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20. Geophysical survey on proposed bore site areas, Kingston and Taroona.

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Recent detailed mapping of Middle Permian formations from Kingston southward has revealed a number of inconsistencies and variations (Moore, 1972) with respect to the accepted section based on Mt Nassau and various other localities (Banks, 1962). One such location is the Grange quarry at Taroona. In order to determine the stratigraphic and faunal succession a drill hole is proposed in the area between Whitewater Creek and Taroona. The nature of the problem is fully discussed by Moore (1972).

The choice of a suitable drilling site is far from simple however, because the area is intruded and to a large extent covered by dolerite. In addition there are few places where it is possible to commence drilling at a known and fixed stratigraphic level. Two possible sites are along the western side of the Southern Outlet road 1-2 km north of Kingston or above the cliffs south of Taroona Beach. In each case drilling would commence several tens of metres above the Risdon Sandstone or its equivalent. From such a level at least 300 m of drilling would be necessary to pass through the horizons to be examined.

In view of the depth involved and the possibility of an intrusion at, or about the specified level a geophysical survey was requested in order to provide more information about the area generally. It was then hoped that one or other site would emerge as a feasible prospect.

GENERAL GEOLOGY

The area between Kingston and Taroona is dominated by the massive southern spur of Mt Nelson and is almost wholly dolerite. East and west of the spur, Upper Permian rocks are exposed dipping westward. Triassic rocks are faulted between Kingston and the southern end of the Nelson spur.

In the region of the Southern Outlet road there are two dolerite bodies exposed, one intruded in the probably faulted margin of the other. The second and smaller body appears to dip steeply eastward. The shape of the larger mass is unknown except that it presumably forms part of the Nelson feeder (Leaman, 1970, 1972).

On the Taroona side of the spur the dolerite boundary appears to be concordant for the most part, although it is faulted (Leaman, 1973). Regionally the dolerite (main body) appears to rise to the east, south and west through the Upper Permian rocks from the centre 2 km north-west of Taroona.

A very thick succession of Tertiary sediments occupies the fault trough which has its western margin at the western end of Taroona Beach and the cliffs south of Taroona.

On the basis of the regional geology either area appears to offer a good drilling site with perhaps some doubt pertaining to the Southern Outlet area. However, problems arise when each area is examined in detail. One kilometre WNW of Kingston a small dolerite plug crops out in Upper Permian siltstone. Further, a regional gravity survey (Leaman, 1973), indicates a positive trend, offset to the south-west of the obvious dolerite of Mt Nelson and its spur. This south-west trend extends from the main dolerite body across the small outcrop to the first major fault west of Kingston (Leaman, 1973). The magnitude of the gravity offset implies either a large or shallow intrusive body somewhere in the section. In the second area, south of Taroona, dolerite intrudes a wide fault zone along Taronga Road. Such narrow

dolerite dykes are often part of a major upstep, in this case possibly from the east (compare Piersons Pt section in Leaman, 1970, 1972).

GEOPHYSICAL SURVEY

In order to evaluate the sites, detailed gravity and magnetic surveys were undertaken. In particular detailed traverses were completed along Taronga Road and Taroona Beach and an increased coverage was installed west of the Southern Outlet Road. Profiles and sections are shown in Figure 29. All gravity stations were levelled. The gravity survey confirmed the south-west offset of the anomaly and showed that when due allowance is made for a NW-SE regional of 0.8 mgal/km, the spine of the anomaly passes toward the small dolerite outcrop in Whitewater Creek. There is also a basalt centre in this same locality but it would be most unlikely for a basalt structure to have caused the anomaly pattern.

The two traverses in the Taroona area show comparable gradients away from the river but the Taroona Beach traverse is markedly affected by the fault trough. The Taronga Beach traverse also confirms the concavity in the contours suggested by the regional survey. A value of 13-14 mgal is typical of this sedimentary block as compared with 16-20 mgal for the Kingston side of the dolerite. The contrast is even greater than is apparent since the crustal regional component would have raised the Taronga block by 2 mgal with respect to western block. Therefore there is a 5-7 mgal contrast between the two blocks which are exposed at the same stratigraphic level.

There is no doubt that the fault intrusion boundary along Proctors Road and the Southern Outlet has controlled part of the Nelson feeder system and this has caused the elevation of values. However, the gradient is far less than would be expected if dolerite were absent west of the road (this is not so further north, see Southern Outlet profile). Therefore, part of the dolerite from a probable multiple feeder intrudes the Kingston block. Examination of the possibilities shown in the section will show that it is not possible to remove the ambiguities of scale and depth in this instance (fig. 29). It appears that only a wedging tongue is present, as the next block to the west probably lacks dolerite (see discussion in Leaman, 1972).

The results along Taronga Road show no effect from the presence of faults or dykes (see map, Leaman, 1973) and the values are consistently low across the block until the eastern side of the Nelson spur is reached.

DETAILED INTERPRETATION

Southern Outlet profile

Three models are shown in Figure 29. The main body of dolerite is coarse-grained and highly differentiated suggesting either a thick sheet below or magma transfer from a feeder. A typical thickness of sheet assuming realistic density values (2850 kg/m^3-2900 kg/m^3, models 1 and 2, compared with Permian high level siltstone at 2520 kg/m^3) results in a reasonable fit to the curve. Due consideration of the chilled dolerite as a dyke results in a very good curve match (model 3). The south-trending anomaly spine confirms this structure. It must be noted that the basic anomaly is 3.5-4 mgal and could only be produced by a thick sheet. It is thus unlikely that any significant sheet continues west of the road.

However, as mentioned earlier the anomaly pattern spreads south of the section (fig. 29) and there is unquestionably dolerite in this area. The extent of the dolerite is very difficult to determine as the Kingston plug is the only outcrop.

Taroona-Taronga profile

Comparison of the four models shown in Figure 29 shows that at least 800 m of Tertiary sediment with density 2000 kg/m^3 is present. Models 3 and 4 imply that this density value is not a good average although the thickness scale and gradients are reasonably correct. Probably a fault scarp is being modelled and this particular area has marked deposits of dolerite boulders within the Tertiary clays. Postulation of a conglomerate wedge (density 2300 kg/m^3) beneath the Tertiary sediments gives a good curve match. The uphill structure of the sheet base overlying Permian rocks appears correct (note also the equivalent gradient in the Taronga profile plotted separately). It appears unlikely that the Permian rocks are intruded by an additional sheet since this would alter the thickness requirement for the Tertiary basin. Addition of a dolerite sheet 300 m in thickness would imply increasing the Tertiary section of the model by about 150 m. The total thickness already implied is very large and more would be excessive.

CONCLUSIONS

The two blocks examined are apparently devoid of large masses of dolerite with the exception of the southernmost part of the Kingston block. However it is possible that the Nelson mass is of greater thickness than presumed and such a consideration would permit the introduction of a western sheet from which the chilled dyke may be an eastern limb. Since the interpretation only deals with gravity differences this cannot be determined. Also pertinent to this point is the erratic nature of all magnetic results, which range up to 150 gammas whereas in normal un-intruded Permian rocks this would not be so. As a consequence, the Kingston block cannot be recommended as a drilling site with any great assurance.

Drilling could be recommended with a much higher degree of safety above the cliffs south of Taroona.

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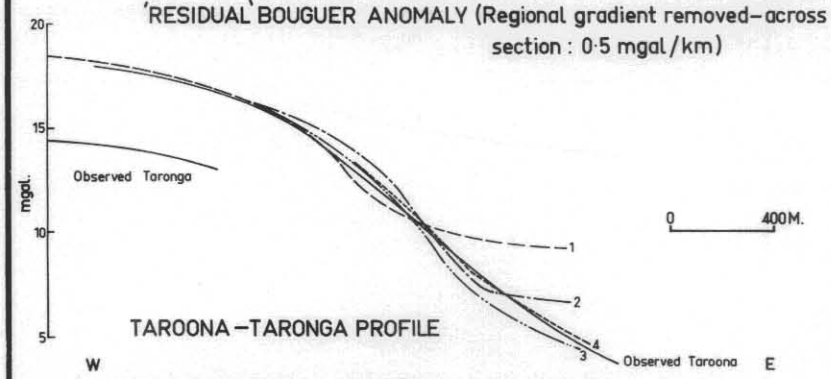
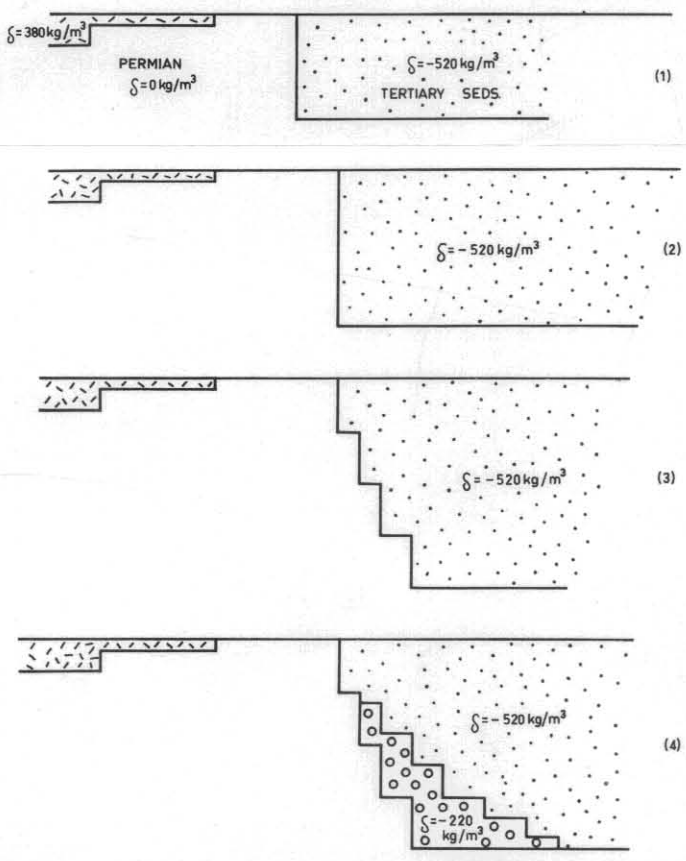
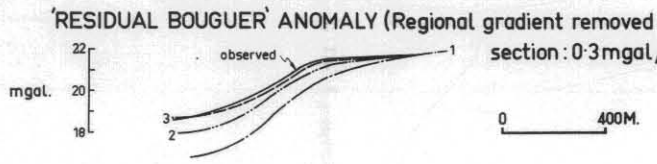
'RESIDUAL' BOUGUER ANOMALY (Regional gradient removed–across section : 0·5 mgal/km)



TAROONA–TARONGA PROFILE

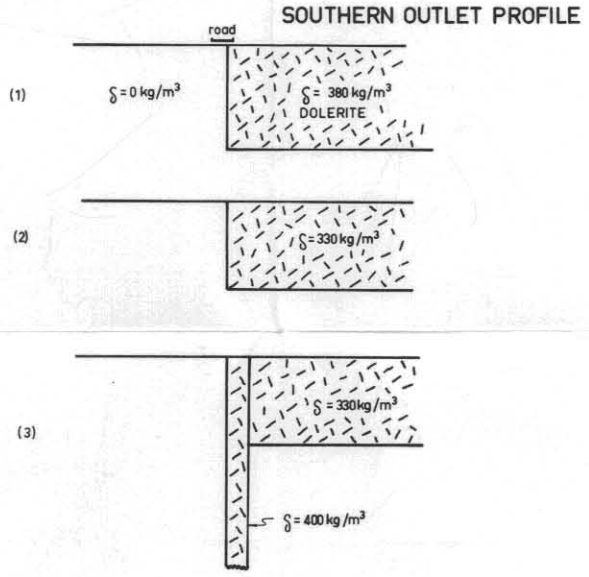


'RESIDUAL BOUGUER' ANOMALY (Regional gradient removed – across section : 0·3 mgal/400m.)

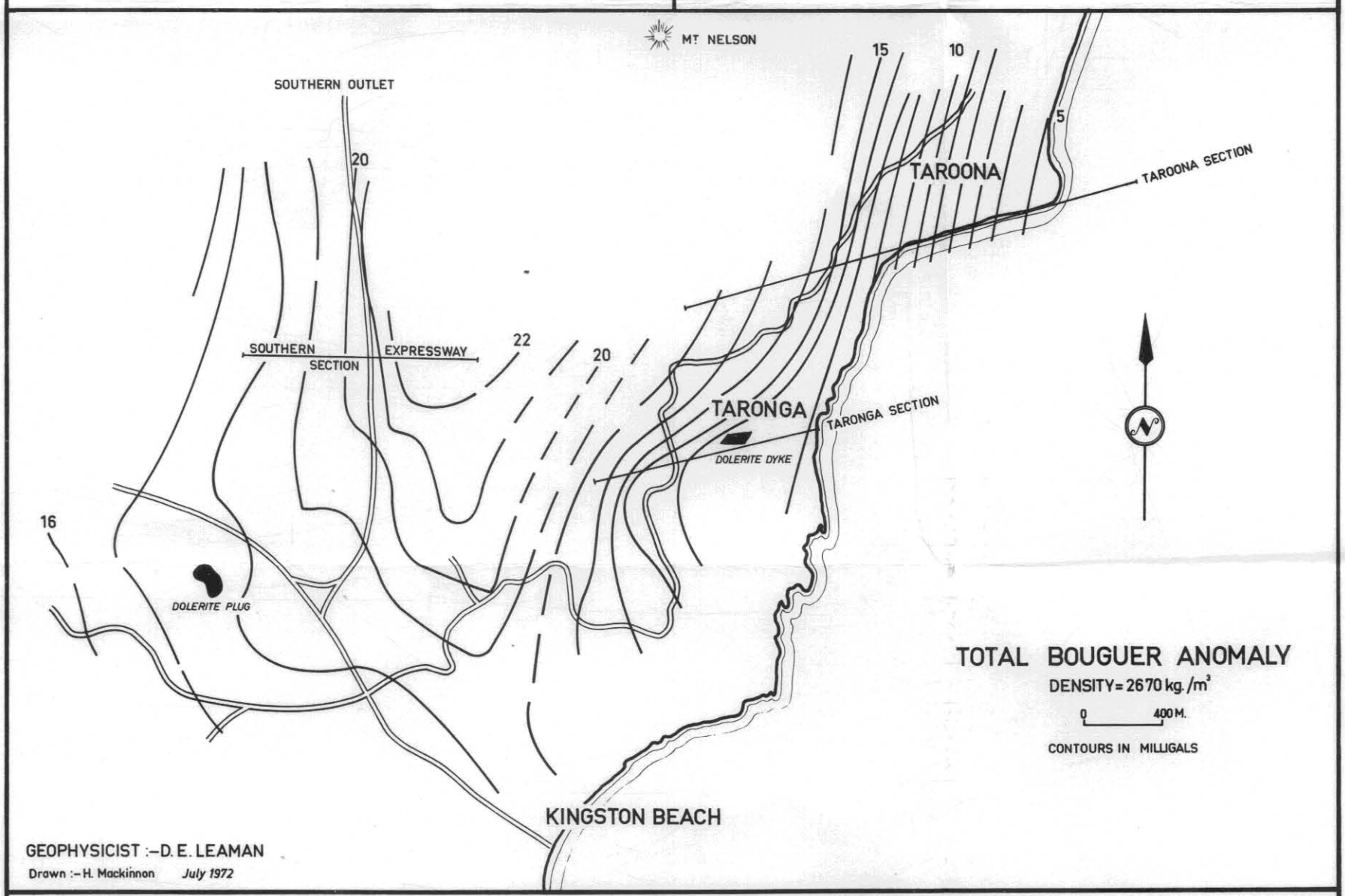


W E

SOUTHERN OUTLET PROFILE



MAGNETIC PROFILE



GEOPHYSICS—KINGSTON AND TAROONA AREA

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Figure 29.

5 cm