TASMANIA
DEVELOPMENT
AND RESOURCES

Tasmanian Geological Survey
Record 1995/08

Inspection of core from a hole drilled on Exploration Licence 1/88, North Bruny Island

by S. M. Forsyth

INTRODUCTION

The core of a hole, drilled within the tenement area of Exploration Licence 1/88, was inspected on site on 4 May 1995. The hole was drilled on the flat crestal part of a ridge leading down to the south side of Variety Bay on North Bruny Island [EN338159].

LOCAL SURFACE GEOLOGY

General features

Previous mapping by Farmer (1981) and a subsequent report (Farmer, 1985) indicate that the hole was collared in Lower Parmeener Supergroup strata and that these strata are intruded by a thick, sheet-like intrusion of Jurassic dolerite. The strata dip west at 10–17° along the south side of Variety Bay. The main dolerite intrusion is approximately conformable to the strata and also has a westerly dip component.

Farmer (1981) mapped the strata at the bore site as the Minnie Point Formation. The underlying rocks, the Deep Bay Formation, are exposed in nearby coastal cliffs.

Irregularities of Jurassic dolerite intrusion

Although the dolerite sheet intrudes the Deep Bay Formation for several kilometres north and south of Variety Bay, some irregularities of the intrusion are known. For example, a dyke-like intrusion of dolerite, approximately 70 m wide, trends west towards the bore hole. The western limit of this feature is uncertain, and any additional western extension would pass very close to the bore site.

A broader and less regular dyke or horn of approximate southerly trend passes about 200 m west of the bore site and extends upward to intrude into the Minnie Point Formation. Strata to the east of this feature show relative downward displacement and a steep reversal of the regional dip.

Faults

Two normal faults occur near the bore site. A SSE-trending fault lies 0.5 km to the east, with the bore being sited on the upthrown side. A second fault trends southeast and downthrows strata on its southwest side. The projection of this fault beneath the sea passes about 450 m from the bore site.

REGIONAL STRATIGRAPHY

Detailed geological mapping, stratigraphic drilling and palaeontological studies established the existence of a paraconformity in the Lower Parmeener Supergroup over part of the Kingborough Quadrangle (Farmer, 1985). This paraconformity, separating the Deep Bay Formation from the underlying, and partly eroded, Bundella Formation, is most notable in the Lower Wattle Grove–Deep Bay–Nicholls Rivulet area, where the Bernacchian Stage is missing.

There is a progressive introduction of the Bernacchian Stage through the Palmers Road–Harts Hill area, with firstly the Hickman Formation and then the overlying Harts Hill Limestone. This trend is continued into the Hobart Quadrangle in combination with a change in the depositional environment of the basal Bernacchian from marine to paralic. The stratigraphic relationships have been illustrated by a schematic north-south cross section (fig. 1).

The extent and effect of the paraconformity in an easterly direction from Nicholls Rivulet is not known, although Bernacchian Stage strata were not recorded by Farmer (1981) at Woodbridge 16 km west of Variety Bay. The Bernacchian Stage does occur in bore holes at Palmers Road, Snug Tier and Harts Hill, which are situated 20–22 km northeast of Variety Bay.

On South Bruny Island, 16 km southwest of Variety Bay, an interval (20–30 m) of dominantly poorly fossiliferous baked siltstone occurs beneath richly

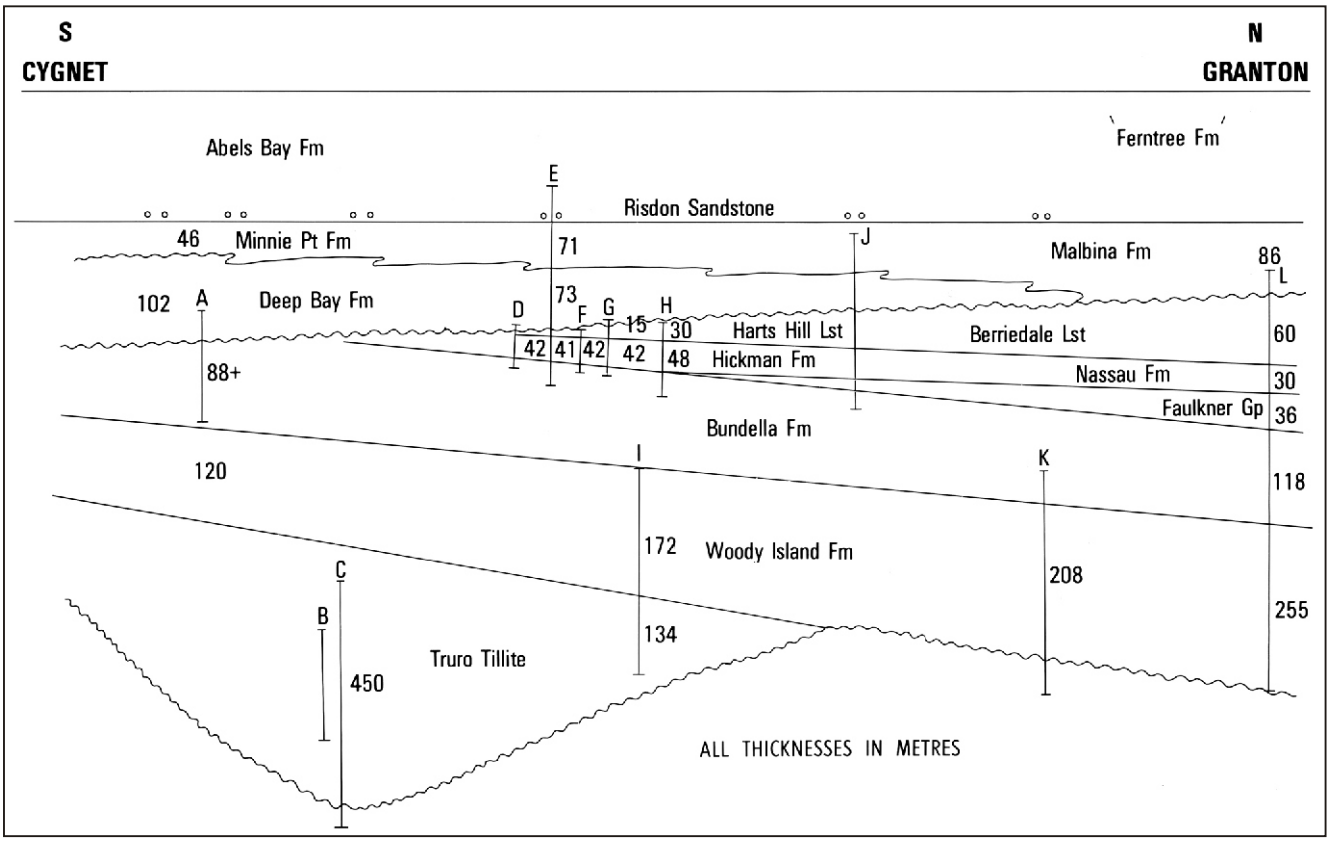

Figure 1

Stratigraphic relationships, Lower Parmeener Supergroup, Cygnet to Granton. Diamond drill holes: — A = Deep Bay; B = Silver Hill; C = Woodbridge; D = Palmers Road; E = Snug Tiers; F = Snug; G = Harts Hill No. 2; H = Harts Hill No. 1; I = Margate; J = Porter Hill; K = Glenorchy; L = Mt Nassau.

fossiliferous Deep Bay Formation (~120 m). The poorly fossiliferous interval contains the linoproductid *Anidanthus* sp., a genus not known from the Deep Bay Formation in the Kingborough Quadrangle. According to Clarke and Farmer (1976) *Anidanthus springsurensis* is a Bernacchian index fossil, whereas a different species of *Anidanthus* is known from faunizones 7 and 8 of the Lymingtonian elsewhere. *Anidanthus springsurensis* is popularly considered to be the Homevale species but this is different to the type which is upper Stage 11. In Tasmania, *A. 'springsurensis'* is the Bernacchian form and the true *A. springsurensis* occurs in the upper Counsel Creek Formation and is faunizone 6. The previous record of faunizone 7 and 8 is revised to faunizone 6 (M. J. Clarke, pers. comm., 17 May 1995).

The *Anidanthus* fossils on South Bruny Island have been regarded as occurring in an older part of faunizone 6 (Lymingtonian) than those occurrences of the abundant faunas found in the richly fossiliferous Deep Bay Formation exposed in the Kingborough Quadrangle (M. J. Clarke, pers. comm., 1990). This interpretation implies that the beds with *Anidanthus* are not part of the Bernacchian Stage, and that if the paraconformity is developed on South Bruny Island, then it lies beneath the beds with *Anidanthus*.

North of Variety Bay the Deep Bay Formation, as mapped (Farmer, 1981), may be greater than 140 m thick if the section is not repeated by faulting. This is about 40 m greater than the thickness in the Snug Tier bore and at the type section. Thermal metamorphism and difficulty of access to the coastal cliffs probably makes palaeontological collecting of the interval below the top 100 m of the Deep Bay Formation a difficult proposition.

East of the meridian of Variety Bay, occurrences of the Bernacchian Stage include:–

Maria Island;

parts of the east coast of Forestier Peninsula;

a bore hole at Eaglehawk Neck, 48 km ENE of Variety Bay (Gulline and Clarke, 1984); and

Cancrinella farleyensis-bearing beds north of Sorell, 52 km NNE of Variety Bay (Gulline, 1982).

It is not known whether rocks correlated with the Cascades Group at Mt Augustus, Mt Mather and near Lauderdale (Leaman, 1972) contain a Lymingtonian or Bernacchian fauna.

Excluding the Bundella Formation at Mt Dromedary, there is no surface exposure of rocks older than Bernacchian in southeast Tasmania between the east coast and either the River Derwent

or the west coast of Bruny Island. This area also lacks bore information. Excluding the occurrence of basement highs, the widespread distribution of the Bundella Formation and the underlying Woody Island Siltstone (or equivalent rock units) elsewhere in Tasmania suggests that these rocks are probably also widespread subsurface in southeastern Tasmania (Clarke and Forsyth, 1989). The type sections of the Woody Island Siltstone and some overlying formations are near Bruny Island but there appears to be no more recently published account of new field examination of the type sections than the original description (Banks, Hale and Yaxley, 1955).

The proximity (16 km) of Variety Bay to the Little Peppermint Bay bore hole (Farmer and Clarke, 1985) suggests that the basal Parmeener formation, the Truro Tillite (450 m thick at Little Peppermint Bay), could extend to Variety Bay. The tillitic formations are, however, very variable in thickness.

VARIETY BAY BORE HOLE

The depth drilled at the conclusion of drilling on 4 May 1995 was 876.4 metres. Core was recovered below 81.4 m, with a reduction in core size below 180 metres.

The general features of the Variety Bay bore hole are in accordance with inferences based on surface mapping. The hole intersected a major dolerite sheet intruding Lower Parmeener Supergroup strata between 154.9 m and 729.8 m and a minor dyke? intrusion of dolerite between 103.7 and 105.9 metres. Dips of 10–15° are evident in the strata above and below the main dolerite intrusion.

The core ranges from good coherence to occasionally very fractured and broken with possible core loss. The most extensive fracturing occurs below 800 m, near intervals of recemented brecciated Parmeener strata that are concentrated between ~847 and 860 metres. The brecciation may indicate fault displacement or proximity to a significant fault.

One or more types of black substance occur in association with some of the fractured rocks. Samples of this material examined by Industry Safety and Mines have been found to contain wollastonite, smectite clays, pyroxene and serpentine. A full description is given by Bottrill (1995). One piece, suspected to be bitumen by the explorer, was boiled in hexane with no result, and was identified as a smectite clay.

An organic odour is emitted from wet fracture surfaces when the core is removed from the core barrel. Subsequent inspection of the core showed that the smell was due to water. Analysis by the CSIRO revealed that the rock contained a very low concentration of 30 ppm of petroleum hydrocarbons, which may have been derived either from contamination or from indigenous organic matter. The fact that the sample could not be washed to remove peripheral contamination, and that two different signatures (from carbonate and terrestrial shale sources) were noted in the petroleum trace, suggest that contamination from two petroleum products is the most likely explanation.

A summary log is presented below and a fuller but incomplete descriptive log is presented as Appendix 1.

As a result of the paraconformity in the Cygnet area, the Deep Bay Formation directly overlies, at different places, the Bundella Formation, Hickman Formation and the Harts Hill Formation. Furthermore, the nature and thickness of the rocks above the paraconformity may vary on Bruny Island. The correct stratigraphic model to apply at Variety Bay is not certain. The problem is compounded by the intense thermal metamorphism caused by a major dolerite intrusion within the critical interval and to a lesser extent by brecciation and possible faulting below that interval. Consequently, about 60 m of strata straddling the dolerite sheet have not been assigned to a particular formation.

Summary log

Depth (metres) From	Depth (metres) To	Thickness (metres)	Stratigraphic thickness dip 12° (metres)	Rock unit
0	20	20.0	19.6	Minnie Point Formation
20	100.3	80.3	78.5	Deep Bay Formation
100.3	116.5	14.0	13.7	Deep Bay Formation?
103.7	105.9	2.2		Jurassic dolerite dyke
116.5	154.9	38.4	37.6	Unassigned Parmeener
154.9	729.85	74.95	62.0	Jurassic dolerite sheet
729.8	756	26.2	25.6	Unassigned Parmeener
756	~847	~91.0	90?	Bundella Formation
847	876.4	29.4	28.8	Woody Island Siltstone

Further steps could be taken to resolve the stratigraphy. These include:–

detailed lithological logging of core, including an assessment of original carbonate content from the calc-silicate hornfels now developed;

biostratigraphic logging, which may require core breaking and acid leaching if the mineralogy of the metamorphosed rocks is suitable;

inspection of the lowest Deep Bay Formation intervals north of Variety Bay (access permitting); and

direct comparative studies with Kingborough bore hole cores.

REFERENCES

BANKS, M. R.; HALE, G. E. A.; YAXLEY, M. L. 1955. The Permian rocks of Woody Island, Tasmania. *Papers Proceedings Royal Society Tasmania* 89:219–229.

BOTTRILL, R. S. Petrographic examination of rocks from DDH Shittim 1,Variety Bay, Bruny Island. *Record Geological Survey Tasmania* 1995/13.

CLARKE, M. J. 1985. A diamond drill hole at Porter Hill (Grange), Lower Sandy Bay. *Unpublished Report Department of Mines Tasmania* 1985/50.

CLARKE, M. J.; FARMER, N. 1976. Biostratigraphic nomenclature for Late Palaeozoic rocks in Tasmania. *Papers Proceedings Royal Society Tasmania* 110:91–109.

CLARKE, M. J.; FORSYTH, S. M. 1989. Late Carboniferous-Triassic, *in:* BURRETT, C. F.; MARTIN, E. L. (ed.). Geology and mineral resources of Tasmania. *Special Publication Geological Society Australia* 15:293–338.

FARMER, N. 1981. Geological atlas 1:50 000 series. Sheet 88 (8311N). Kingborough. *Department of Mines, Tasmania*.

FARMER, N. 1985. Geological atlas 1:50 000 series. Sheet 88 (8311N). Kingborough. *Explanatory Report Geological Survey Tasmania.*

FARMER, N.; FORSYTH, S. M. 1983. Geological atlas 1:50 000 series. Sheet 94 (8311S). Dover. *Department of Mines, Tasmania*.

FARMER, N.; CLARKE, M. J. 1985. A diamond drill hole at Little Peppermint Bay, Woodbridge. *Unpublished Report Department of Mines Tasmania* 1985/24.

GULLINE, A. B. 1982. Geological atlas 1:50 000 series. Sheet 83 (8412S). Sorell. *Department of Mines, Tasmania*.

GULLINE, A. B.; CLARKE, M. J. 1984. A diamond drill hole at Eaglehawk Neck, Tasman Peninsula. *Unpublished Report Department of Mines Tasmania* 1984/76.

LEAMAN, D. E. 1972. Geological atlas 1:50 000 series. Sheet 82 (8312S). Hobart. *Department of Mines, Tasmania*.

[24 August 1995]

APPENDIX 1

Incomplete description of bore core

Depth (metres)	*Description*
0–81.4 m	No core. M. R. Bendall said that this interval consisted of:– 0–20 m Minnie Point Formation 20–81.4 m Deep Bay Formation.
81.4–100.3	Interbedded, off-white, baked, calcareous? siltstone and sandstone. Generally fossiliferous, occasional unfossiliferous sandstone beds. The basal interval 97–100.3 m is a calcareous? arenaceous unit with ghost fossils [Deep Bay Formation].
100.3–116.5	Dominantly baked siltstone with fine-grained dolerite intrusion 103.7–105.9 m inclined ~60° to bedding. Colour change from off-white to grey (75%) and off-white between 108.7 and 110.4 m where ghost fenestellids are common. Thermal metamorphism of strata is more intense [Deep Bay Formation? and Jurassic dolerite dyke].
116.5–139.2	Baked siltstone interbedded with occasional graded sandstone beds containing quartz granules and some pebbles. Sandstone beds more common and thicker near base of interval. Apparently unfossiliferous to poorly fossiliferous. Ghost fossils poorly preserved in hornfels and may include brachiopods [Unassigned — possible correlate of *Anidanthus*-bearing beds on South Bruny Island].
139.2–154.9	Intensely thermally metamorphosed siltstone and crudely mottled sandstone? Fossils more numerous and better preserved than in overlying interval. Stenoporids at 145 m [Unassigned].
154.9–~178	Dolerite, dominantly fine-grained, upper contact inclined ~30° to bedding. Steeply dipping fracture 155–156.3 m. Pods (300 mm) of granophyre at 167 and 172 metres.
~178–~196	Dolerite, interlayered medium-grained (1.5–3.0 mm) and coarse-grained (>3.0 mm). Pod of very coarse-grained pegmatite at 191 metres.
~196–~360	Dolerite, generally coarse-grained. Notable fractures at 238 and 353 metres.
~360–729.8	Dolerite, notable fractures at 430, 437 and 629 metres. Fine-grained near basal contact. Possible xenolith of grey-green baked mudstone (30 mm) at 725.6 metres.
729.8–750	Interbedded to thickly interbedded baked green-grey mudstone and grey sandstone, usually with quartz granules and some pebbles. No fossils seen except for possible shell fragments mixed with quartz and slate pebbles in thin sandstone bed above 740.6 metres. Sand-filled burrows? extend below this bed. 730.2–6; some sulphide minerals along fractures, dendritic black markings adjacent to some fractures. 738; mineral-filled joint (dark balls set in light coloured mineral). Some steeply inclined colour changes from light to dark grey adjacent to zones of closely spaced fractures near 746 and 750 metres [Unassigned].
750–756.2	Fossiliferous mudstone with only occasional quartz granules, interbedded with very light grey rock (originally limestone?) below 753 m, fossiliferous sandstone grading down to conglomeratic sandstone with some cobbles from 755 m to base [Unassigned].
756.2–759.4	Fossiliferous, uniform fine-grained limestone? with minor thin beds of dark grey mudstone [Bundella Formation].
759.4–764.5	Fossiliferous, less uniform, thinly interbedded limestone?, arenaceous calcareous beds and grey mudstone [Bundella Formation].

Depth (metres)	*Description*
764.5–767	More uniform darker sandy mudstone interbedded with subordinate fossiliferous limestone? [Bundella Formation].
767–770.5	Calcareous? beds [Bundella Formation].
770.5–776	Dominantly calcareous? siltstone, subordinate limestone? and siltstone. Fenestellids, stenoporids, some brachiopods [Bundella Formation].
776–787	Fossiliferous calcareous? sandstone, limestone?, some bryozoal calcareous? siltstone. Black material forming broken curved laminae in calcareous? bed at 782.2 m [Bundella Formation].
787–799.5	More or less continuous core lengths and becoming less fossiliferous. Still intervals <1 m of green-grey bryozoal siltstone at 789 metres. Sandy beds with fragmented fossils are more common. Most partings exhibit fenestellids. At 791 m thick shell pieces, possibly *Eurydesma* or brachiopods, *Stenopora*. Below 795 m beds are mostly calcareous? siltstone with some more sandy thin and thick beds with fossils. Nodule (30 mm) of black soft material at 798.4 m. Pink stains in joints at 799.5 m [Bundella Formation].
799.5–811	Steeply jointed broken core. Calcareous? siltstone and sandstone with some fossils. 809.5 m: sandstone with small pebbles and haphazardly arranged discrete blebs and wisps of soft black waxy material with crystals in places [Bundella Formation].
811–814	Breaks in core are mostly along bedding.
814–824	Core includes jointed, fractured and very broken sedimentary rock. Some fossils noted at 814.4 and 823.3 m. Red stains associated with very broken rock at 818.8 m.
824–847	Further fractured and broken core. Spotty rocks; green spots in grey or fawn grey rock, darker spots in green. Intervals of unfossiliferous or poorly fossiliferous strata. Interval 826–828 m; sandy beds with shell fragments, interbedded with siltstone with abundant fenestellids, iron sulphide in joints. Interval 837.5–839 m; unfossiliferous? siltstone. Interval 839–840 m; mudstone with fossil shells and large *Stenopora* sp. Recemented brecciated strata within fracture zones exceeding core width at 833.6, 833.8 and 840 m. Terracotta coloured blebs and stains on joints at ~846 m. Note: no depth markers found between 841.3–860.90 m [Bundella Formation].
~847–~848	Dark grey unfossiliferous siltstone [Woody Island Siltstone?].
~848–856.1	Dominantly recemented brecciated Parmeener strata.
856.1–876.4	Continuous lengths of grey unfossiliferous siltstone with occasional granules. No pebbles observed. Hydroplastic and bioturbation structures define bedding — dip 10–15 degrees. Pyrite? nodule (10 mm). Recemented brecciated strata at 860.1–3 and ~871 m [Woody Island Siltstone].