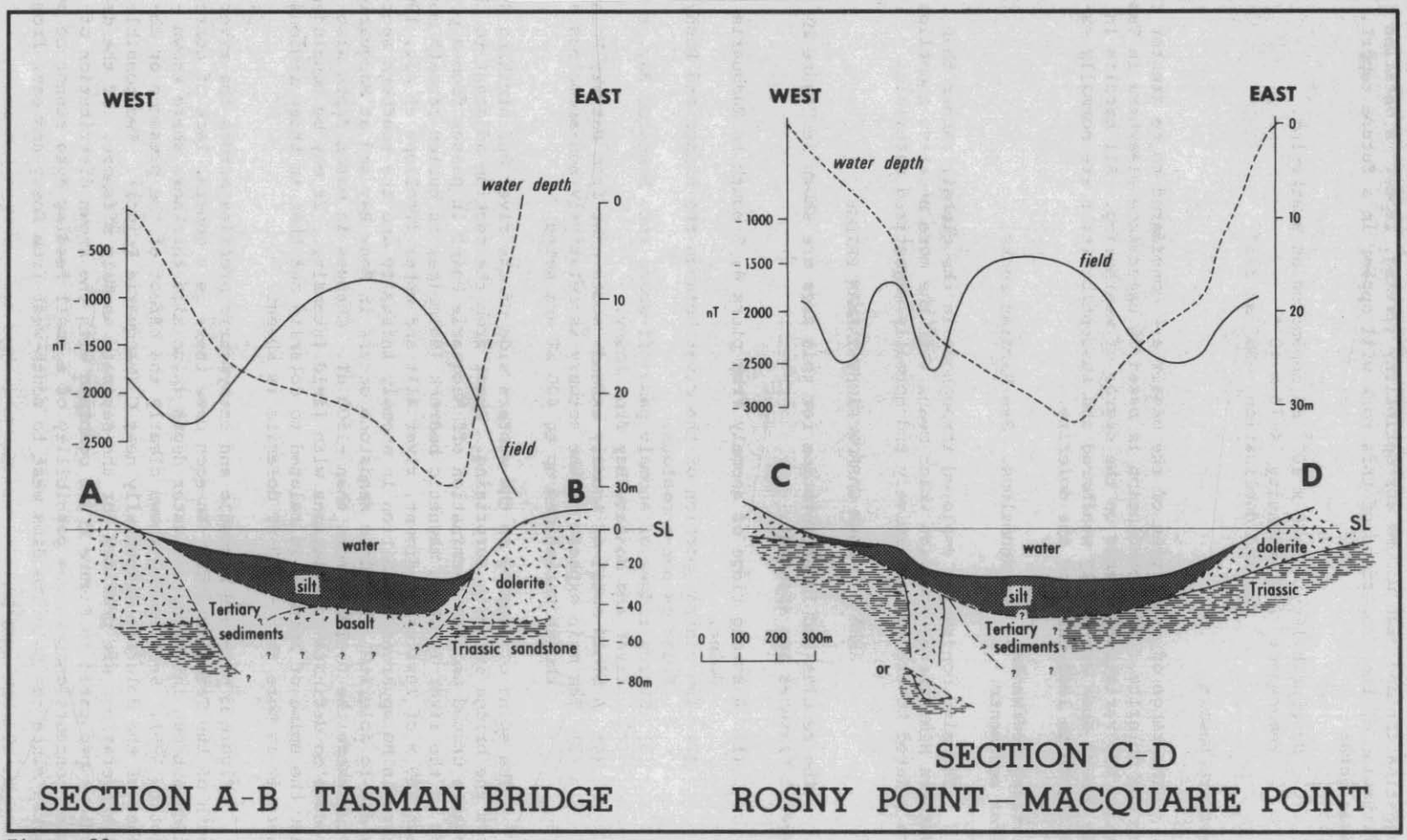

5 cm
WEST
EAST
water depth
field
nT
- 500
- 1000
- 1500
- 2000
- 2500
0
10
20
30m
A
B
SL
water
silt
dolerite
Tertiary sediments
basalt
Triassic sandstone
- 20
- 40
- 60
- 80m
SECTION A-B TASMAN BRIDGE
WEST
EAST
water depth
field
- 1000
- 1500
- 2000
- 2500
- 3000
0
10
20
30m
C
D
SL
water
silt
dolerite
Triassic
Tertiary sediments
or
0 100 200 300m
SECTION C-D
ROSNY POINT — MACQUARIE POINT

Figure 33.

the Domain. As such the structure may be a simple extension of the Lindisfarne feeder trough (Leaman, 1972).

Similar comments apply to the region around Rosny. Dolerite crops out continuously from Kangaroo Bay to the Tasman Bridge and although variable in terms of composition and weathering no inconsistencies are apparent. The highly anomalous zones around Montagu Bay have been confirmed by land traverses. In these zones the dolerite is coarse-grained and partly pegmatitic and granophyric. The dolerite again appears to be terminated in the region of the -1500 nT contour as there is symmetry across river and the Bellerive contact is also at this value. There is no simple relationship between field variations and water depth even though substantial river bed slopes occur around Rosny Point (fig.33, section C-D).

The central portion of the river near the Tasman Bridge has a more positive field intensity than elsewhere in the area. This zone extends about 800 m south of the bridge. Basalt was encountered in the bridge foundations between the two -1500 nT contours and it is therefore implied that the effect is due to basalt which may be reversely magnetised. The peak anomaly in this portion of the river is -600 nT which is significantly higher than any dolerite or sedimentary rock area (fig.33, section A-B).

Areas dominated by sedimentary rocks such as south of Bellerive, offshore near Wrest Point, Rose Bay, Sandy Bay, all yield field intensities of -1400 to -1600 nT with no simple relationship to water depth or silt covering. It may thus be seen that the dolerite areas are 1000 to 2000 nT more negative and the basalt area almost 1000 nT more positive.

The broad swell of anomaly south-east of Battery Point is similarly related to dolerite with values of more than -2500 nT being related to shallow water. The positive area in mid Sandy Bay must represent a 'window' in the dolerite since there are no variations in cover thickness. The general interpretation of the rock units is given in Figure 29 but in summary, it does appear that the dolerite around the eastern Domain, southern portion of Rosny Point and south of Battery Point is lower zone and that the sheet base is present in each case with the erosion of the Tertiary valley of the Derwent revealing the underlying sedimentary rocks. The cover of Tertiary sediments is never reflected in the magnetic field nor does their presence significantly modify its form. A feature which had been anticipated would be anomalous was the basalt centre presumed to exist off-shore near John Garrow Light at Blinking Billy Point. However the field values in this area suggest the presence of dolerite only. It is concluded that no such centre exists or is very minor.

AREA 2. TASMAN BRIDGE-ELWICK BAY

The results and interpretation for this area are shown in Figure 30. Several features are apparent.

(1) The strong ridge of anomaly from piers 4, 5 of the bridge extends north toward Cornelian Bay.
(2) A further strong ridge of anomaly extends off-shore from Rose Bay.
(3) Significant relatively positive anomalies occur off Selfs Point, Lindisfarne Bay and the centre of the bridge.
(4) Other significant anomalies are to be found inshore near Otago Bay, Dowsings Point, Church Point, New Town Bay and Prince of Wales Bay.
(5) Elsewhere this section of river presents anomaly variations of less than 300-400 nT.

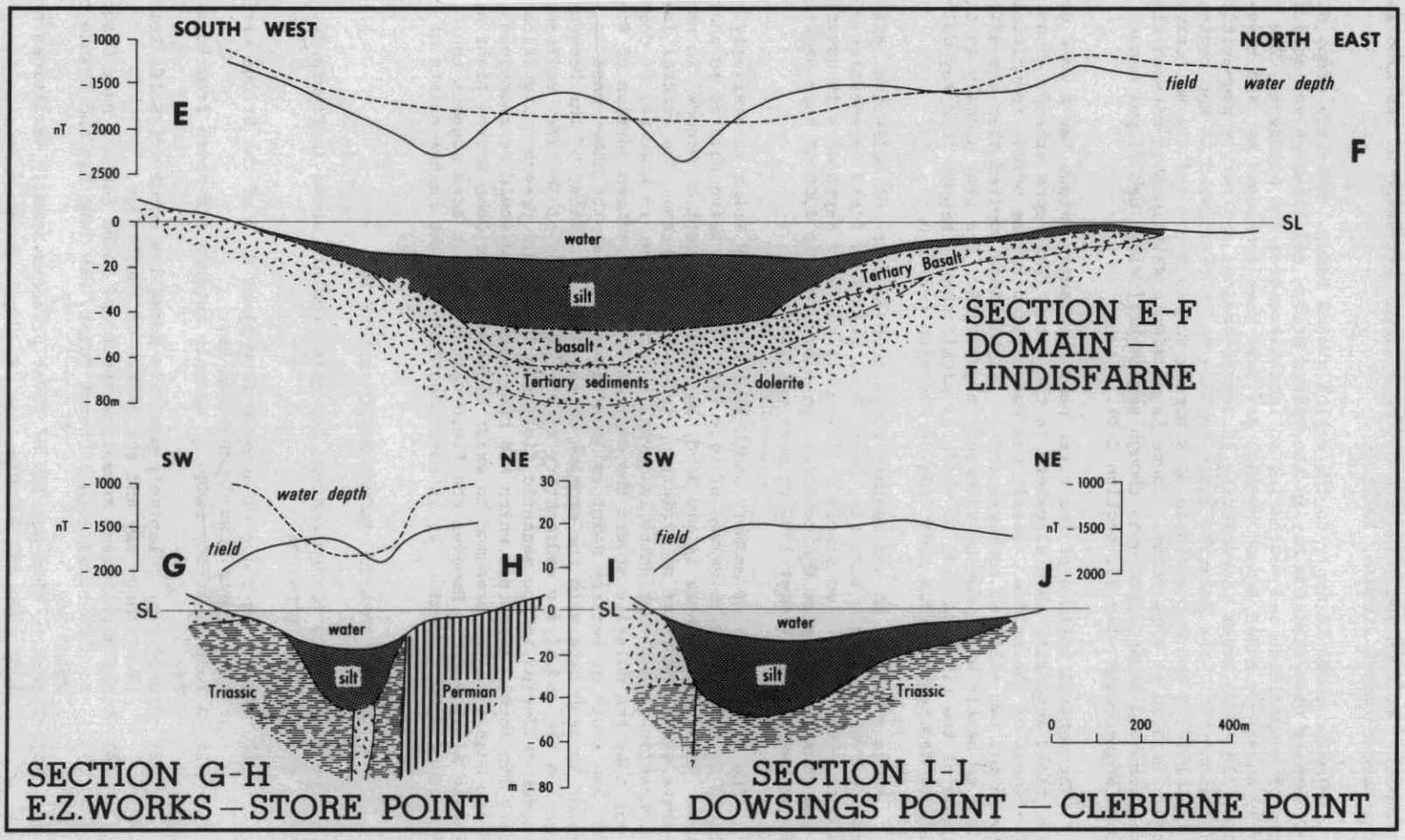

5 cm
SOUTH WEST
NORTH EAST
E
F
field
water depth
nT
- 1000
- 1500
- 2000
- 2500
0
- 20
- 40
- 60
- 80m
SL
water
silt
basalt
Tertiary sediments
dolerite
Tertiary Basalt
SECTION E-F
DOMAIN — LINDISFARNE
SW
NE
G
H
I
J
water depth
field
Triassic
Permian
SECTION G-H
E.Z.WORKS — STORE POINT
SECTION I-J
DOWSINGS POINT — CLEBURNE POINT
30
20
10
m
0
200
400m

Figure 34.

The spine of anomaly in the region of piers 4 and 5 was discussed under Area 1. Similar comments apply for this area. Although no base is exposed for the Domain dolerite, examination of texture and jointing suggest that it is close to sea level south of Cornelian Bay and at Pavilion Point. The -1500 nT contour inshore between these two points probably corresponds closely to the boundary as was suggested above.

Similar comments apply to the anomaly extending offshore at Rose Bay. The -1500 nT contour north of Rose Bay may be correlated with the upper contact of the Lindisfarne dolerite sheet (Leaman, 1972, section 550) which extends across river and also south to Rosny.

Between the two spines of anomaly mentioned above there is a zone in which values as high as -900 nT are recorded (near the Tasman Bridge) and which is an extension of the anomaly due to basalt described under Area 1. The apparent termination of this more positive feature about one kilometre north of the bridge could be due to the absence of basalt or continuity of the dolerite mass across river (contrast fig.33, section A-B, with fig. 34, section E-F). However, since similar anomalies due to basalt are noted on both sides of the mouth of Lindisfarne Bay and at Selfs Point where the basal surface of the basalt is up to 60 m higher than at the Tasman Bridge it seems likely that the dolerite is continuous but partly covered by thick flows of basalt from centres near Selfs Point and Lindisfarne. The basalt may be presumed to occupy Tertiary tributary valleys as well as the Tertiary valley of the Derwent itself. The inferred basalt distribution is clearly indicated in Figure 30 where possible flow directions are also indicated. Again the distribution and thickness of the Tertiary sediments is nowhere indicated.

The basalt exposed on the southern side of Geilston Bay may also be contiguous with the Selfs Point flows. The -1500 nT contour may be correlated with the flow margin and the cross bay traverses each reflect a narrow (∿100 m) band up to 400 nT more positive than background (presumably Permian siltstone). Toward the mouth of the bay this variation is less than 200 nT but still distinct. The 200 nT intensity change could be due to increased depth or the presence of a small volume of material since it is possible that only a thin basalt skin may be present; as suggested by onshore observations. While it was not possible to establish a definite connection with the Selfs Point anomaly, which is very marked, it does appear likely that the two basalts are connected.

The substantial anomaly on the northern side of Selfs Point is, as mentioned above, due to the presence of thick flows of basalt. The limit of the basalt is considered to be picked out approximately by the -1500 nT contour. Basalt is present at shallow depth at the position of the Selfs Point Beacon but is not known further north. Drilling between Woodman Point and the southern section of Bedlam Walls did not encounter any basalt.

The Selfs Point anomaly contrasts strongly with the dolerite anomaly at the western end of New Town Bay, the 'dolerite' anomaly appears to be terminated to the south due to the presence of the basalt cover west of Selfs Point.

The reach of river between Selfs Point and Porters Point is magnetically smooth; there being variations of less than 150 nT. As was noted earlier the Permian rocks produce a slightly more intense field than the Triassic rocks and the contrast between banks of the river may be clearly discerned.

In the region of Store Point and Church Point there is a strong anomaly related to the faulted dolerite dyke which extends from Mt Direction to

the E.Z. works (Hobart map, Leaman, 1973). The anomaly is marked across Risdon Cove but diminishes to the south. The anomalies inshore between the E.Z. works and Prince of Wales Bay are clearly related to the dolerite but are discontinuous. The erratic nature of the anomalies about Abattoirs Point may be explained by the presence of minor intrusions and occurrence of metamorphosed Triassic rocks which suggest that the base of the dolerite is near sea level. The band of anomaly across the central portion of Prince of Wales Bay appears to reflect the western but thicker limit of the Lutana-Dowsings Point dolerite. The region with anomaly values of -1300 to -1500 nT west of Dowsings Point presumably represents a zone where basalt has flowed eastward into a previous tributary valley and is offset from the main basalt occurrences west and north of Prince of Wales Bay.

Anomalies due to dolerite do not generally persist more than 100 m offshore from Dowsings Point. Only near the western portion of Area 2, south of Otago Bay, do these anomalies persist across river. The -1750 nT contour approximates the known limits of the dolerite east of Otago Bay (consistent with the situation off Abattoirs Point and Store Point). Drilling and geophysical surveys between Cleburne Point and Dowsings Point (Leaman, 1977*b*), have shown that Triassic rocks form the bedrock of the region which suggests that the dolerite base is about 30-40 m below sea level off Dowsings Point rising slightly westward and ultimately joined with the dolerite mass at Otago Bay.

The Otago Bay-Dowsings Point-Store Point-Cleburne Point, parallelogram appears to contain mixed Triassic rocks only and the intensity range is less than 200 nT.

The previous discussion has provided general details of the interpretation but certain features have been omitted: the in-river faults. The geological map indicates several structures which should be explained. These are at E on the Domain, opposite Shag Bay, south of Store Point and north of Dowsings Point (see also fig. 34).

Faulting near the Domain

Two major faults are known to pass into the river near the Botanical Gardens. The anomaly pattern in this region is not sufficiently defined to establish whether the faults cross one another or terminate. The interpretation given on Figure 30 is one of several possibilities but it must be noted that the inshore blocks must contain the sheet base as suggested. The western fault may continue up river but a conclusion is not possible on the present information.

Faulting in the Shag Bay region

Two faults are established; one in Shag Bay, the other along Bedlam Walls. The former is relatively minor. However, the Bedlam Walls fault passes onshore with Permian rocks to the west and drilling in the river off New Town Bay has also shown that Permian rocks occur south of Woodman Point. Consequently two faults are indicated; one between Porter Point and the E.Z. works and the other between Woodman Point and Selfs Point. The fault indicated past the E.Z. works allows for the termination of the Store Point anomaly and the general extent of higher field values toward Bedlam Walls. The fault in New Town Bay is considered to be an extension of the Shag Bay fault but with an alteration in displacement character. The seismic survey of Leaman (1975*b*) suggested this arrangement.

Faulting south of Store Point

Fault termination of the Store Point features was suggested above and such an interpretation would also account for the general form of anomalies inshore toward Abattoirs Point. The fault extending from Church Point must also be terminated mid-river, certainly, there is no known expression of it on the western side of the river. A wedge of Triassic sandstone is also believed to extend across river between the dolerite dyke and the latter mentioned fault accounting for the wedging of the anomaly (fig.34, section G-H). Prior to filling near the Risdon ferry terminal, some sandstone was exposed near Store Point.

Faulting north of Dowsings Point

The map indicates a N-S fault between the two Triassic rock series. Whether the trend shown is correct or dolerite occupies the feature cannot be established from the data available. Of greater importance is the matter of the termination of the Dowsings Point dolerite. The overall form of the anomalies suggest a simple sheet base extending from Otago Bay to the E.Z. works with possibly a small fault in Prince of Wales Bay with a downthrow to the north. However, the fault of some magnitude required to be present mid-river from about Shag Bay passes towards Dowsings Point. Since seismic evidence suggests very steep slopes in this region it is possible that the Dowsings Point dolerite mass is terminated by faulting (the possibilities are shown in fig.34, section I-J).

AREA 3. ELWICK BAY-OLD BEACH

The results and interpretation for this area are shown in Figure 31. Several features are apparent.

(1) The anomaly trending southward from Otago Bay (and mentioned under Area 2) is narrow and limited to a band up to 500 m wide.
(2) Substantial anomalies are confined to the Mt Direction shore north of Otago Bay and, with the exception of the reach around Dogshear Point, are very restricted.
(3) A major anomaly is located east of Elliss Point. While the peak anomalous values occur in an area of about 500 m x 500 m the effect of the feature is to be observed over about half of Elwick Bay (<-2000 nT).
(4) Relatively positive anomalies are confined to a band from Old Beach to Dragon Point and south-east across the northern portion of Elwick Bay near the Cadbury's factory.
(5) Anomaly values from Old Beach to Dogshear Point are up to 600-700 nT more negative than sedimentary regions in Areas 1 and 2. Most shore exposures in this area are of Triassic sandstone and mudstone.
(6) There is a general lack of correlation with bathymetry.

The band of anomaly extending southward from Otago Bay was discussed under Area 2. To the east the -1750 nT contour represents the approximate position of the dolerite boundary with Triassic rocks. To the west the -1750 nT contour may represent a similar situation or reflect basalt cover. East of Wilkinsons Point basalt overlies dolerite but it is not known how continuous or persistent this material is. The small areas of >-1500 nT do suggest that the basalt might be general in the eastern portion of Elwick Bay presuming that the flows in this region are reversely magnetised as was the case further south (in Areas 1 and 2). The latter observation cannot be definitive since similar values occur south-east of Otago Bay where Triassic rocks form the magnetic basement.

The major anomaly east of Elliss Point is the most impressive feature located in this survey. It is also solitary and not obviously related to any strongly magnetised material. From Windermere Bay to Rosetta only Triassic sandstone and mudstone crops out on the river banks. There are no small dolerite or basalt occurrences which might suggest a nearby major intrusive or extrusive. Between Rosetta and Wilkinsons Point there are few outcrops but gravel and clay may be seen south of Rosetta and scoriaceous and rubbly basalt is visible from west of Wilkinsons Point to a point south of Otago Bay. The gravity survey of the Hobart area (Leaman, 1972) suggests that a thick trough of Tertiary sediments is present in this region and overlain patchily by basalt. The anomaly is not related to the dolerite bodies on Mt Direction and it bears no simple correspondence with the dolerite dyke at Cadburys. The dolerite at Cadburys (fig.31) is intruded into Triassic rocks but was subsequently overlain by basalt. The western portion of the 'Cadburys' peninsula is capped with basalt. The slightly more positive anomaly at the mouth of Windermere Bay and immediately south of the southernmost promontory on the peninsula is presumed to be related to basalt since dolerite is exposed onshore. The dolerite dyke across the peninsula has a width of about 500 m and a trend slightly east of north. The northern extension of this major anomaly has a comparable trend and real width. This is the only direct correspondence which may realistically, if tenuously, be made about the anomaly which on account of scale and magnitude must be due to dolerite.

The peaking of anomaly off Elliss Point could be explained in several ways; exposure of granophyric material at the surface of the magnetic 'basement'; a feeder; or very shallow depth to dolerite. While the water is shallow in this region it is unlikely that the basement (pre-Tertiary rocks) are at shallow depth since the Tertiary valley of the Derwent must pass across the area of the anomaly as indicated in Leaman (1973, 1976, 1977a) and implied by Leaman (1973). Tertiary sediments underlie the basalt at Windermere Bay and crop out at Knights Point as well as east of Rosetta. If the Tertiary valley of the Derwent has cut into a large dolerite body to a depth of about 100 m then mid-zone magnetic materials would be exposed under the Tertiary cover (fig. 35, section K-L). A similar effect would be observed if a feeder dyke were cut by such erosion. The gravity survey of Leaman (1972) did indicate that the dyke at Cadburys was part of a feeder system and although the trend could not be confirmed at that time it does seem likely, in view of the present information, that the feeder axis passes SSW from the exposed dyke and, where cut by the Tertiary erosion, the anomaly is peaked. A feeder in this position may be inferred from the structural constraints imposed by the complex intrusions on Mt Direction (see also Leaman, 1972).

South of Dogshear Point sizeable anomalies extend across river to the Mt Direction shore. These anomalies appear to pass onshore where only Triassic rocks are exposed. The scale of the anomalies is such that dolerite must be present at shallow depth although there are few indications of this in terms of metamorphism or minor intrusions. The interpretation given on the map shows dolerite as the magnetic bedrock around Dogshear Point. However the symbol (SS/) indicates that a thin sandstone cover is implied. On the eastern bank of the river, opposite Dogshear Point in an area enclosed by faults the increasing anomaly suggests that dolerite is at very shallow depth and rising onto the lower part of Mt Direction. This situation is indicated in Figure 31, section M-N. The mid-river anomalies are less and such an observation is compatible with this conclusion. This was also the model proposed in the gravity interpretation of the area (Leaman, 1972, section 625) although the feeder S8 referred to in that summary is shown as near vertical. The structure is terminated at, or near, an extension of an E-W fault in the region which may also account in part, for the shape of the peninsula.

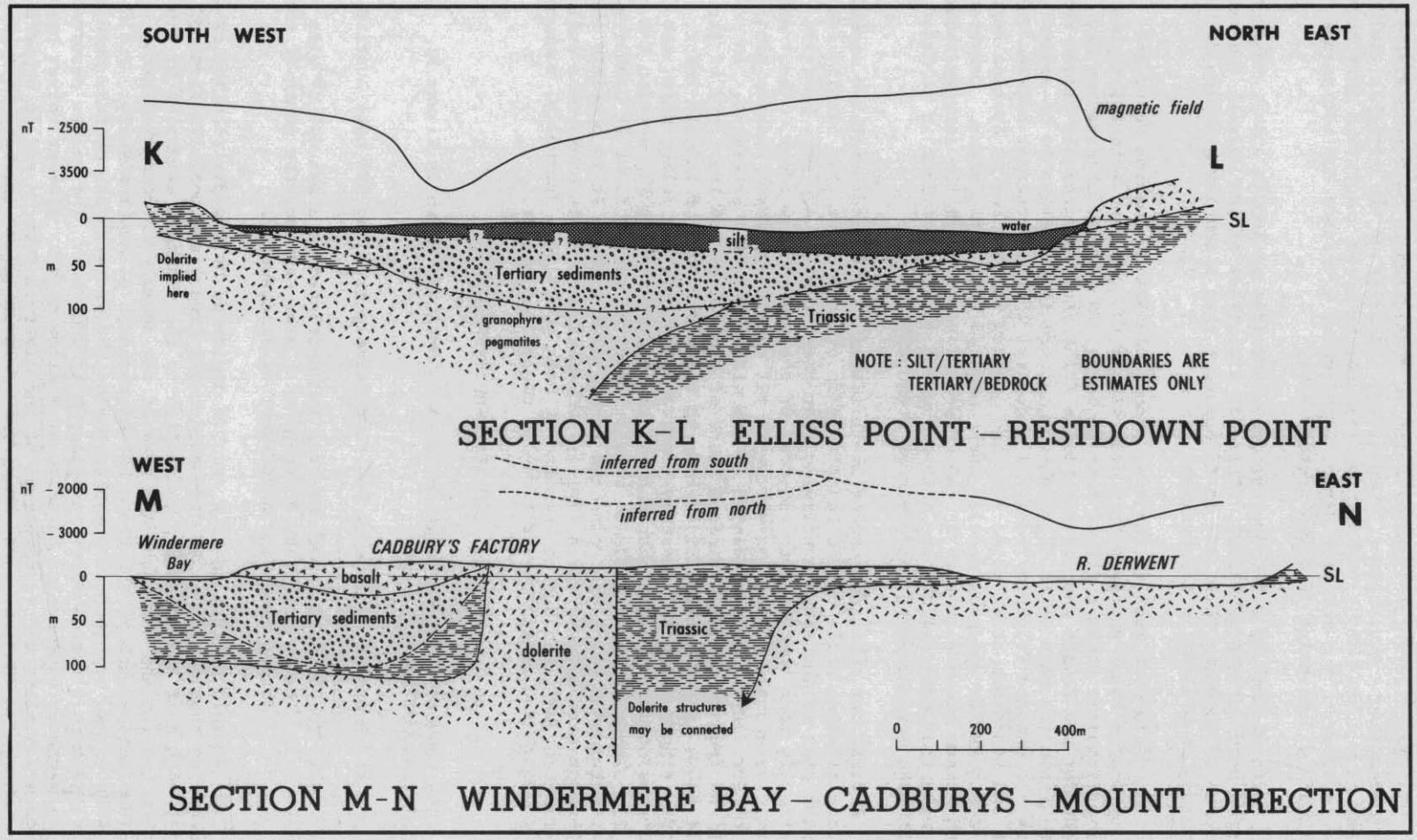


Figure 35.

5 cm

The region north of Dogshear Point is considered to be a predominantly sandstone-mudstone succession. However the intensity of the magnetic field is less than normal (by ∿-600 nT) for sedimentary areas suggesting that dolerite is present at a moderate depth, although at a greater depth than the area south of the point (fig. 35, section M-N).

North of Cadbury's factory the dyke described at length above, has not produced very intense anomalies. There is a contrast of 400 nT with the region north of Dogshear Point and it is apparent that a complex grouping of intrusions is present in this region.

The field over much of the area around Old Beach, Austins Ferry and east of Dragon Point suggests that dolerite is the dominant material with a cover of Triassic rocks north of Austins Ferry. A similar observation may be made for the region west of the Elliss Point anomaly since all values recorded within the bays south of Knights Point are too negative to be accounted for by the exposed Triassic rocks. The general lack of contrast between dolerite and sandstone areas noted near the Cadbury factory and at Austins Ferry provides quite exceptional results when compared with other areas. Conversely the contrasts shown elsewhere in the surveyed area confirm the interpretation and imply that many regions are either free of dolerite or lack it to great depths (the general situation south of Otago Bay).

A final but important aspect in this area is the basalt-related anomaly trending offshore north of Old Beach. It is at this point that basalts from Brighton pass to the river confirming that these basalts are more positive magnetically than the dolerite and most of the sedimentary rocks. The trend of positive anomaly correlates well with all basalt exposures and the presence of Tertiary sediments related to the old valley of the Derwent. An interesting feature of the indicated trend of the valley and the trend of the basalt flows is the general divergence to the south-east of Knights Point. This may simply reflect late-stage topographic details in valley form, the basalts being much younger than many of the sediments (fig.35, section K-L, near L). There is no evidence to suggest that the basalt flows at Cadburys and at Wilkinsons Point are connected across Elwick Bay. It is possible that the interpretation given which implies sedimentary rocks is based on a null rendering of the field due to presence of both positively (normally) magnetised dolerite and negatively (reversely) magnetised basalt.

AREA 4. OLD BEACH-BRIDGEWATER

The results and interpetation for this area are shown in Figure 32. Several features are apparent.

(1) There is a ridge of positive anomaly trending NNE near Austins Ferry.
(2) The anomaly range observed is restricted to about 400 nT with abrupt gradients observed only near Granton, the mouth of the Jordan River and north-west of Bridgewater.

The anomaly pattern in this area is dominated by the distribution of the numerous basalt flows. As discussed under Area 3 the positive ridge of anomaly seen near Austins Ferry is related to the southern extension of the Brighton basalts and the trend and form of the anomaly is confirmed here. The ridge passes onshore about one kilometre north of Austins Ferry. Field values in excess of -2000 nT are observed on the western side of this channel of the river in a region where Triassic rocks crop out. The values observed imply a magnetic basement of dolerite at shallow depth. Similar values have been observed along the western side of the river to Granton and it appears

likely that the dolerite observed adjacent to the Midland Highway is the roof of an intrusion transgressing from the east.

Leaman (1972) considered this dolerite to form a sheet base (section 650). This conclusion is not consistent with the present observations and the feature can most simply be explained as the transgressive western arm of feeder S8. Such an interpretation resolves the problems in gravimetric interpretation noted by Leaman (1972) for blocks C, C1, C2, C3 in sections 600-700. The present conclusion would also be consistent with the re-interpreted Collinsvale structure (Leaman, 1975*c*) and the gravimetric implications of the lower Glenorchy sheet (also in blocks C, section 550-575) (Leaman, 1972).

Along the eastern side of the river more negative anomalies are related to dolerite or a thin basalt cover on dolerite. The anomaly pattern at the confluence of the Derwent and Jordan Rivers is difficult to interpret. The anomalies are strongly negative suggesting a general absence of basalt or a very thin cover on dolerite (in the east) and sandstone (in the west). Strong gradients have been observed in this region suggesting a rapid thinning of the basaltic materials. Similar gradients have been noted south-east of Granton. In general, however, the reach of the river south of the Bridgewater causeway appears to have a base of basalt flows on dolerite or rocks containing dolerite.

The contrast between the situation of dolerite and basalt on dolerite was observed north-west of Bridgewater where an abrupt gradient with 300 nT relief in anomaly was noted.

REFERENCES

IRVING, E. 1956. The magnetisation of Mesozoic dolerites of Tasmania. *Pap. Proc.R.Soc.Tasm.* 90:157-168.

LEAMAN, D.E. 1971. Hobart engineering geology map series. *Department of Mines, Tasmania.*

LEAMAN, D.E. 1972. Gravity survey of the Hobart district. *Bull.geol.Surv. Tasm.* 52.

LEAMAN, D.E. 1973. Geological atlas 1:50 000 series. Sheet 82 (8312S). Hobart. *Department of Mines, Tasmania.*

LEAMAN, D.E. 1975*a*. Magnetic anomalies, Derwent Estuary and Storm Bay. *Tech.Rep.Dep.Mines Tasm.* 18:55-59.

LEAMAN, D.E. 1975*b*. River Derwent seismic and magnetic survey. Site of proposed Bedlam Walls bridge. *Tech.Rep.Dep.Mines Tasm.* 18:103-105.

LEAMAN, D.E. 1975*c*. Structural re-interpretation of the Glenorchy-Collinsvale region. *Unpubl.Rep.Dep.Mines Tasm.* 1975/13.

LEAMAN, D.E. 1976. Geological atlas 1:50 000 series. Sheet 82 (8312S). Hobart. *Explan.Rep.geol.Surv.Tasm.*

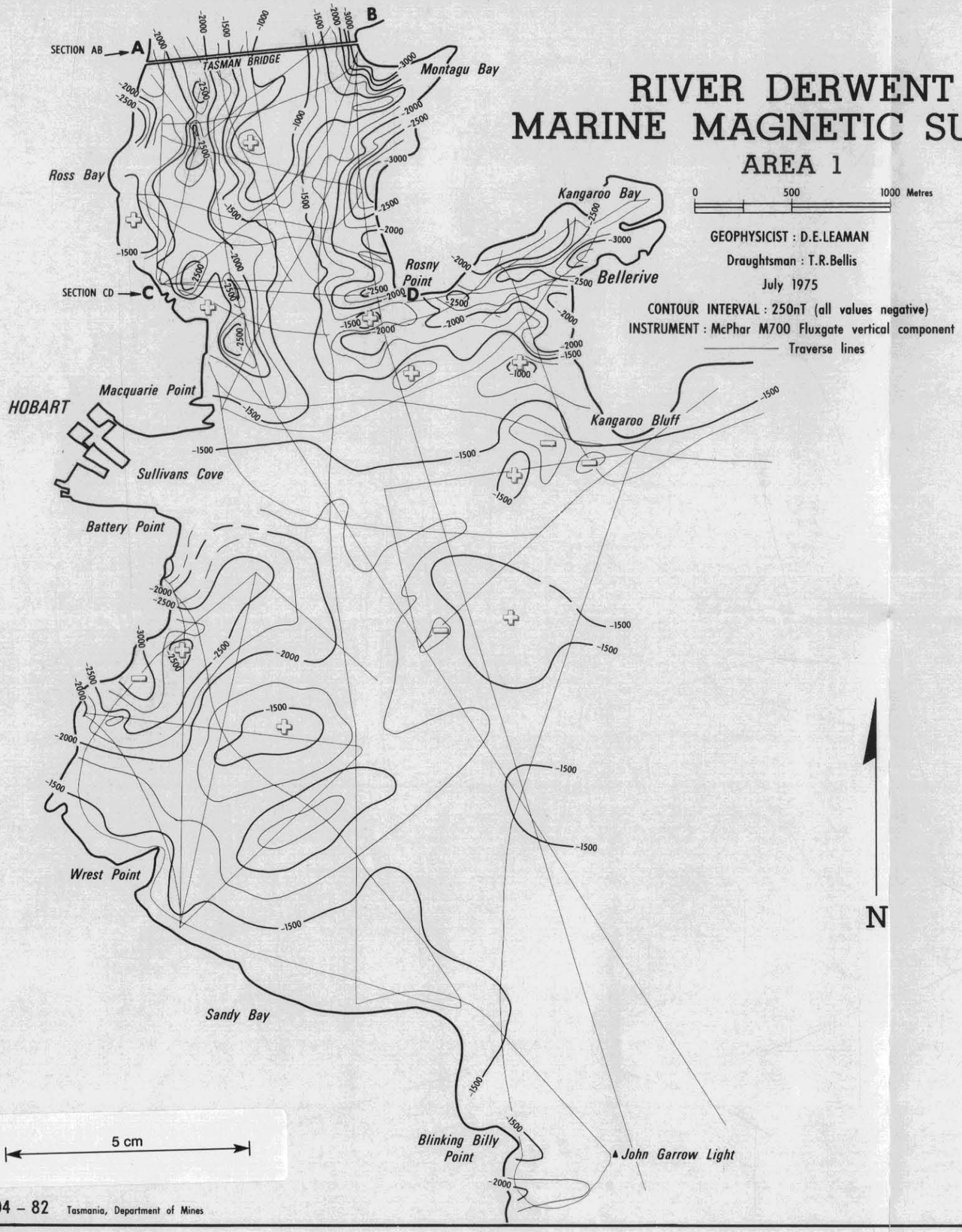
LEAMAN, D.E. 1977*a*. The River Derwent: Elwick Bay to Macquarie Point. Geology: Facts, deductions and problems. *Tech.Rep.Dep.Mines Tasm.* 20:85-101.

LEAMAN, D.E. 1977*b*. Second Derwent Crossing Study. Magnetic and seismic survey: Dowsings Point area. *Tech.Rep.Dep.Mines Tasm.* 20:102-115.

TROLLOPE, D.H.; FREEMAN, McD.; PECK, G.M. 1966. Tasman Bridge foundations. *J.Instn Engrs Aust.* 38:117-130.

[3 July 1975]

RIVER DERWENT
MARINE MAGNETIC SURVEY
AREA 1



0 500 1000 Metres

GEOPHYSICIST : D.E.LEAMAN

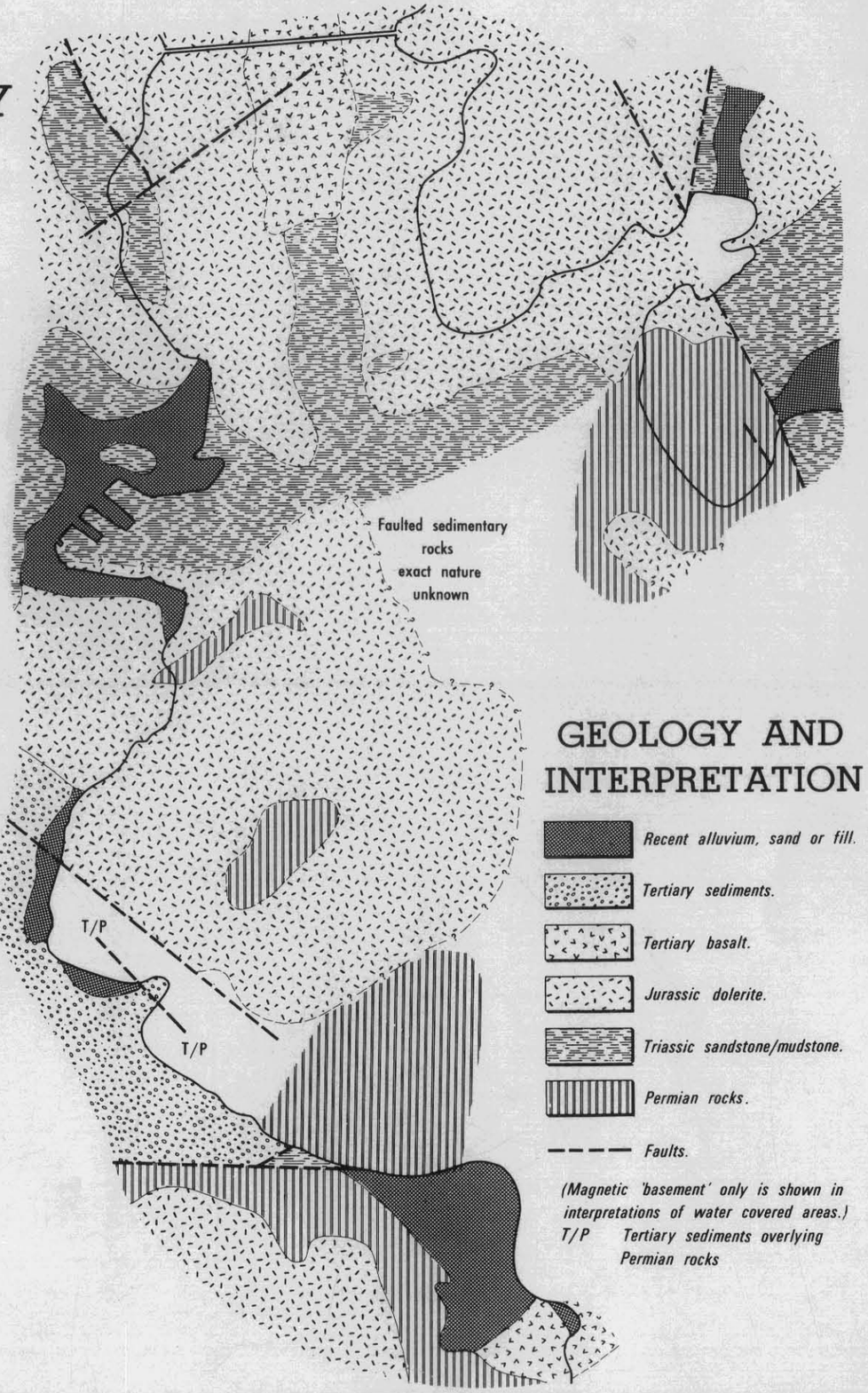
Draughtsman : T.R.Bellis

July 1975

CONTOUR INTERVAL : 250nT (all values negative)

INSTRUMENT : McPhar M700 Fluxgate vertical component

Traverse lines



GEOLOGY AND INTERPRETATION

- *Recent alluvium, sand or fill.*
- *Tertiary sediments.*
- *Tertiary basalt.*
- *Jurassic dolerite.*
- *Triassic sandstone/mudstone.*
- *Permian rocks.*
- *Faults.*

(Magnetic 'basement' only is shown in interpretations of water covered areas.)

T/P Tertiary sediments overlying Permian rocks

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FIGURE 29

TR20-116-118

RIVER DERWENT
MARINE MAGNETIC SURVEY
AREA 2

0 500 1000 Metres

GEOPHYSICIST : D.E.LEAMAN

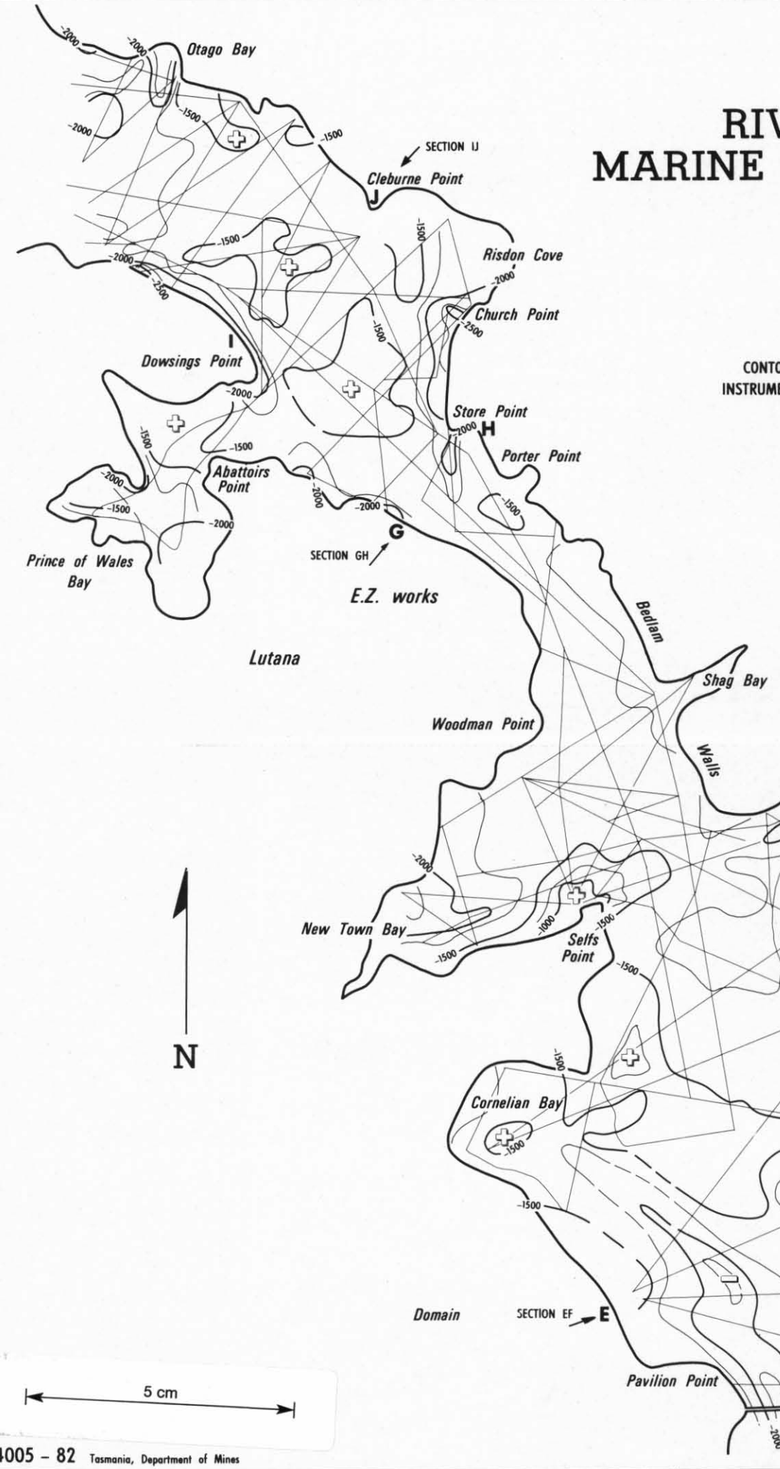
Draughtsman : T.R.Bellis

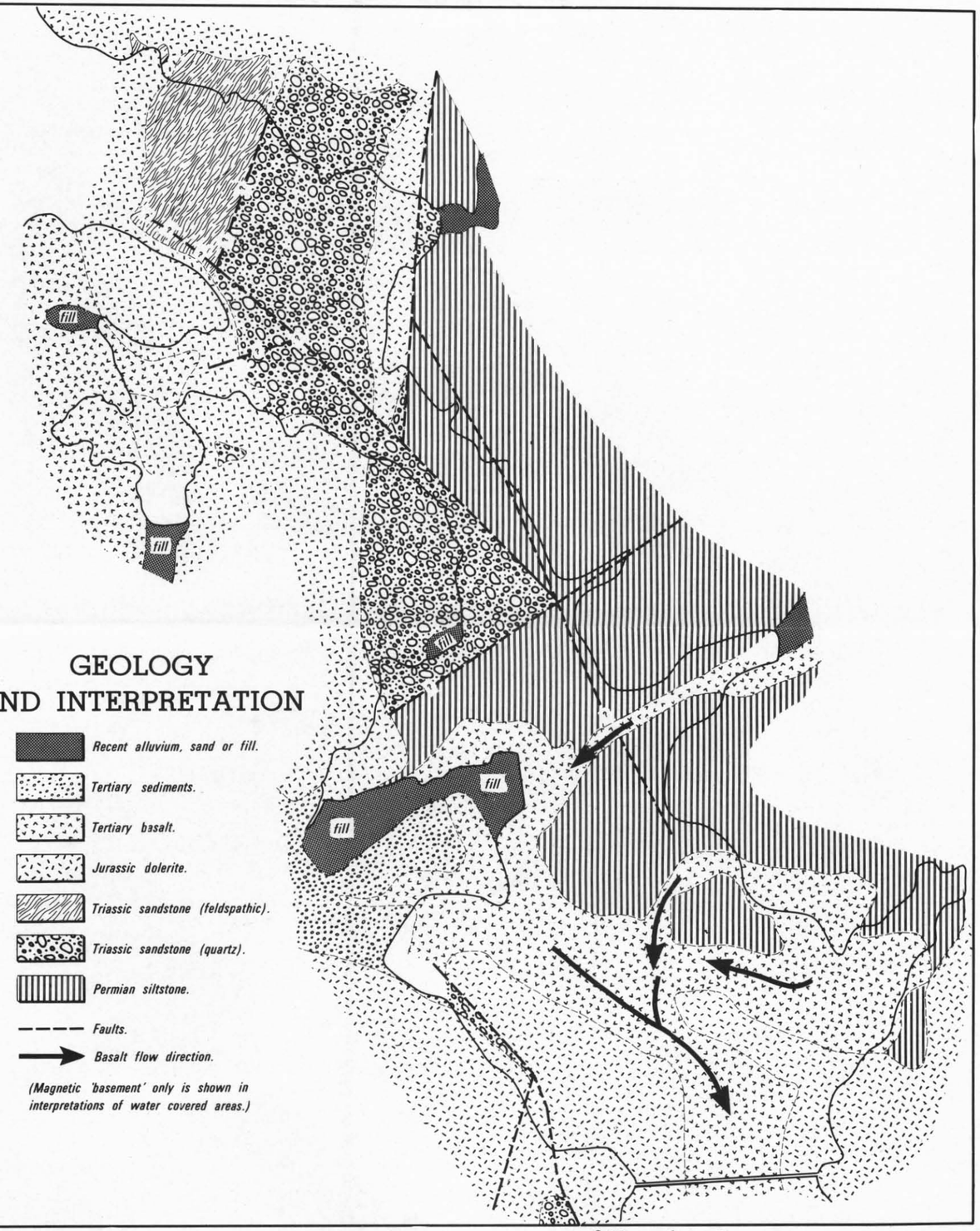
July 1975

CONTOUR INTERVAL : 250nT (all values negative)

INSTRUMENT : McPhar M700 Fluxgate vertical component

——— Traverse lines





GEOLOGY AND INTERPRETATION

- Recent alluvium, sand or fill.
- Tertiary sediments.
- Tertiary basalt.
- Jurassic dolerite.
- Triassic sandstone (feldspathic).
- Triassic sandstone (quartz).
- Permian siltstone.
- Faults.
- Basalt flow direction.

(Magnetic 'basement' only is shown in interpretations of water covered areas.)

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FIGURE 30

TR80_116_118

Tech.Rep.Dep.Mines Tasm. 20.

RIVER DERWENT
MARINE MAGNETIC SURVEY
AREA 3

0 500 1000 Metres

GEOPHYSICIST : D.E.LEAMAN

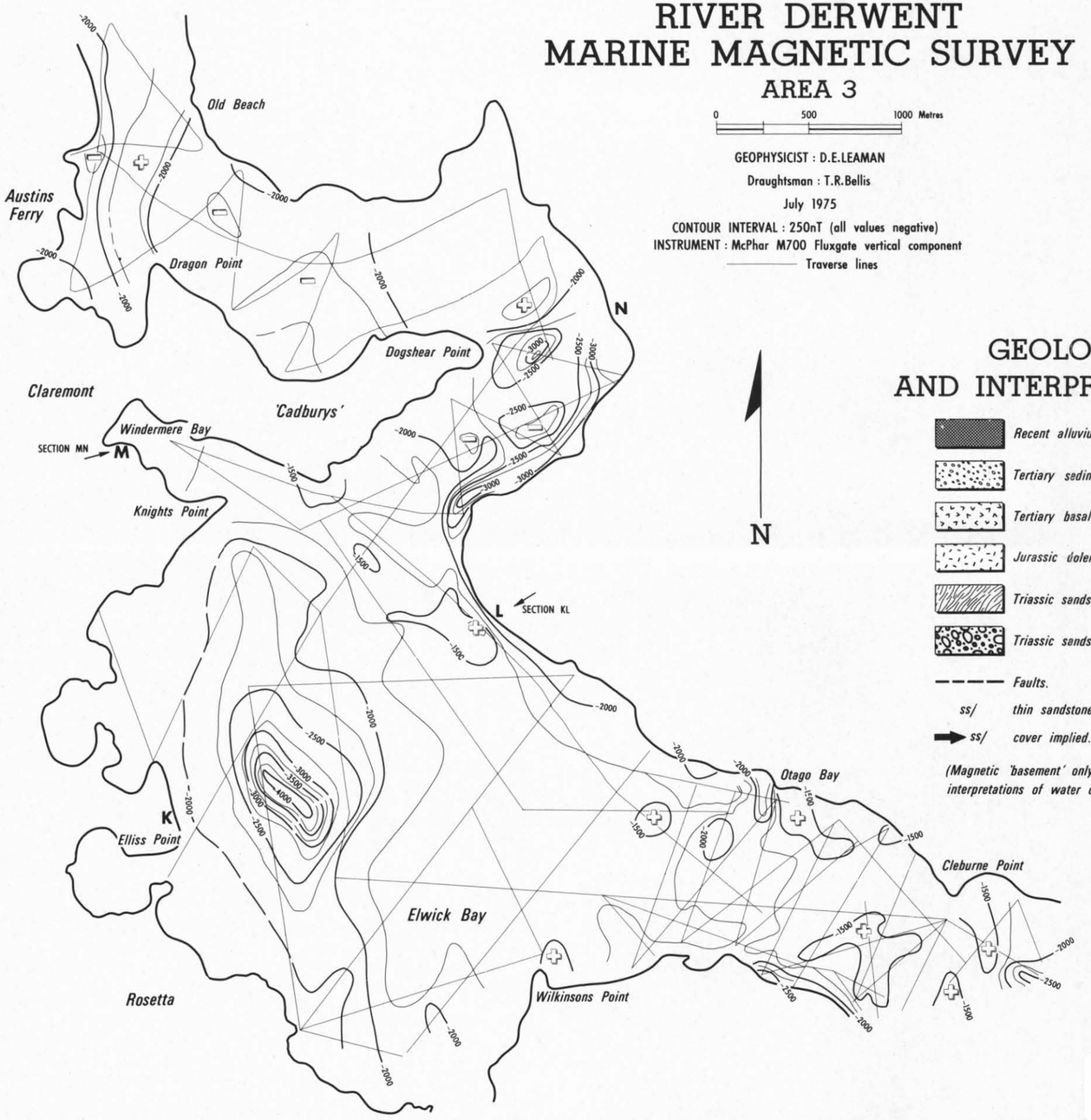
Draughtsman : T.R.Bellis

July 1975

CONTOUR INTERVAL : 250nT (all values negative)

INSTRUMENT : McPhar M700 Fluxgate vertical component

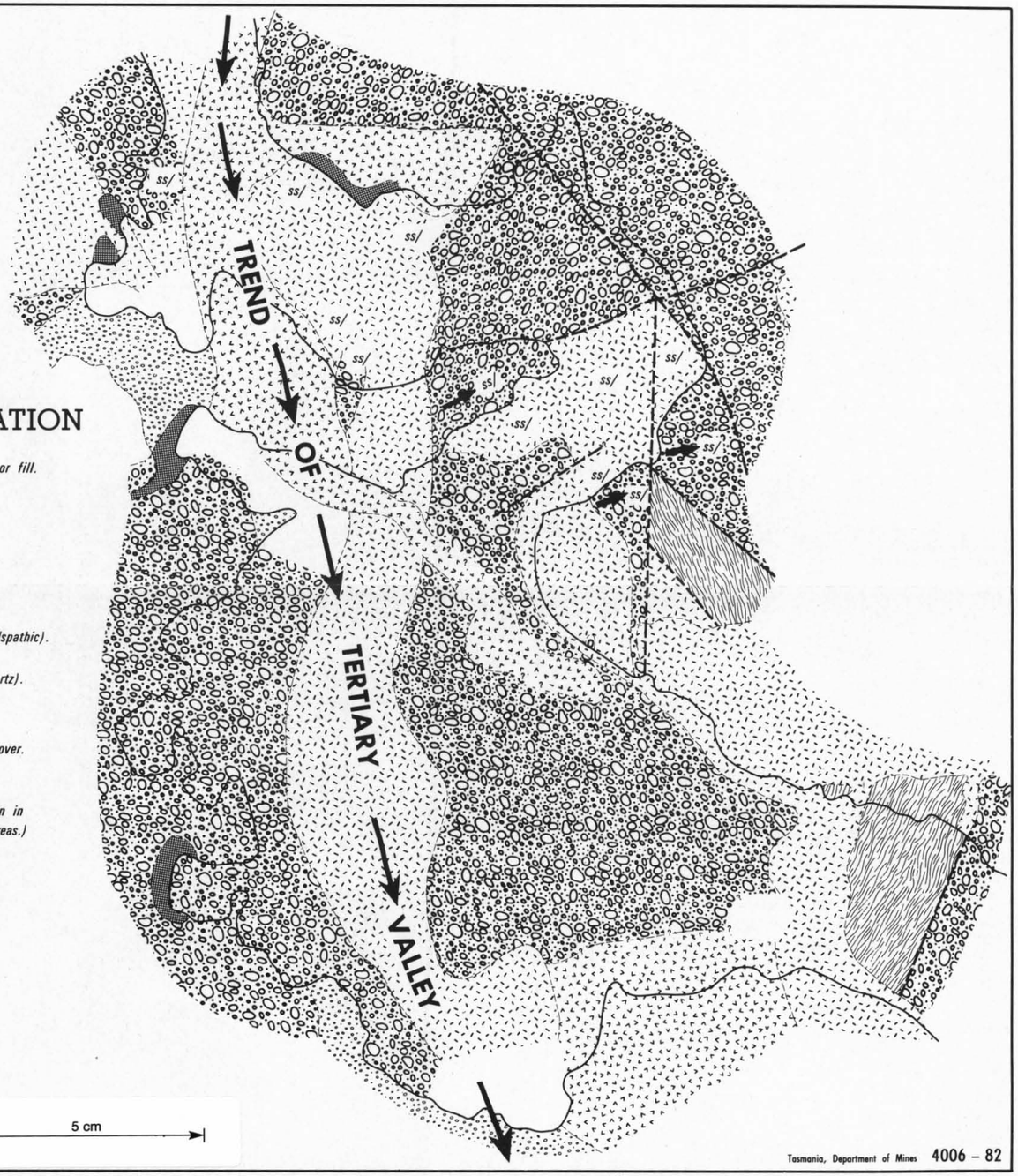
Traverse lines



GEOLOGY AND INTERPRETATION

- Recent alluvium, sand or fill.
- Tertiary sediments.
- Tertiary basalt.
- Jurassic dolerite.
- Triassic sandstone (feldspathic).
- Triassic sandstone (quartz).
- Faults.
- ss/ thin sandstone series cover.
- ss/ cover implied.

(Magnetic 'basement' only is shown in interpretations of water covered areas.)



5 cm

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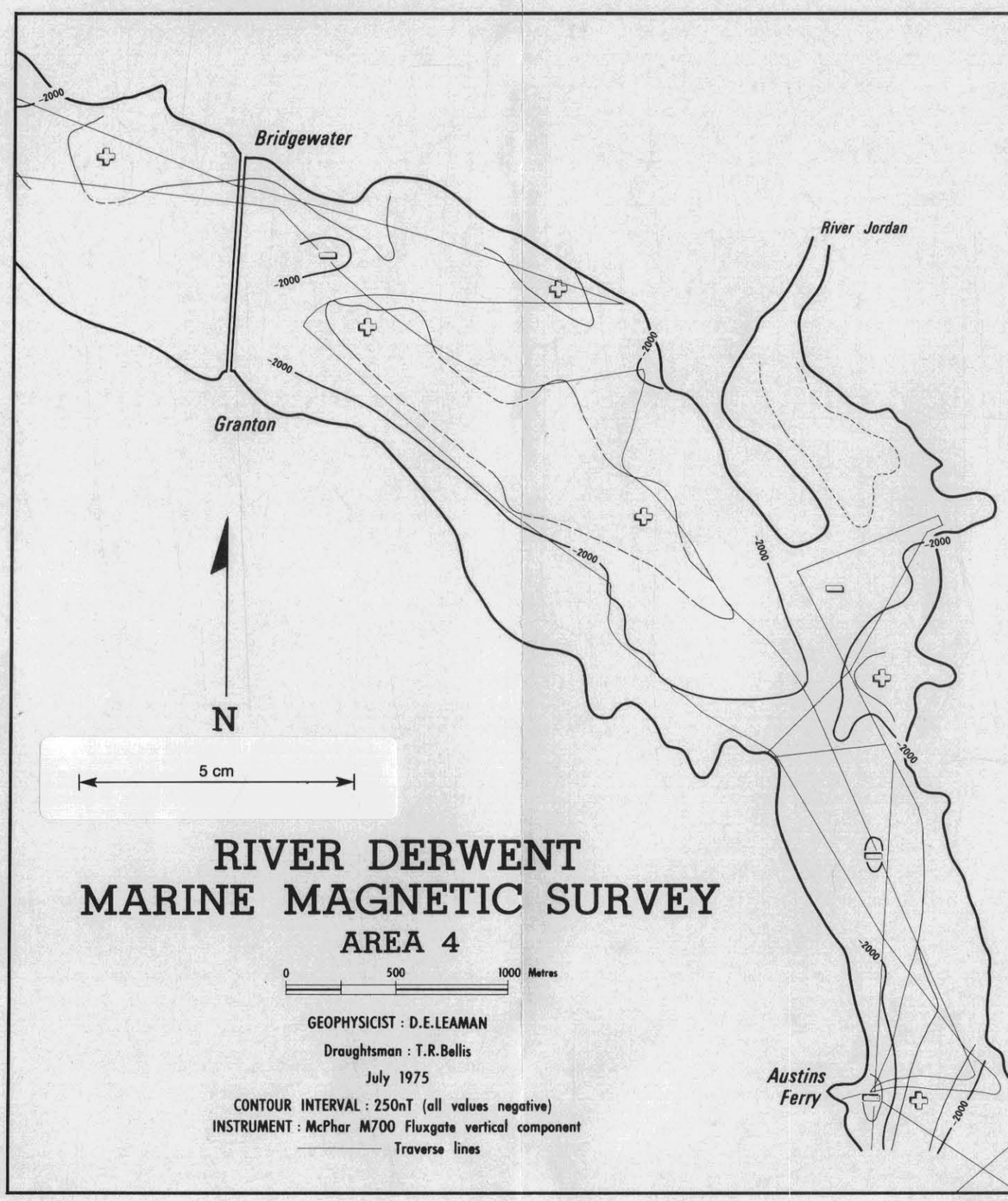
FIGURE 31

TR20-116-118

Tech.Rep.Dep.Mines Tasm. 20.



RIVER DERWENT MARINE MAGNETIC SURVEY

AREA 4

0 500 1000 Metres

GEOPHYSICIST : D.E.LEAMAN

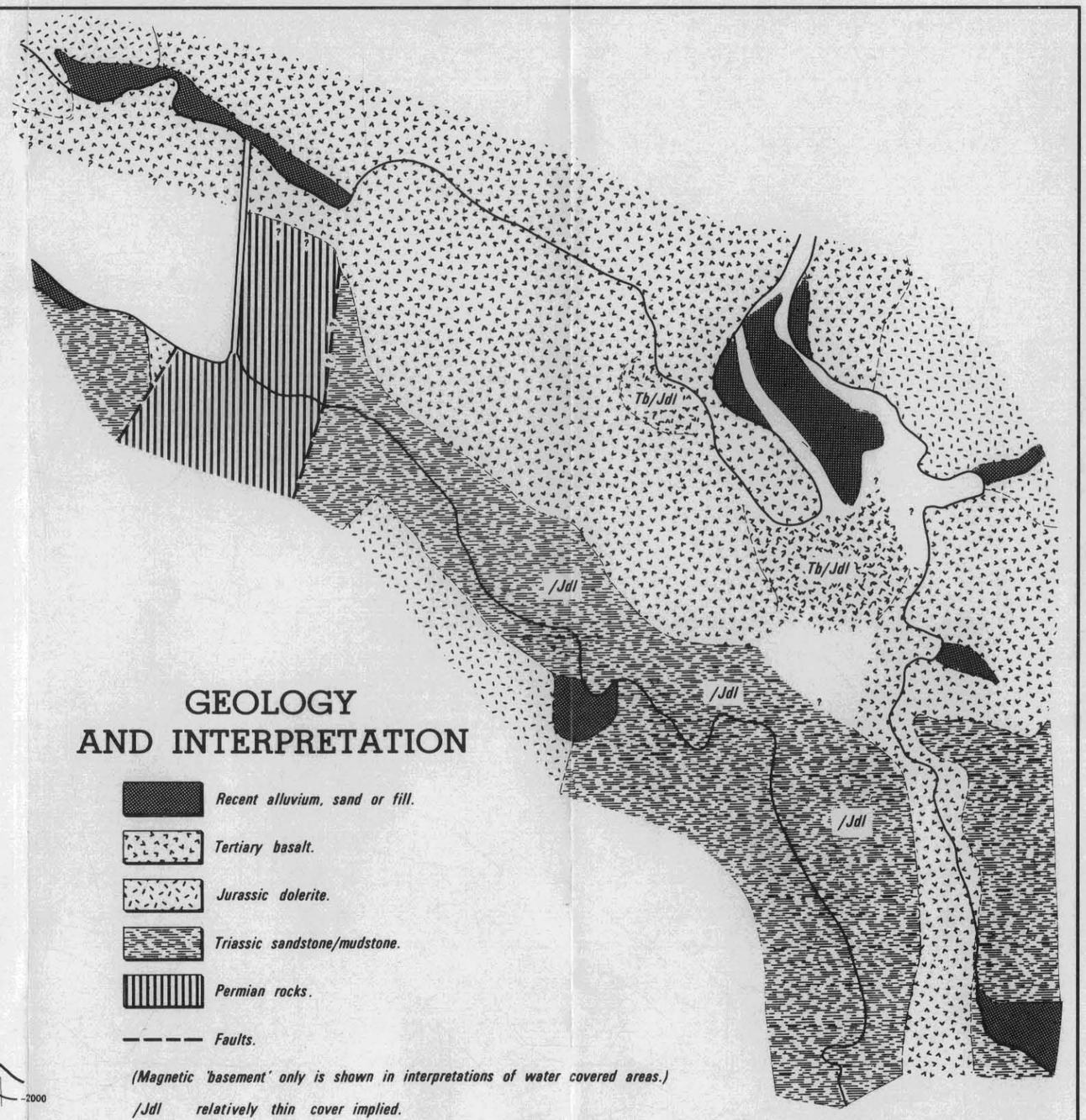
Draughtsman : T.R.Bellis

July 1975

CONTOUR INTERVAL : 250nT (all values negative)

INSTRUMENT : McPhar M700 Fluxgate vertical component

——— Traverse lines



GEOLOGY AND INTERPRETATION

- Recent alluvium, sand or fill.
- Tertiary basalt.
- Jurassic dolerite.
- Triassic sandstone/mudstone.
- Permian rocks.
- ———— Faults.

(Magnetic 'basement' only is shown in interpretations of water covered areas.)

/Jdl relatively thin cover implied.

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FIGURE 32

TR20_116_118