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Structural re-interpretation of the Glenorchy-Collinsvale region.

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The structure of the dolerite intrusions to the north-west of Glenorchy has eluded a satisfactory interpretation. Sutherland (1964) deduced a single 'cone sheet' using the isostrat concept of Carey (1958). Sutherland also mapped many faults, and in examination of the structure attempted the first petrographic maps of a dolerite area. However problems remained unresolved, including an apparent sheet bottom on the eastern end of the Mt Hull ridge above the cone sheet.

From 1968-1970 the author carried out a regional gravity survey of the Hobart area and provided detailed interpretations. Sections 525-600 (Leaman, 1972) cover the area under consideration in this report. Significant agreement with the conclusions of Sutherland was reached, although the requirement for a second sheet in the area was indicated. A complex feeder system trending north-east to south-west was also proposed to occur east of the Mt Hull-Goat Hills axis (Leaman, 1972, 1973). Mt Hull was considered part of a dyke-feeder. These interpretations appeared to provide an adequate explanation of the structure.

However, a deep probing bore hole located in Chapel Street, Glenorchy, encountered dolerite at a depth that did not conform to the earlier postulates (Leaman, 1972*a*). It therefore appeared that a third intrusion over a wide area and at a low stratigraphical level, may be present in the Collinsvale region. The original gravity survey interpretation by the author did not consider the existence of this intrusion because of its relative depth and extent, and the lack of surface evidence. From his examination of dolerite outcrops in Lenah Valley, Sutherland (1964, p.130) did suspect such an intrusion and section 550 (Leaman, 1972) indicated a possible solution.

Exposure of some key contacts at Glenorchy has allowed for a new interpretation of the structure. Topographic, stratigraphic or isostrat evidence influenced all earlier writers, including the author, to believe that the major frontal contact from Glenlusk to Mt Arthur dipped to the west. This assumption is probably still valid near Chigwell, but is now rejected in the area from Elliott Road, Glenorchy to Mt Arthur. Extensive opening of the contact by the Glenorchy Quarries west of Jackson Street, has established several hundred metres of dolerite dipping shallowly and consistently to the east. On extrapolating the average visible dip to the Chapel Street bore hole, an excellent agreement between predicted and observed depths is obtained. This observation alters all prior deductions concerning these intrusions, and also disputes the accuracy of the isostrat concept in difficult circumstances (see also Leaman and Naqvi, 1968).

The gravity field has thus been re-interpreted and prior to discussion of the models used, some listing of pertinent factors is necessary if the features of the area are to be properly resolved.

INTERPRETATION FACTORS

Model 1 incorporates all the geological factors to be considered, and contains reference labels for the following discussion. The section line is drawn from EN105560 to EN250560 and is an east-west line passing just to the south of the Chapel Street bore hole.

(1) Immediately north of the section (at A), a dolerite sheet crops out in a deep valley cut. The dolerite intrudes the Permian Cascades Group rock. Sheet thickness is unknown.

(2) South of the section (near B) dolerite caps Collins Cap. The dolerite intrudes Lower Triassic rocks in the form of a relatively small, detached fragment of a concordant sheet.

(3) A major north-south trending fault/contact (between B and C), separates the Collinsvale structures from the elevated plateau region to the west. This fault has been mapped as an intrusive contact (Leaman, 1973) and appears to have had a history of complex movement during the intrusion period. There is no known evidence of Cainozoic displacement.

(4) From Collins Cap to the east across southern Collinsvale and to Mt Hull (C, D, E), all observations indicate a simple, shallow transgressive sheet disrupted by small faults. There are many roof remnants commonly of mid-Permian rocks (D, E), but some Triassic rocks are included (C).

(5) A displacement of 350-400 m is required by any fault to place mid-Permian rocks and Triassic rocks at a comparable topographic level. There is no evidence of a fault with a throw of this magnitude in the area, so an additional intrusion with an equivalent thickness could contribute the necessary displacement in the section. Such a body would be required to extend no further west than D and must extend to about E. It would also pre-date the upper intrusion. Alternatively there could be an intrusion of similar age limited to the region of C and extending no further east than D. The selection of such alternatives must be resolved in interpretation, although the dilation factor is fixed and does impose limits.

(6) The situation in the region of Mt Hull (F) and the Goat Hills range is complex. Dolerite contacts exposed along the northwestern side of the range are sheet roofs (E-F), but at the eastern end evidence exists of a sheet base contact. This implies the exposure of a basal section of an intrusion which originally rose from one side of the present range and intruded over the top of it (see Model 3). The surface evidence is insufficient to determine the sheet involved. This factor amongst others (see also 4 and 5), precludes general acceptance of the single sheet concept.

(7) The southern side of the Mt Hull-Goat Hills range is characterised by the presence of another group of mid-Permian roof fragments (G). This may suggest two simple, approximately concordant sheets located close together toward the south (Model 3), due to the roughly equivalent topographic position and stratigraphic level of the roof fragments on either side of the range. Alternately the situation may fortuitously rely on the suitability of one or two formations to sill injection-horizons, which have been occupied from two sides in a sedimentary slab. Interpretation is necessary to test the validity of these alternatives whilst maintaining the dilation-stratigraphy balance.

(8) The Chapel Street bore hole, petrographical information and contact observations suggest that the sheet section from H-J has a roof-dip slope approximately adhering to the topography of the hill slope. This solution accommodates the roof fragments observed at G.

(9) The dolerite exposed in the fault block east of the Cascades Fault (J-K), is of unknown thickness, but less than one kilometre to the south of the section it is intrusive into Lower Triassic rocks.

(10) In the Springfield-Moonah area (L), dolerite is intrusive into Upper Triassic rocks. The observation of this and the dolerite intrusion into Lower Triassic rocks in the fault block (K) immediately to the west, appears to indicate either an abrupt transgression or the involvement of two separate sheets. This is especially relevant since the fault (K-L) is downthrown to the east.

Section Model 1 has been drawn with the above criteria in view, and where alternatives are advanced, those more reasonable geologically are presented. Model 1 can thus be regarded as a purely geological attempt to explain the structure. The importance of factor (8) is obvious when seen in section (*e.g.* compare with section 550 of Leaman, 1972; or the section of Sutherland, 1966).

INTERPRETATION PARAMETERS

The density values tabulated below and quoted in Leaman (1972) have been used throughout.

Permian rocks	2570 kg/m^3
Triassic rocks	2450 kg/m^3
Dolerite	2900 kg/m^3

The interpretation process is based on the two dimensional prism method outlined in Leaman (1972). The anomaly pattern is not two dimensional and in consequence exact fitting cannot be attempted. The interpretation is intended to provide a good fit and to distinguish the more acceptable alternatives.

INTERPRETATION

Model 1

The geological basis for Model 1 has been explained above. A small feeder was added at A to account for the sizeable anomaly west of the end of the section. As the profiles show, Model 1 is an inadequate representation of the mass distribution. However, it does assist in reducing the number of structural possibilities.

(*a*) Two sheets are not practicable for the Springfield block (L).
(*b*) The sheet at K must have a substantial thickness.
(*c*) The lower sheet (D-H) should not have such a wide distribution. North of the section the anomaly distribution is of the calculated value, and it therefore appears that the lower sheet upsteps to the south and thus has a reduced gravimetric significance. (Models 2 and 3 reflect this tendency, although Model 1 is probably the valid solution at the section line).
(*d*) The anomaly ridge on the southern side of the Goat Hills range continues to remain unexplained, although two sheets from D-H are allowed for.

Model 1A

Model 1A incorporates two simple variations on Model 1 as seen in blocks G and L. It confirms that only one sheet is required at L and that a feeder at G is not unreasonable, but the lower sheet as drawn remains too extensive.

Model 2

Model 2 has a simple contraction of the lower sheet of Model 1, largely to assess the particular requirements of mass distribution. As a solution it is very deficient in the area of A-D where the features are mainly two dimensional.

Model 2A

Model 2A is an attempt to resolve the two areas of greatest misfit (B-D, and I). The asymmetric anomaly between E and I may be due to relative deficiencies between the north and south sides of the range or the inclination of the feeder axis. Both are suggested in this model although it is not possible to deduce the dip of the feeder. The more significant variations are faulting at H and a reduced thickness of the sheet in the same area. The addition of further dolerite and a small, but non-essential feeder at C improves the interpretation.

Model 2B

A final variation of Model 2 illustrates the desirability of a feeder to the west of the section, and also the requirement of a sheet approximately 350 m in thickness from A-B since a sheet greater than, or equal to, 400 m thick was originally assumed. The additional mass at C must be irregular and its thickness attributed to more than one body. The total distribution increases the likelihood of a small feeder.

Model 3

This model is the principal geological alternative to Model 1, since Model 2 may be regarded as a variation of Model 1. The model maintains the established forms west of B and east of H, but presents a simple two sheet concept for Mt Hull. Due to the requirements of the dilation relationship, severe constraints are placed in the regions to the west of C and from C-G. Model 3 is a simple variation of the initial interpretation as given by Leaman (1972*a*), but adapted to satisfy the new observations. Evaluation of the mass requirements of the section do not permit it to be an adequate solution.

Model 3A

Modifications to Model 3 include a feeder at G, deduced in earlier interpretations (Leaman, 1972; Models 1A, 2), and increased thickness of the sheet from G-H. These changes provide adequate solution.

CONCLUSION

Only the structures of the type represented by 2B and 3A satisfactorily explain the gravity field in this area.

Both models have similar features, although they differ greatly in the region from F-H. Model 3A must be preferred for several reasons.

(1) It is of a more simple concept.
(2) Sedimentary fragments, in relation to topography, correspond over a wide area in the vicinity of Mt Hull, an unlikely situation with overlapping sheets.
(3) No interpretive difficulties arise with the allowance of a lower sheet and feeder lateral to the section.

DEDUCTIONS

The main Collinsvale sheet is related to the Collins Cap sheet above the section at B. The Collinsvale sheet may also have a feeder axis slightly to the east of the Mt Hull topographic axis.

Mt Hull is not composed of an elevated, cone dyke-feeder as regarded in earlier interpretations.

At least two intrusions are involved in the Collinsvale area, assuming that the feeder system at C is related to the upper Mt Hull body. The system at C must in any case pre-date the major intrusion, as there is no petrographic evidence of cross-cutting.

Only one sheet is present in the Triassic rocks in the Springfield-Moonah area (east of K). This implies major upsteps near the faults which pass through the area and further suggests a complex history of activation for these faults.

The Collinsvale sheet is transgressive from the south-east and is possibly related to the dolerites which project to the south-west in Lenah Valley. The feeder system suspected in South Hobart (*S18*, Leaman, 1972) may be the basic centre for this sheet with the pipe at G being subsidiary to, or part of a higher sheet. Multiple pipes are probably a better solution because of the requirements of intrusion mechanism. The additional thickness of the dolerite near the feeder at C appears to exclude such conditions in that vicinity.

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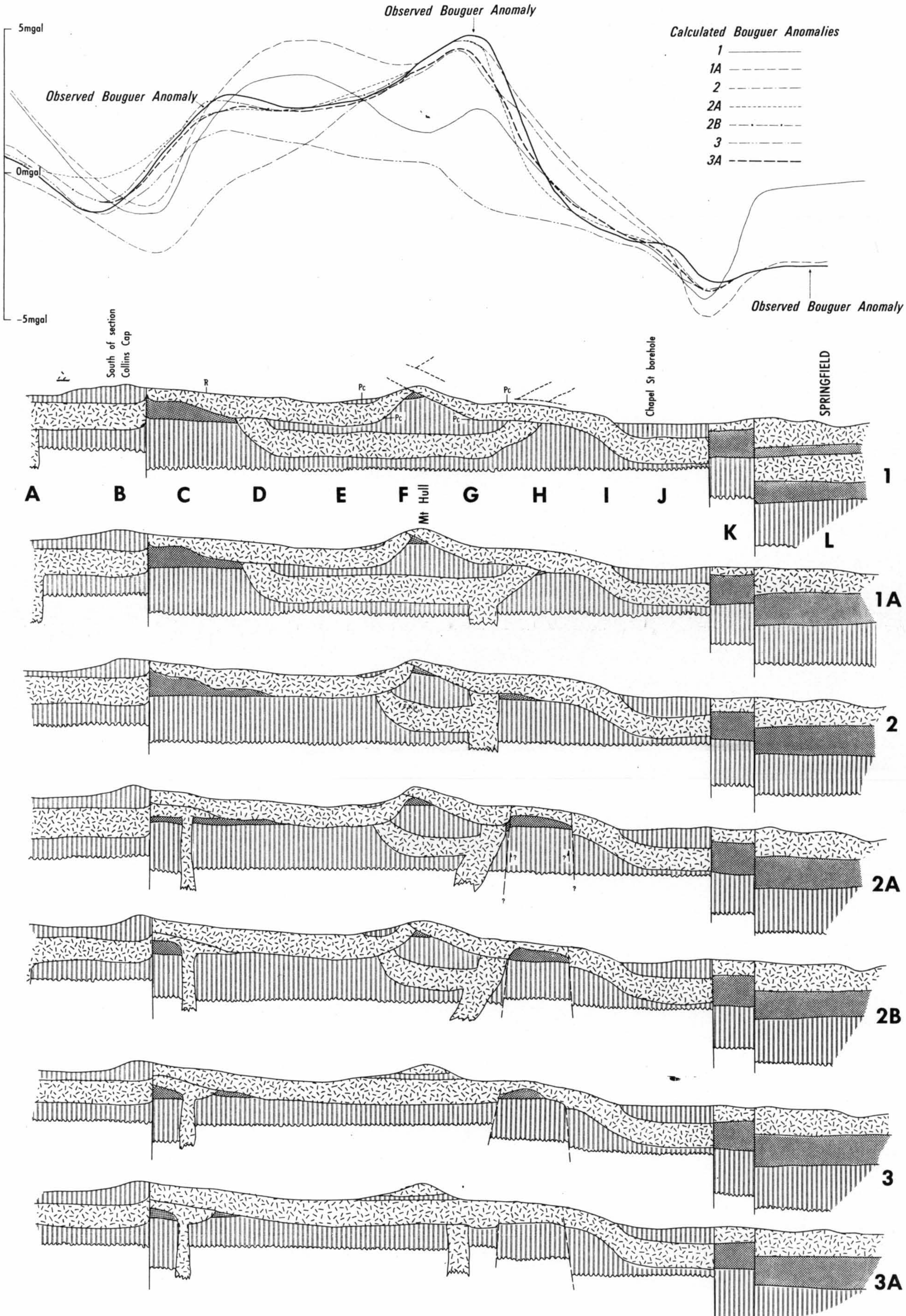

GRAVITY INTERPRETATION : GLENORCHY - COLLINSVALE REGION

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Figure 1.

Triassic sediments

Permian sediments

Jurassic dolerite

0 1 2 3 Kilometres

5 cm

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