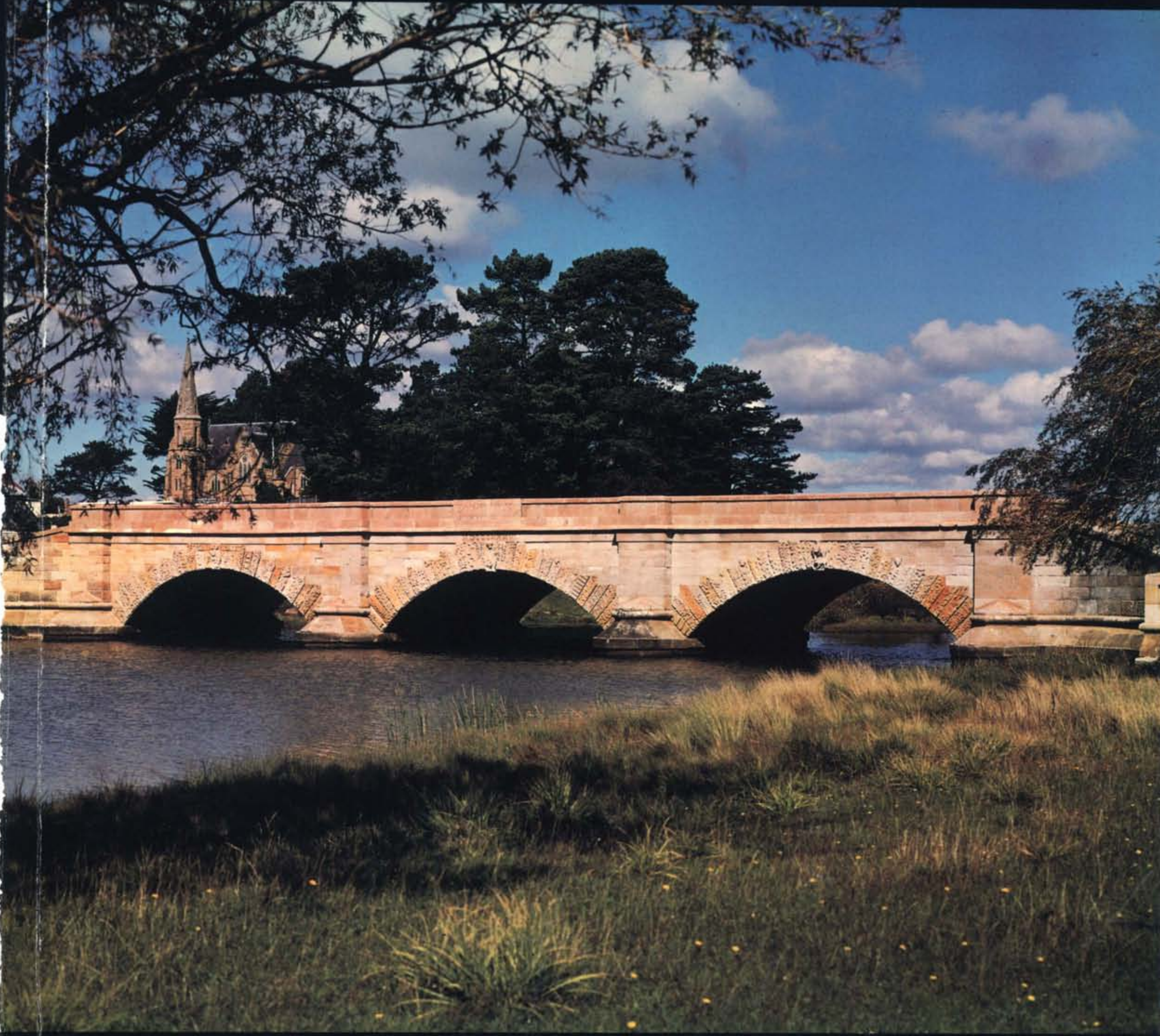
GEOLOGICAL SURVEY EXPLANATORY REPORT

SHEET 61

INTERLAKEN



TASMANIA DEPARTMENT OF MINES

ROSS BRIDGE

The Upper Parmeener Supergroup sandstone in the Ross area was used extensively as a building stone in the Ross township, with the Ross Bridge being probably the best known example.

The sandstone bridge at Ross was built to replace an earlier bridge which was damaged by floods in 1828 and collapsed in 1831, hindering communications between the north and south of the State. Late in 1831 the civil engineer John Lee Archer visited Ross and recommended the construction of a freestone bridge, as there was an excellent quarry nearby. Archer submitted a design to the Colonial Secretary but he later amended his design so that only three spans would cross the river, reducing the number of spans by two.

Construction of the bridge commenced in 1833, initially under the control of the architect and artist Charles Atkinson but later coming under the control of a Captain Turner. On 14 July 1836 Turner wrote to John Lee Archer informing him of the completion of construction, and the bridge was formally opened by Lieutenant-Governor George Arthur on 21 October 1836.

The bridge has three arches supported by piers with cut-waters. Voussoirs on all six arch faces are carved in high relief with foliage motifs and forms of animals and human heads. The rock used in the bridge has weathered extremely well and most carving detail has survived. Decay has been minor and only minor replacement, mostly near the waterline, was needed during work in 1978. The durability of the rock is due to the complete absence of swelling clays, although the high effective porosity renders it susceptible to salt attack or gypsum growth.

Formerly on part of the Midland Highway, the bridge has been bypassed by the main highway and now carries only light traffic.

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TASMANIA DEPARTMENT OF MINES

1989

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SHEET 61 (8313N)

INTERLAKEN

by S. M. FORSYTH, B.Sc.

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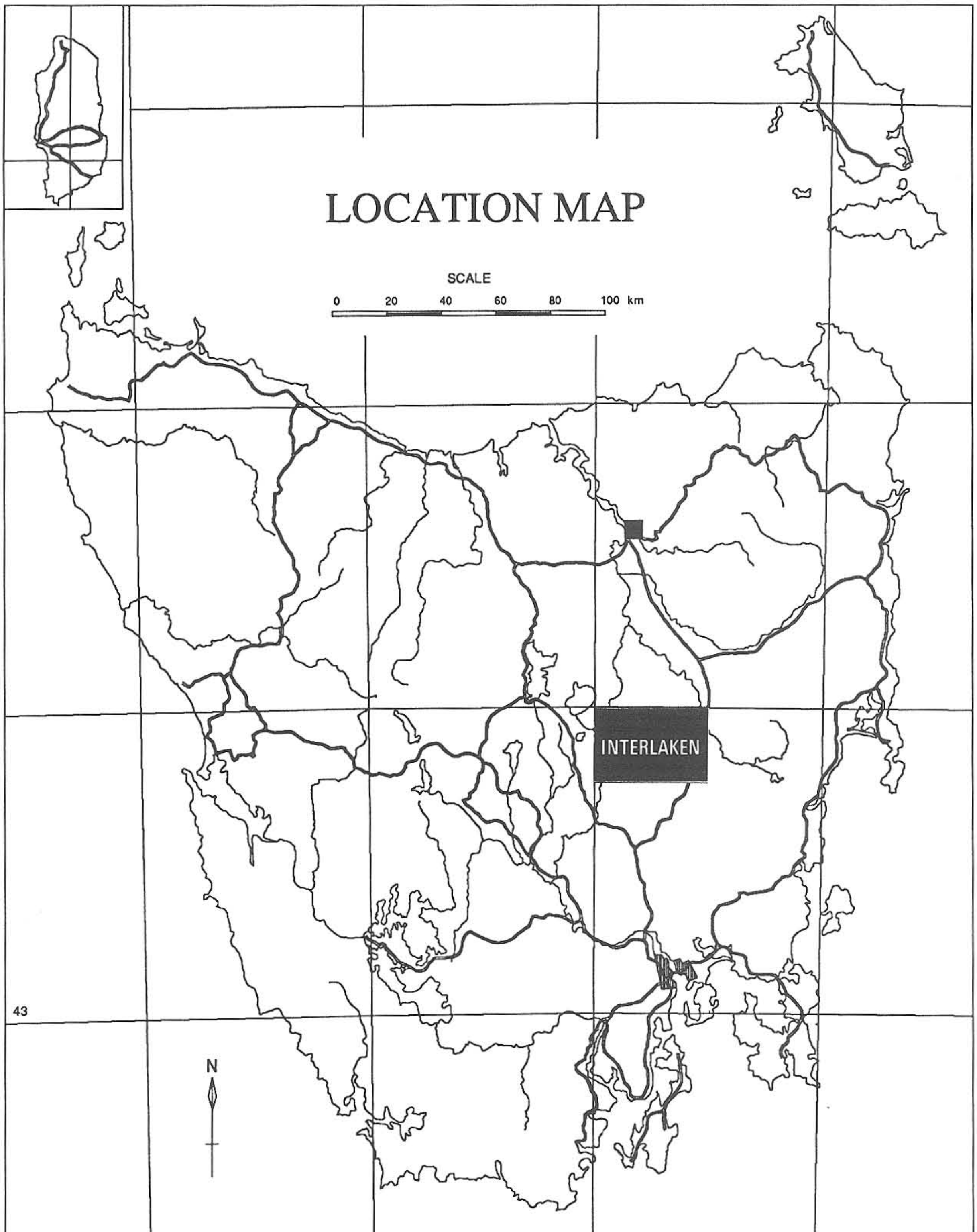


Figure 1. *Location of Interlaken Quadrangle.*

5 cm

INTRODUCTION

The Interlaken Quadrangle (fig. 1, 2) covers an area in eastern central Tasmania extending from the Central Plateau to the lowlands of the Midlands. A large part of the quadrangle was included in a geological map prepared by Nye (1921) but a significant portion of the quadrangle remained unmapped prior to the current work. Completion of the Interlaken mapping closed the gap between recently-mapped quadrangles of Lake River (Matthews, 1974) to the north and Oatlands (Forsyth *et al.*, 1976; Forsyth, 1984*a*) to the south, completing quadrangle mapping in a strip of country extending from Bass Strait to the D'Entrecasteaux Channel. A complementary program of deep diamond drilling has assisted in relating the separate stratigraphies of the Lower Parmeener Supergroup in northern and southern Tasmania (fig. 4).

The escarpment of the Great Western Tiers crosses part of the quadrangle and provides a clear distinction between the lowlands and plateau country in the north but this boundary is difficult to define in the south. The main highway (Midland Highway) and railway linking Hobart to northern Tasmania run side by side across the lowlands and became the locus for the population centres of Ross (population 300) and Tunbridge. Much of the lowlands in the lee of the Great Western Tiers suffer from a rain-shadow effect and this is one of the driest areas of Tasmania. Information supplied by the Bureau of Meteorology indicates an average annual rainfall of 458 mm at Tunbridge, with slightly higher averages of 508 mm at Ross, 511 mm at Woodbury, and 585 mm at 'Verwood' [250440]* at the base of the Tiers escarpment. Lowland soils are predominantly brown soils or podzolic soils on dolerite and sandstone, with some brown, black, solodic and recent soils on alluvium, and minor lateritic podzolic soils (Leamy, 1961). Caliche nodules are common in soils throughout the lowlands.

The lowland vegetation ranges from natural and cleared grassland, through open savannah, to open Eucalypt woodland. Typical tree species include *Eucalyptus pauciflora, E. viminalis, E. rubida, E. tenuiramis, E. ovata, E. amygdalina* (especially in well-drained areas such as on lateritic soils), *Casuarina stricta, Banksia marginata, Exocarpus cupressiformis* and scrubby *Acacia dealbata. A. melanoxylon* occurs along streams emerging from the Tiers. Forest ground cover consists of bracken and heath-like cover in some areas. A small area of *Cyathodes* sp. extends off the Tiers escarpment near Verwood.

Sheep, cattle and a few goats are run on the lowlands, and the area is well suited for superfine wool production. Semi-permanent streams descending from the Tiers and some water bores maintain the viability of the area during dry seasons but these resources are not pervasive and water boring in Tertiary clay has not been very successful. River flats and terraces and some other areas of subdued topography are used for growing cereal and feed crops on a rotational basis, with irrigation being used occasionally along the Macquarie River.

A network of public and private roads and tracks serves the lowlands, and most areas are readily accessible. Gravel country roads extend onto the plateau area from Tunbridge, from further south off the Midland Highway at Oatlands, and from the Lake Highway at Bothwell and at The Steppes. These roads join near the popular fishing district of Interlaken, between Lake Sorell and Lake Crescent. Access to isolated areas of the plateau may also be gained by other rough roads and tracks extending up the Lake River, from Arthurs Lake, and from Hunterson. Some secondary roads on the plateau are negotiable by car but generally four-wheel drive vehicles and long day walks are required to reach some areas. Nine separate field camps were established to facilitate mapping of the plateau and escarpment.

Soils of the plateau and escarpment are generally developed on dolerite or dolerite-derived material and are very rocky, yellow-brown to brown coloured and in places reddish coloured. In poorly-drained areas, organic gley soil occur on flats, about lakes and marshes, and on alluvium (Leamy, 1961; Pemberton, 1986). The area is clothed in *Eucalyptus* forest throughout, except where drainage is too poor or soils too thin over expanses of dolerite outcrop, where open grassed clearings occur.

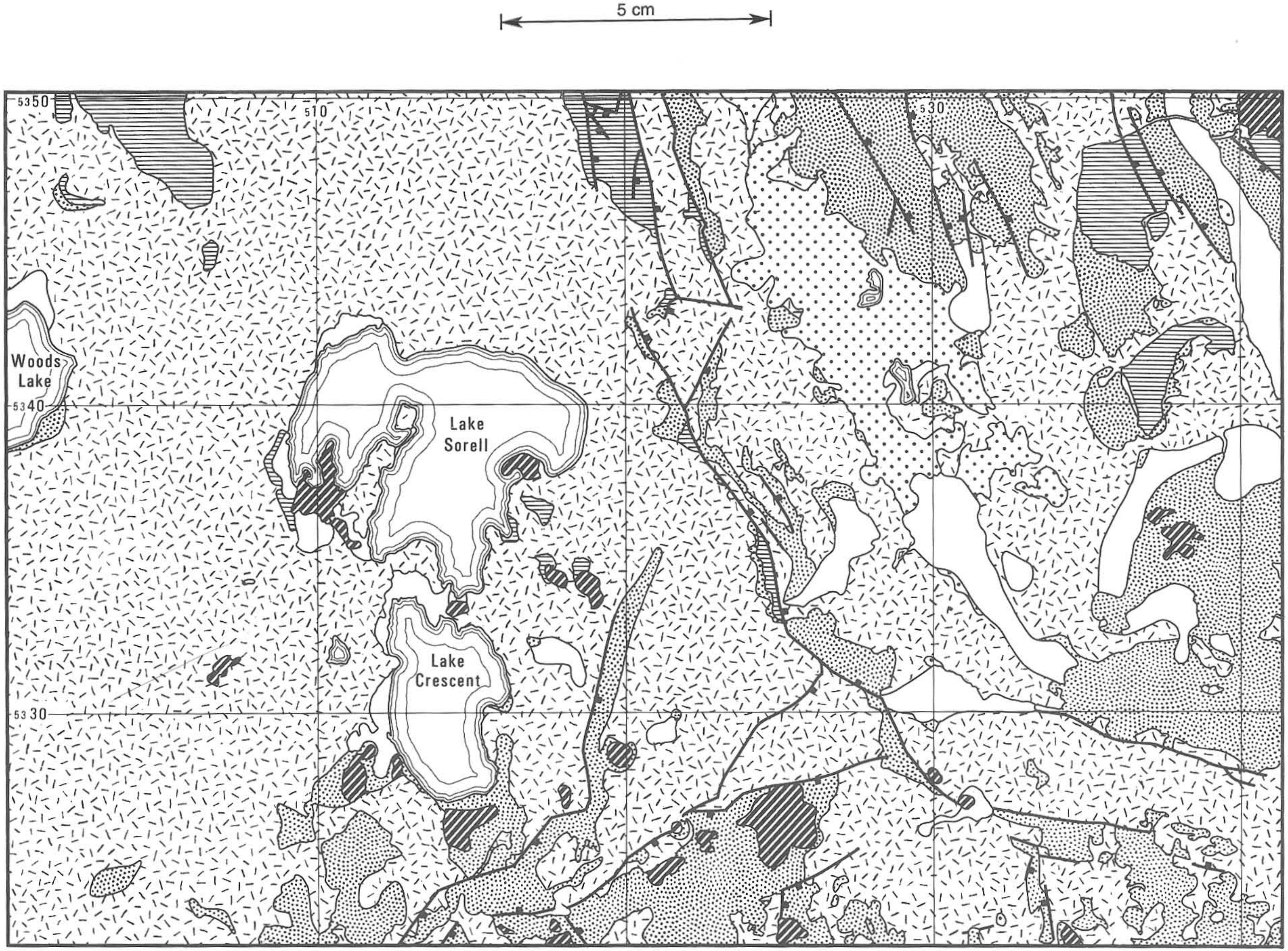
The rainfall at Interlaken is higher than on the lowlands, and the dry sclerophyll forest of the lowlands gradually develops into a more luxuriant wetter sclerophyll type up the escarpment. Floristic associations growing on the slope components comprising the escarpment and major escarpment re-entrants are listed by Pemberton (1986) under the Land Systems Scarp—Tunbridge Tier, Scarp —Threshermans Hill, Blackman River, and Table Mountain.

The escarpment is dominated by *Eucalyptus delegatensis* and *E. dalrympleana*, but other *Eucalyptus* spp. more typical of the lowlands extend onto the foothills and into the area of ill-defined escarpment in the south (see Pemberton, 1986—Blackman River Land System). Typical understorey tree, shrub and heath species include *Acacia melanoxylon, A. dealbata, Banksia marginata, Hakea sp., Pittosporum bicolor, Bedfordia salicina, Olearia phlogopappa, O. viscosa, Pultenaea juniperina, Cyathodes parvifolia, Lissanthe montana, Lomatia tinctoria* and *Pteridium esculetum*. Generally, scrub and heath cover tends to be discontinuous, in part because of the lack of soil over rock outcrops and scree. On drier, lower slopes grasses may form the main ground cover. In places, deeply incised or suitably orientated shady gullies support a variety of fern species and *Olearia argophylla. Dicksonia antarctica* is rare. *Atherosperma moschatum* occurs on some southerly-facing slopes south of Table Mountain and Lake Crescent, in areas where Pemberton (1986) records *Tasmannia lanceolata. Nothofagus cunninghamii* is more restricted but is present on Table Mountain.

On the plateau, *Eucalyptus delegatensis* forest or woodland is widespread. The highest areas are generally well drained and covered with stunted *E. coccifera*. Other *Eucalyptus* species are widespread in areas of low to moderate altitude. *E. dalrympleana* occurs on slopes, *E. pauciflora* grows in areas subject to cold-air drainage and in some high exposed areas, and *E. amygdalina* is found at the lowest locations. *E. viminalis* and *E. obliqua* are more restricted, and *E. rodwayi* generally occupies poorly-drained areas (Pemberton, 1986). In some grazed flat country an almost park-like grass cover has developed between *Eucalyptus* spp. Elsewhere, the understorey is predominantly low open heath, although low open scrub is present in some sheltered areas.

Pemberton (1986) indicates *Cyathodes parvifolia, Lissanthe montana* and *Pultenaea juniperina* are widespread understorey plants. *Acacia dealbata, Lomatia tinctoria, Banksia marginata* and *Pteridium esculetum* do not extend into the highest areas. In these higher areas *Coprosma nitida* and *Hakea lissosperma* occur more commonly, and in places *Orites revoluta* and *Gaultheria hispida* may be present. *Olearia phlogopappa* and *Tasmannia lanceolata* are not common, the latter species occurring at Table Mountain and Mt Penny (Pemberton, 1986), and occurring with ferns beneath high *Leptospermum* canopy in some lower areas. Poorly-drained areas support grasses, sedges and, in places, *Leptospermum lanigerum, Callistemon viridiflora* and

* All references lie within the 100 000 metre grid square EP.



5 cm
5350
510
530
Woods Lake
5340
Lake Sorell
Lake Crescent
5330

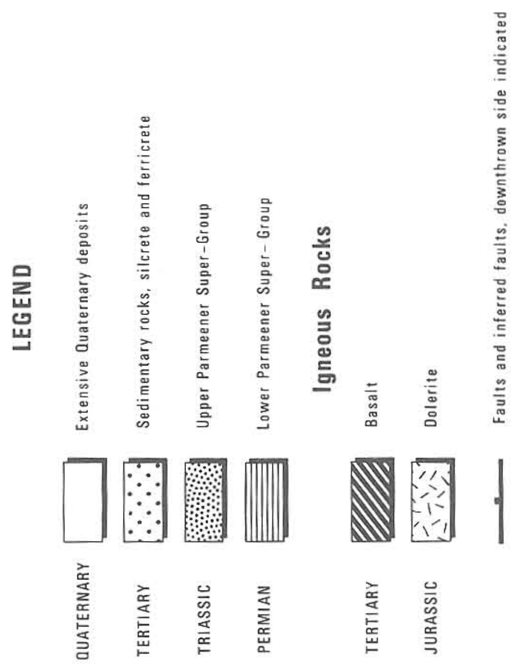


Figure 2. *Generalised geological map, Interlaken Quadrangle.*

Sphagnum swamp and rarely, at Round Lagoon and Table Mountain, cushion plant vegetation. The rocky nature of the ground surface generally impedes walking more than the vegetation does, except where *Leptospermum* thickets become extensive, and in the far north, where a dense two metre high cover of *Cyathodes juniperina* occurs in some forest areas.

Forest harvesting is undertaken in many areas. Periodic winter snow reduces the suitability of the area for year-round rough grazing, and only two pastural properties appear to be permanently based in the upland area.

From the time of initial settlement in the lowlands, Triassic quartz sandstone has been locally quarried for construction stone, and has been worked intermittently to the present day, especially at Ross. A newly-developed quarry is located near Mike Howes Marsh.

Tertiary lateritic material and derived lag deposits near Bells Lagoon have proven suitable for road construction, and were widely used in the construction and realignment of the Midland Highway. Small, stone-aggregate quarries operate elsewhere, utilising closely-jointed and friable weathered Jurassic dolerite and contact metamorphic rocks.

Coal occurs in Triassic coal measures, and some small test pits were opened up at Mike Howes Marsh near the turn of the century. Coal deposits at Woodbury have attracted recent exploration under the current Exploration Licence 31/80.

Previous work

If it was not for the aridity of the lowlands and the desire to provide water, either by boring or diverting water from plateau lakes, the area may not have attracted any previous work until recent time. This is especially so as metalliferous-bearing rocks are absent, coal seams are generally concealed, and the prevailing rock type is Jurassic dolerite, notable for its bland uniformity. The lithology of Early Triassic sandstone, extensively exposed in quarrying operations at Ross, did become well known and was considered to characterise the Ross Sandstone. Not formally defined until 1957, the Ross Formation type section is not at Ross but 50 km away at Poatina (McKellar, 1957).

It is perhaps fitting that some of the earliest records of a geological nature pertaining to the lowlands relate to saline deposits of lagoons precipitated during the dry season (Barwick, 1890; Reid, 1919*a*, 1919*b*), and it was the possibility of diverting water from Lake Sorell which led to perhaps the first geological report on the highland area (Twelvetrees, 1902). The diversion possibility was further discussed by Nye (1924, 1926).

Twelvetrees (1902) noted many geological features of the plateau top, especially the dolerite composition; the occurrence of stratified Parmeener Supergroup rocks; Tertiary basalt occurrences; sandy beaches around Lake Sorell, possibly of material derived from beneath the lake water; and the occurrence of sandstone outcrops 200 m below lake level on the Tiers escarpment. Twelvetrees was uncertain about the age of 'quasi tesselated' clayey sandstone with pebbles on the lake shore, now referred to the Lower Parmeener Supergroup, and considered what are probably basalt flow remnants to be volcanic cones. He did not relate carnelian, jasper and other varieties of quartz occurring as beach pebbles and sand to the volcanic rocks but considered them to be the result of contact metamorphic effects of dolerite on sandstone. Petterd (1910) subsequently noted the occurrence of wood opal, agate, common opal and chalcedony at Lake Sorell. Twelvetrees concluded his report with observations on shallow pits and dip workings exposing a coal seam at Mike Howes Marsh.

The first and only previous geological mapping covering a large part of the quadrangle was undertaken by Nye (1921), and published as part of a report on underground water. The area mapped by Nye included that part of the quadrangle east of a line drawn from the River Clyde, around Lake Crescent and the eastern shore of Lake Sorell, to Ellinthorp Plains, and thence to the northern boundary of the quadrangle. Nye's map (approximate scale = 1:83 000) gave a reasonable outline of the distribution of the main rock types, including a category of alluvium and windblown sand, but did not indicate Tertiary sediments or ferricrete, which were depicted either as Upper Parmeener sandstone or as dolerite. Similarly, extensive Quaternary dolerite clast cobble beds were depicted as dolerite outcrop. Nye did discuss sub-basalt sediments east of Tunbridge, and he subsequently referred to Tertiary sediments at Ellinthorp Plains and dolerite cobble beds

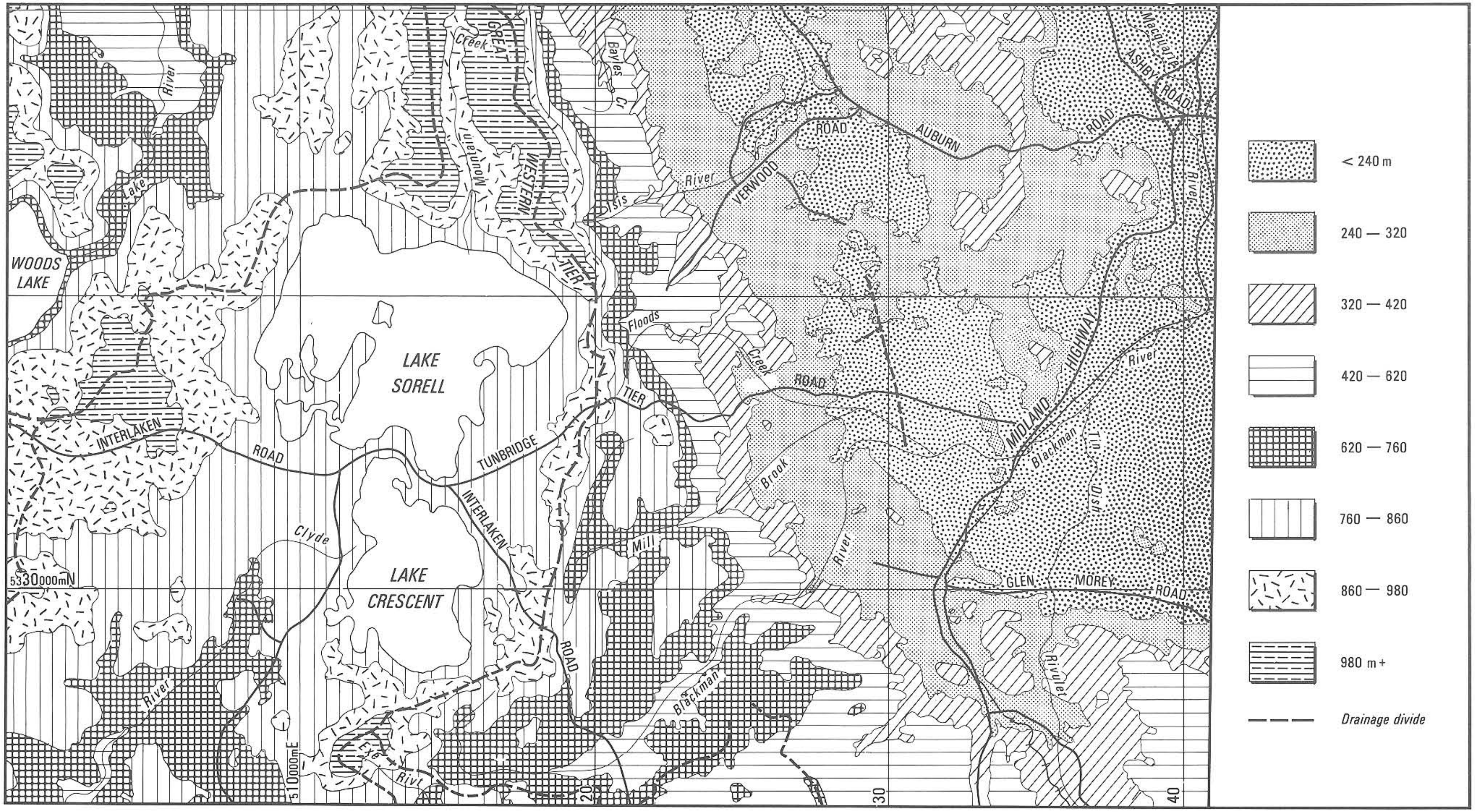
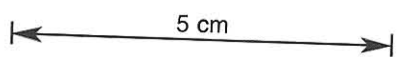


Figure 3. *Generalised relief of the Interlaken Quadrangle (metres above sea level), and major rivers and drainage divides.*



elsewhere, the latter which he erroneously regarded as being Tertiary in age (Nye, 1926).

Nye (1921) indicated the main areas of 'Permo-Carboniferous' rocks (Lower Parmeener Supergroup) about Ross and some areas along the Tiers, noting that they consisted of white mudstone with some fossiliferous limestone near Ross. It is interesting to note that Nye separately mapped sandstone and conglomerate beds within the Lower Parmeener Supergroup as Trias-Jurassic (Upper Parmeener Supergroup), considered granite erratics to represent basement, and based on the palaeontological evidence of the day, erroneously considered the sequence to correlate with the 'Lower Marine Formation' of the Permo-Carboniferous system. Nye's conclusions regarding conglomerate (9 m) forming the base of the Upper Parmeener Supergroup and containing clasts with reworked Permian fossils are largely erroneous, as he appears to have been referring to Lower Parmeener rocks; this is especially evident by reference to the original field notes describing the fossil occurrence. Nye's map divided the Upper Parmeener Supergroup into a 'Lower' quartz sandstone and an overlying 'Feldspathic' sandstone sequence, indicated to occur in the Brent Sugarloaf–Woodbury area.

Although Twelvetrees (1902) had regarded Parmeener strata capping the highlands to have been uplifted by faulting and by uplift due to dolerite intrusion, Nye (1921) took a narrower and retrograde view, considering the escarpment not to be fault-related but to be an intrusive margin in the form of a massive step in the upper surface of an all-pervasive dolerite sheet, and specifically discounted the extension of mapped strata beneath the plateau dolerite. Although the reasons for this interpretation can be readily understood, based on the rock distribution along the escarpment, it is nevertheless surprising, as Nye had observed the evidence for faulting where one of the major escarpment faults is located. Nye contributed significantly by his observations on dolerite dykes, his conclusions of pre-dolerite or syn-dolerite fault-like displacements of strata on opposite sides of some dolerite intrusions, and a detailed record of metamorphic effects caused by dolerite.

Following his initial mapping, Nye (1922) described the Mike Howes Marsh coal seam as being associated with quartz sandstone. This association referred to quartz sandstone, which may occur stratigraphically close to and below the coal or may be faulted into position, but not to sandstone in the coal pits which is of the volcanic lithic type.

The application of Nye's groundwater study can be followed through a series of unpublished and published reports on site investigations for proposed bores, the results of bores, and rarely logs of the boreholes (Hills, 1923; Nye, 1925 *a-i*; 1926; 1929; 1930*a, b, c*; Scott, 1930). Drilling near Woodbury intersected 'feldspathic' sandstone, black mudstone and coal (Nye, 1925*b*). Further drilling logs of holes put down near Woodbury are presented by Matthews (1961), and other unpublished results are included in Appendix 1.

Nye's (1921) view that the Great Western Tiers was not a fault scarp was not shared by A. N. Lewis, and resulted in some controversy (Nye, 1928; Lewis 1928; 1933). Lewis (1933) considered the area north of Lake Sorell to have been glaciated, and again differed from Nye (1921) in proposing a possible glacial origin for the lake.

The physiographic relationship of various Tertiary basalt flows was discussed by Edwards (1939). Nye (1921, 1924, 1926) included descriptions of soils. The distribution of soils in the eastern half of the quadrangle was mapped (1:63 360, Leamy, 1961), indicating for the first time the distribution of lateritic profiles. Soils of the plateau and escarpment have been described by Pemberton (1986). Seismic and resistivity profiles over Quaternary alluvium west of Ross have been carried out by W. L. Matthews (Department of Mines plans 3708, 3724). The results of detailed studies of Quaternary aeolean deposits at White Lagoon have been published by Sigleo and Colhoun (1982). The results of an intensive coal exploration drilling program are currently not generally available except for some isolated scout holes (Summons, 1981). Some interim reports have been produced on the current quadrangle mapping program (Forsyth, 1976; 1983; 1984*b*).

Acknowledgements

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R. Cavaleri, J. Hudspeth, P. Ruzicka and S. Walker undertook many of the magnetometer traverses, and W. L. Matthews assisted in locating the sites and logs of groundwater bores. The vegetation descriptions in this report were critically read by J. B. Davies and M. Pemberton, who also provided additional botanical information. Dr E. Williams and M. J. Clarke read and helped to improve the manuscript.

PHYSIOGRAPHY

The most prominent physiographic feature of the Interlaken Quadrangle is the NNW-trending escarpment of the Great Western Tiers, which separates lowlands from a mountainous and irregular plateau area in the west. The lowlands (from 180 m to about 320 m above sea level) occupy about one-third of the quadrangle (fig. 3). From the lowlands, the Tiers escarpment rises 500–800 m over a distance of a few kilometres to highlands (720–1100 m). In the south (south of Big Enfield [245305]) the highlands fall more gradually to merge with an extension of the lowlands into slightly higher country (320–420 m), and the continuity of the escarpment as a single major feature is lost.

The major part of the escarpment was considered by Nye (1921) to be the original edge of a dolerite intrusion, in the form of a large step in the upper surface of an all-pervasive dolerite sheet. Nye's hypothesis led to some controversy (Lewis, 1928; Nye, 1928) and the opposing view of Lewis (1933), that the escarpment was generated by the faulted uplift of the highlands, is now considered to be correct. Throughout the quadrangle the different susceptibility to weathering of dolerite compared to that of softer sedimentary rocks strongly influences the basic physiographic features, and it is the distribution of dolerite, either determined by the original shape of intrusions or the effect of subsequent faulting, which determines many landforms. The first-order features of the physiography are erosively generated, with only minor depositional features formed by basalt flows, Cainozoic depositional and lateritic surfaces.

Highlands

In a general sense, the highlands fall from north to south, probably related to a general tilting of the Central Plateau over a much larger area (Banks, 1973). Two closely interconnected lakes, Lake Sorell (about 8×10 km) and Lake Crescent (about 8×3.5 km) lie in shallow depressions near the eastern edge of the highlands at an altitude of a little over 800 m. Thin remnant skins of Parmeener Supergroup strata, associated with the fine-grained upper margin of the dolerite intrusion about and underlying the lakes, indicate the lakes occupy exhumed, more or less original upper surface depressions in the dolerite sheet.

North-east of Lake Sorell, a NW-trending scarp is also related to an original irregularity of the dolerite intrusion, in this case a steep transgressive step through at least 200 m of Lower Parmeener Supergroup strata and probably extending up into Upper Parmeener strata. North of this scarp is the largest area of the quadrangle with an elevation greater than 1000 m a.s.l. (fig. 3). The Parmeener Supergroup strata have been completely stripped from this area and few remnants of the upper dolerite margin remain. Stream dissection has taken place, probably partly controlled by megajoints or faults cutting the dolerite, particularly controlling the N–S drainage of Mountain Creek flowing into Lake Sorell. Other irregularities may be erosional or partly controlled by dolerite form but in a general sense this area falls westward similar to the dolerite structure in the adjacent Lake River Quadrangle (Matthews, 1974), and drainage becomes directed away from Lake Sorell, eventually flowing into the Lake River.

Further west the highland country is broken by the valley of the Lake River at Regents Plain [040500] where the influence of dolerite structure is again apparent. The dolerite intrusion here is both stratigraphically and topographically lower, and from the Lower Parmeener Supergroup rocks flooring Regents Plain (520–580 m) the dolerite intrusion shelves westward (620–700 m) before rising to heights in excess of 1000 m on Mount Penny [010450] and Frog Hill, and to lesser heights to the south and east.

Woods Lake (738 m), cut by the western margin of the quadrangle, is separated from Lake Sorell by a relatively large area of highlands above 860 m rising to Alma Tier (1075 m). These highlands appear to be related to the dolerite transgressing to higher stratigraphic horizons immediately west of Lake Sorell to intrude relatively high in the Upper Parmeener Supergroup at Woods Lake. Woods Lake occupies a depression bounded by steep straight scarps on the north-western and eastern sides, and to a lesser extent on the southern side, and by low ground on the south-western and north-western corners.

Although there is some ambiguity as to whether the top or bottom of the dolerite sheet is exposed at Woods Lake, the depression probably occupies an exhumed block of Upper Parmeener Supergroup rocks set into the top of the dolerite sheet, at least on its southern and eastern sides. Headwater erosion by the Lake River appears to have breached, at Devils Throat, the highlands that probably once extended from Frog Hill to Alma Tier.

South-west from Interlaken, along the Interlaken Road, the upper surface of the dolerite intrusion falls gradually to 700 m and the River Clyde flowing out of Lake Crescent, and the river's tributaries, dissect the dolerite highlands to below 560 m. Occasional projections of the intrusion above 860 m, such as at Soldiers Marsh Hill (>1000 m) may be related to original bosses in the intrusion's upper surface [010300]. In the south-west corner of the quadrangle, Bushrangers Creek [010240] and Good Marsh [035245] are structurally controlled.

Table Mountain (1095 m), south of Lake Crescent, is capped by a flat-topped thin dolerite sill which appears to have arisen by splitting from the main underlying intrusion. This capping sheet, abutting dolerite transgressions or bosses from the underlying intrusion, and some Tertiary basalt flows, all have served to protect accompanying Upper Parmeener Supergroup strata from erosion in this area. Collapse of the capping sheet margins at Table Mountain has produced a cliff-line almost encircling the mountain.

Lake Sorell and Lake Crescent are bounded to the east by a gently-rising rim, probably an eroded transgressive intrusion segment at Gillwell Peak [200390]. South through Dogs Head Tier, Harrisons Lookout and Old Mans Head, the rim is probably partly original intrusion form and partly the edge of a tilted block bounded by a probable fault, downthrowing to the east. This rim forms a drainage divide; to the east rectilinear drainage at Racecourse Marsh [198317] flows into Mill Brook descending the Tiers escarpment, while further south such drainage flows into the Blackman River. In the extreme south the streams flow into the Jordan River [126240].

The rim also marks the commencement of a step-like loss of integrity of the Tiers escarpment. This effect is not immediately marked at Tunbridge Tier [225358] and Big Enfield [245305], as from the probable fault bounding the rim the dolerite surface again rises eastward to 840-900 m. Further south the sandstone country forming the south shore of Lake Crescent drops to Boggy Marsh (660 m) [160240], and capture of the lake by the Blackman River headwaters has probably only been prevented by the presence of capping basalt flows. South-east of a fault and/or graben structure which runs south of Big Enfield, the topography seldom exceeds 720 m in height, except where basalt flows are present. An increased proportion of Upper Parmeener Supergroup strata is present near the successive down-steps of the dolerite sheet, and only a 40 m high divide of sandstone contains the Blackman River from flowing south into the Jordan River system at Mike Howes Marsh [210240]. The Blackman River flows in the fault and graben system north-east across Mike Howes Marsh before cutting a deep gorge in its descent into the lowlands.

Although the dolerite is found at higher stratigraphic levels near Currajong Hills [285240] it is downfaulted, and the topography continues to fall to the east, exceeding 620 m only where higher-level dolerite sheets or basalt flows have been preserved. The fall continues through an area of rectilinear drainage to country 460–560 m a.s.l. near St Peters Pass (<280 m), where the dolerite is cut by a north—south graben [335240]. Further east the dolerite sheet descends to lower stratigraphic and topographic levels, and merges with plains country on the Sorell Springs Road [365245], before again rising both stratigraphically and topographically, complicated by faulting, to reach 540 m on Black Tier [410264].

Escarpment

Although local average escarpment gradients of 1:2 extend over vertical distances of 300 m, the total average gradient of the escarpment is generally much less and extends over a horizontal distance of several kilometres, partly because the escarpment has been produced by erosion back from a series of well-spaced step faults.

As a result of multiple faults, some ridges parallel to the escarpment have been produced. Streams draining the escarpment, such as Bayles Creek, descend steeply until reaching such ridges and are then diverted to flow in perched valleys parallel to the escarpment trend until a suitable outlet to the lowlands is found. In other areas, erosion has proceeded to isolate the ridges as low foothills surrounded by lowlands. The prominent scarp found in the highlands north of Lake Sorell appears to be projected into the escarpment and lowlands areas as stratigraphically and topographically higher dolerite at Snobs Point [220410] and Gavins Sugarloaf [240402].

Near the northern boundary of the quadrangle the maximum escarpment gradients occur on dolerite bedrock, as distinct from lower gradients developed on underlying strata. Cliff sections are not well developed and are usually only a few metres high (maximum), laterally discontinuous, and confined to near the upper shoulder of the escarpment. An unusual exception occurs lower on the escarpment [187460]. An irregular cliff (tens of metres high with vertical columns) stands above and back from a ridge of slightly broken dolerite with columns inclined at 45°. Forward rotation of the column inclination appears to have taken place by falling away from a structural weakness in the dolerite sheet, rather than by *in situ* tilting during faulting. Small swamps enclosed by hummocky slope deposits are rare.

Lowlands

The lowlands are broken by a zone of hills and ridges (up to 440 m a.s.l.) between Abbotts Hill [350495] and Steeles Bluff [335425], with lesser hills south through Tunbridge, and at Grimes Sugarloaf [402399] and Horton Hill [385440]. Much of this hilly country has been uplifted and tilts back towards the Tiers escarpment, so that a zone of lowland (200–260 m a.s.l.) runs along the escarpment foot and has accumulated Cainozoic sediments which have buried previous topographic irregularities to a depth of more than 100 m. Escarpment drainage dividing around Gavins Sugarloaf has resulted in the preservation of a dipping lateritic surface in the lee of Gavins Tier. Drainage diverted northward flows into the small Isis River which flows NNW along the escarpment foot, whereas drainage diverted southward forms Floods Creek which flows into the Mill Brook—Blackman River system, joins with the Tin Dish Rivulet system at Tunbridge, and then skirts the hilly country of the lowlands by flowing north-easterly into the Macquarie River at Mona Vale. The lateritic surface near Gavins Sugarloaf dips shallowly onto the escarpment foot lowlands, and away from this area shows increasing stream dissection to produce mesa-like hills of low relief (less than 40 m) where it is formed on soft Tertiary sediments.

Streams reaching the lowlands from dolerite country during the Quaternary Period deposited beds of dolerite cobbles which have subsequently been eroded by modern streams, producing low terraces bounding alluvial flats. Cobbles deposited as proximal alluvial fans, or more distally as braided stream deposits, are a common feature of the lowlands and extend up to ten kilometres away from the escarpment and downstream along the Tin Dish Rivulet [360305]. Stream course changes are evident, such as the former course or spill-over deposit of the Stringy Bark Rivulet immediately east of Green Spur [288290], and the boulder deposit which extends north of Woodbury parallel to the Midland Highway [323310]. Sub-basalt gravel at Ballochmyle may suggest a much earlier (mid? Tertiary) westward diversion of the Tin Dish Rivulet caused by basalt filling the previous valley (Edwards, 1939).

The aridity of the lowlands has led to deflation and deposits of lunette and other dune systems. The lunettes are usually occupied by either semi-permanent lagoons or seasonal lagoons which develop salt pans. Lunettes are particularly common east of Tunbridge and north of Bells Lagoon [290410].

Some isolated hills on the plains are related to remnants of higher-level dolerite sheets, for example at Red Ridge [390316], and features similar to the conical hills of York Plains (Forsyth, 1984*a*) have developed on a sequence of lithic sandstone capped by dolerite at Brents Sugarloaf [412295]. A small circular mesa developed on other rock types capped by basalt occurs at Dunns Battery [407366]. Away from the plains tract of streams, the lowlands consist of gently-rolling hills usually composed of dolerite or sandstone, rarely with basalt flow cappings, and starker terrain is usually only developed where faults or dolerite intrusion features have been exhumed. The topography is too low for significant dissection except in some dolerite and sandstone areas between Abbotts Hill [353495] and Hanging Sugarloaf [298485].

Physiographic Development

The physiographic development has probably passed through stages similar to those envisaged by Lewis (1933). Following mid-Jurassic dolerite intrusion (Schmidt and McDougall, 1977), an extended period of erosion started the removal of the strata above the dolerite intrusions. Faulting, especially resulting in the relative uplift of the highlands, then took place. It is not possible to tell from exposure of fine-grained dolerite with quenched texture occurring rarely along the escarpment fault whether the dolerite intrudes the fault plane or consists of fault slithers. Dolerite-intruded faults, of the same trend as the Tiers escarpment faults (Forsyth, 1984*a*), occur elsewhere but such faults usually have little physiographic expression.

The trend is also repeated by faults bounding basins which accumulated Tertiary sediments further north (Matthews, 1983), and by faults cutting Tertiary sediments in the Bass Basin. The escarpment faults may have originated in the Jurassic but the main movement probably occurred during the Late Cretaceous or Early Tertiary. Stripping then proceeded at a faster rate in the highlands, removing the Parmeener Supergroup strata from above the dolerite intrusion in many areas.

More Parmeener Supergroup strata are preserved above the dolerite intrusion in the lowlands, especially in relatively down-faulted areas. The oldest post-Parmeener deposit found adjacent to the escarpment in the quadrangle is dolerite conglomerate (38 m). The conglomerate is immediately overlain by a sequence (74 m) of sandstone, siltstone, claystone and lignite, capped by laterite, which is no older than middle—late Eocene at the base. On the property 'Verwood' the conglomerate overlies Triassic coal measures which have been stripped from neighbouring areas but do not appear to be represented in the basal conglomerate.

The impression gained is that the coal measure rocks had been eroded from adjacent areas prior to middle–late Eocene sedimentation. This suggests that faulting, then a considerable period of erosion, during which detritus by-passed or was later removed from the area, occurred before middle–late Eocene sedimentation. This is not inconsistent with the geological history of the similar, but much larger, Longford Basin to the north, where sedimentation commenced during the Palaeocene and basin subsidence probably continued through to the middle Eocene (Matthews, 1983).

There is a possibility of subsurface continuity between the Tertiary sediments near Verwood and those in the Longford Basin. However the area is too poorly known to determine whether the Verwood area was a closed basin; linked with the Longford Basin; or underwent subsequent subsidence. The record of sedimentation following the middle–late Eocene to the present is very incomplete but the only other volumetrically significant coarse-grained dolerite detritus preserved is believed to be of Quaternary age. Detritus from the dolerite escarpment was either not readily eroded and transported, was trapped behind the ridges parallel to the escarpment, or bypassed the lowlands. The last possibility is very unlikely, especially during the period following laterite formation. Thus the sedimentation gives no evidence of tectonic rejuvenation of the escarpment following the middle–late Eocene.

Practically the complete thickness of the Parmeener Supergroup strata which once overlay the dolerite intrusion about Lake Sorell had been stripped prior to the eruption of basalt flows, inferring that this area had been uplifted prior to volcanic activity. The distribution of basalt flows about Lake Sorell and Lake Crescent suggests that the depressions occupied by the lakes had developed before basalt extrusion but there is no evidence of aquagene volcanic rocks, suggesting the lakes themselves had not formed.

By analogy with dated basalt rocks elsewhere in Tasmania (Sutherland and Wellmann, 1986; Baillie, 1986*a*, *b*, 1987), the flows may be Palaeocene to late Miocene in age but a more restricted range of middle Eocene to lower Miocene is assumed, based on the geographic distribution of the flows. Some basalt clearly post-dates some faulting [250230], and basalt may occupy a fault plane at 248343. Edwards (1939) considered that some of the basalt south of Lake Crescent had flowed south down old valleys of low gradient, and to have been subsequently disrupted by faulting to produce flat-bottom flows at different altitudes down the inferred valleys. Elsewhere other flows appear to have moved down steep slopes probably related to fault scarps [224260, 310270]. Providing volcanic agglomerate in Currajong Rivulet is not a vent occurrence, a pre-basaltic relief of over 200 m is indicated for this area, again suggesting pre-basalt uplift [304252]. Conclusive evidence for post-basalt faulting is lacking.

Conditions favourable for the formation of ferricrete and silcrete horizons which draped the general topography occurred sometime after the onset of volcanic activity. This is suggested by the occurrence of ferricrete developed on rocks with agate pieces and diatomaceous rocks south of Bells Lagoon, and post-basalt ferricrete precipitated below basalt at Butlers Rise [376352]. Much of the ferricrete was eroded during the late Cainozoic.

Lewis (1933) considered that the valley of Mountain Creek had been glaciated, and noted erratics along the valley floor. No detailed investigation has been carried out to distinguish possible glacial deposits from periglacial deposits, and although part of the highlands may have been sufficiently high to have been glaciated, low precipitation rates may have prevented significant ice sheets from forming. Boulders of dolerite are found in some flat areas, and more than periglacial conditions may be required for their transport. Blocks of dolerite occur overlying Lower Parmeener Supergroup outcrop and shingle deposits on the floor of Lake Sorell but a human intervention cannot be dismissed. Similar blocks of dolerite occur overlying Lower Parmeener hornfels east of Lake Sorell, in an area of low gradient and where human intervention is unlikely. Matrix-supported deeply-weathered doleritic boulders underlying alluvial cobble fans or delta deposits in Mountain Creek suggest an older period of deposition by a different mechanism, but slightly upstream the dolerite basement is similarly weathered to clay and the boulder clasts may have been essentially rotted before transport. Some raised beach deposits at Lake Sorell indicate previously higher lake levels but evidence of morainal damming has not been found. Curious raised angular blocks of dolerite on some lake and lagoon shores may be related to periglacial ice lift. Ferruginous-cemented polygonal structures of vertically-orientated shingle occur beneath Lake Sorell.

Veneers or locally thicker deposits of periglacial deposits generally have not been mapped in the highland country but are widespread. Talus occurs on the escarpment but is not as voluminous, especially south of Lake Sorell, as in quadrangles further north. Rarely do very large boulders (up to several metres) extend far beyond the limits of dolerite outcrop, and in those areas where such deposits are found the deposits appear to be isolated remnants of deposits which may be significantly older than the more common small boulder talus.

Minor modification to the physiography also took place during the Quaternary. Cobbles were deposited as alluvial fans and braided stream deposits in the lowlands and at Regents Plain; as deltas into Woods Lake and Lake Sorell; and as various perched fans on the escarpment and elsewhere. Aeolian dune and sheet deposits are, in some cases, younger than the cobble deposits but also extend back into the last Interglacial period (Sigleo and Colhoun, 1982).

STRATIGRAPHY

Pre-Parmeener Supergroup rocks

The oldest exposed rocks in the Interlaken Quadrangle belong to the flat-lying Late Carboniferous to Late Triassic Parmeener Supergroup, but older folded rocks have been intersected in two deep stratigraphic bores and are described below. The older rocks form the sub-surface pre-Parmeener Supergroup basement near Ross and at the Great Western Tiers escarpment west of Tunbridge.

Probable Precambrian rocks intersected in the Tunbridge Tier bore

The Tunbridge Tier bore [24513487], collared at 410.9 m a.s.l. and marked as RG145 on the map, intersected folded rocks from 905.68 m to 914.45 m. From an examination of core and two thin sections at 906.1 m, two at 909.2 m, one at 909.4 m, and two at 913.3 m, Dr E. Williams has provided the following description:

"In general the rock is of interdigitating lenticular laminae, which are up to 1.75 mm in thickness. The rock laminae are composed of quartz, quartz-muscovite and carbonaceous-micaceous mixtures. Most laminae are within the latest cleavage—a transposition cleavage, which is some 30° from the drill core axis. Some micro-lithons contain discordant laminae which are crenulated, and the resulting crenulation cleavage is parallel to the transposition cleavages bounding the lithons. An event later than the development of transposition cleavage resulted in the formation of micro-breccia. Post-tectonic pyrite crystals grew by replacement of pre-existing rock minerals.

Quartz-rich laminae: Usually the laminae show polygonal recrystallisation with grain size varying from 0.05 mm to 0.1 mm. Large remnant quartz grains (up to 2.5 mm) commonly display strain and occasionally partial polygonisation. Grains of calcite with deformation lamellae occur with sutured margins against coarse quartz grains in one sample (913.3). Some discordant laminae were originally quartz veins as indicated by remnant patches of comb structure with crack-seal characteristics.

Quartz-muscovite laminae: Quartz has a polygonal texture, whilst the grains of muscovite are aligned within the latest cleavage. Mica-rich laminae show optical continuity and orientation of the micaceous material in the transposition cleavage direction.

Carbonaceous-rich laminae: Included with the carbonaceous material are fine grains of quartz (0.02 mm) and mica with a preferred orientation in the transposition cleavage direction.

Micro-breccia: In one sample (906.1) the rock laminae are brecciated and fragments, which have been rotated up to some 90°, are set in a fine-grained (0.02 mm) mixture of carbonaceous material, mica and quartz. The boundary of the micro-breccia against the unfragmented laminated rock is an annealed irregular surface.

Pyrite: Cubes (approximately 0.1 mm) and interpenetrating cube twins occur in most samples. There is no disturbance of the surrounding rock fabric, and the crystals appear to be post-tectonic and to have replaced the pre-existing rock minerals. Quartz-rich lenticles abut the pyrite crystal faces within the tranposition cleavage surfaces indicating chemical differentiation during pyrite crystal growth.

Conclusions: This finely laminated tectonite has received lower grade metamorphism. The degree of tectonic/metamorphic modification and the overall mineral composition are unlike those displayed by the rocks of north-eastern Tasmania, but are consistent with the rock belonging to the Precambrian sequences of western Tasmania."

Unassigned rocks intersected in a bore west of Ross

Drill hole Ross 1 (shown as RG146 on the map) [36284716] was collared at 199.8 m a.s.l. and intersected hornfelsed folded rocks between 540.80 m to 615.4 m, overlying a major Jurassic dolerite sheet in which drilling was terminated at 652.80 m. The folded rocks consist almost entirely of dark grey hornfels with only rare vertical to horizontal arenaceous laminae. Pyrrhotite is common in some laminae, such as at 570.1 m (P. W. Baillie, R. Woolley, pers. comm.), and has been identified by X-ray diffraction.

Dr E. Williams described the sequence as follows:

"Thin sections of core at 567.90 m, 570 m, 607.20 m, two at 607.30 m, 609.30 m, 611.20 m and 612.85 m have been microscopically examined.

The sequence is of dominantly fine-grained carbonaceous material with minor variable amounts of quartz grains varying in diameter from 0.025 mm to 0.05 mm. At 570 m occur 10 mm thick layers which have a median grain size of 0.025 mm and consist of quartz with minor carbonaceous aggregates. Similar quartz-rich layers at 609.30 m contain micaceous grains, which vary in amount from layer to layer. At 612.85 m the rock is of dominantly quartz. In general the compositional laminae are at a very high angle (60-80°) to the core length.

Carbonaceous-rich spots, averaging 0.1 mm diameter, are not only notable in the layers of dominantly carbonaceous material but also in some of the quartz-rich silt-grade laminae. Pyrite ovoids, approximately 0.75 mm in length, occur at 567.90 m. These ovoids and the carbonaceous spots may be of diagenetic origin. Euhedral pyrite or pyrrhotite up to 0.50 mm diameter appear at 570 m, and become more numerous down-hole to 611.20 m.

A slaty cleavage, consisting of lenticles up to 0.05 mm thick, is developed in both the carbonaceous-rich and quartz-rich silt-grade laminae. The cleavage is approximately along the core length at 567.90 m, some 25° to core length at 570 m, 20° at 609.30 m, and approximately 90° at 607.30 m. The cleavage is axial to a fold with a half wavelength of 5 mm of a quartz-rich laminae at 570 m, and is related to the penetration of material from a more carbonaceous-rich laminae into quartz-rich laminae as anastomosing seams. At 609.30 m micaceous material shows growth alignment in the slaty cleavage, which is strongly refracted at compositional boundaries. Well-developed beards to both the carbonaceous spots and pyrite ovoids are formed of mainly quartz fibres aligned within the slaty cleavage at 567.90 m. Thin rims of quartz fibres occur around occasional euhedral pyrite grains at 570 m, and some carbonaceous spots at 607.30 m. However, euhedral pyrite or pyrrhotite grains are usually unaccompanied by beard development and are post-deformation, and become more numerous at lower levels.

The slaty cleavage appears to be axial to folds of ptygmatic quartz veins at 607.20 m and 607.30 m. The veins are approximately 0.5 mm thick and consist of polygonal growths of quartz grains. Aggregates of euhedral pyrrhotite? penetrate and cut across the earlier formed veins.

Crenulation cleavage gently folds the slaty cleavage and mineral fibres of grain beards at frequencies of 0.25 mm to 0.50 mm. The attitude of the cleavage varies from 30° to core length at 567.90 m and 570 m to 60° at 609.30 m. The long axis of ovoids of both pyrite and carbonaceous material are commonly aligned along the crenulation cleavage.

At 607.20 m appear discordant veins consisting of segregations of quartz and pyrrhotite? grains, of a median grain size of 0.5 mm, and clusters of interpenetrating clinopyroxene crystals. The distribution of clinopyroxene becomes more general with depth, and at 611.20 m subhedral crystals of approximately 0.025 mm diameter are dispersed in the more quartz-rich layers amongst recrystallised polygonal quartz grains. At 611.20 m and 612.85 m subhedral clinopyroxene grains form margins to 0.5 mm thick veins of polygonal quartz and perthitic feldspar. Occasionally small clinopyroxene grains are segregated in bands. At 612.85 m wavy lenticles up to one millimetre thick consist of polygonal quartz grains, and they have developed perpendicular to the core length. Some lenticles have a median grain size of 0.025 mm whereas others are of a 0.1 mm grain size. Many lenticles display quartz comb structure with fibre growth parallel to core length, and fine extension fractures occupied by inclusions of bubbles and crystals have commonly developed parallel to the lenticle margins. Irregular stylolitic structures occur sub-parallel to the lenticles.

Growth of subhedral clinopyroxene, polygonal quartz, feldspar and most of the euhedral sulphides (pyrrhotite or pyrite) is post-cleavage formation. These minerals progressively increase in amount with depth and they, together with the lenticular and associated structures at 612.85 m, are related to the occurrence of a dolerite intrusion encountered at 615 m.

The sedimentary sequence displays minor structures indicative of two pre-dolerite fold phases. Such deformation is commonly developed in pre-Middle Devonian sedimentary sequences throughout Tasmania. The dominantly carbonaceous-rich sequences may be compared with successions in the Rocky Cape Group. No sequences of a similar comparison are known within the Mathinna Beds of NE Tasmania".

Lower Parmeener Supergroup rocks

INTRODUCTION

No complete section of the Lower Parmeener Supergroup is exposed in the quadrangle but almost the entire sequence (approximately 900 m) was fully cored to basement in the Tunbridge Tier borehole [RG145, 24513487]. Much of the sequence was also fully cored in a bore west of Ross [RG146, 36284716] (fig. 4).

The oldest exposed rocks occur at Regents Plain but have been eroded and disrupted by a Jurassic dolerite intrusion, and only parts of the overlying succession remain. Dolerite locally underlies, or is interpreted to underlie, the succession.

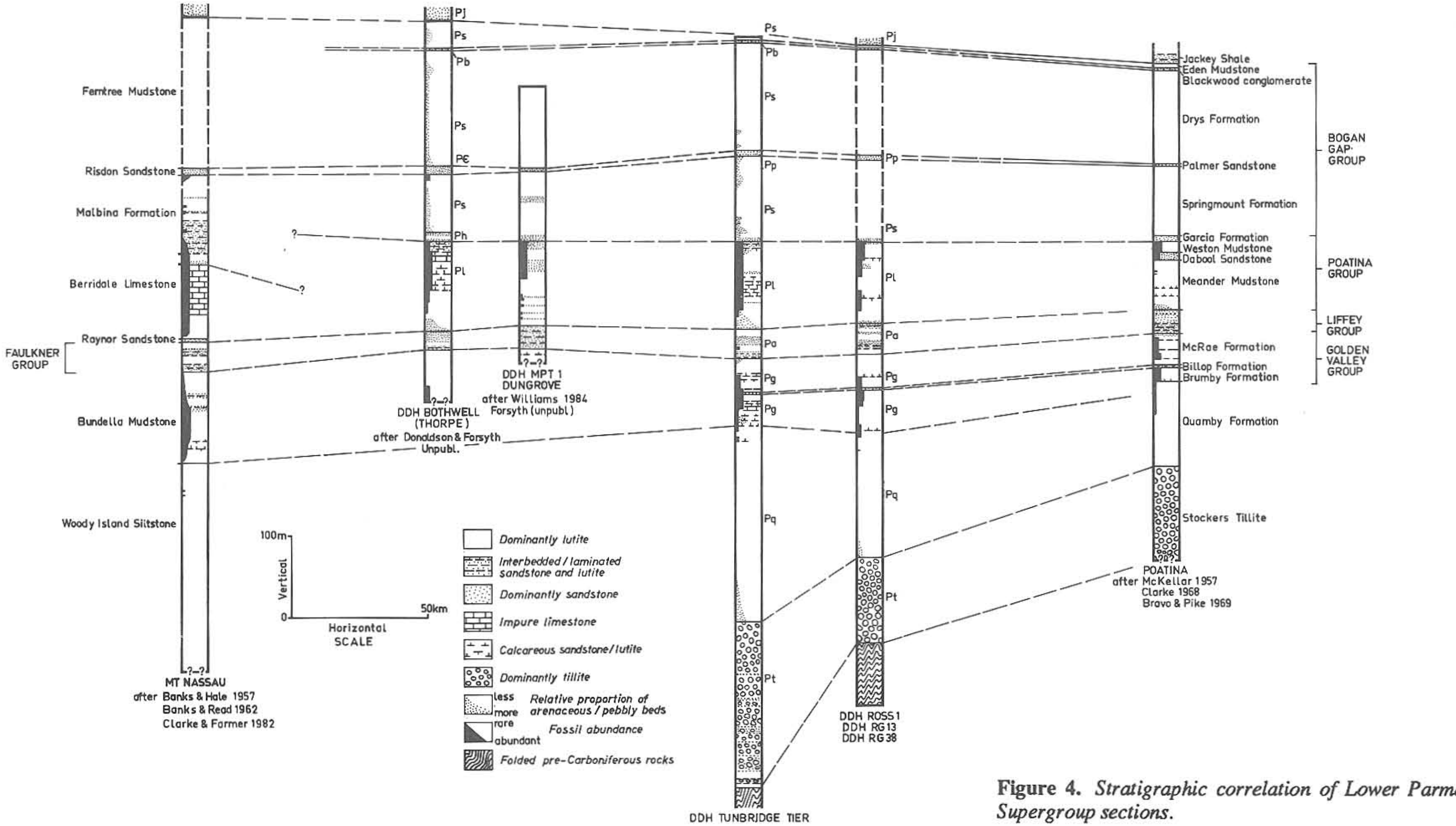


Figure 4. *Stratigraphic correlation of Lower Parmeener Supergroup sections.*

5 cm

This pattern continues through the Lake Sorell area, where many newly recognised outcrops of Lower Parmeener strata were found overlying the Central Plateau dolerite sheet. Thicker sequences of strata occur beneath the dolerite sheet along the Tiers escarpment from Mill Brook to the northern margin of the quadrangle. Other exposures of Lower Parmeener strata occur in the north-eastern part of the quadrangle near Ross

STOCKERS TILLITE CORRELATE

Tillite is not exposed in the Interlaken Quadrangle but is widespread in the adjacent Lake River Quadrangle to the north (Matthews, 1974), where it occurs on the Tiers escarpment about 13 km north of the Interlaken Quadrangle and also to within two kilometres of the quadrangle boundary in the Lake River–Regents Plain area. In the Tunbridge Tier bore the tillite sequence is 199 m thick (fig. 5), and in the Ross bore the sequence is 101 m thick (excluding a Jurassic dolerite intrusion within the sequence). Such thickness variations are common elsewhere, as the underlying basement rocks possessed pronounced landscape irregularities, presumably due in part to glacial erosion.

The tillite clasts are predominantly of granule to pebble size with lesser cobble-size material, especially at Ross. Only a few small boulders less than 600 mm were intersected. Some striated clasts occur in the Tunbridge Tier bore. Dark clasts resembling the underlying hornfelsed basement are present in the Ross bore.

Tillite is not the only rock type present (fig. 5). Well-sorted traction deposits occur, ranging in grain size from fine sandstone to cobble conglomerate, and suspension-deposited mudstone and siltstone are present. In the Tunbridge Tier sequence laminated mudstone occurs primarily as two intervals three to seven metres thick in the basal 10 m of the sequence. Near Ross this lithology is much less prominent and occurs higher in the sequence. In both areas non-tillite rocks are more prominent in the lower part of the sequence. At Tunbridge Tier about one-third of the lower 70 m of sequence consists of non-tillite rocks or units of intimately interbedded tillitic and non-tillitic rocks, whereas the remainder of the sequence contains about 6% non-tillitic intervals. Individual beds of sandstone or conglomerate are seldom greater than one metre thick and generally much thinner. Some sandstone layers are inclined at low sub-horizontal angles in the drill core but only occasionally is cross-bedding and disturbed bedding clearly evident. The conglomerate beds vary from very clean and well sorted to closed framework with a muddy matrix.

Some intersections of open framework 'tillite' rock range from a few tens of millimetres thick up to two metres thick, and are interbedded with non-tillitic rocks. It is unlikely that these intervals of 'tillitic' rocks were deposited by the same process depositing intervals of tillite tens of metres thick, unless they are merely erosional remnants of thick sequences. The thin intervals of 'tillitic' rock may be reworked till. Clasts of the well-sorted lithologies are occasionally found in the tillite, and an irregular sub-vertical contact between sandstone and 'tillite' extends for over one metre in one of the interbedded intervals. This may indicate deformation, or the inclusion of semi-lithified or frozen blocks of sandstone.

The traction-deposited rocks may have been outwash deposited beyond the temporary extent of the ice sheet, or deposited by water flowing beneath the ice. The more uniform tillite intervals near the closing stage of deposition may be related to deposition into standing water, with no opportunity for water current reworking.

By analogy with sequences elsewhere (Clarke and Farmer, 1976) the oldest tillite may be as old as the Hellyerian Stage, the upper part of the Stockers Tillite correlate probably being equivalent in age to the Early Tamarian Stage. The Stockers Tillite correlate is therefore probably wholly Late Carboniferous in age (Clarke, *in* Clarke and Forsyth, 1989).

QUAMBY MUDSTONE CORRELATE (Pq)

The Quamby Mudstone correlate is characterised by very uniform, grey, very finely micaceous siltstone which generally lacks conspicuous bedding features, dropstones and fossils. Surface outcrops tend to rapidly fret by the development of cuboidal to conchoidal close jointing, with a tendency for subhorizontal joints to occur more frequently. In drill core a perfect fracture parallel to inferred bedding, and sometimes very closely spaced, is much more commonly developed. Elsewhere glendonites are common in the Quamby Mudstone but none was observed in the only outcrops of the correlate, which were found near Regents Plain.

Glendonites are not conspicuous in the Ross bore but are persistent through the correlate in the bore at Tunbridge Tier. Other features observed in the Tunbridge Tier core include large pyrrhotite nodules in the lower 130 m interval, especially in the basal 44 m interval; calcareous horizons, generally less than 20–330 mm but up to one metre thick, some of which exhibit bioturbation and may be either beds or concretions; numerous horizons with rare, large agglutinated Foraminera tubes; and through the main interval of the correlate only three dropstones, one associated with rounded shell fragments. Some partings reveal abrupt surface indentations and numerous small pits about 0.5 mm in diameter. Possible faecal pellets and rare synaeresis cracks occur on some horizons.

The base of the Quamby Mudstone correlate is transitional in the Tunbridge Tier bore. Although the top of the underlying tillite is relatively abrupt, pebbles and granules extend up into the Quamby Mudstone correlate base to overlap the occurrence of glendonites, pyrrhotite nodules, and Foraminifera about 24 m above the tillite. Granules extend a further 24 m up the core and an isolated pebble was found a further eight metres above that. Above the transitional basal interval the basic siltstone lithology shows little variation except for occasional zones which are slightly coarser grained and lighter grey in colour, and less commonly zones of dark mudstone. Towards the top of the sequence a one metre core interval disaggregated rapidly on exposure.

The boundary between the correlates of the Golden Valley Group and the Quamby Mudstone is quite gradational and difficult to define, as small changes in lithological characters occur at different stratigraphic positions. In the Tunbridge Tier bore glendonites become very rare but extend up to 220 m above the base of the Quamby Mudstone correlate. A 30 mm thick calcareous layer with fossil fragments occurs two metres below the highest glendonite, and tiny isolated fenestellids occur at one metre and 9–10 m above the glendonite. Coincident with the oldest fossils above the glendonite, bioturbation appears and becomes persistent, and two metres higher the siltstone coarsens slightly. Occasional regularly-spaced dropstones occur from 232 m above the Quamby Mudstone correlate base; a calcareous unit (330 mm thick) with pebbles and a sandy base occurs at 235 m; sandy beds with granules occur at 236 m and 238 m; and the brachiopod *Trigonotreta* was found at 239 m above the base of the Quamby Mudstone correlate.

Preliminary logs of the Ross bore indicate a similar difficulty in defining the top of the Quamby Mudstone correlate, and glendonites may be absent. A more precise boundary could be defined, for example, by considering occasional fossils to be present in the uppermost part of the Quamby Mudstone correlate or by considering there to be no lithological change in the basic siltstone lithology at the boundary and by adopting some other character(s) to define the boundary. Despite difficulties in defining the top of the correlate, its thickness near Ross (126–146 m) is clearly much less than at Tunbridge Tier.

Surface outcrops of the Quamby Mudstone correlate occur only in the Regents Plain area. Here the correlate was recognised by the occurrence of uniform grey siltstone outcrops with the characteristic jointing pattern or weathering and the lack of conspicuous bedding, fossils and dropstones. Glendonites were not observed but occur in adjacent areas in the Lake River Quadrangle (W. L. Matthews, pers. comm.). The sequence at Regents Plain is enclosed by Jurassic dolerite on all sides except to the north, and neither the base nor top of the correlate is exposed in the quadrangle.

The western boundary of outcrop is marked by a steep-sided dolerite body which has intruded along a fracture which is inferred to pass northward to juxtapose Bogan Gap Group correlate rocks against the Quamby Mudstone correlate. Some of the Bogan Gap Group correlate rock lithology is very similar to that of the Quamby Mudstone correlate, and it is difficult to distinguish the two correlates in the field. With thin sections, the western limit of the Quamby Mudstone correlate is more clearly defined but is still ambiguous.

GOLDEN VALLEY GROUP CORRELATE

The Golden Valley Group correlate is distinguished in the two borehole intersections by its variable lithology, especially calcareous beds and pebbly sandstone horizons, and by its sparse to abundant shelly fauna. The distinguishing features occur more towards the middle part of the correlate, and the top and bottom parts may be considered gradational into boundary sequences, although an arbitarily chosen top is easily recognised. The correlate is about 80 m thick in the Tunbridge Tier bore and slightly thicker in the Ross bore.

Description of core—Tunbridge Tier bore

In the Tunbridge Tier bore the approximate basal 20 m of the correlate consists of thick beds of muddy siltstone punctuated by thin sandy siltstone or thin calcareous beds. Granules, pebbles and some fossils occur primarily in the thinner beds. The succeeding interval (12.5 m) contains fewer granules and pebbles, and except for some sparsely fossiliferous bioturbated grey siltstone units up to 3.5 m thick, this interval is more commonly fossiliferous. Six limestone beds, mostly about 500 mm thick, occur and most granule horizons immediately overly limestone. Bryozoal shale (almost two metres thick) forms the base of the interval. Some bryozoa, including ramose *Stenopora*, occur higher, as do a few spiriferids.

The overlying interval (8 m) includes sandstone beds with pebbles and granules, interbedded with sparsely fossiliferous grey muddy siltstone, and lacks limestone. The interval commences with very pebbly fine-grained sandstone which grades up over 800 mm into grey silty mudstone. Then follows several thinner sandstone beds interbedded with siltstone. Some shelly fossils occur, and Foraminifera tubes occur in otherwise unfossiliferous siltstone. A more significant sandy section commences about 5.5 m above the base of the interval. Here a section (one metre thick) coarsens up through fine-grained to medium-grained sandstone with brachiopods, *Peruvispira*? and *Eurydesma*?, through well-sorted, clean, medium-grained sandstone to muddy bioturbated medium-grained to coarse-grained sandstone with pebbles, brachiopods, and *Stenopora*. The grain size then decreases sharply to a section (about one metre thick) of coarsely bioturbated, muddy, sandy, silty rock but the pebble occurrence initiated in the coarsest bed below continues upward with shells and shell fragments and granule concentrations in large burrows. Some pebbles also persist up into the overlying interval (3 m) of variably fossiliferous siltstone.

The succeeding interval (23 m) of dominantly muddy siltstone contains only minor calcareous horizons, and pebble and granule frequency vary. The interval is less fossiliferous in the top and basal few metres, where a few *Stenopora* specimens and rarer *Fenestella* occur. In a two metre section only Foraminifera tubes were intersected. Elsewhere stenoporids and fenestellids, and occasional brachiopods, are more common, and Foraminifera tubes are found in rare thin beds of dark grey mudstone. One fossiliferous section (two metres thick) contains unbroken siltstone laminae.

The top interval (13 m) consists of thick beds of muddy siltstone separated by slightly sandy beds which occur at about a two metre separation near the base and more frequently near the top. Granules and pebbles also occur more frequently near the interval top. A medium bed of pebbly muddy sandstone with bioturbation and hydroplastic deformation caps the correlate. Shelly fossils are virtually absent in this interval, although Foraminifera tubes occur sparsely but regularly.

The coarsest pebbly sandstone of the central sandy interval of the Golden Valley Group correlate occurs about 41 m below the correlate top in the Tunbridge Tier bore. This pebbly sandstone is comparable to a conglomeratic sandstone (1.35 m) with large pebbles and some silty partings which occurs about 44 m below the top of the correlate in the Ross bore. Although probably less conglomeratic than the Billop Sandstone at Poatina, the pebbly sandstone at Tunbridge Tier and Ross is probably related to the same event which resulted in the Billop Sandstone.

Description of core—Ross bore

Some shell fossils were found 74 m and 59 m below the Billop Sandstone correlate in an interval which could be referred to the Quamby Mudstone correlate. Rare fossils occur intermittently up to a clast (200 mm) which occurs 53 m below the Billop Sandstone correlate. Above the clast an interval (6.5 m) contains beds with some fossils, calcareous zones and some pebbles but these features then become less frequent until an horizon 26 m below the Billop Sandstone correlate. An interval (14 m) from some bryozoal siltstone with *Deltopecten* up to the base of the Billop Sandstone correlate contains fossils more commonly, and the higher beds of the interval are sandier and more pebbly. As in the Tunbridge Tier bore, shell fossils extend up to 16 m above the Billop Sandstone correlate, where at Ross a limestone bed (200 mm) occurs. Fossils, including bilaminar ramose *Stenopora* and agglutinated Foraminifera tubes, occur 13 m below the top of the Golden Valley Group correlate. The top of the Golden Valley Group correlate is considered to be the top of a transition zone (two metres thick) in which sand laminae in siltstone become progressively less disrupted by bioturbation, plant pieces appear, and dispersed pebbles and granules reach their local upper limit.

No surface outcrops were found. Loose pieces of fossiliferous rock south of Regents Plain [058465] and loose pieces of contact metamorphosed calcareous breccia found near the dolerite contact with the Quamby Mudstone correlate west of Regents Plain may be derived from the Golden Valley Group correlate but no unequivocal evidence indicating this was found.

FAULKNER GROUP CORRELATE (Pa)

The Faulkner Group correlate consists primarily of carbonaceous grey mudstone with interbedded to interlaminated well-sorted current?-deposited sandstone. The sandstone/mudstone units range from dominantly sandstone units up to eight metres thick, through thin to medium interbedded sandstone and mudstone beds, to dominantly mudstone with or without sandstone and siltstone laminae. Also present are intervals of intensely bioturbated muddy siltstone or fine-grained sandstone, and bioturbated mudstone and poorly-sorted sandstone intervals with dispersed pebbles and granules. The latter interval type was probably deposited under glaciomarine conditions, and includes a shelly marine fauna on one horizon in the bore at Tunbridge Tier. Large agglutinated Foraminiferal? tubes, similar to those described from the Bogan Gap Group correlate (Forsyth, 1984*a*), occur.

Description of bore intersections

In the bores at Tunbridge Tier and Ross, and also in a bore near Bothwell in the adjacent Oatlands Quadrangle to the south (fig. 6), the base of the Faulkner Group correlate is transitional with the Golden Valley Group correlate and its equivalent. Above the local upper limit of the occurrence of marine bioturbation, dropstones and granules, occurs a 3–6 m thick interval in which silt and sand laminae are preserved. Some sand laminae are micaceous, some have erosive bases and fine upwards, and some consist of medium-grained sandstone. The proportion of mudstone varies from about 80–40%. Some sand laminae are lenticular and starved ripples occur. Stacked cosets of rippled laminae form beds up to 300 mm thick. Plant pieces, including occasional *Glossopteris* leaves, are present and some shiny black bituminous? smooth partings occur. The deposits resemble those of a muddy shallow aqueous environment subject to occasional wave or storm-induced currents.

In the three bores there is then a return to more normal glaciomarine conditions, represented by an interval (3–5 m thick) including sparse to common bioturbation, dropstones and granules. The marine influence was more strongly felt in the Tunbridge Tier bore, where the interval is thickest and contains a bed (700 mm thick) of very muddy sandstone with a layer (150 mm) with brachiopods, gastropods and fenestellids. Some ripple-laminated sandstone beds and laminae are not bioturbated.

Above the glaciomarine-influenced interval the detailed stratigraphies of the bores differ. At Tunbridge Tier next occurs an interval (6.5 m) of siltstone and fine-grained sandstone laminae (5–40%) in mudstone, with a possible agglutinated Foraminiferal tube. Pyrite occurs in some of the sand laminae. In the top 1.5 m of this interval, some thicker sandstone beds are also present (up to 130 mm thick), and some muddy beds and laminae are bioturbated. Sandstone beds range from planar laminated to sub-planar laminated and ripple laminated. Flaser bedding and starved ripples occur. Rarely very thin sandstone beds coarsen upwards. The succeeding interval (7 m) consists predominantly of low-angle, cross-bedded, fine-grained sandstone, rarely reaching a cross-bed thickness of 170 mm, and most beds are <100 mm thick. The top and base of the interval are gradational from enclosing mudstone. At the base, a thin interval of bioturbated mudstone is overlain by a coarsening-upward, very fine-grained to fine-grained sandstone (180 mm), planar to sub-planar laminated fine-grained sandstone (220 mm), and then further stacked, low-angle, cross-bedded 100 mm thick cosets. Each of these units is separated by muddy intervals with indications of bioturbation.

Apart from a unit (180 mm) of muddy siltstone and interlaminated, very fine-grained sandstone, the main sandstone interval contains occasional mudstone breaks in sedimentation, usually less than 20 mm thick but occasionally up to 50 mm thick. Although these mudstone beds are not always associated with bioturbation, bioturbation is common, often as vertical burrows, some burrows extending 80 mm into underlying sandstone. The stacked sandstone beds are commonly erosive and a few possess very thin basal layers of granules. Near the interval top, the cross-bedded sandstone passes into soft, very finely laminated, very fine-grained sandstone with grey carbonaceous, micaceous partings (350 mm) and intensely bioturbated (marine?) sandstone (580 mm) with mud wisps and a pebble, before grading rapidly into mudstone.

The succeeding mudstone interval at Tunbridge Tier (4.5 m) contains two beds (130 mm) with granules and sand (less than 15%) from which sand-filled burrows extend downward; some slightly micaceous fissile mudstone with some coarse-grained siltstone or fine-grained sandstone laminae; and some Foraminifera.

Next abruptly follows an interval (approximately 6 m) consisting of intensely bioturbated light to medium grey (yellow weathering) mudstone with frequent sandy zones (15–20 mm) which may possess internal fine laminae of mudstone. Burrows are sand-filled but some large sub-vertical mud-filled burrows occur, and the basal sand-dominated bed (250 mm) contains burrows defined by mud rims. Foraminifera occur in the lower half of the interval, and reworking by currents to produce low-angle cross-bedded laminae and thin beds is evident near the top. Current activity is more pronounced in the next interval (1 m) in which bioturbation is less intense. In this interval, mudstone with disrupted, very fine-grained sandstone laminae and a few thin to very thin sandstone beds with ripple or low-angle cross-bedding enclose an unbioturbated unit (400 mm) of rippled and low-angle cross-bedded fine-grained sandstone. The entire sequence is capped by medium-grained sandstone (680 mm), with a calcareous matrix in the lower part.

The Faulkner Group correlate at Ross is of almost identical thickness (approximately 36 m) to that at Tunbridge Tier (approximately 38 m) but differs in the stratigraphic position of the major rock-type intervals. Thus the main marine incursion near the base is succeeded by a gradual reintroduction of unbioturbated siltstone and sandstone laminae and very thin beds (5%) in a unit (approximately one metre), followed by a well-sorted sandstone bed (approximately 300 mm), a mudstone bed (approximately 300 mm), and current-deposited sandstone (2.4 m) with steep cross-bedding near the base and coarser, fine-grained to medium-grained uniform sandstone above. The sequence then passes up into sandstone with 5–15% siltstone partings. Next follows interbedded to interlaminated low-angle cross-bedded sandstone and 20–250 mm thick siltstone beds in an interval (approximately 4 m), then a lesser proportion of similar sandstone interlaminated to thinly interbedded (<60 mm) in 60–90% siltstone forming a 4.2 m thick interval.

The succeeding sandstone is intensely bioturbated (3.1 m) and overlain by mudstone (2 m) with Foraminifera, and with two thin beds of sandy siltstone with granules or pebbles. This is overlain by a unit (9.5 m) showing a gradual decrease in lutite proportion from 95% fissile mudstone with silt laminae and Foraminifera to less than 5% siltstone in sandstone. A corresponding increase occurs in laminae, bed thickness and grain size of the well-sorted, usually current-deposited sandstone layers to a maximum in the uppermost 2.5 m, where small scale cross-bedding and low-angle cross-bedding occurs. In this top 2.5 m unit grain size rarely reaches medium-grain sand grade with some granules (?), and in some lower layers slight bioturbation is present. The sequence is capped by intensely bioturbated (worm cast) sandstone (2.4 m) with pebbles near the top.

Surface Outcrops

Surface outcrops of the Faulkner Group correlate are restricted to a small area along the Great Western Tiers scarp near the northern boundary of the quadrangle, where massive, cross-bedded and worm-cast sandstone is underlain by traces of grey siltstone.

Discussion

Unlike sequences further north at Poatina, and especially near Liffey (Liffey Sandstone) (McKellar, 1957; Pike, 1973), the Interlaken sequences lack clear indications of fluviatile and coal measure deposition. Instead glaciomarine deposition is clearly indicated near the base and more subtly at other horizons. Greater similarity is shown with southern Tasmanian sequences such as the Faulkner Group at Mt Nassau (Banks and Hale, 1957; Clarke and Farmer, 1982).

Variation of lithology through the sequence reflects variation in energy level of the depositional environment and fluctuations in the degree of glaciomarine influences. Concordance between the sequences at Ross and Tunbridge Tier can be achieved by postulating attenuations within the sequences but alternatively the facies changes may be related to evolving depositional environments and not basin-wide sea level changes, except in the case of the most intense marine-influenced interval.

No analysis of trace fossils has been undertaken to determine whether bioturbation is exclusively marine or includes bioturbation in fresh-water environments. Foraminifera of the type occurring in the sequence have previously been used to indicate continuity of marine influence (Forsyth, 1984*a*) but as pointed out by Calver (*in* Turner and Calver, 1987) may indicate primarily a restricted marine (brackish) water environment. The well-sorted sand and silt laminae, and thinner beds occurring interbedded with mudstone, closely resemble the fine-grained storm layers of both the inner and outer shelf environments of the Danish Basin described by Pederson (1985). Although the proportion of suspension-deposited graded sandstone layers is fewer, other laminae without cross-lamination may be of this type. The overall geological setting differs from the Danish Basin in that a more proximal position relative to terrestrial deposition is indicated for the Interlaken sequence, and closure of the area to fully marine conditions usually prevailed, as indicated by the rarity of marine fauna and ice-rafted debris.

The preferred environment reconstruction is a brackish water lagoon complex with limited connection to, and perhaps grading into, a very broad (low energy) gently undulating shallow-water marine shelf. Thin, pebbly, bioturbated sandstone with lithological discontinuities may represent lag deposits formed during regressions or transgressions. The spectrum of marine influence probably extends from the extreme of shelly fauna, through bioturbated rocks with ice-rafted pebbles, granules to sand, through unbioturbated rocks with Foraminifera, to black mudstone with no obvious marine influence. The distribution of marine microplankton has not been determined. Thick sequences of intensely bioturbated silty mudstone or sandstone were probably deposited below storm wave base seaward of lagoons or near lagoon mouths. Only one possible channel sandstone deposit with steeply dipping cross-bedding was detected, and this formed a relatively thin unit. The persistence of mudstone laminae, and thin beds often showing signs of bioturbation through the main sandstone intervals, suggests mud was the normal deposit in the area and that the low-angle cross-bedded, the ripple-laminated, and planar-laminated sandstone beds were deposited during transient conditions of higher energy, perhaps as swash deposits over shoals or as a storm wave or surge-generated deposits. Hummocky cross-bedding, which may be present in the Faulkner Group at Mt Nassau, does not seem to be present in the bore cores but the core diameter does not facilitate recognition of this structure. Some irregular sand bodies may be due to scouring or soft-sediment deformation.

MARINE SILTSTONE AND SANDSTONE WITH FOSSILIFEROUS AND CALCAREOUS BEDS (Pl)

Overlying the Faulkner Group correlate is a sequence of glaciomarine, interbedded silty mudstone and muddy sandstone which is variably calcareous and fossiliferous. The sequence maintains an approximately uniform thickness and is 99 m thick in the deep bore near Ross, 105.5 m at Tunbridge Tier, with a comparable 108 m thickness in the adjacent Oatlands Quadrangle in the bore near Bothwell (fig. 4, 7). The thin, unfossiliferous to sparsely fossiliferous basal interval is similar in all three deep bores, but the central (major) interval varies, especially with respect to the proportion of abundantly fossiliferous beds and thin limestone beds which are present. The central fossiliferous interval is thickest at Tunbridge Tier, where bryozoal siltstone is particularly prominent. The central interval appears to split towards Ross into a sparsely to commonly fossiliferous lower part with only one calcareous bed, separated by 22 m of unfossiliferous strata from an upper part which contains abundantly fossiliferous beds including a thick (7 m) unit of bryozoal siltstone and several thinner beds of the same rock type. A single bryozoal siltstone discontinuously mapped along the Great Western Tiers scarp west of Ross was correlated with the Weston Mudstone of the Poatina Group.

Fossils continue through to the top of the sequence but the top interval shows a greater variation of lithology, generally being sandier with a greater proportion of pebbles and granules. Other units of the Poatina Group (the Dabool Sandstone and Garcia Sandstone) were not confidently recognised. Unfossiliferous sandstone, here included in the base of the overlying Bogan Gap Group correlate, may be equivalent to the Garcia Sandstone. Much of the sparsely fossiliferous to unfossiliferous strata of the sequence in the northern part of the quadrangle is probably equivalent to similar strata forming part of the Meander Mudstone at Poatina.

Description of bore intersections

In the three deep bores the base of the sequence commences with either slightly calcareous sandstone or bioturbated sandstone with pebbles and granules (maximum thickness 2.4 m near Ross) overlain by a few metres of dark grey mudstone with very thin to medium-bedded lighter-coloured sandy beds with granules and occasional dropstones. Foraminifera are present in the dark mudstone at Tunbridge Tier. Bioturbation is more conspicuous in the sandy beds.

These rocks are not greatly dissimilar to rocks included in the Faulkner Group correlate, differing primarily by the absence of well-sorted sand laminae and current-deposited sandstone. The dark grey mudstone passes up into lighter coloured (medium grey) muddy siltstone and muddy sandstone. In the Interlaken Quadrangle rare shelly fossils or fossil fragments appear about 10 m above the sequence base, occasionally concentrated with pebbles at the base of sandstone beds or otherwise occurring in coarser beds and possibly dumped with ice-rafted material. In the neighbouring Bothwell area, fossil shells appear slightly higher (16 m) and do not become abundant until 46.5 m above the base (i.e. 61.5 m below the sequence top) compared with the marked increase in fossil abundance 23 m above the base at Tunbridge Tier. Fossils do not become abundant near the base of the sequence at Ross (or in surface outcrops along the Tiers) but extend from 10 m to 34.8 m above the sequence base, in some places becoming common and probably *in situ*, and in a limestone bed (200 mm thick) 30 m above the base.

Pebbles are not uniformly distributed through the basal interval of the sequence at Tunbridge Tier but are found from 0–4 m, 8–13 m and 21–22 m above the base. A thick pebbly, muddy sandstone bed 3.7 m above the base is succeeded by diffusely thin to medium interbedded grey silty mudstone and sandier beds which become more thickly bedded at the second pebbly horizon, where fossils are also present. The succeeding non-pebbly interval is medium to thick bedded with rather fine-grained sandy beds and darker muddy siltstone beds with persistent occurrences of Foraminifera, until the third pebbly horizon is reached. Here some sandy mudstone or muddy sandstone is slightly calcareous, and some shells and fragments are found before the sequence passes up through a thin interval of fossiliferous mudstone and limestone into thick interval of bryozoal siltstone.

The central, richly fossiliferous interval at Tunbridge Tier is punctuated by a 1.7 m thick pebbly, unfossiliferous interval about 66 m from the base of the sequence but otherwise pebbles occur only rarely. Although the basic lithology is sometimes coarser grained at equivalent horizons at Ross, consisting at some horizons of yellow, very fine-grained silty sandstone, the Ross sequence similarly contains only sparse pebbles and granules. Intervals of up to 16 m are free of pebble intersections. The dominant lithologies at Tunbridge Tier are grey muddy siltstone with numerous fenestellids and usually numerous stenoporids and occasional brachiopods (in slightly sandy beds), and more lime-rich rocks grading into limestone in which brachiopods are sometimes more common. Limestone beds are very thin to thick bedded, interbedded with bryozoal siltstone, and some bryozoal siltstone with limey matrix forms units over two metres thick. Some calcareous beds seem less fossiliferous compared to adjacent strata, and some limestones are apparently unfossiliferous. This may be a diagenetic effect.

In the central interval at Tunbridge Tier, calcareous beds are confined to between 29 m to 62 m above the base. A bed (900 mm thick) 31 m above the base contains abundant brachiopods and pink crinoidal debris enclosed in medium grey non-calcareous mudstone. *Eurydesma* occurs 54 m above the base and *Aperispirifer wairakiensis* occurs 60 m above the base. About 57 m above the base commences a unit (about 9 m thick) of diffusely thin to medium-interbedded medium-grey mudstone with bryozoans and in places brachiopods, and lighter coloured coarser-grained beds with more brachiopods and large stenoporids. Some of the lower coarser beds have a calcareous matrix, and the top mudstone beds contain only a few fossil fragments. The overlying unfossiliferous unit (1.7 m) consists first of thinly interbedded grey muddy sandstone and much cleaner sandstone, particularly rich in pebbles and granules near the base, but also extending up to a top bed (800 mm) of medium-grained to coarse-grained, relatively clean sandstone with coarse sand and granules (25%) and pebbles of slate, quartz and quartzite up to 50 mm size (5%).

Fine-grained siltstone occurs abruptly above the sandstone unit, and stenoporids, followed by fenestellids, gradually reappear over the next two metre interval to give rise to a further unit (15 m) of bryozoal siltstone with a few slightly sandy layers in which brachiopods are also present.

A few thin interbeds with granules and large brachiopods then occur over the next two metres of strata, in which bryozoa tend to be concentrated in particular thin beds. These strata pass up into an interval (9 m) deposited under intermittently higher energy conditions and which consists of very thinly to medium-interbedded siltstone or sandy siltstone and coarser-grained sandstone. The muddy rocks contain incipient to well-developed bryozoal faunas, and the sandstone includes beds with abundant shell hash and frequently a calcareous cement. Brachiopods occur. The fawn-coloured calcareous beds or impure limestone are more prevalent higher in the interval. In the uppermost one metre of strata a fawn calcareous bed (303 mm) with fragmentary fenestellids and quartz granules passes up into thinly-bedded grey siltstone and calcareous zones, grading into dominantly grey siltstone with sandy, sometimes calcareous interbeds.

The uppermost eight metre thick interval of the sequence commences with a zone of thinly to thickly-bedded sandstone rich in granules and shell hash, interbedded with some muddy siltstone with granules. The sandstone reaches a medium-grain to coarse-grain size at the base, and scattered fossils occur throughout. Higher, medium-interbedded, very fine-grained sandstone and poorly-laminated muddy siltstone is followed by a thick limestone bed and some mudstone. Pebbles and granules occur at various horizons through the interval and beds range from unfossiliferous to richly fossiliferous. *Sulciplica transversa* occurs seven metres from the sequence top.

The top of the sequence is taken as the base of a fine-grained to medium-grained sandstone with pebbles, which coincides with an increase in sand grain size, increase in pebble and granule frequency, and relatively abrupt disappearance of shelly fossils and calcareous matrix. Some of the highest fossils may be reworked into sandstone. Occasional Foraminifera occur in the top few metres of the sequence but become more common in the overlying sequence.

Rare fossils reappear in the deep bore near Ross in the sequence 40.2 m below the top, above the central unfossiliferous interval, and clusters of fossils in siltstone occur six metres higher. Some thick beds of fine-grained sandstone occur above these fossils, and dispersed sand grains in siltstone extend up to 25 m below the sequence top. Scattered fossils occur in siltstone which becomes increasingly more calcareous towards a thick calcareous interval (1.1 m) with rare fossils which extends up to 19 m from the sequence top. Then follows bryozoal siltstone (6.7 m) with 10% thin calcareous zones, the overlying top interval, consisting of fossiliferous siltstone with calcareous beds, darker beds of bryozoal siltstone and calcareous sandstone or calcarenite beds. Non-calcareous sandstone occurs in the top metre and about four metres lower, but overall the upper part of the sequence contains fewer sandstone beds with pebbles and granules, and the sandstone is of finer grain size compared to the sequence at Tunbridge Tier.

Surface outcrops

The richly fossiliferous beds intersected in the deep bore near Ross are exposed in shallow quarries in impure limestone on the 'Ashby' property, a little over one kilometre NNW of the bore collar. This is probably the locality described by Nye (1921) as "4 miles west of Ross". The fossil fauna found in the quarries includes:-

Wyndhamia dalwoodensis Booker
Sulciplica transversa Waterhouse
Sulciplica tasmaniensis (Morris)
Undopecten fittoni (Morris)
Etheripecten sp.

and in a leached sandstone slightly higher:-

Sulciplica spp.
'Schuchertella' sp.
Vacunella curvata (Morris)
ostracods

indicating a mid-Lymingtonian faunizone 7 or 8 age (M. J. Clarke, pers. comm.; Clarke and Farmer, 1976). *Paraconularia derwentensis* (Johnston) from the 'Ashby' property may be from a similar horizon. Other exposures of fossiliferous and unfossiliferous strata occur in a creek bed two kilometres south of the deep bore, and on the hill side north of the creek [373456]. This is probably Nye's (1921) locality "2-1/2 miles West-South-West of Ross". Fossils in the creek include *Ambikella* cf. *etheridgei* (McClung) and *Ambikella* cf. *plica* (Campbell).

The most extensive outcrops occur on the Great Western Tiers scarp west of Ross. The entire sequence may be exposed in the area but is affected by faulting and is not continuously exposed. Flaggy sandstone of the Faulkner Group correlate passes up into siltstone with *Ambikella* and then coarse-grained wormcast sandstone with two further bioturbated marine sandstone occurrences an estimated 15 m and 25 m above the Faulkner Group correlate. From above the highest marine sandstone, fossils in siltstone include:-

Ambikella plica (Campbell)
Ambikella sp. cf. *ingelarensis* (Campbell)
Sulciplica stutchburii Auctt.

indicating a Lymingtonian faunizone 6 or 7 age [197499] (M. J. Clarke, pers. comm.). Higher in the sequence, probably within the 10–20 m interval immediately below the Weston Mudstone correlate, M. J. Clarke identified *Megadesmus nobilissimus* (de Koninck) and *Myonia* sp. cf. *carinata* (Morris) [195494] and nearby *Undopecten fittoni* (Morris), and elsewhere, probably from this interval, *Wyndhamia dalwoodensis* Booker, *Ambikella etheridgei* (McClung) and crinoid columns.

Deltopecten limaeformis (Morris) and *Sulciplica* sp. occur above the Weston Mudstone correlate at 193483. The most extensive fauna collected is from an outcrop 200 m north of the map boundary in the Lake River Quadrangle [20055035]. M. J. Clarke described the fauna as:

Wyndhamia dalwoodensis Booker
'Schuchertella' sp.
Ambikella etheridgei (McClung)
Sulciplica sp.
Trigonotreta sp. cf. *wairakiensis* (Waterhouse)
Pseudosyrinx ulladullensis (Armstrong)
Fletcherithyris sp.
Atomodosma (Aphanaia) sp.
Aviculopecten sp.
Fenestella spp.
Stenopora sp.
gastropods
ostracods

A section through the top (about 55 m) of the sequence is discontinuously exposed on a spur near Bayles Creek [202483]:

Barometer height	
425 m	sandstone with pebble concentrations
415 m	fossiliferous sandstone
405 m	stenoporid and fenestellid shale (Weston Mudstone correlate)
395 m	sandstone with some fossils overlying hard siltstone with occasional fossils
370–395 m	sparsely to unfossiliferous glaciomarine beds

The fossiliferous sequence overlies the Central Plateau Jurassic dolerite sheet at Micks Creek [065450] and at various localities near Lake Sorell. The Micks Creek occurrence is extensively contact metamorphosed and consists principally of bryozoal mudstone with *W. dalwoodensis* Booker, *S. transversa* Waterhouse, *Deltopecten* sp. and *A. (Aphanaia)* sp. At Lake Sorell small outcrops of fossiliferous strata occur in Mountain Creek, and bryozoal shale outcrops occur nearby. The Mountain Creek Fauna includes:

Ambikella sp.
Sulciplica sp. cf. *transversa* Waterhouse
'Schuchertella' sp.
Stutchburia sp.

and ostracods, numerous fenestellids, and stenoporids [157420] (M. J. Clarke, pers. comm.). About four kilometres to the south-east richly fossiliferous strata was also intersected in two shallow bores (RG51 and RG52). A small area of the sequence also occurs on St Georges Island and includes the following fauna identified by M. J. Clarke:

W. dalwoodensis Booker
S. transversa Waterhouse
'Schuchertella' sp.
letcherithyris sp.
Etheripecten sp.
Keeneia sp.
Peruvispira sp.
ostracods

indicating a Lymingtonian faunizone 7 or 8 age.

A small occurrence of metamorphosed fossiliferous rock adjacent to the Quamby Mudstone correlate south of Regents Plain could belong to the sequence, or alternatively to the Golden Valley Group correlate [Pu, 058465].

Age

The age of the basal beds of the sequence is not known but as in the adjacent Oatlands Quadrangle (Forsyth, 1984*a*) no evidence for Bernacchian Stage faunas has been found in either deep bores or surface outcrops. As indicated above, faunas indicate correlation with the Lymingtonian Stage in the range of faunizones 6–8 (Clarke and Farmer, 1976). The oldest faunas (approximately 25 m above the base) are older than faunizone 8 and therefore older than the Poatina Group at Poatina, whereas the faunas near the top of the sequence are younger than faunizone 6 and probably equivalent in age to faunas in the Poatina Group (Clarke and Farmer, 1976).

BOGAN GAP GROUP CORRELATE (Ps)

The Bogan Gap Group correlate consists predominantly of unfossiliferous glaciomarine muddy siltstone, muddy sandstone and mudstone, probably at least 248 m thick at Tunbridge Tier. Some better-sorted basal sandstone beds occur, and two distinctive thin pebbly sandstone horizons, the Palmer Sandstone correlate and the Blackwood Conglomerate, occur 104 n and 241 m respectively above the base, separated by 133 m of strata. The stratigraphic subdivision is essentially the same as that applied at Poatina (McKellar, 1957; Bravo and Pike, 1969) and in the Oatlands Quadrangle (Forsyth, 1984*a*), except that it has proved more convenient to map basal unfossiliferous sandstone as part of the correlate and not to exclude similar sandstone as done in the Oatlands Quadrangle (Forsyth *et al.*, 1976; Forsyth, 1984*a*), and as probably done (referring to the fossiliferous to unfossiliferous Garcia Formation) further north (Bravo and Pike, 1969).

Although only 99.7 m of strata separate the Palmer Sandstone from the Blackwood Conglomerate at Poatina both marker beds have been mapped more or less continuously across the Lake River Quadrangle (Matthews, 1974) to the Interlaken Quadrangle. Little variation in the marker bed separation is shown from Tunbridge Tier (133 m) to the deep bore near Bothwell (139 m). No significance, for correlative purposes, can be attached to marked thickness variation of the interval between the Blackwood Conglomerate (and its correlates) and the base of the Upper Parmeener Supergroup, as pre-Upper Parmeener erosion of this interval probably occurred in some areas. With or without the inclusion of basal sandstone in the Bogan Gap Group correlate, the interval between the Palmer Sandstone correlate and the underlying richly-fossiliferous sequence (Pl) is at least 20 m thicker at Tunbridge Tier than at Bothwell and at Poatina. This could be because of variation of subsidence/sedimentation/compaction rates, diachronism of units, or differential winnowing of sandstone horizons. Equivalence of the lower sandstone marker beds at Tunbridge Tier and Bothwell in turn infers approximate equivalence of the Palmer Sandstone and the Risdon Sandstone of the Hobart area, and correlation of the Springmount Mudstone with part of the Malbina Formation. Fossils found in the sequence of fossiliferous siltstone, fossiliferous sandstone and unfossiliferous sandstone mapped collectively as the sequence Pe in the Oatlands Quadrangle are much rarer in the Interlaken Quadrangle but a few fossils have been found in the beds underlying the Palmer Sandstone correlate and rarely within the correlate itself.

Description of bore hole intersections

In the deep bore at Ross, the basal pebbly sandstone is only 1.4 m thick, but near Tunbridge Tier an interval of almost four metres consists of medium to thick beds of pebbly sandstone with granules, interbedded with medium beds of muddy siltstone. Foraminifera are abundant on some horizons where the top bed of the sandy interval grades into sandy, muddy siltstone. Initially the overlying unit (11 m) contains numerous thin to medium sandy beds which grade up into wispy siltstone, and granules and pebbles are common in one such bed. In the next interval (21 m) of wispy siltstone and interbedded muddy siltstone and wispy siltstone, only three thin and thick sandy beds are especially notable. There follows (3.5 m) interbedded granule-rich zones and granule-free medium grey mudstone with Foraminifera, and then a silty mudstone interval (24 m) in which thick zones are relatively granule-free, and in places sand free. Occasional very thin beds or rare thin beds containing sand or granules occur in this interval, and one cluster of pebbles was observed.

The remaining strata (24 m) up to the Palmer Sandstone correlate consist of interbedded muddy siltstone or silty mudstone and granule-bearing wispy siltstone, or in the lower 15 m somewhat sandy beds form the coarser interbeds. The frequency of the coarser beds, and especially the proportion of granules, gradually increases through the first 10 m of the interval to reach a maxima with associated pebbles through six metres before gradually decreasing, and then increasing again to a second maxima in a zone (1.75 m) of sandy muddy siltstone with very thin beds containing 25% granules immediately below the Palmer Sandstone correlate. Foraminifera occur rarely through the 24 m interval.

Other features found in the Bogan Gap Group correlate below the Palmer Sandstone correlate include three horizons with small crystal moulds, thin leached zones, and rare laminae with *Stenopora, Protoretepora, Fenestella* and brachiopods from 50–60 m above the base of the sequence. Shelly fossils also occur 26–29 m and 8–13 m below the Palmer Sandstone correlate.

The Palmer Sandstone correlate is four metres thick in the Tunbridge Tier bore. The basal bed includes some remnant muddy laminae in silty sandstone, and the coarsest sandstone (medium-grained to coarse-grained feldspathic) is found in the top half, where thin beds with pebble concentrations also occur. In a shallow bore four kilometres west of Ross the Palmer Sandstone correlate is similarly about four metres thick but difficult to define precisely because of both a gradational top and bottom. Sub-horizontal muddy laminae occur more frequently in the lower part, where a thin fossil band was intersected and a very thin cross-bedded sandstone bed is present. One major and some minor conglomeratic layers and some scattered pebbles occur. Bioturbation, including rather large burrows, tends to be more prominent in the upper part. Maximum grain size is achieved in the central core part of the correlate, where medium to coarse-grained sandstone and coarse-grained sandstone are the predominant lithologies.

At Tunbridge Tier the Palmer Sandstone correlate is overlain by two metres of muddy sandy siltstone grading into silty mudstone, with a reduction in the proportion of granules from 10% to 1%. The 132.6 m of strata separating the Palmer Sandstone correlate from the Blackwood Conglomerate correlate consists primarily of diffusely interbedded muddy siltstone and lesser beds of silty mudstone. Sandy beds with granules and occasional pebble concentrations occur 16–20 m and 39–40 m above the Palmer Sandstone correlate. Some colour variation occurs according to the proportion of dark mudstone in the silty beds, and one noticeably darker medium to dark grey, thick, silty mudstone bed is enclosed between beds possessing remnant, very fine-grained sandstone laminae. Occasional remnant sandstone laminae were also observed elsewhere where bioturbation was less intense. It may be possible to correlate individual darker-coloured mudstone intervals, as they appear to correspond within a few metres with similar horizons in the deep bore near Bothwell. Pebbles occur sparingly throughout the interval up to the Blackwood Conglomerate correlate but no fossils, other than occasional Foraminifera and wood, were observed. Some calcareous and leached zones may be beds or concretions, and beds which disintegrate rapidly upon exposure appear to have the same clay mineralogy as surrounding beds.

The Blackwood Conglomerate correlate consists of 2.4 m of clean sandstone, with quartz granules present in some layers and pebbles present near the top. The correlate is 1.8 m thick in a shallow bore on the Midland Highway north of Ross. A few pebbles occur at the base and the sandstone coarsens upwards from medium-grained to coarse-grained with layers containing granules, and the top unit is a pebble conglomerate with abundant mud matrix. Pebbles and granules may be absent near Ross in the succeeding 3.8 m interval of mudstone and fine muddy siltstone up to the Upper Parmeener Supergroup.

Surface outcrop

Surface outcrops of the Bogan Gap Group correlate occur discontinuously along the Great Western Tiers scarp south to Mill Brook; near Ross; White Lagoon [370390]; near Lake Sorell; and west of Regents Plain [020050, 028456]. Some outcrops of uniform pebble-free mudstone west of Regents Plain proved difficult to distinguish from the Quamby Mudstone correlate. Some difficulty was also experienced recognising intensely-hornfelsed outcrops but occasional large dropstones, for example granitic cobbles, south of the Tunbridge Tier Road [185347] are a useful indication of glaciomarine parent rock.

Outcrops of the basal sandy beds of the Bogan Gap Group correlate were found to be too impersistent or too thin to map as a separate unit along the Tiers scarp. West of Ross a hard, very fine-grained sandstone crops out persistently and is underlain by a softer, medium-grained sandstone bed at one locality [358483]. The Palmer Sandstone correlate also crops out west of Ross, where it consists of labile-rich sandstone with thin continuous layers of pebbles which are probably lag deposits. Rare pelecypods including *Astartila intrepida* (Dana), a patch of common *Warthia micromphala*, and large burrows about 10×80 mm were found in the sandstone west of Ross. Outcrops of the Palmer Sandstone correlate along the Tiers scarp are similar but no shelly fossils were found. Some sparsely fossiliferous strata appear to underlie the correlate, and fossils present include *W. micromphala* [191493]. In Bayles Creek and a tributary, about 10 m of fissile medium-grey siltstone is apparently overlain by about 10 m of fissile, hard siltstone and sandy siltstone, passing up over an interval of two metres from siltstone into sandy siltstone, sandstone, then to conglomerate (300 mm) forming part of the Palmer Sandstone correlate [206472]. Verification is required that a further fauna comes from the Bogan Gap Group correlate near Bayles Creek. This fauna contains:

Sulciplica clarkei (de Koninck)
Pseudosyrinx sp.
Ambikella spp. incl. *A.* sp. cf. *magna* (Campbell)
Echinalosia sp. cf. *ovalis* (Maxwell)
Warthia micromphala (Morris)
Phestia sp.

An outcrop of leached, very coarse-grained siliceous sandstone, occasionally containing pebbles, occurs at Diamond Beach at Lake Sorell and may possibly be the Palmer Sandstone but may also be the Blackwood Conglomerate correlate or partly silicified Tertiary sandstone [163358].

The outcrop of the Blackwood Conglomerate correlate mirrors that of the Bogan Gap Group correlate as a whole near Ross and along the Tiers scarp. Outcrops also occur near Interlaken [148338] and possibly on the northern side of Lake Sorell, where contact-metamorphosed pebbly, very coarse-grained sandstone occurs [172428]. An unidentified bioturbated glaciomarine conglomeratic sandstone occurs west of Regents Plain [017471]. Outcrops of the Blackwood Conglomerate correlate were omitted from the published map [202488, 210455].

West of Ross the Blackwood Conglomerate correlate shows considerable thickness and lithological variation over a distance of less than one kilometre. Where thinnest (150 mm) the correlate is enclosed in muddy siltstone and consists of rounded quartz-pebble conglomerate with a muddy matrix. Nearby the correlate may exceed two metres in thickness and consists predominantly of fine-grained to very coarse-grained sandstone, often with dispersed granules and some pebbly layers. A single shell fossil, probably *Etheripecten leniusculus* (Dana), was found [351456]. The clean sandstone layers are usually siliceous and sometimes contain a siliceous cement but white kaolinitic grains (0–15%) are sometimes present. The pebble conglomerate with a muddy matrix is a characteristic lithology which often caps the correlate.

In thin section, this lithology from near White Lagoon, south of Ross, and near Tunbridge Tier [243357] contains ovoid structures which are probably accretionary lapilli. West of Ross the matrix of this lithology includes abundant volcanic shards [365446]. The ovoid structures show fine concentric lamination composed of lighter brown-coloured and finer grained material than the enclosing matrix. Some ovoid structures possess a quartz fragment core which, in rare cases elsewhere, appears to be of a high grade metamorphic quartz type which abounds in the conglomerate. Some broken ovoids occur. These structures may have potential to aid in recognition of the Blackwood Conglomerate, and are present in the correlate in the Oatlands Quadrangle and at Poatina near the type section of the Blackwood Conglomerate.

The topographically highest rocks of the correlate on the Tiers scarp consist predominantly of medium-grained to very coarse-grained granule quartz sandstone with some pebbles and labile grains (5–15%). Downfaulted sandstones nearby have been mapped as either correlates of the Blackwood Conglomerate or Palmer Sandstone, depending on their closer affinity with the local lithologies. Some revision may prove necessary.

Strata above the Blackwood Conglomerate are poorly exposed, especially along the Tiers scarp. Foraminifera were found to be common in these strata east of the Midland Highway near White Lagoon.

Age

Both *W. micromphala* in the Palmer Sandstone correlate and *E. leniusculus* in the Blackwood Conglomerate correlate indicate a late Middle to Late Lymingtonian Stage faunizone 8–10 age.

Upper Parmeener Supergroup

Most outcrops of the Upper Parmeener Supergroup rocks in the Interlaken Quadrangle were mapped before stratigraphic drilling and palynology helped elucidate the stratigraphy in the adjacent Oatlands Quadrangle to the south (Forsyth, 1984*a*). Mapped litho-assemblages and sequences in the Interlaken Quadrangle are an extension of the Oatlands region (Forsyth *et al.*, 1976), with some generalisation because of poor exposure and difficulty in recognising lithic sandstone composition. Continuing re-assessment of the Poatina succession of McKellar (1957) enables a closer comparison to be made with that area than has previously been possible.

BASAL FELDSPATHIC SANDSTONE SEQUENCE (Pj) (CYGNET COAL MEASURES CORRELATE)

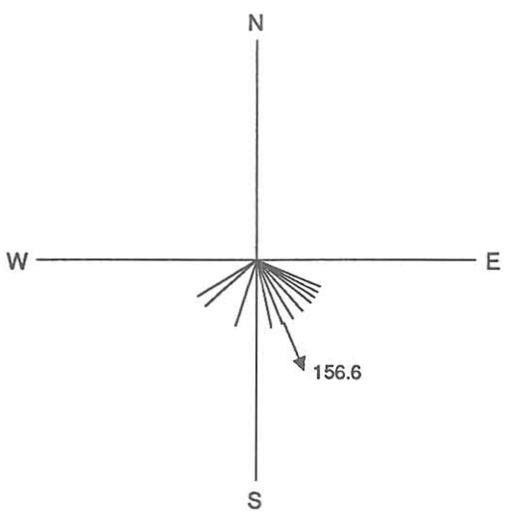
The Cygnet Coal Measures correlate is best exposed west of Ross but it also occurs near White Lagoon, at scattered localities along the Tiers scarp, and possibly west of Regents Plain. The most characteristic lithology is a mottled arkosic to feldspathic quartz sandstone, identical to sandstone included in this sequence in the Oatlands Quadrangle to the south (Forsyth *et al.*, 1976; Forsyth, 1984*a*). This lithology contains non-glistening quartz grains, muscovite, graphite and carbonaceous fragment-rich laminae on some horizons, and occasional pink laminae or zones rich in garnet. Quartz grains are commonly covered by a clay film, beyond which quartz overgrowths have not developed. Rarely authigenic feldspar is present.

This sandstone is readily distinguished from rocks of younger, dominantly quartz sandstone sequences. Only slightly less distinctive is arkose with discrete white feldspar grains, which may grade into sandstone with fewer feldspar grains but abundant white or brown-stained clayey matrix. With decreasing feldspar/matrix content, the sandstone lithologies may prove indistinguishable from feldspathic sandstone of younger sequences. Basal lenses of pebbly sandstone or conglomerate may be sufficient criteria to recognise the sequence in the Interlaken Quadrangle but are not always present. Carbonaceous lutite and beds with plant fossils may provide supportive evidence in recognising the unit but such rocks seldom crop out, except near Ross.

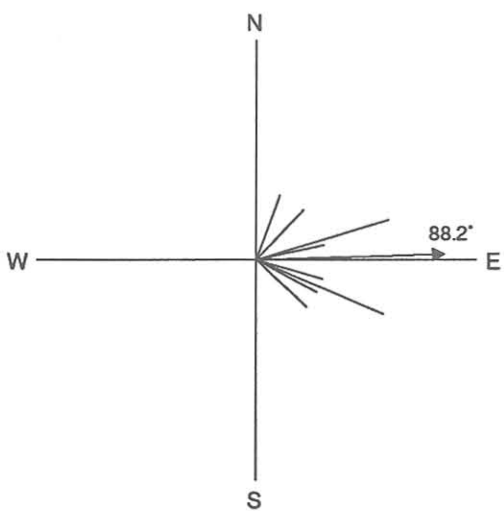
Exposures about five kilometres west of Ross are cut by the Auburn Road, and are best exposed south of the road. Here the sequence is an estimated 40 m thick, and may be subdivided into a lower part in which sandstone is exposed, and an upper part in which much shaly lutite is exposed. The upper beds of the Bogan Gap Group correlate crop out poorly up to the base of the Cygnet Coal Measures correlate. Scattered along the inferred boundary of the two units are large blocks of silicified material bearing angular fragmented and distorted, but largely uncompressed, plant debris ranging from stems to possible spores. Near Tunnack, in the Oatlands Quadrangle, silicified clasts occur in the basal bed of the Cygnet Coal Measures (Forsyth, 1984*a*). A range of coarse-grained rocks, from coarse-grained sandstone to quartz pebble conglomerate, occur as lenses in the basal beds west of Ross. Some pebbly sandstone of medium grain size is arkosic but better sorted coarse-grained sandstone and granule conglomerate is more siliceous and sparkling. The basal beds or bed are probably no more than one metre thick, and in places may consist of a single cross-bedded thick bed. The overlying fine-grained to medium-grained sandstone includes the characteristic mottled lithology and is several metres thick, often with pachydermal jointing. Cross-bedding cosets in these beds are thinner than in the basal beds and usually of the festoon type, with festoons up to 3–4 m across. Some ripple cross-lamination occurs in some micaceous beds. Palaeocurrents determined for the area indicate a south-south-east current (157°, N=11) (fig. 8*a*).

Shaly beds are common higher in the sequence and include grey carbonaceous shale, micaceous siltstone, and interbeds of feldspathic sandstone. Equivalent beds exposed in the guttering of Auburn Road include ripple cross-laminated, very fine-grained micaceous sandstone with numerous stem and leaf fragments. No identifiable leaves or palynomorphs were found. The top of the sequence is not satisfactorily defined but was arbitrarily taken as the base of a feldspathic sandstone which in places exhibits pachydermal jointing and festoon cross-bedding overlying tabular cross-bedding. In hand specimens the sandstone composition is within the range of lithologies found in the Cygnet Coal Measures correlate and the overlying, dominantly quartz sandstone sequence. It is overlain by rocks including an unknown proportion of shale. The sandstone and immediately overlying rocks have been depicted as TRp? on the map. An alternative upper limit for the Cygnet Coal Measures correlate is the base of a medium-grained to coarse-grained granule sandstone with very rare small pebbles. This sandstone is of more quartzose composition, and has been depicted as TRp on the map.

The basal five metres of the sequence was intersected in a shallow bore on the Midland Highway north of Ross (RG13)



(a)



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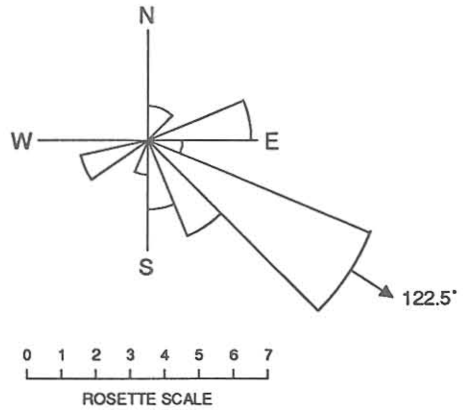


(c)

Figure 8. *Palaeocurrent vectors for Cygnet Coal Measures correlate (Pj).*

(a) Auburn Road area:

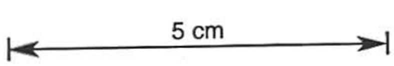
N=11, Direction of Mean Vector θ=156.6°, Mean Vector Amplitude (MVA)=8.35, MVA/N=0.76

(b)"Wetmore" area:

N=10, θ=88.2°, MVA=8.3, MVA/N=0.83

(c) Total:

N=21, θ=122.5°, MVA=13.80, MVA/N=0.66



[404482]. The strata consisted of medium to thick bedded, cross-bedded and finely to coarsely rippled cross-laminated sandstone and mottled, generally massive feldspathic sandstone with prominent dark carbonaceous-micaceous partings on some horizons, and some garnet-rich layers. The basal section (150 mm) includes a few pebbles and granules in a bed, approximately one metre thick, of medium-grained to coarse-grained sandstone with garnet concentrations, and with poorly-defined cross laminae in an otherwise featureless mottled sandstone. Yellow-rimmed dark blotches or concretions are common throughout the interval, and were also observed in a deep bore intersecting the Cygnet Coal Measures correlate east of Bothwell. Other nearby holes intersected thicker intervals of micaceous ripple cross-laminated shale. The base of the correlate was passed through in bore RG16, suggesting pebbly sandstone boulders further north [402488] belong to the correlate. Nearby pebbly sandstone (Ru) may be equivalent [400392].

South of Ross a narrow strip of the Cygnet Coal Measures correlate parallels the eastern side of the Midland Highway, eventually being crossed by the highway near White Lagoon, where the correlate was intersected in a water bore adjacent to hole RG35 [369387]. A further possible outcrop of feldspathic sandstone occurs near Grimes Lagoon [394385]. The characteristic mottled arkose lithology was found in a waterhole at 376407, and carbonaceous mudstone was intersected in the water bore. Limited exposures of sandstone occur and range from arkose to feldspathic quartz sandstone in which very rich garnet-bearing layers were found. Cross-bedding indicates currents to the east (88°, N=10) (fig. 8*b*). Loose blocks of pebbly sandstone and granule sandstone occur. The sequence is capped by a Jurassic dolerite intrusion, and although it is not clear that all strata do belong to the Cygnet Coal Measures correlate, they have been so depicted for convenience. The outcrop near Grimes Lagoon would appear to overly the dolerite intrusion.

Outcrops of the sequence beneath the Central Plateau dolerite sheet along the Tiers scarp are less distinctive, but at a few localities (Isis River, Tunbridge Tier Road, and south of Mill Brook) arkose, in places with muscovite and rarely with carbonaceous fragments, serves to indicate that the Cygnet Coal Measures correlate is probably present. Basal beds are pebbly one kilometre north of Mill Brook [246338]. Associated rocks include feldspathic sandstone and rarely siltstone. Some medium-grained to coarse-grained sandstone with a feldspar content up to 10–15% has been excluded from the correlate and included, with varying degrees of confidence, in the overlying sequence (Rp?, Rp) but outcrop is poor and the immediately overlying dolerite intrusion prevents a proper assessment being made. As mapped, the Cygnet Coal Measures correlate is indicated to be about 20 m thick. Downfaulted strata overlying the dolerite sheet further east have been inferred to be part of the sequences, based on field descriptions from isolated localities of rocks more feldspathic than those normally found in the overlying quartz sandstone sequence.

On the Central Plateau a single hornfelsed outcrop at Agnews Marsh (Ru) [171325] may be part of the correlate (Pj) and coarse-grained rocks, including pebble conglomerate and pebbly sandstone north of Mount Serat, may belong to the correlate but have been mapped as part of the quartz sandstone correlate Rp [088265 to 093268]. The source of ripple cross-laminated micaceous sandstone with plant remains occurring in Quaternary-age dolerite talus (Qtt) west of Regents Plain [015469] was not located. This material may be derived from the Cygnet Coal Measures correlate. No Cygnet Coal Measures correlate was mapped at the base of the Upper Parmeener Supergroup about one kilometre to the south-east but this boundary is inferred from loose pieces of sandstone as no outcrop was observed.

Age and correlation

No new evidence for the age of the correlate has been found. In the adjacent Oatlands Quadrangle, palynomorphs from near the top of the correlate suggest correlation with the upper *Protohaploxypinus microcorpus* zone of latest Chhidruan to Early Griesbachian age (Forsyth, 1984*a*). Rocks from near the base of the Upper Parmeener Supergroup in the Ben Lomond Quadrangle are older and contain a microflora which can be correlated with Upper Stage 5 microfloras (Price, 1983). Some lithologies identical to those occurring in the correlate are found in the Jackey Formation mapped in the adjacent Lake River Quadrangle to the north.

QUARTZ SANDSTONE SEQUENCE (Rp)

The quartz sandstone sequence consists primarily of glistening, cross-bedded, fine-grained to coarse-grained quartz sandstone often with down-current overturning of cross-bedding laminae. Other rock types do occur, and some lutite-rich intervals have been mapped separately (Rpc). Lutite-rich intervals with thin beds of silicified, bioturbated sandstone which frequently contain microfossils (Rpc') occupy a unique position at the top of the sequence in all areas in which these intervals have been found.

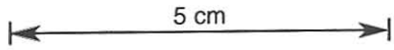
The sequence is exposed extensively through the lowlands south to Tunbridge; also along and near the Tiers scarp from the Isis River to Stringy Bark Rivulet [210430 to 290280]; from near Headlam Top [265270] to Lake Crescent and its environs, occurring especially in downfaulted areas; and in an isolated area west of Regents Plain [025465].

The sandstone at Ross and outlying areas was widely quarried and used locally as a construction stone, and was also transported to Launceston where it was probably used in several buildings (Spry, 1983; Sharples *et al.*, 1984). The lithology typified by the construction stone consequently became well known and was recognised in sequences elsewhere, informally referred to as the 'Ross Sandstone' or Ross Series (Smith, 1957). The Ross Sandstone, as formally defined, has its type section about 50 km north-west of Ross at Poatina (McKellar, 1957).

The Ross Sandstone (McKellar, 1957) is regarded as a litho-correlate and palyno-correlate of the main sandstone part of the sequence Rp in the Interlaken Quadrangle, whereas the upper lutite intervals with silicified sandstone (Rpc) are litho and palyno-correlated with the base of McKellar's (1957) overlying Cluan Formation (see below).

No complete section through the main, quartz sandstone-dominated part of the sequence Rp was found in the Interlaken Quadrangle but the equivalent sequence (Rp) in the Oatlands Quadrangle was found, on drilling near Bothwell, to be 220 m thick (Forsyth, 1984*a*). At Poatina the Ross Sandstone is 200 m thick (McKellar, 1957). A similar thickness may be expected through much of the Interlaken Quadrangle.

The quartz sandstone sequence north-east of Ross is thinner but the extent to which the thinning may be expressed in the Interlaken Quadrangle is unknown. A minimum thickness of 140 m is indicated by outcrops in the central southern region of the Interlaken Quadrangle, and an estimated 100 m of strata is exposed 10 km west of Ross. About 25 km north-east of Ross, in the Ben Lomond Quadrangle, the quartz sandstone is probably less than 100 m thick (Blissett, 1959), and further east near St Marys it is entirely absent. The upper lutite-dominated interval (Rpc) is unlikely to exceed 40–60 m in thickness.



Sandstone beds of the dominantly sandstone interval are usually deeply leached in surface outcrops and show a porous, almost entirely quartzose composition, with only remnants of muscovite, feldspar, other labile grains, and a ferruginous clay matrix less than 5%. With less weathering, a range of compositions is evident from quartz sandstone to feldspathic quartzose sandstone. Occasionally labile grain or matrix-rich sandstones occur which have been deposited in lower energy environments compared to the strongly cross-bedded quartz sandstone. Sandstone described from stone quarries at Ross appears to contain little more than 50% quartzose grains, as clayey grains and matrix averages about 30% and porosity about 15% (Sharples *et al.*, 1984). The clay component more commonly consists of illite than kaolinite (Sharples *et al.*, 1984). In drill core the sandstone consists of monocrystalline quartz with overgrowths and quartzite grains (70–80%), with chert, potash feldspar, plagioclase, microcline, muscovite and 5–15% clayey matrix (RG26) [374475]. Graphite is often present in hand specimens, and mud pellets up to boulder size may be locally abundant.

The basal beds of the quartz sandstone sequence are exposed about five kilometres west of Ross. As noted earlier the exposure is inadequate to determine whether some beds near the base show greater affinity to the Cygnet Coal Measures correlate (Pj) or the quartz sandstone sequence (Rp). This problem may be resolvable with detailed mineralogical and provenance studies of the outcropping sandstone beds, or drilling to determine the nature of lutite present. Palaeocurrents of these beds are shown in Figure 9. If the base of the quartz sandstone sequence (Rp) is taken as the base of a medium-grained and coarse-grained sandstone unit with quartz granules and occasional small pebbles, similarity is shown with the basal beds in the Oatlands Quadrangle, where granule horizons are often present. Vertebrate bone fragments were noted above the base [369441] and collected from a younger locality west of White Lagoon [353396].

The sequence base on the Tiers scarp east of Lake Sorell is too poorly exposed to elucidate the stratigraphy, and contact metamorphism and limited sections south of Tunbridge Tier Road do not enable a completely confident recognition of the base, although locally a medium-grained to coarse-grained and coarse-granule sandstone with 10–15% feldspar has been mapped as the basal unit of the sequence.

Granule sandstone and conglomerate overlie a lutite-rich interval south of Lake Crescent [150248]. As no contrary evidence was found, the lutite-rich interval has been depicted as Rpc but could be the top of the Cygnet Coal Measures correlate. Granule sandstone forms the oldest strata nearby on a spur a few hundred metres to the east-north-east. Granule sandstone exposed east of Dogs Head Tier could also be the basal beds of the quartz sandstone sequence [197325].

Quartz granules dispersed in sandstone or scattered on foreset laminae persist to higher stratigraphic horizons than was recognised in the Oatlands Quadrangle, occurring at horizons interpreted to be many tens of metres above the sequence base both south of Lake Crescent and between the Isis River and Auburn Road.

Lutite-rich intervals occur within the dominantly quartz sandstone interval at some localities, and have been indicated (Rpc) and mapped out where continuity could be established [290294].

Towards the top of the dominantly sandstone interval there is a tendency for sandstone to be finer grained (very fine-grained to fine-grained), to develop pachydermal jointing, to contain less quartz (60–70%), and more brown matrix, mica and graphite. Some sandstone of this type appears to be less porous and of higher specific gravity than is usual, and weathers with a hardened purple rind. Some isolated lutite localities with siltstone and carbonaceous siltstone occur (Rpc), but at slightly younger horizons lutite appears to be more common than the sandstone layers and an interval of such strata is mappable. In the mapped intervals, the lutite includes carbonaceous beds with occasional sphenopsid stems; fissile, richly micaceous beds often associated with thin-bedded sandstone; rare red-purple coloured siltstone; and in places, red to orange iron-stained irregular joints. Initially such intervals appeared to be indistinguishable from lutite intervals lower in the quartz

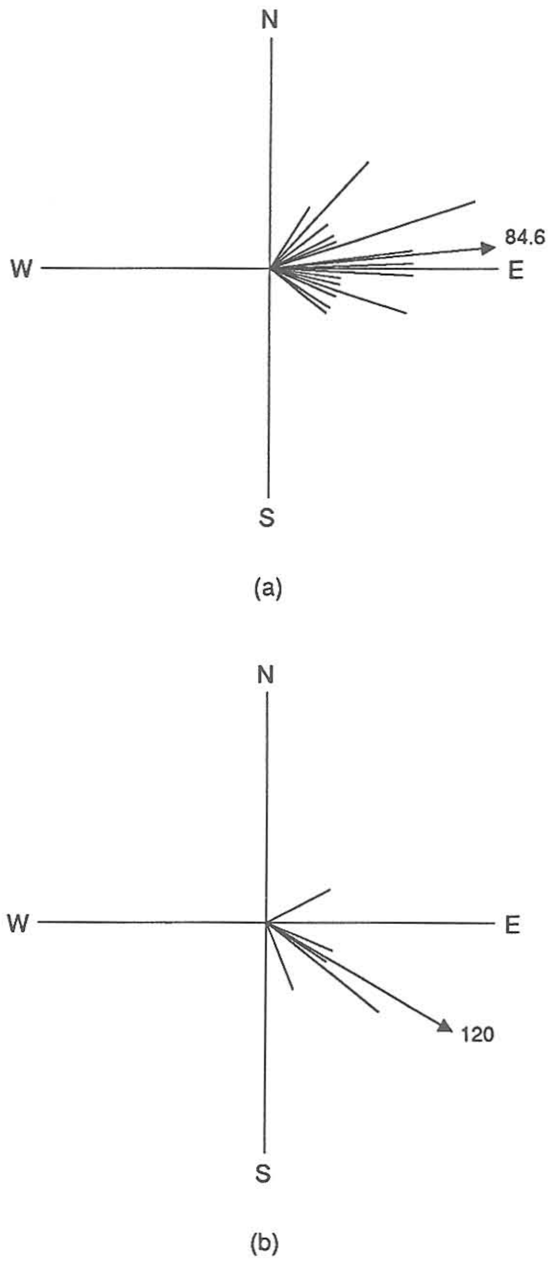


Figure 9. *Palaeocurrent vectors for sandstone beds* (Rp?, Rp) *overlying the Cygnet Coal Measures correlate, Auburn Road area.*

(a) Rp?: *Mean vector calculated from festoon and tabular cross-bedding, festoon axis, ripple and primary current lineation measurements of relative unit length.*
N=23, θ=84.6°, MVA=20.84, MVA/N=0.91

(b) Rp: *Mean vector calculated from festoon cross-bedding measurements of relative unit magnitude.*
N=6, θ=120°, MVA=5.30, MVA/N=0.88

5 cm

sandstone dominated interval, both in the Interlaken and Oatlands Quadrangles, but as evidence accumulated it became apparent that their stratigraphic position, where determinable, was at the top of the sequence and their possible equivalence with the Muddy Fluvial Plain facies (TRm) of the Oatlands Quadrangle (Forsyth, 1984*a*) was indicated. At that stage no biostratigraphic data was available to support that possible correlation.

A second feature noted at this horizon was extensive outcrops of thin-bedded to medium-bedded, bioturbated, silicified sandstone with at least four distinct types of trace fossils and rare layers with abundant conchostracans. Because of poor outcrop, the silicified sandstone was mapped in isolation (TRpc') but in better exposed areas it was later found to occur within the lutite-dominant interval. In a shallow bore intersecting rocks including pale to medium, blue-green siltstone and purple-grey mudstone, small fossils (about 1 mm) with black chitinous or carbonaceous shells were numerous in thin beds of the silicified sandstone with narrow, vertical trace fossils (RG45) [273498]. This particular fossiliferous sandstone lithology is widespread, occurring west to the Tiers scarp [221479], south to beyond the map boundary [220224], east of Tunbridge [394328], and at numerous localities west of Kitchener Ridge to the Tiers scarp.

It has not proved possible to recheck all lutite-rich sections for the presence or absence of distinct silicified sandstone layers, but field notes indicate silicified bioturbated sandstone beds are present south of Kitchener Ridge [343421], and non-silicified bioturbated sandstone occurs 1.5 km west of White Lagoon. Silicified, bioturbated sandstone is widespread in the Oatlands Quadrangle in the Muddy Fluvial Plain facies (TRm), and also occurs near Kaoota (Farmer, 1985), and at Mt Wylly near the south coast. Silicified sandstone and bioturbated sandstone occur separately in the lower Cluan Formation at Poatina. The evidence to date suggests that the silicified bioturbated sandstone layers are restricted to the upper part of the quartz sandstone sequence.

Lutite-rich intervals were found near the top of the quartz sandstone sequence south of Table Mountain but all silicified rocks found were interpreted, at the time of mapping, to be contact metamorphic rocks. Outcrop is particularly poor in this area but some siltstone, resembling rocks normally found in the upper part of the quartz sandstone sequence (TRp), have been indicated as TRpc? [112227], whereas yellow mudstone exposed further north-west has been indicated as TRu [105230]. Subsequent to map compilation, additional outcrops were found underlying the last locality, and are of a range of lutite lithologies typical of the upper lutite-rich interval of the sequence TRp. At the western end of Mike Howes Marsh, beds including carbonaceous siltstone, quartz sandstone and arkosic pink sandstone should be indicated as TRpc, but are depicted as TRp? [187234]. Limited support for these beds occurring at the top of the sequence TR p has been obtained by palynological confirmation that nearby beds are part of the overlying sequence (TRls) [185236].

The sedimentary structures found in the quartz sandstone sequence (TRp) are closely comparable to those found in the Oatlands Quadrangle (Forsyth, 1984*a*) but the nature of the outcrop yields a greater number of plan views of festoon fields, especially on platforms near the Blackman River north of Tunbridge. Occasional steep-sided tabular cross-bedded bars overlain by festoon cross-bedding have been noted [331465, 386349]. The bar cross-beds range from inclined laminae to what appears to be inclined thin beds, but what may actually be groups of poorly defined cross-laminae. Bar amplitudes rarely exceed one metre, and the dip of the inclined bar layers trends obliquely to the palaeocurrent directions of the overlying festoons. The structures may be braid bars. The sandstone of the sequence TR p, as in the Oatlands Quadrangle, is considered to be formed from the deposits of low sinuosity rivers. Average palaeocurrent direction lies between east-south-east and south-east (fig. 10).

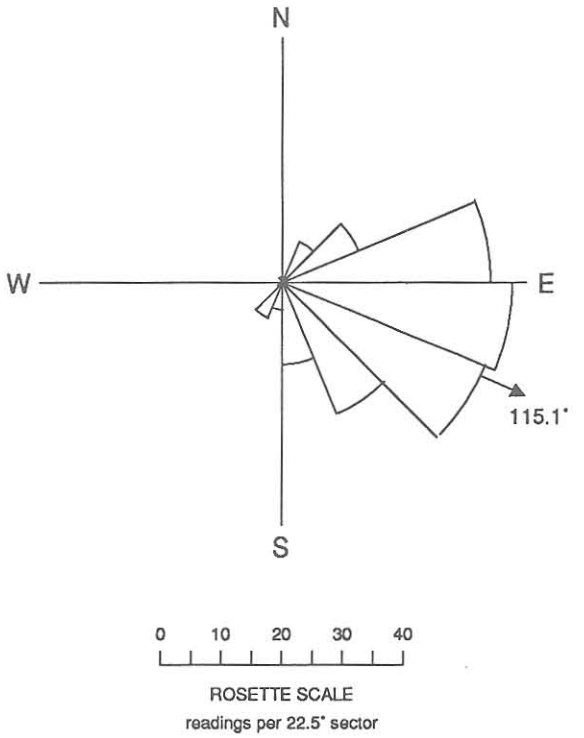


Figure 10. *Palaeocurrent vectors in the quartz sandstone sequence (TRp). Mean vector calculated from cross-bedding and festoon axis measurements of relative unit magnitude.*

N=196, θ=115.1°, VMA=150.2, VMA/N=0.77

Palaeocurrents depositing sandstone beds in the upper lutite-rich interval appear to show a greater degree of azimuth variations. This may be related to inclusion of data from an overlying sequence at one locality, where currents are directed westward [320493]. Westward palaeocurrents were also measured elsewhere, and could indicate overbank current directions without necessarily implying a significant change in palaeoslope.

The main quartz sandstone-dominated interval of the sequence TRp is an extension of the quartz sandstone sequence (TRp) of the Oatlands Quadrangle (Forsyth, 1984*a*), and is a litho-correlate of the Ross Sandstone at Poatina (McKellar, 1957). The litho-correlates outside of the Interlaken Quadrangle contain a microflora indicating correlation with Griesbachian to mid-Smithian rocks of Western Australia (Playford, 1965; Forsyth, 1984*a*). A broadly similar microflora was obtained from a shallow bore near Ross which intersected the quartz sandstone sequence. This microflora lacks *Aratrisporites*, contains species found in the Western Australian floras, and appears to be younger than the *Protohaploxypinus microcorpus* zone (RG28) [391473]. The microflora is dominated by cavate spores, especially *Lundbladispora brevicula* Balme, 1963, with *Densoisporites playfordii* (Balme) Dettmann, 1963; *Densoisporites nejburgii* (Schulz) Balme, 1970; circular and subtriangular cingulate spores including *Limatulasporites fossulatus* (Balme) Helby and Foster *in* Foster, 1979; and *Playfordiaspora crenulata* (Wilson) Foster, 1979. Bisaccate forms are not common but include *Falcisporites australis*, *Protohaploxypinus* spp. and *Lunatisporites*. Microfloras of this type extend virtually to the base of the quartz sandstone sequence near Baden in the Oatlands Quadrangle but the upward limit of the microflora is unknown.

The upper, lutite-rich interval of the quartz sandstone sequence (Ʀp) is regarded as being a litho-correlate of the Muddy Fluvial Plain facies (Ʀm) of the Oatlands Quadrangle, and the basal 40 m interval of the Cluan Formation at Poatina. This is partly based on re-interpretation of the Poatina succession which has shown that the basal Cluan Formation contains lithologies such as light blue mudstone, purple mudstone, grey-purple mottled mudstone, silicified sandstone, and bioturbated beds not previously indicated by McKellar (1957). The re-interpretation also indicates that microfloras previously described from the Tiers Formation (Playford, 1965) are from the Cluan Formation, and the older microflora and possibly the younger microflora are from the interval of strata litho-correlated with the lutite-rich interval in the Interlaken Quadrangle. Subsequent to map compilation, the upper lutite-rich interval with fossiliferous silicified sandstone (Ʀpc') intersected in shallow bore RG45 [273398] was found to contain a microflora of limited diversity with abundant *Aratrisporites wollariensеis* Helby, 1967 [298451]. A similar *Aratrisporites* spp. microflora and *Dicroidium* sp. were found in grey mudstone tentatively assigned to the upper lutite-rich interval of the sequence Ʀp, and intersected in RG44 beneath quartz sandstone with pink granules assigned to the overlying sequence (Ʀls"). [Note that bore RG44 is incorrectly shown as RG46 on the map]. The microflora found in the upper lutite-rich interval of the sequence Ʀp, like the microfloras from litho-correlates in the Oatlands Quadrangle and at Poatina, is assignable to the *Aratrisporites tenuispinosus* Assemblage Zone (Helby, 1973). Whereas microfloras in the Oatlands Quadrangle suggest a mid-Smithian to early Anisian age, consideration of megafloras there suggests a pre-Anisian age (Forsyth, 1984*a*).

SEQUENCES OF PREDOMINANTLY LITHIC SANDSTONE (Ʀl)

A lower sequence (Ʀls) and an upper sequence (Ʀlg) constitute the sequences of predominantly lithic sandstone. The upper sequence (Ʀlg) consists predominantly of volcanic lithic sandstone with prominent dark volcanic grains with coal measures, and is more thickly bedded and coarser-grained than the lower sequence. Silicified wood, extrabasinal cobbles and small boulders, and rare tuff beds occur in the upper part of the upper sequence. The lower sequence (Ʀls) includes horizons with quartz sandstone, but lithic sandstone beds tend to lack the common dark volcanic grains. Lutite and fine-grained sandstone predominate through much of the lower sequence, and coal is absent in the lower part.

The two sequences correspond to the subdivision used in the Oatlands Quadrangle (Forsyth *et al*., 1976; Forsyth, 1984*a*).

Interlaken	*Oatlands*
Ʀlg	Ʀg
Ʀls	Ʀs

Within the lower sequence, intervals or outcrops containing quartz sandstone have been indicated by Ʀls", and intervals or outcrops lacking quartz sandstone have been indicated by Ʀls'. In some areas a clear distinction between the two sequences was not sustained and undifferentiated rocks have been depicted by Ʀl.

Difficulties in differentiating between the two sequences are caused by both poor exposure and lateral variation of the detailed internal stratigraphy of the sequences. Small outcrops of poorly-exposed and deeply-weathered lithic sandstone (indicated by Ʀl) may occupy any horizon within the sequences. Where one or both of the sequences occur and a precise boundary between the sequences was not recognised, unassigned rocks near the boundary have similarly been indicated Ʀl. In the Oatlands Quadrangle a thick (approximately 100 m) interval of quartz sandstone and lutite with prominent dark carbonaceous beds and some lithic sandstone (Ʀsq') extends up to within 40 m of the base of the volcanic lithic sandstone sequence (Ʀg) (Forsyth, 1984*a*). At Table Mountain in the Interlaken Quadrangle, quartz sandstone beds are not conspicuous, and the interval with quartz sandstone in the Oatlands Quadrangle is interpreted to either thin northward or to contain a much reduced proportion of quartz sandstone. This is the most conspicuous difference between the sequences of the Oatlands and Interlaken Quadrangles, and contributes to the difficulty in subdividing the lithic sequences. The interpreted northward change in the interval with quartz sandstone is consistent with the occurrence of a thinner and diachronous interval with quartz sandstone elsewhere in Tasmania at Poatina, St Marys, and Mt Lloyd.

Lower sequence of lithic sandstone, quartz sandstone, lutite and some carbonaceous beds (Ʀls)

This sequence is considered to consist of from bottom to top:

(i) a basal interval (20 m) in which quartz sandstone is present.

(ii) an interval (70–100? m) of lithic sandstone and lutite in which thick units of grey lutite are not conspicuous and coal seams are absent.

(iii) an interval (100? m) with prominent grey lutite, lithic sandstone and, in most areas, quartz sandstone.

(iv) possibly an upper interval of lutite and lithic sandstone without quartz sandstone.

This concept is based on the succession at Table Mountain, where at least the lower three intervals occur. Seldom do more than two of the intervals form an exposed succession elsewhere in the quadrangle, although the presence of other intervals can be inferred from isolated occurrences in local areas. Only those parts of the sequence consisting of quartz sandstone and lutite (Ʀls"), and lithic sandstone and ?lutite (Ʀls') have been differentiated on the map. Because outcrop is poor lutite beds are rarely seen, and it has not been possible to indicate where quartz sandstone beds are associated with abundant carbonaceous lutite and diverse *Dicroidium* floras, or whether this is not the case. This distinction was possible in the Oatlands Quadrangle and enabled determination of whether quartz sandstone occupied a basal or higher stratigraphic position. The occurrence of quartz sandstone at higher stratigraphic horizons does not necessarily define the limits of the third type of interval listed above, and therefore does not necessarily provide a simple means of separating intervals of the second and fourth type as is the case in the Oatlands Quadrangle (Forsyth, 1984*a*).

Quartz sandstone (Ʀls") *- basal beds*

The base of the lower lithic sequence (Ʀls) is exposed 8–15 km west of Ross; near Table Mountain; and probably at several other localities, e.g. 1.5 km west of White Lagoon [355388]. These occurrences are characterised by one or more of the following features; granule sandstone or conglomerate which may contain abundant pink to red quartzose sand grains or granules; laminated or ripple-laminated clean quartz sandstone; or interlaminated to interbedded lithic sandstone, quartz sandstone and lutite.

The outcrops skirting the lower slopes of Table Mountain on the northern, western and southern sides consist of clean, white quartz sandstone with cross-bedding and ripple cross-lamination, and occasional thin lenses of granule conglomerate [106229, 109231, 104249]. Features resembling incipient development of the longitudinal sedimentary structure illustrated by Forsyth (1984*a*, p.64) occur at 116259. Contact metamorphism caused by a Jurassic dolerite intrusion affects the strata, but hardened silicified quartz sandstone may be an earlier diagenic effect in some areas south of Table Mountain. Interbedded yellow-weathering lutite may occur but is poorly exposed and/or of uncertain stratigraphic position. The interval is overlain by lithic sandstone (Rls').

Beyond Kitchener Ridge, six kilometres west of Ross, the strata dip south-westerly but are frequently upfaulted towards the Tiers scarp, so that the same horizons repeatedly crop out. Granule sandstone and granule conglomerate lenses with prominent red and pink quartzose grains form the base of the sequence at several localities [273497, 281483, 283481 and 326458]. Laminated clean quartz sandstone occurs rarely above the basal granule sandstone at the last two localities. Incipient longitudinal sedimentary structures were found at the last locality, and from there the granule sandstone appears to pass laterally (northward) into sandstone in which quartz granules are rare. Better developed examples of the longitudinal structure were found further north in blocks of laminated quartz sandstone with feldspathic laminae, associated with yellow and grey-weathering conchoidally fracturing mudstone and minor lithic sandstone, all dug from a waterhole [319472]. Along this fault block are found quartz sandstone with abundant cosets of linguoid ripple cross-lamination, and some massive carbonaceous mudstone of a type found in the equivalent sequence (Rs) of the Oatlands Quadrangle.

Laminated quartz sandstone crops out west of the Isis River but is erroneously indicated as Ru on the map (Rsl", 250480; Rsl"?) [253478]. Nearby sandstone, with moulds of sphenopsid stems, is probably a southern extension of the same strata beneath the overlying Tertiary cover [255481]. Similar silicified? sandstone with sphenopsid stem moulds occurs further south on a lagoon floor [283452]. It is probable that this area conforms to the general structural pattern, and many of the isolated outcrops indicated Rls" on the map, and much of the undifferentiated Upper Parmeener strata (Ru—which in this area is quartzose sandstone) probably form a band along the western side of the lagoon extending north to the final mentioned outcrops west of the Isis River. This interpretation is supported, in part, by the occurrence of lithic sandstone immediately west of (overlying?) the band, unlabelled on the map [275358]; possibly at the ferricrete outcrop [267462]; and intersected in the bore in the Isis River where the river crosses through the band [265463].

There are special problems in identifying strata in the Isis River–Ellinthorp Plains area, as occurrences are usually poorly exposed, often occurring as loose blocks on the muddy floors of lagoons or largely obscured by aeolian material. Distinguishing features are rarely encountered or are not well developed. In some lagoons deeply leached Parmeener sandstone resembles slightly-cemented Tertiary sandstone, and has been recognised by the occurrence of joints parallel to the main fault direction. Some sandstone blocks appear to be rotated and may not be *in situ*. Faulting juxtaposes less granule-rich horizons of the quartz sandstone (Rls") against similar granule-bearing, near-basal horizons of the older quartz sandstone sequence (Rp). In this area the older quartz sandstone sequence (Rp) contains dominantly clear, white or bluish-white quartz granules but rare pink granules have been observed in this unit elsewhere.

In general, in the area south of the Verwood Road, the quartz sandstone indicated as Rls" consists of clean, laminated, quartz sandstone, including the unlabelled outcrop [312418], and could occupy a basal or higher stratigraphic position in the sequence Rls. Evidence for inferring a basal stratigraphic position for other outcrops is as follows:- stratigraphic position and presence of a few pink quartz granules [Rls", 288457, 292457]; the presence of a few rudimentary 'longitudinal sedimentary structures' and white quartz granules [287459]; and stratigraphic position and white quartz granules [Rls?, 311439]. Sandstone with prominent granules and a ferruginous cement in Clarks Lagoon proved, on drilling, to be a Tertiary sandstone overlying sandstone with abundant pink quartzose grains impregnated with hematite? prior to deposition [Hole RG44 not RG46, 298451]. Microflora in grey carbonaceous mudstone beneath the pink sandstone is assignable to the *Aratrisporites tenuispinosus* Assemblage Zone, and supports a near-basal stratigraphic position for the pink sandstone.

Rocks exposed in Reedy Lagoon (west of Clarks Lagoon) possess a structure thought to be festoon cross-bedding and if correctly interpreted, indicates depositional currents to the south-west [Rls"?, 293448]. Individual palaeocurrent directions derived from outcrops of quartz sandstone (Rls") south-east of Reedy Lagoon are towards the south-west, north and north-east, as indicated on the map. Two kilometres to the north-west, in Forest Lagoon, undifferentiated quartz sandstone (Rq) indicates currents to the north-west [278459]. Palaeocurrents deduced from two outcrops where inferred basal beds (Rls"?) occur range from towards the south to towards ENE, but average south-easterly at both localities [N=4, N=5, 288459, 292454] (fig. 11). At the northernmost outcrop of the basal beds (Rls"), currents are directed to the north and NNW, and not as indicated on the map [251489]. The basal quartz sandstone (Rls") was not recognised on a hill east of Hanging Sugarloaf but it is noteworthy here that the palaeocurrent directions in the sandstone (Rp?) approximating the stratigraphic position of the base of the sequence Rls are directed towards the west. South of Mike Howes Marsh [320493 and 222226] palaeocurrents are towards a little east of north (fig. 11).

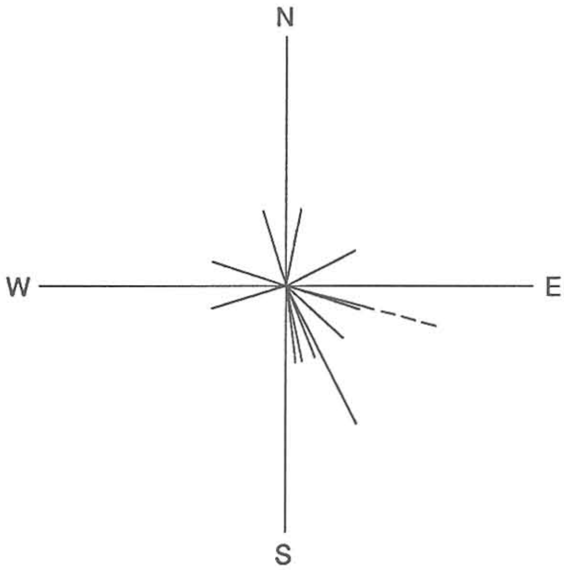
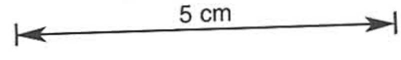


Figure 11. *Palaeocurrent vectors, inferred basal quartz sandstone beds* (Rls"?) *of dominantly lithic sandstone sequence, Ellinthorp Plains area. Vectors from possible equivalent horizons elsewhere mapped as* Rp? *are shown dashed. Data locations: 295462 (343°); 288459 (108, 133, 153, 153, 168°); 292454 (63, 103, 158, 173°); 222227 (11, 103°); 319493 (253, 288°); 225248 (298, 343°)*



The palaeocurrent data are difficult to interpret because of uncertainty of stratigraphic position. Slight variation in the position of mapped faults, or the occurrence of unmapped faults, could drastically alter the interpreted stratigraphic position of some outcrops. Rocks of the sequence Rls show a greater degree of variation of palaeocurrent directions away from the dominantly ESE direction which prevailed during deposition of the underlying sequence (Rp). A similar situation may exist as in the Oatlands Quadrangle, as the only two outcrops with SE-directed palaeocurrents are of rocks not readily distinguished from the underlying sequence (Rp), and may in fact occur as a wedge of sandstone between the lutite-rich beds with silicified bioturbated beds (Rpc'), and the younger sequence (Rls). Alternatively the palaeocurrents directed to the south-east may occur in the quartz sandstone sequence (Rp) faulted into a position adjacent to Rls.

Possibly only a single bed of laminated and massive quartz sandstone occurs west of White Lagoon, and this bed has been inferred to be the basal bed of the sequence Rls" [352394]. South of Tunbridge, laminated quartz sandstone and granule sandstone occur east of the lane to Township Lagoon [354338], and may be the basal beds of the sequence, but other outcrops of quartz sandstone near Tunbridge may be of younger horizons. Outcrops differ from those indicated on the map, as the Rls pattern has overprinted the Township Lagoon, and rocks with this pattern east of Tertiary ferricrete one kilometre south-east of the lagoon are undifferentiated quartz sandstone. Undifferentiated quartz sandstone occurs east of Township Lagoon, not lagoonal sediments [356337]. Basal quartz sandstone may occur west of Antill Ponds between the older quartz sandstone sequence (Rp) and lithic sandstone (Rls') but the relationships are obscured by dolerite talus [300275].

A thin unit of quartz sandstone with some signs of lamination has been indicated (Rls"?) east of Mike Howes Marsh but the nature of underlying rocks (Rp) is obscured by a thin veneer of basalt-derived talus. The same quartz sandstone unit may be downfaulted to the north (Rls"), and possibly also to the south-west [210230]. Near the western extremity of Mike Howes Marsh laminated quartz sandstone (Rls"?) probably occupies a basal position in the sequence [187227, 186232]. The northernmost outcrop abuts a lutite-rich sequence (Rp?), and microflora confirms that a nearby outcrop in the Blackman River does belong to the sequence Rls [184235].

A small area of coarse-grained quartz sandstone south of Mike Howes Marsh is probably near the base of the sequence [210224]. Outcrops of laminated quartz sandstone west of Boggy Marsh are associated with overlying carbonaceous siltstone with plant fragments and calcareous concretions, and may belong to the basal interval [155240]. Near the Blackman River, west of Woodbury, a granule sandstone was included in the quartz sandstone sequence (Rp) but could belong to the sequence Rls [285313].

Quartz sandstone (Rls") *younger horizons*

The distinction between basal and higher horizons of quartz sandstone in the lower lithic sequence (Rls) has not been as easily made in the Interlaken Quadrangle as in the Oatlands Quadrangle.

Lithic sandstone and siltstone at Table Mountain separate the basal quartz sandstone from some quartz sandstone of higher horizons. Quartz sandstone blocks on the north-western side of the mountain were traced up to a probable outcrop or boulder about 70 m above the basal quartz sandstone [119256]. Quartz sandstone, volcanic lithic sandstone, and what was probably deeply-weathered coal were found about 100 m above the basal quartz sandstone before construction of the current vehicular track to the firewatchers hut, but the exposures may have since been buried during track construction [112240]. Talus obscures much of the sequence, and no microfloras have been found in outcrops of carbonaceous mudstone which occur at some horizons up to the base of the overlying dolerite intrusion. The upper quartz sandstone horizon may crop out again on the south side of Boggy Marsh, where quartz sandstone contains coalified material, suggesting affinity with the upper quartz sandstone (Rsq') of the Oatlands Quadrangle. Much of the quartz sandstone (Rls") west of the Interlaken Road at Mike Howes Marsh probably belongs to the upper horizon, as outcrops on the northern side of the marsh appear to be overlain by volcanic lithic sandstone with oxidised coal and carbonaceous mudstone. Outcrops on the southern side appear, in the absence of faulting, to be overlain by mudstone at a waterhole, with a microflora containing *Annulispora folliculosa* [197234]. *A. folliculosa* first appears within or above the youngest quartz sandstone horizon elsewhere in Tasmania. A rich *Dicroidium–Xylopteris* megaflora was found on the northern side of the marsh [190240] but its position with respect to the quartz sandstone is not known. Outcrops of quartz sandstone were found near Sydenham Hill, and probably belong to the upper horizon [263224].

Further quartz sandstone which may belong to the upper horizon occurs about five kilometres east of Mike Howes Marsh. Possible volcanic lithic sandstone overlies one occurrence [271246] and possibly another [288226] but the relationship is less clear at 263225.

In the Sorell Springs area, east of the Midland Highway in the south-eastern part of the quadrangle, a thin interval of laminated quartz sandstone (Rls") overlies a Jurassic dolerite intrusion and is superseded by volcanic lithic sandstone. In view of the prominent development of the upper quartz sandstone sequence in the York Plains area, a few kilometres to the south (Forsyth, 1984*c*), the Sorell Springs quartz sandstone is also considered to belong to the upper horizon. Further north, in an area south-east from Tunbridge, several outcrops of quartz sandstone may belong to the upper horizon, particularly at a waterhole from which was dug black shale and quartz sandstone [356333].

A narrow graben may flank the Tiers escarpment west of Woodbury. Here quartz sandstone with laminae composed of labile grains contains abundant moulds of *Dicroidium* spp. and rarer, very large elongate reniform pinnules. It is impossible to tell from the collected specimens whether the *Dicroidium* species are unipinnate or bipinnate but pinnule outlines resemble *D. zuberi* var. *feistmantelii* (Johnston) Retallack, *D. odontopteroides* var. *remotum* (Szajnocha) Retallack, and *Johnstonia stelzneriana* var. *serrata* Retallack. The abundance of *Dicroidium* suggests that the quartz sandstone may belong to the upper horizon. This correlation is supported by an occurrence of steeply-dipping carbonaceous mudstone and lithic sandstone (possibly underlying quartz sandstone) in the next stream to the south [279308]. The quartz sandstone includes layers with granules [278308].

Outcrops of quartz sandstone in the northern part of the quadrangle appear to overlie lithic sandstone, and are therefore probably part of the upper quartz sandstone horizon, but in all cases the relationships are obscure. A graben containing lithic sandstone is crossed by the Auburn Road, and contains laminated quartz sandstone blocks further north [303470]. Microfloras in drill holes further south (RG40 and RG42) indicate that the lithic sandstone intersected is at least as young as the upper quartz sandstone recorded in the Oatlands Quadrangle. Further west, quartz sandstone dips westerly at a moderate angle (20°?) and appears to overlie lithic sandstone to the east [249429]. Quartz sandstone occurs topographically higher than lithic sandstone [263410], and

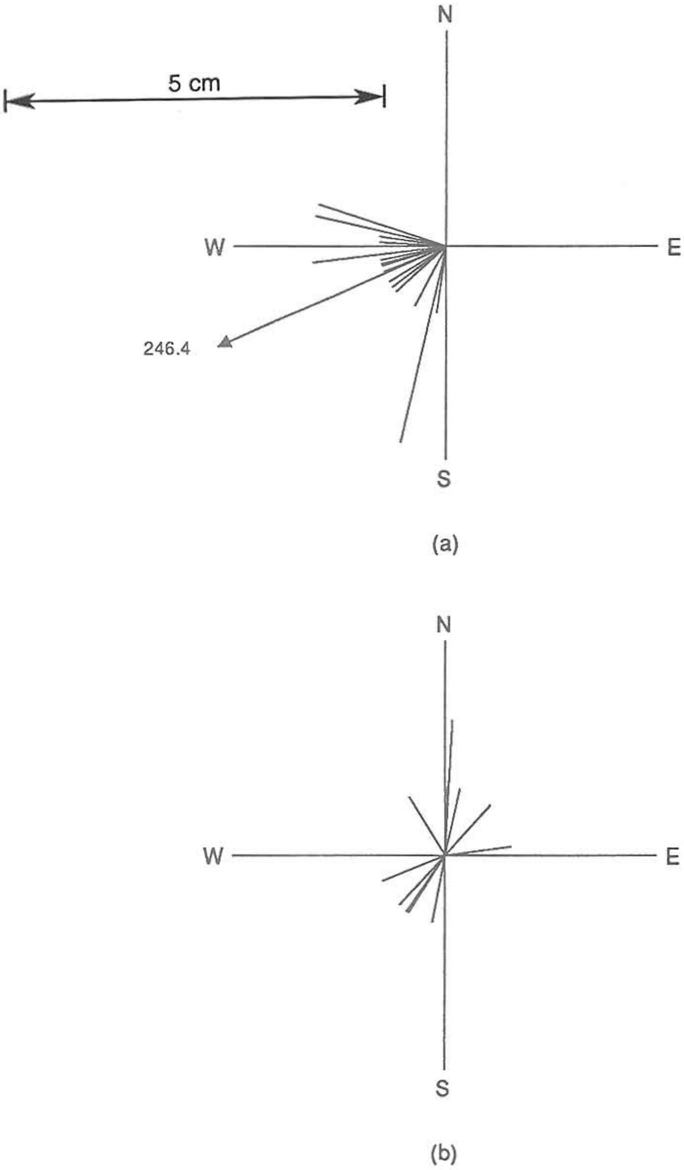


Figure 12. *Palaeocurrent vectors for quartz sandstone* (Rls") *of dominantly lithic sandstone sequence.*

(a) Woods Lake. Mean vector calculated for cross-bedding, ripple lamination and festoon axes measurements of relative unit magnitude.
N=20, θ=246.4°, MVA=16.8, MVA/N=0.84

(b) Ellinthorp Plains. Measurements of cross-bedding, primary current and ripple cross-lamination, and inferred festoons. Data locations: 292448 (191, 223, 248°); 295442 (3, 43, 213°); 251489 (3, 13, 328°); 262410 (83, 215°)

indicates palaeocurrents towards the south-west and east. A similar relationship occurs closer to Lake Sorell [227412], and massive dark mudstone at about the same height occurs a few hundred metres to the south (Rb).

Quartz sandstone, including laminated types and some exhibiting longitudinal sedimentary structures, occurs closely associated with lithic sandstone at Woods Lake [000386]. Palaeocurrents depositing the quartz sandstone were flowing, on average, towards the south-west (fig. 12).

LITHIC SANDSTONE (Rls')

Interbedded lithic sandstone and lutite, about 70–100 m thick, overly the basal quartz sandstone (Rls") on Table Mountain. Outcrops are predominantly of fine-grained sandstone and siltstone, often showing low-angle cross-bedding or ripple cross-lamination. Some coarser sandstone beds and a little grey mudstone are also present. The sandstone and coarse siltstone tend to be creamy to buff weathering, usually without prominent grey lithic grains. A brown speckled appearance is common, caused by brown fine-grained cement. In thin sections, fine-grained volcanic? rock fragments are estimated to form 10–15%, monocrystalline quartz 15–20%, feldspar grains and overgrowths 20–35%, but other lithic grains, including chert and quartzite, predominate. Biotite is usually present, and apatite rosettes are occasionally common.

Fragmentary plant fragments are abundant on some horizons but identifiable leaves have not been found. Muddy beds tend to be green-grey or yellow when weathered, and grey carbonaceous beds are usually thin and subordinate. Scattered, usually vertical burrows a few millimetres in diameter, occur in some beds. The rocks are regarded as a correlate of the lower lithic sandstone and lutite (Rsfl) sequence of the Oatlands Quadrangle (Forsyth, 1984*a*), and some sandstone lithologies are identical to beds in the Tiers Formation at Poatina.

Part of the interval (about 16 m) is exposed in the bed of the River Clyde west of Table Mountain [034247]. Lutite and sandstone occur in equal proportions, the three thickest sandstone units being 1.5–2 m thick with planar, low and steep angle cross-bedding, and featureless beds. The coarsest sandstone unit is of medium grain size and contains a few small pebbles of metamorphic rock, unlike rocks found in north-eastern Tasmania (N. J. Turner, E. Williams, pers. comm.). The other units exhibit festoon cross-bedding, indicating palaeocurrents towards 285° and 345°. Some thick units of medium interbedded yellow to khaki sandstone and siltstone occur with thin grey shale interbeds. Units of interbedded khaki and light to medium-grey siltstone occur in places with thin interbeds to laminae of sandstone. Numerous cylindrical and strap-like plant? remains, 2×100 mm in dimension, occur on some horizons.

Microfloras contain prominent taeniate bisaccates including *Protohaploxypinus* sp. cf. *jacobi*, indicating palynocorrelation with the lower lithic sandstone and lutite sequence (Rsfl) of the Oatlands Quadrangle (Forsyth, 1984*a*). Other lithocorrelates occur in the Mike Howes Marsh area [209225, 219246], west of Antill Ponds [303273], and possibly near the Verwood Road [275458]. Near the last locality a drill hole (RG48) intersected lithic sandstone and lutite but microfloras are lacking. Lithocorrelates may be inferred to be present at other localities on the basis of their probable stratigraphic position, for example those outcrops apparently underlying quartz sandstone south of Verwood Road [251430, 267408], in the Blackman River [279368], and on the downthrown side of faults near Old Mans Head [180270]. Carbonate concretions and rare *Dicroidium* leaves were found at one of the localities south of Verwood Road [263408].

In the area south and west of Currajong Hills [280240] rocks indicated Rls' and Rls'? on the map include siltstone, quartz-rich lithic sandstone, and lithic sandstone without prominent dark grains, and pass up into thick-bedded volcanic lithic sandstone (Rlg). These sequences may overlie the upper quartz sandstone horizon.

Rocks exposed west of Woodbury [298294] and south-east of Tunbridge consist predominantly of lithic siltstone and lesser sandstone [352334, 357330, 361327]. Precise assignment of these rocks in the sequence is not indicated. Lithic sandstone grading into volcanic-lithic sandstone was intersected in several shallow bores on Ellinthorp Plains and further west [RG47, 251464; RG50, 260447; RG40, 303462; RG42, 312454]. In all bores *Semiretisporis denmeadi* or

Annulispora folliculosa are present, indicating that the rocks are younger than the older lithic interval, and perhaps are palynocorrelates of the upper quartz sandstone horizon elsewhere, or are younger strata.

VOLCANIC LITHIC SANDSTONE AND COAL MEASURES (Rlg)

The volcanic lithic sandstone and coal measures sequence crops out mainly in the south-east corner of the quadrangle; in the area east of Woodbury, the Antill Ponds to York Plains area, and as scattered outcrops west from here to the fault at 251240. It also occurs in the Mike Howes Marsh area, where it hosts coal seams described by Twelvetrees (1902) and Hills *et al.* (1922); and south-east of Table Mountain, where it has been indicated with the wrong pattern on the map [148234]. The sequence was probably intersected in shallow bores south-west from Ross [RG37, 395449; and RG32, 390455], where volcanic lithic sandstone contains large pieces of carbonaceous material; on Ellinthorp Plains [RG42, 312454]; and possibly further west [RG47, 251464; and RG50, 260447], where coal occurs in association with very thin beds of fine-grained white sandstone which may be quartzose in composition, indicating also a possible affinity with older sequences. The sequence may also have been intersected in water bores east of Bells Lagoon (e.g. RG112) and crops out nearby [297403] but other possible outcrops nearby are too small and weathered to differentiate and are indicated by Rl.

The sequence is characterised by the presence of dominantly thick units of very fine-grained to very coarse-grained lithic sandstone which contains prominent dark grey volcanic fragments. The range of sandstone composition probably overlaps that of the underlying sequence, but sandstone of the volcanic lithic sandstone sequence tends to contain a greater proportion of volcanic grains and a lower proportion of quartz. Lutite-rich horizons have been indicated (Rlg'). Extrabasinal cobbles and small boulders, and thin brittle tuff beds occur in the upper part of the sequence, usually associated with silicified wood which may also occur elsewhere. Silicified wood, tuff beds and clasts all crop out near the top of Brents Sugarloaf [413296] and just east of the quadrangle boundary [415303] but their distribution as floaters or in Quaternary deposits elsewhere is widespread.

Clast compositions resemble those of the Oatlands Quadrangle (Forsyth, 1984*a*), with acid or intermediate quartz-feldspar porphyries with bipyramidal quartz phenocrysts being the most common type occurring. Metamorphic rocks show affinity with both west and east Tasmanian rocks, granitic rocks, and Permian fossiliferous and unfossiliferous siltstone. Lapilli tuff pieces found in Quaternary alluvial deposits south of Glen Morey Road may be angular broken clasts derived from the coal measures, or derived directly from tuff beds in the coal measures.

Outcrops of tuff contain abundant volcanic shards in some layers and resemble tuff found south-east of Bothwell. Tuff shards are rare through much of the rock at Bothwell (Forsyth, 1984*a*), but shards are abundant in some layers. Some pieces of silicified wood from Brents Sugarloaf are derived from tuff beds. A large mass of silicified material on the northern slopes of Brents Sugarloaf encloses much plant matter, including stems of trees and small tree ferns. Similar blocks with silicified tree ferns, with adhering lithic sandstone matrix and the pollen *Falcisporites australis*, were found south of Glen Morey Road [401283], and an excellently preserved tree fern trunk was found in Quaternary alluvial deposits. Other silicified wood includes stems or trunks with both very fine growth rings and coarse growth rings. A trunk or root base occurs on the eastern side of Brents Sugarloaf, suggesting a tree diameter of 1.5 m. Where silicified wood is found in outcrop it lies either perpendicular or parallel to the current direction of enclosing sandstone. Wood fossils are also found as carbonaceous matter or partly replaced by ferruginous material, or sometimes as poorly-defined moulds in sandstone. Numerous large trunks are preserved in all four manners in a sandstone bed with some basal extrabasinal clasts immediately east of the quadrangle boundary. The sandstone immediately overlies a thin tuff bed capping mudstone with leaf fossils [415305]. Fragmented wood pieces occur commonly on some horizons south of Glen Morey Road and were also found in hole RG32 near Ross, and north of Mike Howes Marsh [219264]. Fossils found in mudstone 400 m south of the last locality include *Johnstonia coriacea* var. *coriacea* (Johnston) Walkom.

Coal was exposed in pits and dip tunnels at Mike Howes Marsh (Twelvetrees, 1902; Hills *et al.*, 1922). These exploratory workings are probably those which occur in volcanic lithic sandstone west of Interlaken Road [209235]. This area is close to quartz sandstone but the coal does not seem to be directly associated with the quartz sandstone as indicated by Hills *et al.* (1922).

Glenie *et al.* (1981) indicate that only minor coal (110 mm) was intersected in a nearby bore hole, but Summons (1984) suggests further intersections may be present in this hole but not in a second bore further east on the Interlaken Road. Coal was intersected south of Glen Morey Road in an early diamond-drilled water bore (Nye, 1925*b*). This and nearby areas have been extensively drilled during recent coal exploration, and a small deposit has been indicated.

Uneconomic coal was also found beneath Tertiary sediments 15 km west of Ross in hole RG50 [261447] but the enclosing strata may occur below the volcanic lithic sandstone sequence (Rlg).

The thickest exposed section of the volcanic lithic sandstone sequence is about 120 m. At Brents Sugarloaf, about 80 m of strata is partly exposed as a series of sandstone shelves and cliffs. Extrabasinal clasts are found in the top two sandstone cliffs, where a thick bed with large angular lutite clasts over 0.5 m long is exposed on the eastern side of the hill. Large ovoid carbonate concretions also occur. Outcrops elsewhere suggest that subordinate, lutite-rich intervals may separate the sandstone units. By analogy with the stratigraphic distribution of extrabasinal clasts in the St Marys district (Turner and Calver, 1987) and in the Oatlands Quadrangle (Forsyth, 1984*a*), the sandstone units with extrabasinal clasts are regarded as occurring near the top of the sequence.

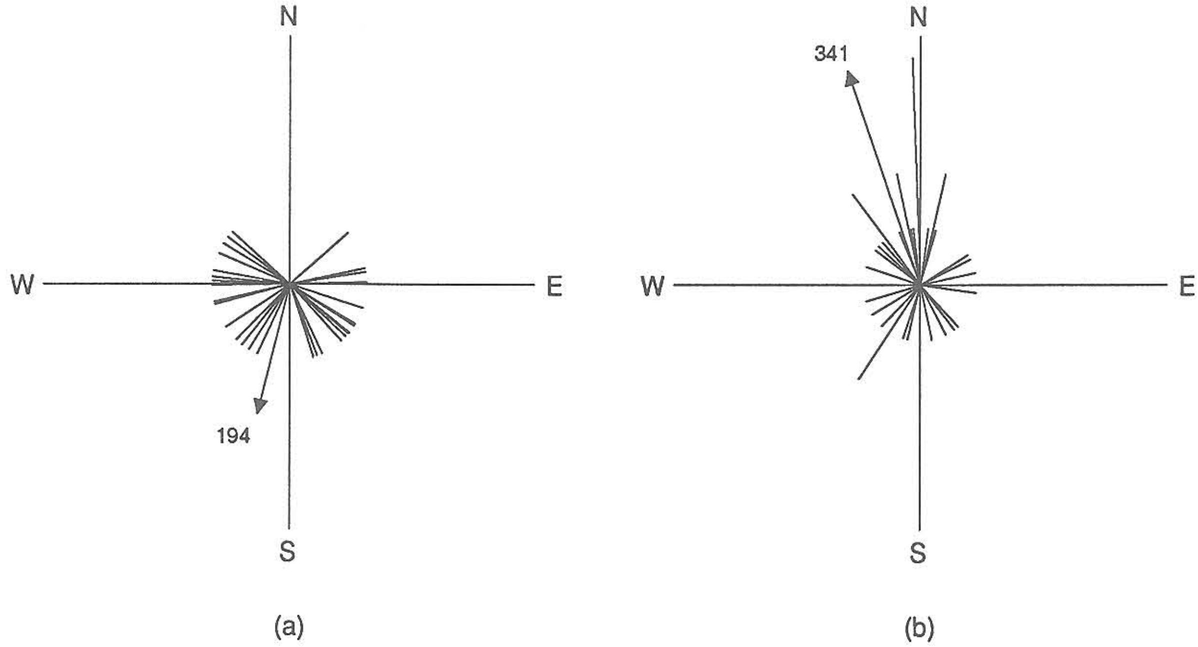
Palaeocurrent analyses of cross-bedding and festoons in plan in the sandstone units at Brents Sugarloaf, after correction for a 7° dip towards 198°, indicate a statistical mean palaeocurrent towards 194°. The mean palaeocurrent direction bisects an almost bimodal distribution of palaeocurrent directions (see fig. 13*a*). Individual sandstone units also tend to show a poor relationship between mean and modal palaeocurrent directions. Data from spot localities elsewhere in the south-eastern corner of the quadrangle show a variety of palaeocurrent directions. These are indicated in Figure 13*b*.

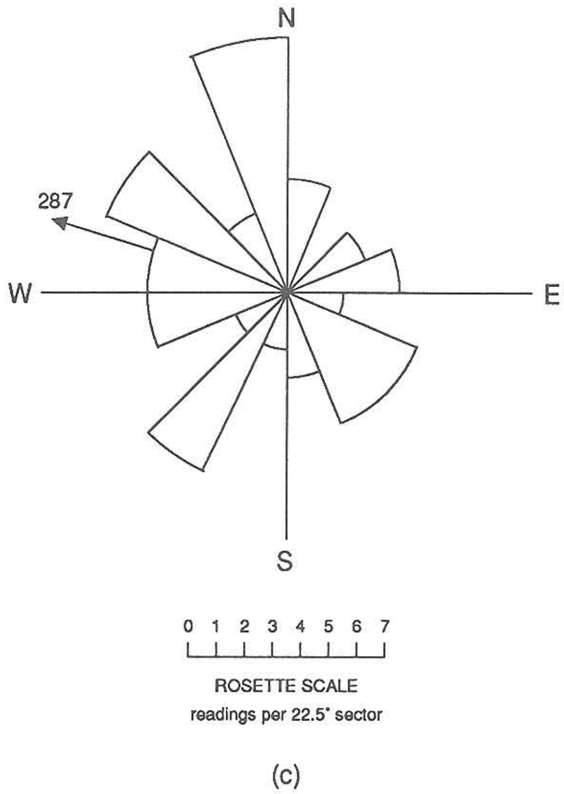
Megafloral localities, with *Cladophlebis, Heidiphyllum elongatum* (Morris) Retallack and *Dicroidium* spp., were found near Brents Sugarloaf in lutite layers (Rlg, unlabelled) [408306, 408308]. Reasons for assigning a late Triassic Karnian age to the sequence in the Oatlands Quadrangle were discussed by Forsyth (1984*a*).

The occurrence of silicified wood, tuff and clasts reworked from the sequence into Quaternary deposits has been indicated where the deposits are probably close to the source rocks but not in alluvial deposits where transport from the source may be greater. These deposits are indicated on the map by:

	Quaternary talus deposits	*Lag deposits*
with silicified wood	Qtdw	Qlw
tuff	Qtdf	
reworked clasts	Qtdc	Qlc

In the area east of Woodbury, extrabasinal clasts are found in Quaternary deposits south of Glen Morey Road from about one kilometre west of Tin Dish Rivulet to the eastern edge of the quadrangle [350299], and an abundance of tuff fragments occurs at one locality [399293]. Tuff fragments may be present on the south-west side of Red Ridge and clasts were found near the top of the dolerite talus at the east end of Red Ridge, although the possibility that the clasts were recently introduced for track construction could not be dismissed. Some silicified wood in lag deposits north of Red Ridge is probably locally derived, but much of the other material, and including extrabasinal reworked clasts, is associated with clasts of coarse-grained Jurassic dolerite which is foreign to the area and must be fluvially transported. A single, highly-polished clast was found on Black Tier on dolerite terrain, and could be lag after coal measures or perhaps introduced to the area by human (aboriginal?) intervention. Extrabasinal clasts derived from the coal measures are also found in the York Plains area [380225, 395232, 403226]; near St Peters Pass [330257]; south-east of Table Mountain [138234], where silicified wood is also common; and in an alluvial fan deposit overlying volcanic lithic sandstone, coal and mudstone with *Cladophlebis* sp. near Mike Howes Marsh [205255].





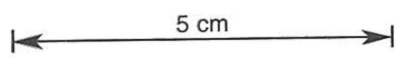


Figure 13. *Palaeocurrent vectors for volcanic lithic sandstone and coal measure sequence* (Rlg).

(a) Brents Sugarloaf area, corrected for a dip of 7° towards 198°. Mean vector calculated from cross-bedding and festoon axis measurements of relative unit magnitude.

N=29, θ=194°, MVA=7.9, MVA/N=0.27

(b) Other areas.

N=34, θ=341°, MVA=9.7, MVA/N=0.29

(c) Total

N=63, θ=287°, MVA=5.3, MVA/N=0.08

Tertiary

INTRODUCTION

The sequence of Tertiary sedimentary rocks is up to 111.2 m thick and is capped by a lateritic profile which, in places, is associated with silicastone. The thickest known sequence occurs on the western side of Ellinthorp Plains, and extends from north of Joes Creek [240470] SSE to Tunbridge Tier Road, and perhaps beyond to the Midland Highway. In a general way this coincides with the maximum downthrown Parmeener Supergroup strata. Tertiary rocks east of Bar Lagoon [280440] and Bells Lagoon [290410] extend with a similar SSE trend towards Tunbridge. The distribution of Tertiary sedimentary rocks near Ross is only poorly known and is based on two shallow bore-hole intersections. Poorly consolidated Tertiary sedimentary rocks, silicastone and ferricrete elsewhere generally form only thin veneers over older rocks, and underlie some basalt flows in both the Central Plateau area and in the lowlands north-east of Tunbridge.

Borehole intersections

The Tertiary sequence near Verwood Road was intersected in three cored bores:

Hole	*AMG reference*	*Collar height (m)*
RG46	2406546838	237.7
RG47	2525046365	230.4
RG50	2602644744	266.4

A further bore (RG48; 2650046202; collar 227.51 m a.s.l.) failed to recover Tertiary sedimentary rock core but core of Upper Parmeener Supergroup lithic sandstone was recovered below 218.5 m a.s.l. in this hole. From RG48 the basement falls to the west with an average gradient component of about 1:60 to 195 m a.s.l. in RG47, and falls SSW with an average gradient component of about 1:26 to 155 m a.s.l. in RG50. Doleritic conglomerate, 37.7 m thick, extends from the base of the sequence in RG50 up to 192.9 m a.s.l., i.e. not as high as the base of the sequence in RG47, where doleritic conglomerate is absent. Hole RG46 was terminated in the doleritic conglomerate at 197 m a.s.l. In RG46 the conglomerate extends up with increasing weathering to about 207 m a.s.l., and probably 5–10 m higher, where only 25% of the core was recovered. This core consisted of white and pink clayey material with a texture suggesting deeply-weathered conglomerate, and included one hard dolerite clast.

Taken in conjunction with outcrop data and the regional structure, the bore-hole data is interpreted to indicate that the Tertiary basin has a floor dipping south-westerly towards one or more faults (trending a little west of north) which uplift basement rocks several hundred metres. The doleritic conglomerate is interpreted to form a wedge thickening towards the western boundary fault zone, thickening both by a falling lower surface and by a rising upper surface. The influence of erosional irregularities in the basement has not been considered.

The brown-grey doleritic conglomerate includes boulders up to 500 mm diameter in RG50, set in a dark matrix with common quartz grains and ferruginous cement. A single quartzose sandstone cobble was found. The conglomerate interval is finer higher in the bore, and 25 m above the base the clasts are well-rounded dolerite cobbles up to 150 mm, and some pieces of wood are present. The conglomerate is very much like the less-weathered conglomerate in RG46, where clasts include fine, medium and coarse-grained dolerite with weathering rinds of about 10 mm, and common large pieces of wood. Coarse-grained quartz sand and granules are common in the matrix, and granules and pebbles of sub-angular, brown fine-grained, possibly baked mudstone occur.

The top seven metre interval of conglomerate in RG50 contains an increasing upward proportion of tan-coloured sandstone matrix, and eventually passes up into a fining-up unit (1 m) of sandstone into clayey siltstone, followed by more sandstone which passes up into grey siltstone with layers of fossil leaves. A particularly dark grey and abundantly fossiliferous, almost lignitic layer (about 1.5 m thick) occurs about 198 m a.s.l., and is overlain by thickly-bedded white and cream clayey siltstone and sandstone with further lignitic layers about 207–209 m above sea level. Large, often vertical wood pieces occur above about 195 m a.s.l., up to and including the interval 225.4–230.5 m a.s.l. of medium interbedded pallid claystone, brown carbonaceous mudstone and lignitic material with sandstone beds in the upper part. The sequence in RG47 is similar but only 25% core recovery was achieved in the lowest 15 m interval. The sequence in RG47 starts with white clayey sandstone with a wood fragment. Higher up, the sequence includes an interval (1 m) of white brittle clayey siltstone, and between 207–210 m a.s.l. includes an interval (1 m) of grey carbonaceous siltstone with numerous fossil leaves and wood. Above this horizon only a single large piece of fossil wood was recovered.

The lignitic horizons contain palynofloras, including the following species:

Hole	RG50	RG47
Depth (m a.s.l.)	199.9	207–210
Cyathidites splendens Harris 1965	x	
Gothanipollis bassensis Stover 1973		x
Matonisporites ornamentalis (Cookson) Partridge 1973		x
Nothofagidites asperus (Cookson) Stover and Evans 1973	x	x
Propylipollis latrobensis (Harris) Martin and Harris 1975		x
P. reticuloscabratus (Harris) Martin and Harris 1975		x
Proteacidites adenanthoides Cookson		?
P. crassus Cookson 1950		
P. pachypolus Cookson and Pike 1954	x	x
Santalumidites cainozoicus Cookson and Pike 1954	x	x
Stereisporites (Tripunctisporis) sp.		x
Tricolpites simatus Partridge 1973		x
Triporopollenites ambiguus Stover, 1973		x
T. chonosus Partridge 1973	x	

The microfloras from both bores are assignable to the Lower or Middle *Nothofagidites asperus* zones, indicating a Middle or Late Eocene age (Stover and Partridge, 1973; Partridge, 1973; Partridge, 1976; Stover and Partridge, 1982). Palynomorphs *Nothofagidites* spp., and possibly *Matonisporites ornamentalis*, were also found in the conglomerate interval of RG46 at 201.7 m a.s.l., possibly indicating a Middle to Late Eocene age for the conglomerate. Subordinate reworked Middle or Late Triassic palynomorphs were found in RG50 at 203.5 m above sea level. A younger microflora in RG50 at 230 m a.s.l., with abundant

Phyllocladidites mawsoni (Cookson) Stover and Evans, *Nothofagidites* spp., and other long-ranging coniferous pollen, is less diagnostic but contains no species indicating a post-*N. asperus* zone age. The presence of a species closely comparable to *P. adenanthoides* and *Equisetosporites notensis* and *Beaupreaidites verrucosus* Cookson supports an *N. asperus* zone assignment.

The upper part of the sequence in holes RG50 and RG46 includes ferricrete. In RG46, pink and white conglomerate extends up to a depth of about 25 m, and a hard layer, about 60 mm thick, appears to consist of coalescing pisoliths at 23–24 m depth. About one metre of uniform brick-red sandy-textured rock, with brown sand-grain size patches and some paler yellow patches, was cored between 19 and 22 metres. This was overlain, between 16–19 m, by 0.8 m of white claystone, followed by 0.5 m of red, passing up to brown, sandstone and quartz-granule sandstone with white pellets and various granules, capped by 0.2 m of doleritic? lithic granule sandstone with brown-green pyroxene? granules. Overlying rocks include one metre of greenish granule clayey sandstone with some grey material between 13–16 m depth; one metre of bright amber claystone, white and pinkish clayey sand-textured material with a clast and nodule between 10–13 m depth; and with a few hundred millimetres with dolerite clasts and hard ferricrete-cemented doleritic? conglomerate between 7–10 m depth. The bore was sited on deeply-weathered yellow lithic sandstone underlying Quaternary doleritic cobble beds.

The thick to very thickly-interbedded white claystone and sandstone layers in the upper part of RG50, up to the capping lateritic horizon, includes several fining-up units. The sandstone appears to be of lithic composition and generally of fine to very fine grain size, although some medium-grained sandstone and clayey rock with coarse-grained to very coarse-grained sand texture occurs. A few beds contain slightly coarser clasts (sand grains or granules) near the base consisting of quartz, labile grains, or mud pellets. At 14.90 m depth a layer 80 mm thick includes white granules and pellets, and rare quartz up to eight millimetres diameter.

The distribution and thickness of the poorly-consolidated Tertiary sedimentary rocks is, in places, indicated by groundwater bores. For example, clay intersected in bores near the 'Landing Strip' on Tunbridge Tier Road is inferred to be Tertiary clay underlying Quaternary cobble beds.

No surface outcrops of lignitic material were found, however lignitic material was encountered in a water bore near the Tunbridge Tier Road [287370]. This bore is west of the inferred western bounding fault, in what appears to be dolerite terrain, and was probably drilled into a valley leading into the Tertiary basin. The only other leaf fossils found occur in a nearby silicastone, which contains moulds of coniferous fronds similar in gross morphology to *Athrotaxis* [280374]. Fossil *Nothofagus* leaves are also present (R. H. Hill, pers. comm.).

Only thin Tertiary sequences were intersected in bores in the Ross area. In RG24 on Ashby Road, immediately north of the quadrangle boundary, only 150 mm of hard pebble conglomerate was recovered above Parmeener basement at 7.00 m depth. Clasts in the conglomerate include hornfels and sedimentary rock pieces set in a red to purple ferruginous matrix. Hole RG19, drilled near the Auburn Road and Midland Highway, intersected coloured clay, probably from beneath a lateritic surface, down to Parmeener basement at a depth of about sixteen metres. Pink clay was augered, and 0.5 m of brick-red claystone was cored between 7 m and 8.5 m depth. White, pink and mustard-coloured mottled, streaked and banded clays, and fine-grained sandstone, occur between 8.5–13.6 m depth, and a little white claystone was recovered below 14.30 m depth.

NATURE OF SURFACE EXPOSURES OF POORLY-CONSOLIDATED TERTIARY SEDIMENTARY ROCKS

The laterite profile appears to drape irregularities which existed in the landscape. With few exceptions, most natural surface outcrops of poorly-consolidated Tertiary sedimentary rocks lie close to the lateritic profile, and are either strongly ferruginised or alternatively leached white. Many natural and artificial exposures reveal poorly cohesive materials, ranging from clay to cobbles, which have been indicated as sediments on the geological map. For many examples the materials are probably weathered, poorly-consolidated sedimentary rocks. Herein the term 'poorly-consolidated sedimentary rock' is used to describe these poorly-cohesive materials, although the possibility that some material may be sediment has not been excluded.

Erosion is rapid once the lateritic duricrust is removed, giving rise to a mesa-like terrain in dissected areas. Deep erosion close to the mesas may result in exposures of poorly-consolidated sedimentary rocks below the lateritic profile, for example grey and blue-grey clay [260432]. The lateritic profile is frequently found over pre-Tertiary rocks and there has been, in places, a complete conversion of igneous rocks to clay without any relict textures. For this reason surface outcrops of clay have been specially indicated (Tcc), as a sedimentary origin for the clay has not been proven.

POORLY-CONSOLIDATED SEDIMENTARY ROCKS, DOMINANTLY SILTSTONE AND SANDSTONE, AND RARE COBBLE BEDS (Tc)

Poorly-consolidated sedimentary rocks, indicated by Tc, consist predominantly of siltstone and sandstone, and range in colour from white to orange to brown. Quartz is the chief constituent but labile grains may be abundant. The sedimentary rocks are usually semi-consolidated, with grains easily brushed off specimen surfaces. Clay may be interbedded, and occasional beds with quartz granules are widely scattered, probably occurring mainly in proximity to the lateritic surface as outcrop or indicated by Quaternary lag deposits [e.g. 255486, 273454, 310413, 335373, 340368, 300316].

Excluding sub-basaltic occurrences, cobble beds were observed at only a few localities. Beds with dolerite cobbles on the 'Plassy' property were considered to be of Tertiary age, as they appear to underlie a laterite profile? covered by abundant loose ferruginous pisoliths derived from lateritic rocks [244487]. A little further north beds of well-rounded siliceous cobbles, including silicified wood, follow the contours for a few hundred metres below a lateritic profile, and are reliably inferred to underlie the laterite [249496]. Isolated patches of cobbles were found nearby [251495, 250500, 250502]. Quaternary lag deposits, several kilometres south-east of Bells Lagoon, contain some boulder-sized silicified wood, and appear to be derived from horizons immediately below the lateritic profile [325388]. Some concentration of siliceous clasts prior to lateritisation may have taken place, i.e. the clasts may be derived from an older Tertiary lag or alluvial deposit, or a combination of deposits.

LITHIC SANDSTONE (Tcl)

White clayey lithic sandstone was excavated from several agricultural dams and water holes, and is probably widely distributed. The lithology is characterised by the presence of quartz, clayey grains, and common dark grains. Typically the sandstone is coarse-grained to granule grain size but some medium-grained sandstone is readily recognised by the presence of the dark grains. A sample from a water hole contains, in thin section, grains of agate and grains with volcanic shards [299386]. In other thin sections, monocrystalline quartz forms approximately 50% of the rock, with 'chert', altered feldspar, spherulitic fragments (some with rutile needles) and silicified wood set in an abundant clayey to recrystallised bauxitic? matrix. Clasts up to cobble size of agate pieces, and silicified wood and granules of clear quartz, occur in the lithic sandstone and as a lag deposit overlying the sandstone elsewhere. The cherty dark grains probably include Parmeener hornfels and silicified wood derived from the volcanic lithic sandstone sequence (Rg). Fragments with shards may similarly be derived from the sequence Rg. Other silicified wood pieces, agate, and clear quartz are probably derived from Tertiary sequences.

DIATOMACEOUS ROCKS (Tcd)

Extremely finely laminated, fissile, freshwater diatomaceous limestone is overlain by massive ferricrete in a gravel pit north of Tunbridge Tier Road [287379]. A variety of diatoms are present, including *Melosira* spp., *Gomphonema* sp., *Navicula* spp., *Stauroneis* sp., *Cymbella* sp., *Achnanthes* sp., and *Pinnularia* sp.

Similar finely laminated rocks occur nearby but generally do not appear to be calcareous and may be partly silicified. Disaggregation of these rocks is difficult but some diatoms have been extracted [285366]. Other nearby rocks resemble silicified diatomite but the degree of recrystallisation prevents diatoms from being found. This lithology contains vertical straight tubes approximately 0.5 mm in diameter. Other possible diatomaceous rocks occur east of Tin Dish Rivulet, incorrectly indicated on the map with dot overprint [361313].

OCCURRENCE OF POORLY-CONSOLIDATED TERTIARY SEDIMENTARY ROCKS IN RELATION TO LATERITE AND BASALT

Poorly-consolidated sedimentary rocks underlying laterite

In the absence of marker beds or biostratigraphic control, only an approximate model for the stratigraphic distribution of rock types can be postulated. Diatomaceous rocks, lithic sandstone with dark grains, lithic and quartz granule sandstone, siliceous cobble beds, agate and silicified wood pieces, and clear quartz pieces all appear to occur in close proximity to overlying lateritic rocks, or where the lateritic surface may be reasonably inferred to have occurred prior to erosion. For example, ferruginous granule sandstone occurs on the 'Plassy' property [255486] and granule sandstone occurs north of One Mile Hill [340368]. Quaternary lag of quartz granules [273454, 310413, 335373] and granule sandstone, and lags of quartz granules, black hornfels? pebbles and silicified wood in the small area of Tertiary sediments mapped north Old Tier Road [300316], all occur a few metres below ferricrete outcrops.

The deeper bores in the Tertiary sequence indicate that coarse quartz detritus is most common in the lowest part of the sequence but here it occurs in the matrix of the doleritic conglomerate. Otherwise the deepest occurrence (RG50) of coarse-grained quartz sand is in a medium-grained lithic? sandstone above the uppermost carbonaceous beds at 32 m depth. Relatively coarse-grained clayey sandstone beds were found in RG50 at approximately 14, 15, 19.5 and 28 m depth. The sandstone appears to lack the darker grains of the surface-mapped lithic sandstone. The sandstone of the higher intersections is probably deeply leached, and the original composition is difficult to determine. Some beds are now claystones with a granular texture. Similarly the claystone at 19.5 m in RG50 has a coarse to very coarse sand-grain texture. The coarsest material occurs as a basal current lag (80 mm thick) of white granules and clayey pellets with rare quartz (8 mm) at 15 m, and as clayey granules extending 300 mm up into a sandstone unit at fourteen metres.

Sedimentary rocks underlying basalt

Several basalt flows overlie thin veneers of Tertiary sediments. The sub-basalt sedimentary rocks have commonly been altered to silicastone or ferricrete.

Basalt flows north-east of Tunbridge overlie gravel and ferruginous conglomerate [370363, 389367] which include, in places, clasts of black hornfels and silicified wood [376353]. Quaternary lag deposits of quartz gravel [385352], and including hornfels and silicified wood at Dunns Battery [406367], are almost certainly derived from sub-basalt sedimentary rocks. In this general area, the ferricrete which underlies the basalt flows is usually massive and, in places, infills vesicles in the basalt. The ferricrete has been precipitated by groundwater flowing beneath the basalt (W. L. Matthews, pers. comm.), and in places clearly replaces sediment or sedimentary rock, as the ferricrete contains quartz granules [383354]. The ferricrete replaces wood at Dunns Battery, and closer to Tunbridge contains a replaced tree stump [377359].

Uncompressed plant fossils occur in some silicastone outcrops which occur marginal to the basalt, indicating that the material which was silicified was not Parmeener Supergroup rock but was probably of Tertiary age. In some cases silicastone replacing Lower Parmeener Supergroup rocks is difficult to distinguish from that replacing Tertiary sediment or sedimentary rock, and the original nature of silicastone north of Ross was not recorded [409490]. South of Tunbridge the Quaternary alluvial terrace deposits contain abnormally large blocks of silicastone. These were probably eroded from nearby outcrops now obscured or removed. This silicastone appears to be indurated material similar to the sub-basalt ferruginous conglomerate found further north. The clasts in the silicastone include silicified wood, tuff and black hornfels derived from the Upper Parmeener Supergroup, but appears to lack dolerite clasts.

Nye (1921) noted that the sub-basalt deposits near Ballochmyle Homestead (east of Tunbridge) were similar to those occurring along the course of the Macquarie River in the adjacent Tooms Quadrangle.

On the Central Plateau rounded quartz pebbles and granules occur in lag deposits west of a basalt flow crossed by the Tunbridge Tier Road four kilometres east of Interlaken. The pebbles are probably derived from sub-basalt sedimentary rocks, with a possible preceding provenance of Parmeener Supergroup strata. Probable sub-basalt silicastone occurs on the south side of Dogs Head [163379] and at Silver Plains [093367]. Nearby silicastone was indicated Tf on the map but ferricrete was only found at the end of the indicator bar [095370]. Possible sub-basalt gravel occurs south of the Alma Road [078343 and nearby]. Silicastone underlies basalt south-west of Lake Crescent [113285], and at Wild Pig Tier dolerite cobbles occur near the base of a basalt flow? overlying sandstone, and are probably derived from sub-basalt sedimentary rocks rather than from xenoliths. In the Blackman River valley dolerite cobbles underlie basalt flows west of Headlam Top [209260] and in the area incorrectly coloured as Tertiary basalt [228259]. The basalt flow two kilometres south of Headlam Top may overlie Tertiary sediments, and ferricrete with wood fragments was found on the northern side of the flow. The relationship between basalt and the Tertiary poorly-consolidated sedimentary rocks one kilometre west of St Peters Pass is not known [323232]. Poorly-exposed basaltic agglomerate in Currajong Rivulet probably formed contemporaneously with the igneous activity [303252].

SILICASTONE (Ts) AND FERRICRETE (Tf)

Silicastone and ferricrete often occur in close association, and where relationships can be deduced ferricrete invariably overlies silicastone. The distribution of silicastone is patchy.

Silicastone outcrops usually consist of silicified sedimentary rock in which the resistance to fracture of the matrix approaches that of the contained clasts, resulting in a brittle conchoidal fracture passing through clasts. Occasionally some silicified sandstone? possesses a sacchoidal or granular texture and less regular fracture [094266]. Silicification appears to have been caused by coalescing of overgrowths of quartz grains.

Rocks ranging from the Bogan Gap Group correlate to Tertiary sediments have undergone silicification, and show a range of initial lithologies from cobble beds to siltstone with sand clasts. Some silicastone derived from the Bogan Gap Group correlate closely resembles that derived from Tertiary sediments, for example in the vicinity of St Georges Island at Lake Sorell and possibly north of Ross [409490]. Silicastone derived from Tertiary sediments may contain clasts originally derived from Parmeener Supergroup rocks, for example hornfels and tuff in blocks of silicastone in higher level alluvial terrace deposits along Tin Dish Rivulet north of Glen Morey Road. Uncompressed plant material has been regarded as diagnostic of silicastone derived from Tertiary sediments. The plant material may occur as moulds or as silicified wood, and includes fossil conifer fronds and well-preserved fossil *Nothofagus* leaves (R. H. Hill pers. comm.) near Gavins Tier [280374]. Nearby silicastone contains radiating structures, which may be root bases of trees, various vertical smooth-sided tubes 0.5–3 mm in diameter, and annulated horizontal burrows? 4 mm in diameter.

Silicastone usually forms rounded masses (about one metre thick) with irregular bounding surfaces or more slabby, similarly irregularly bounded, thin beds and is probably discontinuous locally and certainly discontinuous over greater areas.

Ferricrete (Tf) consists of iron-enriched rocks in which chemical replacement of the host rock has occurred. Where possible, massive ochrous ferricrete has been indicated (Tfo), pisolitic conglomerate (Tfc), and lateritised sandstone (Tfs). The mineralogy of the ferricretes is reflected in the range of specific gravity values and the range of colours from black, purple, brown, amber, yellow and red, and pink and white. Some of the lighter coloured rocks, especially light yellow and tan pisolitic rocks west of Tunbridge, are probably bauxitic [341359].

Typically the ferricrete forms a duricrust or occurs beneath basalt flows. Duricrusts over Tertiary sequences are, with few exceptions, pisolitic to nodular, whereas duricrusts developed over or near? dolerite, and ferricrete beneath basalt, are more massive. Granules or sand grains visible in hand specimens or in thin section indicate replacement of sedimentary rocks, and relict textures are visible in some replaced igneous rocks. Some Tertiary sandstone may retain a strong sandstone appearance, and this has been indicated as lateritised sandstone [also omitted 263413, 309410, 313404]. Upper Parmeener quartz sandstone retains a sparkling quartzose appearance. The initial nature of some ferricretes could not be determined with certainty. For example massive, non-pisolitic ferricrete with a concentric and box-work internal structure and strongly magnetic minerals, which overlies diatomaceous limestone and yields a lag of magnetic granules, could be in part an altered basalt or sub-basalt ferricrete but no basalt was found in this area [287379]. In some layers this ferricrete contains plant fossils.

Both the type of ferricrete and the occurrence of limestone is anomalous to the area, and this could indicate that different groundwater conditions prevailed above the limestone. The proximity of dolerite further west could be a contributing factor to the occurrence of this ferricrete but fresh dolerite found nearby, and previously considered to represent basement highs through the Tertiary sequence (Forsyth, 1976), is no longer considered to be *in situ*.

The duricrusts are usually underlain by a deeply-leached pallid zone, and some sub-basalt ferricretes are overlain by pallid porous basalt. The pallid zone is particularly noticeable in dolerite, where the dolerite may be altered to white clay with clear relict doleritic texture. In some areas liesegang rings and wedges, and concretions of limonitic material, extend down into white clayey dolerite, possibly influenced by jointing. Purple ferricrete with 'swiss-roll structure' in white uniform clay resembles kernels of deeply weathered dolerite.

Ferricrete and silicastone occur in three types of settings which are not necessarily mutually exclusive:

1. Underlying basalt flows.

2. More or less directly overlying Parmeener Supergroup rocks or dolerite.

3. As the youngest rocks of Tertiary sequences.

Underlying basalt

As indicated above, small areas of sub-basalt sediment have been altered to silicastone or greybilly? at various localitions about Lake Sorell. The silicastone is associated with ferricrete near Silver Plains [093367], and small areas of ferricrete were found near basalt at Diamond Bay [e.g. 165356]. Massive ferricrete, some with wood fragments, underlies basalt at Headlam Top but includes some pisolitic ferricrete on the north-west side of the flow [241267]. Pisolitic ferricrete also occurs close to basalt near St Peters Pass [322233].

Sub-basalt ferricrete found north-east of Tunbridge is generally of a brown, massive type, and in places contains fossil wood. The ferricrete may exceed one metre in thickness and exhibit some large scale (about 500 mm) concentric structure. Some leaching of the immediately overlying basalt is apparent, and limonitic amygdales occur. Silicastone occurs at only a few localities, for example at Dunns Battery [406366] and beneath ferricrete further west [388358], but a larger area of silicastone can be inferred to be sub-basalt [382363].

Most sub-basalt ferricrete is probably formed by groundwater depositing iron-rich minerals beneath the capping basalt.

Overlying pre-Tertiary rocks

Ferricrete overlies a variety of pre-Tertiary rocks in areas removed from the present distribution of basalt. The ferricrete reflects the composition of the underlying rocks, so that hard red and purple or brown sandstone and other brown limonitic material, in places as veins or joint fillings in unaltered sandstone, overlies quartz sandstone. A brown to chocolate-coloured rock, in places with mud pellets, overlies lithic sandstone, and massive to ochrous brown to purple ferricrete overlies dolerite after grading down through white claystone into pallid dolerite with relict igneous texture. In places the ferricrete may show remnant doleritic or less distinctive igneous texture.

Massive ferricrete in close proximity to dolerite extends discontinuously across the quadrangle, especially 315333–280386. It also occurs in equivalent positions bounding dolerite at the northern margin of the quadrangle. Similar massive ferricrete forms outcrops on dolerite south of Tunbridge [350320], while smaller outcrops occur east of Kitty Hawk Rivulet, near Bells Lagoon [288395], and further east [for example 317398]. Some water bores adjacent to dolerite outcrops do not appear to have produced unweathered dolerite cuttings, and may have intersected pallid clayey dolerite [RG110, RG114; 279386, 326399]. Silicastone occurs infrequently over dolerite but has been found in close proximity at some localities, for example various outcrops occur between 313400 and an un-indicated outcrop at 310413. These outcrops are possibly on an altered thin veneer of Tertiary sedimentary rocks, and this is proved at the silicastone outcrop with Tertiary fossils near Gavins Tier [313400]. Other silicified material at the last-mentioned locality contains attractive mottled white and brown transluscent to transparent amorphous silica. Associated ferricrete nearby shows 'swiss roll' structure. Adjacent outcrops of dolerite and silicastone were omitted from the map one kilometre further south [286361]. Silicastone (Ts) adjacent to dolerite is incorrectly indicated by the Tc symbol south of Old Tier Road [286308].

Silicastone has also been found in close proximity to Upper Parmeener rocks, for example three kilometres east of Bar Lagoon [308439].

It has not been possible to determine whether groundwater conditions overlying pre-Tertiary rocks have facilitated silicastone formation or whether the preservation potential of silicastone overlying Tertiary sequences is enhanced at their intersection with pre-Tertiary rocks.

Overlying Tertiary sequences

Tertiary sedimentary rocks are overlain by an extensive eroded lateritic profile in the Ellinthorp Plains area from north of Tunbridge Tier Road to the northern map boundary, with occasional outlying remnants elsewhere. In a general way the lateritic surface dips gently away from the Tiers scarp on to the Ellinthorp Plains and associated lowlands, and crosses north of Bells Lagoon, rising to the east two kilometres east of Bells Lagoon. In detail the surface appears to express local variations, apparently draping the topographic irregularities which existed prior to, or developed during lateritisation. If more than one horizon of thick ferricrete is present, the precision in recognising the lateritic surface may be less than considered during mapping, and conceived irregularities in the surface may be of lesser magnitude. Drilling suggests thin ferricrete layers may be dispersed through an interval in excess of ten metres. In addition large concretionary limonitic masses and irregular downward-extensions of ferricrete have been found associated with white sediment, and may lie well below the top of the lateritic profile. Similar limonitic masses in the Brighton Quadrangle contain siderite cores (R. S. Bottrill, pers. comm.).

The concept of the lateritic profile built up during mapping varied from place to place but north of Bells Lagoon the profile is considered to be as follows:

A sequence of white or salmon-coloured claystone or siltstone, often very pallid near the top, is overlain by a unit of brightly coloured ferricrete which in turn is overlain? by a topographically higher, lighter coloured 'pisolitic' layer. In detail the change from white sedimentary rock to ferricrete appears to be abrupt and in places irregular, and drilling indicates minor changes may occur repetitively. Sandstone occurring at this horizon tends to be slightly ferruginous with slight yellow or red-brown colouration, and may be sufficiently indurated to form a low cliff. Silicastone may also occupy this horizon, for example omitted outcrops east of Bells Lagoon [309406] and west of Bar Lagoon [260435, 272437]. Two different silicastone horizons may occur at the last locality but it is more likely that the silicastone descends with a moderate gradient to crop out at a lower position near the creek 250 m to the south. At the three noted localities silicastone appears to occur immediately below ferricrete. On a knoll 300 m south-west of the second locality, silicastone is overlain by further slightly-cemented grey claystone which exhibits vertical, somewhat prismatic downward extensions of limonitic material. A slightly similar structure is developed in ferricrete-replaced sandstone east of Bells Lagoon, where a more definite prismatic structure is formed and hollow vertical prismatic 'tubes' of ferricrete weather from the outcrop [314404]. The tubes are less than 100 mm broad and several hundred millimetres long, and resemble some prismatic soil peds. Generally brightly-coloured ferricrete forms the edge of the mesa-like hills on which the lateritic profile is preserved. The ferricrete may form a layer (about one metre thick) with red, purple, black, brown, yellow and amber-coloured areas which complexly interconnect and include pisoliths. In places, the ferricrete seems to be represented by a much thinner nodular to irregularly laminated layer, typically with internal yellow and purple colours and an ochrous texture.

Pisolitic gravel overlies the ferricrete and obscures the relationship between well-cemented, higher, pisolitic ferricrete which contains dark, dull purple-brown-black pisoliths, and pisolith fragments of various size in a softer, pale buff to slightly orange matrix. The matrix is slightly sandy, and in places weathers out leaving vugs. The pisoliths are less sandy than the matrix, and some pisoliths exhibit a crude concentric lamination of quartz grains. The reduced percentage of quartz in the pisoliths may be related to the replacement process but the presence of broken examples suggests that the pisoliths are reworked from an older deposit, and that the conglomerate is a cemented pisolitic lag or fluvial deposit of late Cainozoic age.

Bright amber clay or silty clay with dispersed pisoliths is present within the flat mesa tops in some areas. The pisoliths appear to have formed *in situ* in the clay but their stratigraphic position between the brightly-coloured ferricrete and the drab pisolitic ferricrete can only be inferred by topographic comparisons made over long distances, and may not be correct. The hard, drab pisolitic ferricrete dips into some of the shallow valleys of the mesa tops, where it appears to pass laterally into a soft, uncemented, slightly less pisolitic but otherwise similar lithology. This lithology infrequently exhibits clay-filled vertical joints several millimetres broad enclosing crude polygons 100 mm across. The clay filling the joints is usually light grey in colour, in places with a vertical foliation. In vertical exposures the soft pisolitic ferricrete overlies, and may grade down into, clay with *in situ* pisoliths. These clays are patchily coloured light orange, pink, grey and white but pallid clays, as seen on the mesa scarps, are not exposed. Some *in situ* and also possibly reworked nodular to lamellar material occurs in these sequences but their stratigraphic position is obscure.

Some sections, generally south of Bells Lagoon, were described by Forsyth (1976) as "stiff grey sedimentary clay without pisoliths passing up through blotchy orange, brown, red, yellow, grey and green clays with few pisoliths, to more orange-brown blotchy clays with higher concentrations of larger (up to 10 mm) pisoliths. This clay is commonly capped by a hard, cemented pisolitic laterite ranging in colour from yellow-brown through red to purple-red with black (magnetite?) patches. These sections have been interpreted as lateritic profiles in which the pisoliths have been concreted in place". In this case the brightly-coloured ferricrete and the drab pisolitic ferricrete were not differentiated but evidently the pisolitic clays were found beneath the coloured ferricrete.

No laterite profile has been completely cored in drill holes. Hole RG50 was sited above the brightly-coloured ferricrete but only 0.4 m of core was obtained in the top three metre interval. This core consists of nodular ferricrete showing black, red, yellow, amber and purple colours in lighter-coloured material. From 3.0–6.5 m thin (50–100 mm) hard bands of ferricrete occur at approximately 0.5 m intervals, separated by light coloured clayey material with yellow or red and purple mottling and staining, with some intervals of up to 300 mm of pallid grey clay. Bauxitic texture is shown at six metres depth. Hard ferricrete zones also occur at 7.30 m and 8.20 m, and consist of bright purple and amber, paler mauve to grey, and lesser yellow-coloured material with some hard zones. Some vertical contacts with pallid material, and some ferricrete, suggest that concretionary structures are present. The deepest highly-coloured purple and amber material occurs at 12 m depth but consists only of a few granule-size, intensely-coloured zones in pallid sediment. Lighter-coloured orange stains or patchy cement occur periodically in more porous units down to 32 m depth.

Less than 25% core recovery was achieved in hole RG46, usually as one metre core lengths at three metre intervals. The age of sediments in the upper part of the hole, and their position relative to the lateritic horizon, is uncertain. A small piece of conglomerate? with a ferricrete matrix above 10 m could be a clast but sediments below 10 m are tentatively regarded as being Tertiary and not Quaternary in age. At 22–24 m, 60 mm of ferricrete with coalescing pisoliths was recovered above deeply-weathered doleritic conglomerate; between 19–22 m depth occurred about one metre of well-cored, uniform, brick-red sandy-textured material with brown, hard, sand-size material; between 18–19 m commences white claystone (800 mm) overlain by red claystone (500 mm), overlain by red passing up into red-brown granule sandstone with white pellets (500 mm), overlain by brownish-green doleritic? lithic-granule sandstone. Further greenish sandstone (1 m) is found between 13–16 m, and bright amber clay and white and pink mottled clay (1 m) occurs between 10–13 metres. In hole RG19 near Ross white clay passes up into mottled, streaked, and banded white, pink and mustard-coloured clay and sandstone through a six metre interval, which is then overlain by at least 0.5 m of brick-red claystone under an augered interval (4 m) of pink clay. The relationship of the sequence to the top of the lateritic profile is not known.

The general distribution of ferricrete suggests that the lateritic profile developed over the Tertiary sediments was probably continuous with ferricrete developed on older rocks. It is unlikely that ferricrete or silicastone underlies the Tertiary sequence. The relationship between sub-basalt ferricrete and the lateritic surface is unknown. Both occurrences post-date the deposition of poorly-consolidated sedimentary rocks with common black hornfels, and probably formed during the same general period.

DISCUSSION

The doleritic conglomerate and lignite-bearing sediment which form much of the Tertiary sequence occur from 155 m to 235 m a.s.l., whereas the sequence as a whole, including the lateritic profile, extends up to almost 300 m above sea level. The actual dated part of the sequence (195–230 m) contains a Lower or Middle *N. asperus* zone microflora, indicating a Middle or Late Eocene age. This topographic range may be compared to the known occurrence of *N. asperus* zone rocks in the Longford Basin at 90–150 m a.s.l. (Forsyth, *in* Matthews, 1983), and the occurrence of Lower to Middle *N. asperus* zone rocks near Avoca in the New Henbury bores 1 and 2 at about 140 m up to ?200 m above sea level. The *N. asperus* zone rocks are particularly widespread in the Longford and southern Tamar Basins, and were probably deposited during a high sea level stand when alluvium backed up the drainage system similar to deposition elsewhere (Partridge, 1976). The Ellinthorp Basin is now drained by the Isis River, passing through a dolerite constriction at 220 m a.s.l. to the north in the Lake River Quadrangle. Quaternary deposits prevent assessment of the possibility of a buried channel draining from the Ellinthorp Basin to the Longford Basin *via* the Isis River, or *via* the less likely route south through Woodbury or Tunbridge into the Blackman River system. If there is no buried channel, deposition must either have taken place into a closed basin, or at least 65 m of subsidence has occurred after deposition of the doleritic conglomerate and part of the lignitic interval, although younger sediments need not be influenced. The lateritic surface appears to be unfaulted.

If local subsidence of the basement occurred it is likely to have taken place as a closing phase of movement along the inferred fault zone bounding the deeper part of the basin to the west. If quartz sandstone boulders (Rp?) are *in situ* west of the inferred fault zone, the total downthrow is estimated to be at least several hundred metres [240460]. The major part of this movement probably occurred a considerable period before deposition of the basal conglomerate commenced, as there is no evidence in the conglomerate composition for the stripping from the adjacent horst of the Triassic lithic sandstone and coal measures which floor the graben. Only a minor component of spores recycled from the Triassic coal measures was found in one of six palynological preparations from near the conglomerate–lignite horizon.

Closure of the basin by post-depositional regional uplift of northern Tasmania is unlikely, as the *N. asperus* zone is topographically lower further north.

There are several grounds for suggesting correlation of the sub-basalt sedimentary rocks north-east of Tunbridge with those occurring at the top of the Tertiary sequence beneath the lateritic profile. These are:

1. The increase in grain size of poorly-consolidated sedimentary rocks near the top of the Tertiary sequence to include granule sandstone beds is comparable to the deposition of sub-basalt gravel.
2. The occurrence of dark hornfels and tuff fragments in both areas.
3. The volcanogenic aspect of the sedimentary rocks indicated by diatomaceous rocks, agate, and Tertiary silicified wood fragments may be related to the basaltic eruptions.
4. The anomalous ferricrete overlying diatomaceous limestone may be altered basalt or sub-basalt ferricrete.
5. Sub-basalt ferricrete and the lateritic profile may have formed during the same general period

The lack of dolerite in these younger deposits suggest that they were deposited after an extended period of chemical weathering, resulting primarily in siliceous clasts.

Cainozoic

UNDIFFERENTIATED ROCKS

Quaternary lag deposits south of Tunbridge include siliceous clasts derived from the Upper Parmeener horizon, with extrabasinal clasts, tuff beds and silicified wood [355327, 363335]. These clasts are presumably fluvially transported from the Glen Morey Road area or from further south but are mixed with other silicified wood and siliceous rocks of Tertiary appearance. Although some mixing with dolerite clasts, possibly from younger deposits, is evident at the latter locality, the composition of the clasts resembles those found in silicastone and sub-basalt gravel nearby. The lag deposit may be derived from pre-basalt cobble beds, or from younger Cainozoic deposits.

A yellow-brown, porous, weathered conglomerate is exposed over a small area on the side of a mesa-like hill west of Bells Lagoon [261412] and has been indicated Tc? on the map. The conglomerate post-dates the lateritic surface, as it contains ferruginous pisolith clasts set in a deeply weathered, slightly sandy ferruginous argillaceous matrix. Clasts include platy hornfels and larger, deeply weathered coarse-grained dolerite cobbles. The conglomerate exhibits a degree of consolidation not shown by known Quaternary deposits. A question mark has been omitted from the map from a deposit (Qaf?) a few hundred metres further west [260413]. This deposit also contains hornfels clasts but set in a plastic clayey matrix. This deposit is possibly a Quaternary alluvial fan overriding and mixing with Tertiary lateritic clay.

A waterhole east of Bar Lagoon revealed several inclined layers of alluvially-deposited ferruginous pisoliths and sand [287439]. The inclined laminae are steeper than the present land surface, and have been truncated up-dip. No other similar deposits were found.

Recent caliche nodules occur commonly. More massive blocks, partly or wholly silicified and containing crystal moulds and fine box-work structures, are of uncertain age.

Quaternary

TALUS (Qt)

Talus deposits are derived predominantly from dolerite (Qtd) but talus derived from predominantly Upper Parmeener quartzose sandstone (Qtt) and from Tertiary basalt (Qtb) has also been mapped. In some areas talus contains predominantly dolerite clasts but includes notable amounts of other lithologies. This type of mixed deposit has been indicated to show the occurrence of parent rocks other than dolerite which may not otherwise be indicated on the map. Mapped talus types of mixed lithologies are indicated below:

dolerite and Lower Parmeener rocks	Qtdp
dolerite and Upper Parmeener quartzose sandstone	Qtdt
dolerite and Upper Parmeener lithic sandstone	Qtdv
dolerite and Upper Parmeener silicified wood	Qtdw
dolerite and Upper Parmeener tuff	Qtdf
dolerite and Upper Parmeener reworked clasts	Qtdc

Particular attention was paid to mapping the last two categories because of the stratigraphic significance of the parent rock in relation to the Upper Parmeener volcanic lithic sandstone and coal measures sequence (R̶lg).

Talus (Qt) includes all slope deposits lacking a notable alluvial component, as in alluvial fans, but excludes slope deposits consisting of generally angular dolerite but lacking matrix between the clasts. Talus is more readily recognised where it overlies rocks which differ from the parent rock, but it has been recognised elsewhere where the deposit is sufficiently thick to totally obscure bedrock, and where the morphology is consistent with talus deposits and indications of clast transport are present. Clast transport in dolerite talus may be indicated by mixing of dolerite clasts of differing textures or grain sizes, rotation of joint faces, or additions of trace amounts of other lithologies. Rarely do exposures exist where matrix between clasts can be distinguished from soil development, except for the occasional road cut or stream bank exposures.

One of the greatest difficulties in recognising talus on the Central Plateau is to correctly distinguish between detached boulders of coarse-grained dolerite, and the rounded exfoliated tops of prismatic columns of dolerite outcrop in areas of dolerite with uniform texture. This problem could not be resolved except by detailed mapping of joint directions and slight textural changes. Even where detachment of boulders can be demonstrated, the degree of transport may be negligible.

In some areas talus is obviously present between closely-spaced dolerite outcrops but has not been indicated, and the older rock types have been preferentially shown. Talus has been mapped primarily where traverses have been intensely located, particularly in the search for geological boundaries between older rock types, and mapped talus especially serves to demonstrate where these boundaries are not closely defined. Few talus deposits have been depicted on the Central Plateau because traverses were too widely spaced to locate boundaries, and because of the difficulty in recognising talus in this area. The local edge of dolerite outcrops have, in places, been shown as a boundary between Jdl and Jdl?. The areas indicated Jdl? may include dolerite talus, as air-photo interpreted indications of dolerite outcrop are lacking but ground control is scant or absent.

Talus on the Central Plateau usually has an orange-brown, relatively porous clayey matrix where sections through the deposits are present. Boulders up to several metres diameter may be present but clasts are usually much less than one metre in diameter. Talus probably occurs on all steep slopes on the Central Plateau, extending out over flatter valley floors where smaller, rounded cobbles grade into alluvial deposits. Exposures on the Woods Lake weir access road reveal some deposits with predominantly cobble-size clasts set in abundant matrix.

Deposits at Table Mountain are particularly prominent, as vertical, platy-jointed dolerite has shed large blocks from near-vertical cliffs underlain by clayey, weathered Upper Parmeener rocks. Blocks several metres in diameter have moved over one kilometre from their source. The talus totally obscures underlying rocks in most areas but road cuttings indicate that the deposit is relatively thin in some areas.

Dolerite talus appears to be markedly less extensive on the Tiers escarpment compared to occurrences further north in the Quamby and Lake River Quadrangles and at Poatina (Barton *et al.*, 1969; Matthews, 1974; McKellar, 1957). This is indicated primarily by the marked reduction of talus tongues extending below the base of the dolerite sheet, and the scarcity of unvegetated scree slopes, rather than by the apparent absence of talus over dolerite slopes where the distinction between talus and dolerite proved difficult. The most extensive doleritic talus deposits below the dolerite sheet base occur west of Bayles Creek on the higher northern part of the Tiers escarpment.

Talus on the lower slopes of the Tiers escarpment south of the Isis River was observed during early stages of the mapping, and was considered to consist of small boulders. Masses of dolerite greater than 1.5 m diameter were considered to be outcrops or sub-outcrops, as a size discontinuity separated these masses from the smaller talus boulders. Subsequently, very large displaced boulders (e.g. greater than four metres in length) were observed in the upper reaches of Isis Creek [203425] and at lower altitudes in Mill Brook (460 m a.s.l.) enclosed in a semi-consolidated matrix in an 8 m thick section. An incomplete reinterpretation of some of the early mapped 'dolerite' was undertaken, and large blocks of dolerite south of Tunbridge Tier Road have been depicted as talus [250358]. This interpretation is supported by the occurrence, on the southern side, of rounded (alluvial?) dolerite and siliceous cobbles apparently underlying the dolerite blocks; a newly exposed outcrop of Upper Parmeener sandstone (Pj?) on Tunbridge Tier Road which is higher than some of the dolerite blocks; and magnetic profiles which failed to detect *in situ* dolerite in the deposit but indicated a clear anomaly associated with the inferred fault. In view of this re-interpretation, an area to the north was indicated Jdl? and not Jdl on the map, as the criteria used to recognise dolerite outcrop were uncertain and may not have been valid.

The complex dolerite intrusions east of the escarpment fault south of Mill Brook may require re-interpretation [255325]. The interpretation presented represents the simplest model to explain the distribution of rock outcrops and floaters but air-photo interpretation suggests some outcrops could be talus. A cursory re-examination of the area, and some magnetic profiles, substantiates some irregular dolerite intrusions north-east of the fault and the fault position near 253324. Further, as a precautionary measure, an occurrence of coarse-grained dolerite in fine-grained dolerite terrain has been indicated Jdl?, as recorded data did not distinguish between the possibilities of a coarse-grained dolerite boss and a remnant talus deposit.

A brief examination was made of the Tiers escarpment where crossed by the Tunbridge Tier Road. In the area indicated Jdl?, many very large boulders of fresh dolerite were found embedded in rotted, yellow-coloured doleritic material but it was not determined whether the rotted material was dolerite weathered along joints or talus matrix.

The rather limited proven occurrence of very coarse talus on the lower levels of the Tiers escarpment suggests that the occurrences may be eroded remnants of deposits older than the more extensive small-boulder sized material found on the escarpment.

Some small swamps in hummocky dolerite talus have not been depicted [248308].

Very large masses of dolerite, tens of metres thick and hundreds of metres long, which have undergone forward rotation away from the Tiers scarp have been depicted as dolerite [188463]. These blocks may have been rotated by tectonic faulting, or under the influence of gravity as collapse features.

Talus deposits east of Woodbury and in other low areas are usually expressed as rocky red-brown soil. South of Glen Morey Road dolerite (Jdl) and talus (Qt) boundaries have been extensively checked by magnetic profiles. A quarry near St Peters Pass reveals talus with 80% matrix and which resembles till but is probably a mudflow deposit [337239].

Talus derived from Upper Parmeener quartz sandstone consists, at the surface, of dominantly sand with chips to boulders of sandstone [255243]. Basalt talus is found around many flows sited above steep slopes, and may overlie basalt outcrop and older rock types. For convenience silicified wood, probably of Tertiary origin, found in dolerite talus has been depicted as a lag deposit (Qlw) [222472].

DOLERITE SCREE (Qs)

Scree deposits consist of angular to sub-rounded boulders or cobbles without significant matrix between clasts, and have been found or inferred to be present down to an altitude of 600 m above sea level. Lack of matrix generally prevents soil formation, so scree is usually unvegetated and readily apparent on air photos. Boulders up to several metres in length generally form the coarsest deposits, and clasts may be individually visible on air photos. Discontinuous sub-horizontal lines are also visible on some air photos of scree deposits, and are probably related to step-like features observed on the ground, where steep zones several clasts high are separated by areas of lower slope, and probably indicate discontinuous movement. Deposits can generally be traced upslope to outcrops of dolerite.

North of Woods Lake, scree deposits of sub-angular cobble and boulder clasts, in places 200–400 mm diameter but elsewhere up to three metres, thin to about one to two metres and overlie much finer grained clayey, gravelly, and cobble talus deposits. Thin veneers of scree, consisting of large cobbles and boulders, are common throughout the Central Plateau overlying talus, repeatedly revealing a more angular and coarser clast population than the underlying talus. The scree is envisaged as forming by the shattering of cliffs and rocky outcrops, with subsequent translational slippage and freeze–thaw movement.

ALLUVIAL DEPOSITS (Qa)

Alluvial deposits occur along past and present drainage systems in a wide range of environments, from mountain tops to lowland plains. Clast composition reflects source rocks and resistance to abrasion, with dolerite being most common. With increasing distance of transport, some hard siliceous rocks, such as hornfels or silicified wood, may become more concentrated by destruction of dolerite and basalt. Alluvium may be subdivided into different categories on the basis of composition, grain size, degree of weathering, and cementation but geomorphological distinctions have been mainly used to recognise alluvium on modern flood plains (Qa'), higher terrace deposits (Qah), and alluvial fan deposits (Qaf). With decreasing gradient, fan deposits grade into higher terrace deposits. Modern flood-plain deposits may overly the same materials forming older higher terrace deposits. In the highland areas the distinction between low gradient alluvium and marsh deposits, at least of their upper layers, cannot readily be made by either lithological or geomorphological criteria, and marsh deposits in alluvial valleys have been included with alluvial deposits (Qan).

Alluvial fan and higher level terrace deposits

Alluvial fan deposits have formed where streams, draining usually dolerite terrain, emerged from valleys on to flatter country and rapidly dropped their bed load. In plan the deposits resemble a fan in shape, except where the sides are confined to prevent this. The coarsest and most angular material is found at the far apex, and usually consists of boulders grading up and distally into cobble deposits. Small steep streams generally produced small fans of high gradient. The deposits thin distally where granules, sand and silt were sometimes deposited, and similar materials may cap the deposits closer to the fan apex.

Larger streams usually have lower gradients through the dolerite terrain, but deposited dolerite boulders and cobbles at their point of emergence onto flatter country. These deposits continued to be redistributed for many kilometres downstream, and are now exposed as higher-level terrace deposits above the modern flood plain.

The gradient of the alluvial fans is typically 1:15 to 1:30 but small fans may have gradients as steep as 1:5. Fans may also have gradients lower than 1:30, particularly in their distal part. For example a fan east of Gavins Sugarloaf has a gradient of about 1:40 [260415], while a fan at Boggy Marsh reduces in gradient to 1:35 [160243]. The delta fan at Lake Sorell has a gradient of 1:35 and the Mount Penny Creek fan at Regents Plain, with its distinctive arcuate contours, has a distal gradient of 1:50 [040490]. Gradients of the higher terrace deposits fall gradually downstream, typically in the range of 1:35–1:200 but nearer their origin considerable overlap with fan gradient and morphology is shown, and gradients of up to 1:20 occur.

Alluvial fan clasts are typically dolerite, but some hornfels fragments and ferruginous pisoliths occur in the delta fan on the south-east side of Woods Lake, and in the far east of the Gavins Sugarloaf fan [250413].

Silicified wood, quartz-feldspar porphyry etc. derived from Triassic coal measures are common in the fans east of Woodbury and south of Glen Morey Road. Lower Parmeener clasts are present in one fan west of Ross [220475] but the present drainage system intersects no Parmeener strata. Bayles Creek appears to have captured the headwaters of the previous drainage system.

Cobbles generally lie loose on the surface of fans, and larger angular clasts may be exposed in creek banks. A section exposed in Mountain Creek, north of Lake Sorell [156423], revealed three distinct layers. The lowest unit (C) overlies dolerite and is about one metre thick. It consists of poorly-sorted boulders and cobbles of dolerite and rare sedimentary? rock granules in a clayey matrix. Dolerite clasts less than 40 mm thick are weathered through to clay, and larger clasts show equivalent weathering rinds. The overlying unit (B) is 600 mm thick and includes small boulders and cobbles with weathering rinds of about two millimetres. Limonite laminae pass through the matrix and cement some clasts. Upstream, in places, unit B is thicker and includes more angular clasts up to one metre thick but in other places it consists of gravelly sand with some cobbles. Similar alluvial material or talus, showing an equivalent degree of weathering and cementing, is in places overlain by talus with boulders up to two metres in diameter. Unit A is about one metre thick and consists of unconsolidated, closed framework cobbles and boulders with little matrix, cement or weathering, and appears to grade into recent deposits. Deposits of valley alluvium with a similar degree of weathering and cementing to Unit B, and usually consisting of cobbles or pebbles of dolerite, have been found in the floors of other highland creeks, for example west of Snobs Point [213411]. Alluvial fan deposits at Regents Plain include clasts greater than one metre in diameter. Clasts up to 170 mm diameter are completely weathered. A similar degree of weathering is shown by alluvium exposed in the Lake River, where dolerite clasts up to 150 mm can be broken with mild finger pressure and clasts up to 450 mm are partly weathered. This deposit includes fossiliferous Permian hornfels not found in the alluvial fan deposit.

Higher-level terrace deposits are associated with all the major streams that descend from the highlands onto the lowland plains, for example the Isis River and its tributaries, Mill Brook, Blackman River, Stringy Bark Rivulet, Currajong Rivulet, and streams draining north from the Oatlands Quadrangle, such as Tin Dish Rivulet. The most extensive deposits are those which extend east from the Tiers escarpment to cross the Midland Highway and to extend as morphological features for a few kilometres downstream from Tunbridge. Remnants of similar terraces may also occur further downstream, for example near Ross [402467]. The terraces have been eroded, producing steep scarps fringing the modern flood plain. The scarps are commonly up to 10 m or perhaps higher, and may consist of terrace deposits or merely a thin veneer of terrace deposits overlying older rocks.

Some of the former river courses are now abandoned. The Stringy Bark Rivulet once flowed down a valley north of its present course [288270]. In tracing the former valley (of uniform gradient) upstream an abrupt valley is encountered where the present stream crosses the old valley floor. Another abandoned main channel is apparent west of the Midland Highway, where very large cobbles and small boulders occur [322308]. The terrace deposits between Tin Dish Rivulet and Ratharney Creek are cut by a flat-floored, NE-trending valley [370308]. This valley appears to be a former course of the Tin Dish Rivulet, post-dating the highest terrace deposit. Occasionally terrace walls may show sub-terraces. This is generally most apparent near points of emergence from dolerite terrain where stream power, even during modern floods, may be sufficiently concentrated to alter terrace profiles. There are suggestions of more than one terrace level elsewhere, for example deposits north of the Isis River occur above the general level of the main terrace [235450, 232451, 234457].

The composition of the terrace deposits is mostly judged by the common fresh cobbles and boulders which litter the surface, in places still arranged as braid bars. Where excavations reveal the deposit, it is evident that many of the dolerite clasts are deeply weathered and a brown sandy clayey matrix, often with ferruginous pisolith clasts, is present. Farming practice is to stack clasts in piles or heavy roll clasts beneath the land surface, and in some areas clasts are no longer evident. Deposits associated with Bayles Creek in the north of the quadrangle contain prominent Lower Parmeener clasts, which in places are predominant. Lower Parmeener clasts, especially those of Blackwood Conglomerate correlate, are found elsewhere wherever these rocks are exposed in the creek headwaters. Hardened Upper Parmeener quartz sandstone boulders occur in some deposits, especially west of the Blackman River [280330]. Fragments of tuff, silicified wood, and reworked clasts derived from Triassic coal measures east of Woodbury, or further upstream at Sorell Springs or York Plains, occur commonly in the alluvial deposits associated with Tin Dish Rivulet. Traces of these types of clasts are found at least 13 km downstream from their source but it is not known if clast transport necessarily took place during deposition of the terrace deposits. Terrace deposits near Ross include basalt clasts and silicified wood, derived from both Triassic and Tertiary sequences.

It is evident that braided streams crossing the lowland plains caused local erosion, as large blocks of silicastone and ferricrete are commonly incorporated in the terrace deposits. Ferruginous pisoliths derived from Tertiary sequences become an important part of the deposits, particularly at the limits of mapped terrace deposits, either in the lateral sense for large deposits or also in the distal sense for smaller deposits.

Pisolitic gravel may form a capping deposit over cobble beds or, in places, constitute the entire thickness of the deposit. Deposits consisting solely of pisoliths are more difficult to recognise, as they lack imbrication and may lack any signs of alluvial sedimentation, and closely resemble some lag and slope deposits. Rare occurrences of dolerite or other cobbles in pisolitic gravel exposed in artificial pits have, in places, clarified the depositional process. The mere presence of loose exotic cobbles in pisolitic gravel is not a satisfactory criterion to apply indiscriminantly to recognise alluvial sedimentation, as such cobbles are also found at aboriginal flint factory sites. For this reason dolerite cobbles lying on pisolitic gravel north of Bells Lagoon have been indicated Qah? [301421].

The River Clyde flowing out of Lake Crescent is fringed by narrow terraces at some localities. These deposits have been indicated as undifferentiated alluvium (Qa), as the stream power during floods is probably still sufficiently strong to deposit such material and river-course changes appear to be constantly occurring within the material. Some deposits pre-date scree deposits. The terraces are only a few metres wide but occur up to several metres above the summer river level, and have similar vegetation to surrounding valley sides. Boulders on the terraces show rough hackly surfaces, and an alluvial origin for the terraces is only apparent from their morphology, included exotic hornfels clasts, and vertical sections. One section reveals open framework basal boulders in alluvium or possibly talus overlain by alluvial pebbles and cobbles (1.5 m) succeeded by scree (1.5 m) [053255]. At Good Marsh, low terrace deposits broaden over the Parmeener rock-floored valley but are ringed by former river channels and are probably recent deposits [034245]. A shelf area east of Good Marsh has been indicated Qtd?, although the shelf may be related to alluvial deposition or erosion. Very large boulders of dolerite found on the shelf do not appear to be *in situ*, and overlie Upper Parmeener strata at the edge of the shelf. The boulders individually influence the vertical magnetic field but no 'magnetic boundary' was detected between the shelf and the adjacent exposed Parmeener strata.

Erosion of some highland alluvial deposits prevents their classification according to their morphology, and in some cases an alluvial origin may be uncertain. Many of the deposits have a degree of weathering and cementing similar to fan and terrace deposits. Where Mill Brook descends the Tiers escarpment, deeply-weathered dolerite in alluvium was found and indicated Qah? [241326]. Thick sections of alluvial deposits were found in the Blackman River further south and consist of clasts from 150 mm to one metre in diameter, forming a unit about five metres thick overlain by a similar thickness of deposits of uncertain origin, overlain by scree [254295].

Deposits of valley alluvium with a similar degree of weathering and cementing to the unit B at Mountain Creek, and usually consisting of cobbles or pebbles of dolerite, occur in the floors of other highland creeks, for example west of Snobs Point [213411]. Alluvium with weathering similar to unit C is exposed in the Lake River at Regents Plain, where dolerite clasts up to 150 mm can be broken with mild finger pressure and clasts up to 450 mm are partly weathered. This deposit contains Permian fossiliferous hornfels, indicating it is not part of the Mount Penny Creek fan.

Alluvium forming modern flood plains (Qa')

Deposits on modern flood plains usually include basal cobble or gravel beds a few hundred millimetres to several metres thick. In general the basal clasts are slightly weathered but the basal layers have not been systematically investigated to determine to what extent they are eroded remnants equivalent to the higher terrace deposits, or whether they are entirely of younger age. The basal deposits are usually overlain by 0.5–2.0 m of yellow or brown, slightly clayey sand or silt deposits, in turn overlain by a black organic layer usually up to one metre thick but rarely up to two metres thick. Some brown, inorganic silt layers may be interlaminated with organic laminae.

Numerous anastomosing abandoned channels are found on most modern flood plains, and channel migration is also indicated by lenses of bed-load gravel exposed where existing channels intersect filled abandoned channels. The organic-rich top layer is usually waterlogged during winter but may dry out during summer with deep, open, contraction cracks. As with higher terrace deposits, ferruginous pisoliths are a common component of some modern flood plains in areas of Tertiary lateritic profiles.

The organic layer occurs conspicuously on the flood plain of Ratharney Creek and its tributaries, where the valley has a gradient of 1:250. Further downstream in the Blackman River and Macquarie River the gradient decreases to 1:500.

In some areas lacking exposed coarse-grained layers, yellow clay forms the base of exposed sections. Where the alluvium overlies the Tertiary sequence, such as in parts of the Isis River, or overlies Upper Parmeener rocks, such as in the Blackman River north of Tunbridge, it was impossible to tell whether basal yellow clay was weathered bedrock or part of the central clayey to sandy layer. The flood plain north of Tunbridge includes aeolean deposits beneath the upper organic-rich layer.

Modern flood plains in highland areas are, in places, covered with exposed cobbles, or more commonly an upper, black organic layer is present, vegetated with grasses, sedges or swamp plants. Distinct creek channels are not always present and some water flows subsurface in porous gravel, seeps through the organic layer, or moves as surface sheet flow. A clear distinction between alluvium and marsh deposits is not always feasible, and alluvial deposits with marsh-like areas have been indicated Qan. Agate and other siliceous material is prominent in a creek draining past a basalt flow into Lake Sorell [085346]. Fossiliferous Permian hornfels was transported at least six kilometres down Micks Creek and the Lake River to beyond the northern boundary of the quadrangle.

LAG DEPOSITS (Ql)

Lag deposits are the residual materials left at the site of weathering of parent deposits or parent rocks. In essence they are the concentrated, less easily weathered component of parent material. In general, lag deposits derived from other Quaternary deposits have not been shown on the map, although in some cases the age of the parent material may be uncertain and lag deposits from unrecognised Quaternary deposits may have been depicted. A special exception to this is where lag deposits derived initially from Tertiary sequences may have undergone subsequent transport, possibly as slope deposits or less commonly as alluvial deposits. Such deposits have been indicated with a suffix (?) to distinguish them from deposits considered to have been derived by *in situ* weathering.

The nature of lag deposits can usually be predicted from the composition of the underlying material from which they are derived but in other cases no parent is found and the lag deposits are useful indicators of sequences which are unexposed or previously removed by erosion. For example, a lag deposit (Ql) associated with dolerite talus in dolerite terrain at Bushrangers Creek [003242] contains quartz granules, but no source of the granules is known nearby or in the adjacent Lake Echo Quadrangle. The granules may have been derived from Tertiary or Upper Parmeener sequences. Chips of Tertiary ferruginous and siliceous rocks are found above the outlet of Woods Lake, and are the clearest evidence for Tertiary sequences in the Interlaken part of the Woods Lake area. The chips may have undergone alluvial transport.

The stratigraphic significance of lag deposits of silicified wood (Qlw) or reworked clasts (Qlc) derived from the volcanic lithic sandstone sequence (Rlg) has been discussed. These deposits occur in the south-east part of the quadrangle. Other deposits (indicated Ql) in the same area contain either silicified wood or reworked clasts or both but usually as a subordinate component. North of Red Ridge [395325] some large, silicified wood pieces appear to be locally derived from

Triassic rocks but other lag components may be transported. Reworked clasts from the Triassic sequence are also found near Tunbridge but these have definitely undergone alluvial transport and occur associated with cobbles of Tertiary silicified rocks and silicified wood. The Tunbridge lag deposits are derived from Tertiary or Quaternary alluvial deposits [355328, 362336]. Boulders of silicified wood were found near the Tiers scarp [221465] and were indicated Qlw [222472], but these occurrences of silicified wood are probably derived from Tertiary rather than Triassic sequences.

Lag deposits, derived primarily from the Tertiary sequence, have been subdivided (where appropriate) into deposits of ferruginous fragments (Qlb) and deposits of siliceous fragments (Qls), and mixtures of both siliceous and ferruginous fragments (Qlbs). For convenience, some lag deposits of siliceous fragments derived from the Parmeener sequences have also been indicated Qls. Quartzose granules and gravel crossed by the Midland Highway are probably derived from the Permian Blackwood Conglomerate correlate [375403], and cobbles in a deposit near Ross are probably dropstones from the Bogan Gap Group (incorrectly indicated Qd?) [412385]. Concentrations of quartz granules at Folly Lagoon are probably derived from the Upper Parmeener granule sandstone at the base of the lithic sequence [306451]. Other concentrations of quartz granules are derived from Tertiary sequences west of the Isis River [243478, 245477, 245480]; east of Bells Lagoon [308419, 308417, 310412]; and elsewhere to the south-east and north of One Mile Hill [335374] and east of Tunbridge [385352]. Other lag deposits (indicated Ql) close to basalt north-east of Tunbridge were regarded as being derived from sub-basalt sediments but contain a variety of materials.

Many lag deposits of siliceous fragments (Qls) are derived from Tertiary silicastone and are listed below:

263442
258439
258433—boundary to right is indicated by Ts symbol
275435—possible alluvial reworking
277440—possible alluvial reworking
277442—possible alluvial reworking
272438
277446
305440
303443
284448
261429
275428
273422
296415—not indicated on map
309401—not indicated on map
312411
313422
318376
313273

As the Tertiary sequence thins eastward across Ellinthorp Plain the silicastone horizons come to rest directly on Upper Parmeener strata. Lag deposits, especially on lagoon floors in this area, tend to contain a mixture of silicastone and less silicified Upper Parmeener sandstone [300440, 280455, 288453, 293444, 281448, 321391, 323391, 312420]. In some places deposits consist dominantly of slightly hardened sandstone [260488, 260485]. Many of the siliceous lag deposits contain silicified wood, but it is not known whether the wood is derived from Triassic coal measures, from equivalent horizons to the silicastone, or from Tertiary sequences beneath the silicastone where its possible concentration as a lag deposit commenced before the formation of the silicastone. A variety of siliceous rock types occur on some shores of Lake Sorell, and were described by Petterd (1910) and Twelvetrees (1902).

Deposits with ferruginous fragments consist primarily of ferruginous pisoliths but also include ochrous ferricrete fragments. In areas of thick Tertiary sediments, the resistant ferricrete horizon has resulted in a dissected mesa-like topography. Deposits of loose pisoliths on the mesa tops have been indicated Qlb. Similar deposits on the mesa sides have been indicated (Qlb?), as downslope transport may have taken place. Where alluvial transport has been demonstrated or inferred, lithologically similar deposits have been indicated as alluvium.

Where the depth of erosion has entered the sub-ferricrete silicastone horizon (where this is developed), lag deposits of mixed ferruginous and siliceous fragments have developed and are indicated Qlbs. Unfortunately many ferruginous lag deposits and transported lag deposits have been indicated in error as Qlbs and Qlbs?. Deposits correctly indicated Qlbs and Qlbs? are indicated below:

273454	310397	295440
325380	298425	289362
300420	297418	317408 and nearby

Other deposits of Qlbs not shown on the map occur at 272436 and 232456.

Lag deposits derived from Tertiary sequences were being extensively removed for road-making material while mapping of the quadrangle was in progress, and some deposits indicated may no longer exist.

AEOLIAN DEPOSITS (Qd)

Aeolian deposits are widespread in the lowlands, especially on the lee side of lagoons and alluvial flats. Deposits are similarly located in the highlands in the lee of some marshes and lakes. The composition of aeolian deposits reflects source material but may also be influenced by the environmental setting and probably the time period in which they formed. Light-coloured quartz sand, brown lithic sand, poorly-sorted clayey sand, and clayey silt, orange doleritic and black organic deposits all occur. The aeolian deposits are recognised primarily by their morphology as steep-sided crescentic dunes on the lee of lagoons, to low mounds and some longitudinal features with supporting lithological information, or in the case of sheet sands are recognised by the foreign composition of the deposit compared to local rock types. In some cases dissection of non-aeolian deposits may have mimicked a dune-like morphology, and such deposits may have erroneously been included with aeolian deposits.

Aeolian deposits have been deposited through a range of geological time (Sigleo and Colhoun, 1982), and it is evident that deposition continues today. The effects of modern aeolian processes are observable as burial of fence lines, covering of roads by sand sheets, blow-outs of sand (one metre in 24 hours) and shifted dune crests on airphotos separated in time by 12 years. Rare organic black dunes appear to be derived from the upper organic-rich layer of modern flood plains and swamps. In other areas the organic alluvial layer overlies aeolian deposits with nodular caliche.

Many of the younger aeolian deposits consist of loose, well-sorted, coarse silt or sand. Blow-outs of this material commonly reveal a semi-consolidated, jointed, clayey aeolian deposit with a surface lag of granules. Blow-outs also reveal aboriginal occupancy and flint factory sites on the older deposits in some areas.

Large silty or clayey dunes overlie the higher level alluvial deposits but no reverse relationships were observed.

At White Lagoon, Sigleo and Colhoun (1982) recognised three aeolian units overlying alluvial gravel and capped by a black doleritic clay soil. The basal alluvial deposit of rounded dolerite clasts with weathering rinds (about 10 mm), set in a compact matrix of red clay, was considered to have undergone a prolonged weathering phase of unknown age before the aeolian material was deposited. Possibly similar gravel of slope-wash or valley-floor alluvial material was intersected in nearby bore RG36. The oldest aeolian deposit of sandy clay (1.2 m) was considered to have been derived from the beach and seasonally-exposed floor of White Lagoon, and to be possibly older than the Last Interglacial, as the capping soil layer was thicker and better developed than other known Interglacial soils in Tasmania. Nodular carbonate in the lower B horizon of the soil profile was considered to be translocated from an overlying unit. The intermediate aeolian deposit, mainly consisting of sand, was considered to have been transported from the beach during high lake levels during the Last Glacial, when lake evaporation losses were probably less, whereas the upper unit (up to 1.2 m thick) is sandy clay considered to have been deposited soon after the underlying unit during the late Last Glacial, under fluctuating lake level conditions. The upper unit forms the dune surface, and supports a well-developed soil profile with carbonate nodules etc. in the A horizon.

Small quantities of aeolian material are associated with a lagoon developed entirely in dolerite terrain on the Central Plateau [263334] but, in general, indications of the presence of either Parmeener or Tertiary sequences flooring the marshes or lakes provides a satisfactory explanation for the source of the usually sandy deposits. Sandy beaches lie windward of the aeolian deposits, especially at Lake Sorell. A dune line marked the upper lake level at Powell Bay during 1983, when the sand beach was exposed for a width of 400 m. Sand dunes are well developed along the aptly named Sandbank Shore on the east side of Lake Crescent south of Triffitt Point, and also in the south-east corner of the lake. Poor drainage between some dunes has resulted in interdune swamps and marsh. At Sandbank Shore thin humic or ferruginous layers and some charcoal occur in sand which passes downwards into a more consolidated, ferruginously-cemented sand with some coarse-grained layers. In places the modern soil overlies clean sand which may be separated by a poorly-developed thin soil layer from an underlying grey sand. Underlying orange-brown sand, which grades into the more strongly ferruginous basal unit, is up to five metres thick, and includes a possible soil layer. The upper clean sand and grey sand are of relatively recent age, and in places dead or living trees are rooted in the interbedded layers with charcoal.

In places the sand appears to overly brown peat deposits with soft, planed-off tree stumps of *Banksia*?. The peat may also correspond with a possible soil layer in the sand sequences.

Silty or clayey dunes are well developed east of Tin Dish Rivulet, overlying higher-terrace cobble deposits [365310]; in the lee of Bell Lagoon [293410]; and other lagoons further north of Ellinthorp Lagoon; but are often overridden by a sheet or low dune-sand deposit. Sheet and some dune sands have been blown many kilometres from the plains with their associated lunette systems, and in places have ridden up the windward slopes of hillsides, for example climbing 100 m at Steeles Bluff [328430] or been dumped on the leeward side of ridges, for example at Kitchener Ridge [347460]. Superficial deposits nine metres thick, intersected near Horton Hill in bore RG32, probably included aeolian deposits interbedded with some doleritic slope deposits or alluvium [390455].

MARSH DEPOSITS

Marsh and lagoonal deposits are widespread in areas of internal drainage, or in highland areas where stream gradients are low. Marsh deposits and alluvial deposits intergrade in highland areas, and have been depicted as alluvium with marsh deposits (Qan). Many marshes and lagoons have been artificially drained, thereby increasing the frequency of summer drying of the surface layers or producing normally dry areas.

Marsh and lagoonal deposits in the highlands have been mapped peripherally to the major lakes; as discrete flat-surfaced marshes lacking tree vegetation, for example at Agnews Marsh [175320]; as small interdune swamps; and as grassed or herbaceous, less regular areas, where either boulders or outcrops of dolerite may protrude through the deposit, for example around Round Lagoon [167480]. Swampy areas on the Table Mountain plateau have been incorrectly labelled 'Ru [120245 and nearby] and in some other areas. All highland deposits contain a dark organic mud or peaty upper layer, either overlying inorganic sediments or bedrock. With better drainage, tall *Eucalyptus* trees may grow in some areas indicated as marsh deposits, and a gradation occurs into areas indicated as dolerite where trees of an open forest cover are separated by a lawn-like cover growing on black organic soil. Some marsh areas include dense thickets of tea-tree periodically growing in standing water. Rotted tree stumps were found in a peaty deposit below the full level of Lake Crescent.

Peaty material in Agnews Marsh contains fossil diatoms and palynomorphs.

Sediment resembling diatomite also occurs here. Ferricrete found beneath the marsh deposits in some areas is probably a Quaternary bog-iron deposit rather than remnant Tertiary ferricrete. An iron-rich horizon also occurs overlying clay, with incipient ferruginous pisoliths underlain and overlain by dolerite boulders in clay.

Shingle bars beneath the surface of Lake Sorell north of St Georges Island contain lightly cemented, flat, Lower Parmeener clasts in vertical orientation forming crude polygonal structures, and are probably periglacial features. Traces of higher-level beach gravel were found around Lake Sorell adjacent to a swamp in the south-western corner [094355] north to an area mapped as Bogan Gap Group correlate on the north-western shore [170415]; inland of the 'marsh deposit' at Diamond Beach, where quartz granules and dolerite gravel form a terrace [163357]; and possibly at other localities.

Marsh deposits on the Tiers scarp are rare and only occur in hummocky dolerite talus or on flat shelves of unknown origin.

Lagoons on the lowland occupy deflation hollows and contain a dark organic layer where damp conditions prevail throughout most of the year. Other lagoon floors consist mainly of inorganic silty sediment, in places with chips of rock, and grade into lag deposits. Bedrock is exposed in several locations. Several lagoons are saline and precipitate salts during dry periods (Nye, 1921). This is especially so in the case of Mona Vale Saltpan [400356], where large halite crystals form and have, at times, been harvested. Pavements of a grey material (indicated Qu), slightly harder than surrounding sediments, occur around the southern shores of Grimes Lagoon [405375]. This material underlies a black organic layer in some areas, and contains much free carbonate. A channel draining into a lunette at Sweet Flat exposed an iron-rich sandy clay overlain by 300 mm of grey soil with clasts of orange, iron-rich material derived from below, and noncombustible charcoal fragments replaced by iron oxides. Similar charcoal undergoing replacement was also found in the highlands at Agnew Marsh. The iron oxide replacement probably is related to groundwater effects when the lagoon water level was higher, rather than to formation during the Tertiary (Forsyth, 1984*a*). At the time of mapping, a vast swarm of small freshwater snails littered the shore of Folly Lagoon and was being incorporated into the aeolian material [308453]. The snails were not observed elsewhere.

IGNEOUS AND CONTACT METAMORPHIC ROCKS

Jurassic Dolerite

Dolerite is the most common rock type in the quadrangle, occurring as thick sheet-like intrusions several hundred metres thick, and as dykes from a few tens of millimetres to several hundred metres in width. Dolerite intruded all Parmeener Supergroup horizons and the underlying folded basement rocks. Some minor dykes intruded after the crystallisation of major intrusions. Elsewhere in Tasmania, a mid-Jurassic age of intrusion is indicated (Schmidt and McDougall, 1977).

Features within the dolerite intrusions have been mapped primarily to assist in structural interpretation. For the main part, dolerite maintains a uniform mineralogy of labradorite, augite, and pigeonite in sub-ophitic intergrowth, with a felsic-siliceous mesostasis with accessory iron minerals. Rectangular or partly-absorbed dark phenocrysts of orthopyroxenes are visible in hand specimens collected from near intrusive boundaries, and fine-grained rocks of this type have been indicated (fo). Grain size at spot localities has been indicated as:

grain size	0–0.7 mm (vf)
	0.7–1.5 mm (f)
	1.5–3.0 mm (m)
	3.0 mm+ (b)

Near the tops of major sheet intrusions the usually coarse-grained (b) rocks contain granophyric intergrowths of quartz and feldspar, and have been indicated as granophyre (▲). Granophyre specimens usually contain large cuboidal feldspar crystals, and may occur as diffuse pods or sharply-defined dykes or veins in coarse or finer-grained dolerite. The dykes generally become more sharply defined as the upper edge of the sheet is approached, but no granophyric dykes intruding host strata have been observed. Where large masses of granophyre or less-granophyric dolerite occur, weathering is commonly well advanced and numerous closely-spaced micro-joints, lined with a purple film of iron oxides, cut through and enclose crystals, making unweathered rock difficult to obtain. Such weathered rock forms broad, rounded surfaces, resembling granite outcrops in form.

Some granophyre may be altered sedimentary rock, or igneous rock contaminated by sedimentary rock. For example in the area east of Hanging Sugarloaf [306483], no distinct boundary could be found between black granophyric dolerite and intensely metamorphosed biotite?-bearing sedimentary rocks with blebs or diffuse veins of granophyre visible microscopically. The intervening rock is granophyre with very little pyroxene, and appears very leucocratic in hand specimens, with scattered brown fayalite? laths up to 10 mm long. Typical of such occurrences is the apparent lack of a fine-grained dolerite boundary between granophyre and more than normally altered sedimentary rocks not of well-sorted quartz sandstone composition. 'Granophyre' mapped near Black Tier is overlain by metamorphosed sedimentary rocks including hornfels, and underlain in places by fine-grained dolerite typical of the upper surface of a dolerite sheet. The 'granophyre' contains crystals several centimetres long, and is considered to be altered lithic sandstone.

Pegmatite (▼) has been indicated where dolerite varies greatly in grain size but there is no clear suggestion of a granophyric composition in hand specimens. Some pyroxene? crystals reach 40 mm in length and appear to occur in dolerite of normal composition. Very large crystals and crystal moulds occur along the edges of fine-grained to very fine-grained dolerite veins intruding fine-grained dolerite north of Table Mountain [129254].

Large areas of coarse-grained dolerite (b) appear, in hand specimens, to consist of felsic material with a saccharoidal texture enclosing pyroxene crystals 3–10 mm long. Such rocks are quite leucocratic at some locations [061290]. Pink dolerite east of Round Lagoon is probably hydrothermally altered by an adjacent basalt plug [176486]. Dark-coloured dolerite with prominent large feldspar crystals is distinctive, for example on the road to Woods Lake [003451].

The upper part of major sheets often shows, at various scales, gradational lateral grain size changes from fine to medium to coarse-grained granophyre, whereas the lower two-thirds of the sheets appear to be of more uniform grain size.

Occasional close banding (about 5 mm), defined by grain size or compositional changes, occurs in the dolerite. Similar features define small 'folds' and truncation of laminae on the eastern shore of Kemps Bay [116381] but are subject to submergence. At Kemps Bay some banding is defined by an increased proportion of pyroxene, but other banding, possibly of steep inclination, may be caused by diffuse felsic planar veining.

Although the grain size changes in the upper parts of sheets tend to vary from almost imperceptible to relatively abrupt but diffuse, as in granophyre, sharp boundaries are also present. Coarse-grained dolerite dykes (70 mm wide) occur in the finer-grained dolerite on The Island south of Interlaken [133335]. An abrupt boundary, trending about 344°, between coarse-grained dolerite intruding fine-grained dolerite was mapped over a distance of 300 m [007327]. The coarse-grained dolerite gives rise to veins and dykes intruding the fine-grained dolerite. Elsewhere, abrupt grain size boundaries are coincident with air-photo linears [020353]. Sharp contacts between fine-grained and coarse-grained dolerite are also well exposed at 070320. Although, in general, coarser grained dolerite or granophyre intrudes fine-grained dolerite of the upper parts of sheets, some fine-grained to medium-grained dolerite appears to show reduction of grain size against coarser-grained dolerite [175355]. Very fine-grained dolerite dykes are related to younger periods of intrusion, and may intrude irregularly around the major cooling columns of the dolerite sheets. The dolerite of these fine-grained dykes often shows a uniform grey surface with a rectangular to pachydermal joint pattern of negative relief, and superficially resembles limestone.

Generally the dolerite of major sheets has prismatic jointing through the main body, producing vertical columns about one metre wide cut by horizontal to sub-horizontal planar joints. The upper and basal margins of the major sheets develop a closely-spaced platy jointing at right angles to the margins, and occasionally a spherical weathering, cobble size, cuboidal jointing at the very base of the sheet. Thin dykes may be similarly jointed. The sheet capping Table Mountain is thinner than the major sheets and is of intermediate character. It is only fine-grained near the base and at a few places near its eroded top, but it is platy jointed throughout its entire thickness. Some granophyric dolerite occurs near the top of this sheet. Steeply dipping margins of major intrusions are usually vertically platy jointed perpendicular to the intrusive margin. Some glassy dolerite south of Glen Morey Road is cuboidal to columnar jointed on a small, less than 200 mm column width scale, and resembles similar dolerite depicted as Jdlc in the Oatlands Quadrangle.

METAMORPHIC EFFECTS OF DOLERITE

Metamorphic haloes about dolerite intrusions are usually only markedly developed within a few metres of the intrusions. Halo development varies from place to place, possibly because of higher local heat flow, difference in availability of fluids, and host rock composition. Hornfelsed rocks are generally siliceous, and have formed where lutites and some very fine-grained sandstones have been intruded by major sheets, both in the Parmeener Supergroup and in the underlying basement. Calc-silicate hornfels is less common but occurs where some calcareous horizons of the Lower Parmeener Supergroup have been intruded, or where Upper Parmeener strata possess a high proportion of carbonate cement or concretions. The most common hornfels is a dark grey, very fine-grained rock with a conchoidal fracture, but in places creamy banded hornfels occurs. With increasing distance from intrusions, hornfels grades into lithologies showing only slight hardening, and eventually into lithologies of normal appearance, although it is apparent from palynological preparations that more subtle metamorphic effects may be expressed many tens of metres from intrusive boundaries.

Sandstone of simple quartzose mineralogy is altered to quartzite or sub-quartzite. Sandstone of more complex mineralogy, such as the volcanic lithic sandstone (Ꝛlg), may be altered to a suite of rocks ranging from sandstone with slight recrystallisation (occasionally with zeolitisation) of the matrix to, in the extreme case, rocks similar to granophyre. With progressive alteration, non-quartzose grains, cherty grains, and finally feldspars and quartz recrystallise. Initially a sedimentary fabric is retained, but with increasing alteration there appears interlocking laths and long, poorly-developed brown ferromagnesian minerals and veins, or patches of granophyric appearance.

The most intense alteration coincides with doleritic granophyre, and appears to be related to volatiles escaping the doleritic granophyre, resulting in the granophyritisation of overlying strata. No sharp boundary has been recognised between the doleritic granophyre and overlying altered strata. In many cases the strata are too altered to determine their stratigraphic position from hand specimens. Such rocks may develop a granular texture, caused by centres of coarsely recrystallised material set in finely recrystallised zones, or may appear as creamy, fine-grained material with larger mafic crystals.

Metamorphism because of dolerite has been indicated (x) on the map. Granophyre, possibly derived from alteration of strata, has not been distinguished from granophyric differentiates from dolerite magma. Many localities where metamorphism was detected could not be shown on the map.

The most extensive areas of metamorphosed strata overly shallow discordant or sill-like contacts at the upper surface of major dolerite sheets. Metamorphic effects at the base of intrusions tend to be restricted to a thinner stratigraphic interval, and because of erosion or superficial deposits, seldom crop out over large areas. A larger number of metamorphosed rock localities were found at the base of the Central Plateau sheet along the Tiers scarp than shown on the map. For interpretation of structure, metamorphic effects along steeply-dipping contacts with dolerite are the most significant. When taken in conjunction with dolerite grain size, these outcrops help to distinguish steep intrusive margins from post-intrusive faulting. Narrow metamorphic zones usually occur adjacent to thin dykes in sedimentary rock.

Areally, the most extensive and perhaps the thickest hornfels occurs in the vicinity of the Sorell Springs Road in the south-east corner of the quadrangle, where lutite horizons in the lithic sequence (Ꝛl) appear to have been metamorphosed. Near the eastern extremity of the distribution near Black Tier, granophyritised sedimentary rock? occurs between the hornfels and the underlying fine-grained dolerite. All outcrops indicated Ꝛu within two kilometres of the southern boundary of the quadrangle between 270 to 330 mE, and 350 mE to the eastern boundary, are metamorphosed. Most Bogan Gap Group correlate rocks near Lake Sorell show indications of contact metamorphism. This has not been shown on the map; for example creamy weathering dark hornfels with rare relict granite dropstones occurs in gravel pits on Tunbridge Tier Road [185347]. Both the Bogan Gap Group correlate and overlying quartz sandstone south of Mount Penny Creek, and the Bogan Gap Group correlate where it overlies dolerite north of Mount Penny Creek, show metamorphism [025465]. Intensely altered sandstone, in places grading into dolerite or granophyre, was found at the start of Black Snake Road; near Wild Pig Tier; and near Hanging Sugarloaf [093282] (not indicated on map), 145225, and 306483.

Cainozoic volcanic rocks

F. L. Sutherland

The remnants of basaltic eruptive rocks found in the Interlaken Quadrangle fall into two physiographic groups. Those in the western half of the quadrangle lie above 800 m a.s.l. on the Central Plateau, and lack observed pyroclastic deposits. Those in the eastern half lie at lower levels in the foothills and valley floors which bound the plateau, and show minor pyroclastic deposits at a few centres.

GENERAL

The western volcanics are mostly flow remnants infilling shallow drainages cut in the extensive dolerite sheet which caps the area. Several plugs are recognised, but some do not correspond to any remaining flow residuals. These centres mainly intrude dolerite or dolerite contacts with Permian or Triassic beds. The more extensive flow remnants are preserved, largely or in part, in valleys eroded into the sedimentary beds. The volcanic rocks on the south-eastern side of the plateau lie in enclaves of Triassic beds downfaulted into the plateau margin. These are transitional in aspect to eastern flows and related centres, which lie between 300–800 m a.s.l., and are associated with transverse fault blocks. This is the region which terminates the NNW to NW-trending fault system which bounds the scarp of the Great Western Tiers. The most eastern volcanic rocks lie between 180–300 m a.s.l., within the main floor of the Midlands Rift Valley. These are dissected flood basalts which filled the upper Macquarie River drainage, and represent a distinctly different association to the basalts of the uplifted regions.

The central part of the plateau in this region shows lavas flowing into the depression occupied by Lake Sorell and Lake Crescent. This indicates that a low region existed here at the time of volcanism. On the faulted south-east margin, old drainages occupied by flows generally descend away from the plateau, but the direction is largely controlled by the trends of the main faults, which also demarcate sites of eruptions.

Only in two regions does the volume and repetition of flow eruption seem to be sufficient to cause any notable diversions of the earlier drainages. Flows into the southern end of Lake Crescent may have diverted the head of the River Clyde northwards into dolerite bedrock, and a concentration of flows at Headlam Top may have similarly diverted the upper Blackman River where it flows off the plateau margin.

Ages of the eruptions are not well controlled. Two K-Ar dates are available at the extreme north and south ends of the quadrangle. A plug at Round Lagoon in the extreme north and an upper flow from a centre on Wild Pig Tier in the extreme south of the quadrangle both give early Miocene dates between 24–25 Ma (Table 2). However the existence of a variety of petrologies associated with a number of separate centres, and some successions which suggest significant erosive interludes, suggest that a wider range of ages exists in the region. A similar span probably exists as found for the adjacent Central Plateau and southern Midlands areas (21–37 Ma; Sutherland and Wellman, 1986).

The distribution of the volcanic rocks in the region, the petrologic types involved, and the identified centres and their relationships to flow directions are summarised in Figure 14. Detailed descriptions of these volcanic rocks are given under general groupings, which are further subdivided into related centres. The main groups consist of:

(a) Western Plateau volcanics (mainly nephelinites).

(b) Northern Plateau volcanics (nephelinites and basanites).

(c) Central Plateau volcanics (mainly alkaline rocks).

(d) Southern Fault Margin volcanics (mainly nephelinites and alkaline rocks).

(e) South-east Fault Margin volcanics (basanites and alkaline rocks)

(f) Eastern Rift Valley volcanics (mainly tholeiites).

WESTERN PLATEAU VOLCANICS

These rocks include eroded flows lying around the southern end of Alma Tier and descending into the south-west side of Lake Sorell, and a solitary plug west of Lake Crescent.

Alma Tier–Silver Plains flows

Blocks of olivine melilite nephelinite (Table 1, analysis 1) form the highest exposure south-west of Alma Tier at an elevation of 900 metres. The rock contains a few small pieces of mantle peridotite (spinel lherzolite) and sedimentary rocks, and shows some discrete clusters of amygdales. In thin sections, microphenocrysts of olivine and clinopyroxene lie in a fine-grained groundmass of melilite laths, cpx crystallites, granular opaque oxides, and scattered coarser veinlets and patches of nepheline, alkali feldspar (?), twinned zeolite, and amygdales of fibrous zeolite.

A narrow ridge of olivine nephelinite, generally lacking inclusions, east of Alma Tier appears to overlie Tertiary sediments. A magnetic traverse across the ridge produced subdued profiles suggestive of a shallow flow (R. E. Pogson, pers. comm.). Microscopically, glomeroporphyritic olivine and clinopyroxene with strong oscillatory zoning, sieving, and inclusions of opaque oxides and rarely olivine, are set in a well-crystallised groundmass of nepheline, alkali feldspar and zeolites. Similar rocks extend along Silver Plains, infilling old channels along the south-west shore of Lake Sorell. In some samples, the glomeroporphyritic and mafic aggregation of olivine and clinopyroxene becomes more pronounced, and the rock is K-rich olivine nephelinite (Table 1, analysis 3).

South of Alma Tier similar rock, containing a few lherzolite fragments, forms the main part of Whites Flat, but is sodic olivine nephelinite in composition (Table 1, analysis 2). A higher rise near the north end is a microphenocrystic olivine basalt with an intergranular to subophitic groundmass of zoned plagioclase laths, clinopyroxene, opaque oxides and amygdales of chalcedony. It is probably an overlying flow, but none of the sources for any of the western flows were located. The various nephelinite lavas seem to emanate from a region west of Alma Tier, with the melilite nephelinite lying towards known lower Tertiary melilitite plugs at Shannon Tier (Sutherland and Wellman, 1986).

West Lake Crescent plug

A small hill of medium-grained to fine-grained rock is sited on a small enclave of Triassic beds in dolerite. A magnetic traverse over the peak produced a profile suggesting a body extending in depth (R. E. Pogson, pers. comm.). The rock is crowded with lherzolite xenoliths up to 50 mm across and related debris, forming up to 40% of the rock. Some of the sedimentary xenoliths show bright-green reaction rims. Megacrysts include dark green Al augite rimmed with lighter coloured Ti augite, corroded pargasitic kaersutite and pleonaste spinel (Table 3, analyses A). The host rock microscopically is an olivine nephelinite containing phenocrysts of olivine and sieved clinopyroxenes, similar to those seen in the nearby Whites Flat flow. However the abundant inclusions, many of which show cpx-rich reaction rims or are replacements of shale partially fused to yellowish glass, preclude it as a source for the Whites Flat flow. The rare kaersutite megacrysts are not known elsewhere in Interlaken inclusion suites. They are clearly accidental, as they show marked reaction borders replaced with finer-grained clinopyroxene, nepheline, magnetite and rhonite(?) amphibole.

NORTHERN PLATEAU VOLCANICS

These rocks are restricted to a few plugs piercing the dolerite of the eastern edge of the Great Western Tiers.

East Round Lagoon plug

This is a locally prominent asymmetric outcrop with strong E–W jointing, and rises from an elevation of 960 m a.s.l. to 1030 metres. It has brecciated and altered the dolerite on its northern margin, and the eastern side has shed scree boulders down the steep slope. The rock hosts one of the most diverse and best preserved xenolith assemblages found in Tasmania. A variety of upper mantle lithologies include some rarely seen outside western Victoria. Lherzolites, up to 210 mm diameter, range from fine-grained to medium-grained and partly recrystallised types with bright green cpx-rich and glassy patches. Rare lherzolites contain patches of coarse, gem-quality olivine grains up to 50 mm diameter. There are sparse spinel metapyroxenites, cumulate pyroxenites, and harzburgites. Composite xenoliths are particularly noteworthy, and include blocks of partly recrystallised spinel lherzolite surrounded by reaction borders of clinopyroxenites in contact with wehrlites. Unusual feldspathoidal syenites, previously little recorded from east Australian xenolith suites, are also prominent in this plug (Sutherland and Hollis, 1982). Some show banding, and they range from felsic to more mafic types. Most contain sodalite (J. Barron and D. Hendry identification) with nepheline, alkali feldspar, clinopyroxene, olivine, opaque oxides, amphibole, apatite and zeolites, and are best classed as cumulate sodalite malignites (Table 1, analysis 16). Fragments of sedimentary and country dolerite rocks also appear in variable amounts.

The host rock is K-rich olivine nephelinite (Table 1, analysis 5). This rock shows microphenocrysts of olivine and zoned

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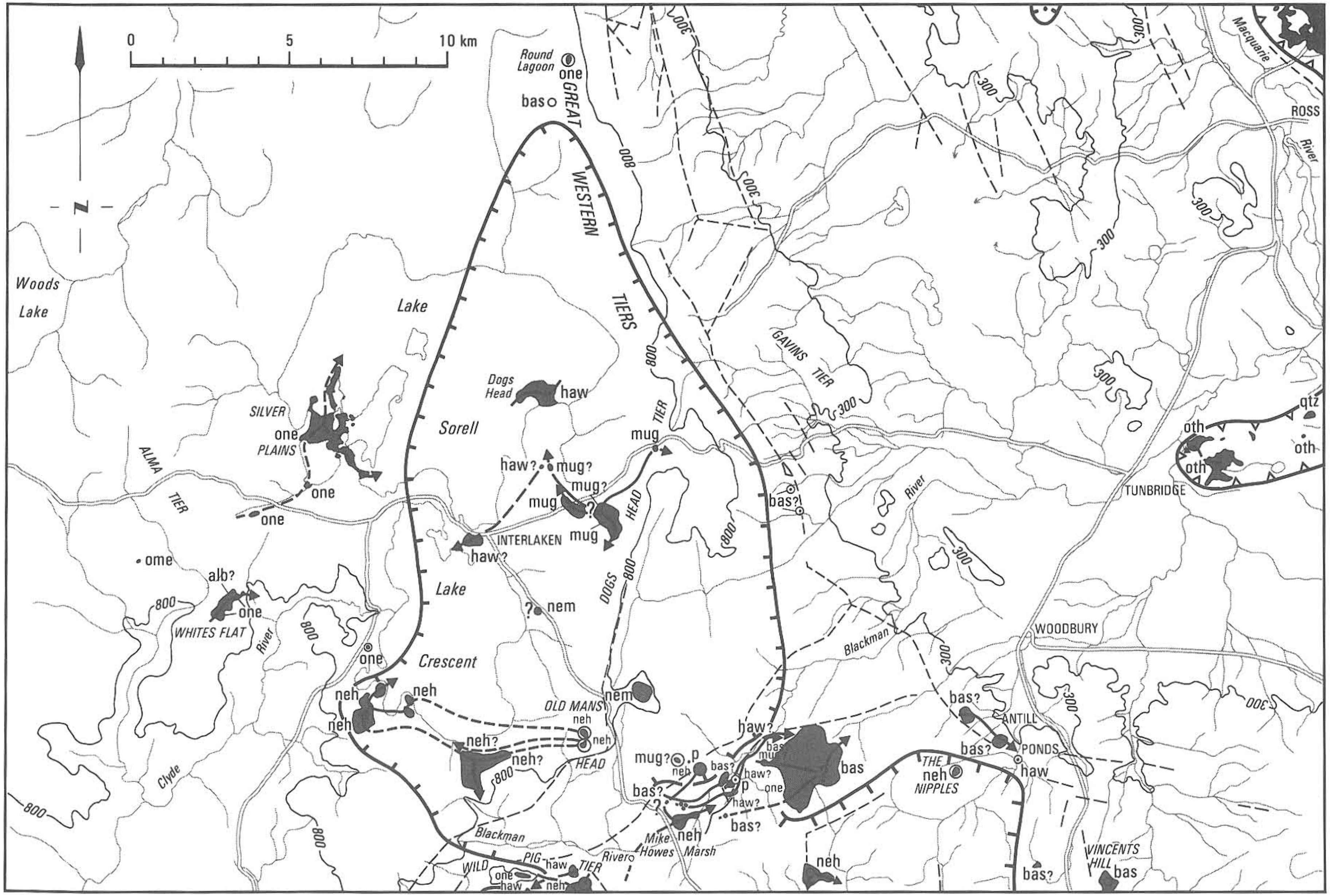
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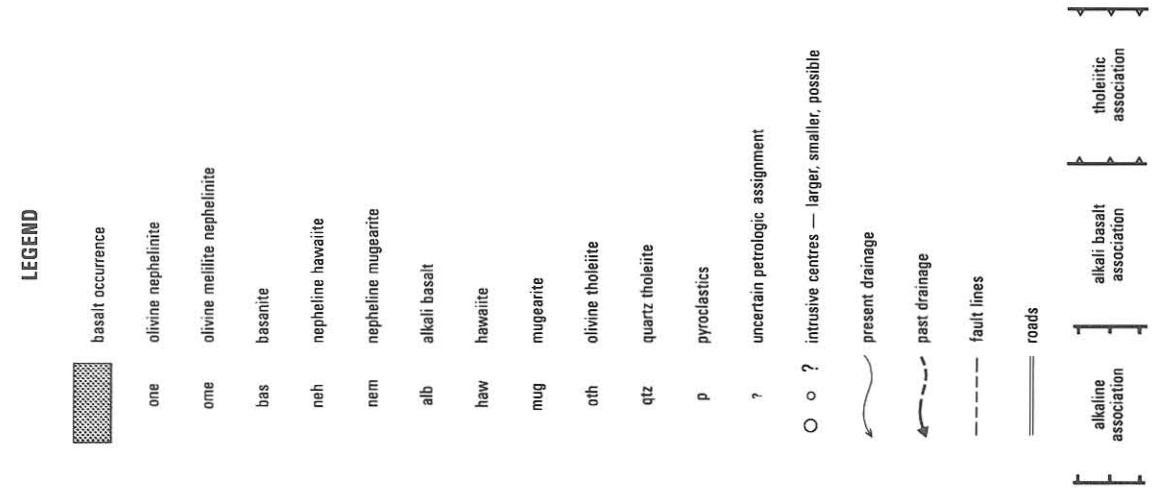

Figure 14. *Geology of Interlaken volcanic rocks*

Ti clinopyroxene with sieved cores in a groundmass dominated by nepheline, clinopyroxene, granular to euhedral opaque oxides, and minor alkali feldspar and zeolites. It is traversed by rare pegmatoidal late-stage veins of the groundmass minerals, with alkali feldspar becoming more prominent. More detailed descriptions of this rock and its inclusion suites will be published elsewhere, but data for its 24.9±0.2 Ma age is tabled here

South Round Lagoon plugs(?)

A few small outcrops of fine-grained dark basalt, 1.5 km south of Round Lagoon, lie between 1030–1040 m a.s.l. and are probably small plugs. The rocks contain numerous lherzolite xenoliths and debris up to 40 mm diameter, and some dolerite and sedimentary fragments. There are rare small spinel metapyroxenite, granulite(?) and clinopyroxene inclusions. One of the bodies is basanite in composition (Table 1, analysis 7).

CENTRAL PLATEAU VOLCANICS

These rocks are mainly flow remnants which erupted within, or flowed down from, the eastern side of the depression occupied by Lakes Sorell and Crescent. A northern group without obviously exposed vent positions is associated with Lake Sorell, and in fact extend below its level. A southern group, associated with Lake Crescent, has a prominent feeder zone exposed at Old Mans Head, and does not descend into the lake itself. Thus, the twin lake depressions, separated by a prominent bar of dolerite at Interlaken, may have different origins. The Lake Sorell low, which received flows at Dogs Head and Kemps Bay, was possibly initiated by drainage descending through the saddle between the Great Western Tiers and Gavins Tier, and graded to a base line on the rift valley floor. Blockage by lavas at Dogs Head Tier may have interrupted the down cutting. The present drainage running off the scarp and out through Tunbridge to the Macquarie River is yet to recapture the lake.

The Lake Crescent low is sited over softer Triassic beds, and may represent local hollowing by the Clyde drainage after displacement from its former valley. The basalt fills have protected the southern margin.

Dogs Head Tier flows

A flat-topped remnant four kilometres east of Interlaken consists of two flows. The lower, at 870 m a.s.l., is platy flinty rock. Sparse olivine microphenocrysts within a feldspathic fluidal groundmass of strongly zoned sodic plagioclase suggest that the rock is a mugearite or mugearitic hawaiite. Similar rock forms a small exposure at 840 m a.s.l. two kilometres to the north-east. In contrast, the upper flow above 870–880 m a.s.l. shows incipient cooling columns and abundant inclusions of lherzolite, dolerite and cherty rock probably derived from underlying Permian(?) hornfels. The rock contains olivine microphenocrysts in a fluidal sodic feldspathic groundmass, and is nepheline hawaiite in composition (Table 1, analysis 11). Other outcrops of this rock lie at similar and lower levels to the NNE and west along Tunbridge Tier Road. Fine-grained floaters of related rock, but containing prominent clinopyroxene and spinel megacrysts, are found between the main outcrops, and may be related to a vent position.

Dogs Head flow

This basalt promontory extends into Lake Sorell at an elevation of between 800–820 metres. The rock has irregular sub-columnar jointing, sporadic vesicles, and a stony flat surface with little soil development. The rock is notable for megacrysts of bronzite orthopyroxene and rarer spinel up to 15 mm diameter (Table 3, analyses C), and carries rare pieces of indurated sediment and quartz. The fine-grained host shows small olivine crystals, clinopyroxene and plagioclase laths, and in parts interstitial brown glass and secondary orange to yellowish opal and chalcedony.

The bronzite megacrysts show reaction outgrowths of prismatic olivine and clinopyroxene. The quenched glassy texture of the rock with the hackly jointing suggests possible aqueous involvement. Chemically the rock is a hy-normative hawaiite, approaching a transitional olivine basalt (Table 1, analysis 15).

Interlaken flow

Dense massive basalt forms a hill between 820–840 m a.s.l. high above Interlaken. The basalt has numerous lherzolite and sedimentary xenoliths, and rarer dolerite and pyroxenite up to 70 mm diameter. Sugary sandstone found at the base may relate to underlying sediments. The host rock contains phenocrysts of olivine and zoned clinopyroxene with sieved cores in a groundmass of zoned sodic plagioclase, clinopyroxene, and granular opaque oxides. The rock resembles hawaiite or nepheline hawaiite. A similar outcrop forms a knoll at 840 m a.s.l. three kilometres to the north-east but xenoliths are scarcer there.

East Lake Crescent plug(?)

A small, subdued outcrop at 840 m a.s.l. comprises irregularly-jointed rock containing abundant quartzite and quartz, common lherzolite, and sparse spinel pyroxenite and granulite xenoliths up to 50 mm diameter. A magnetic traverse across the body showed a profile suggestive of a plug, but the pattern is ambiguous (R. E. Pogson, pers. comm.). The rock shows sporadic olivine microphenocrysts and rare sodic plagioclase megacrysts in a feldspar-rich fluidal groundmass of zoned sodic plagioclase, nepheline, clinopyroxene crystallites, and opaque oxide granules. The rock is a nepheline mugearite (Table 1, analysis 13).

Old Mans Head dyke

This prominent basaltic ridge south-east of Lake Crescent extends from 880–994 m a.s.l. and consists of two adjoining plug-like bodies intruding dolerite. The higher northern body has finer-grained margins and a coarser interior, and both variations contain abundant lherzolite xenoliths. The more chilled rock has abundant nepheline in the groundmass, but in the coarser rock nepheline is crystallised with zoned sodic plagioclase and twinned zeolites, and amygdales are filled with fibrous zeolite. Both rocks carry clinopyroxene megacrysts, some with abundant olivine inclusions in the core, and nepheline and opaque oxide inclusions in overgrowth rims. These appear to be derived from cumulate composites of pyroxene, nepheline and sodic plagioclase, and indicate an earlier magmatic crystallisation before eruption of the Old Mans Head lava.

The lower southern plug under Old Mans Head is a fine-grained rock lacking lherzolite inclusions. It shows near-vertical flow banding close to its margin and is nepheline hawaiite (Table 1, analysis 10). The chilled marginal rock contains fragments of olivine-bearing aphanitic rock with coarser ovoid felsic segregations composed of zoned sodic plagioclase, alkali feldspar, and minor clinopyroxene needles and opaque oxides.

The composite and curved outcrop of the Old Mans Head plugs suggest a possible feeder system within an original crater breached to the west and supplying the flow remnants descending westwards along the southern margin of Lake Crescent.

South Lake Crescent flows

Three areas of flow remnants are exposed, descending from 900 m to 820 m a.s.l. at the western end. Three rock types were recognised. The first type crops out above 860 to 900 m a.s.l. as a capping flow over the other types. It forms blocky to irregularly jointed rock which develops platy to wavy flow lines in places. The rock contains sparse sedimentary and rare lherzolite inclusions, and contains olivine and clinopyroxene microphenocrysts in a groundmass of prismatic clinopyroxene, opaque oxide grains, abundant nepheline, zoned feldspar, thin alkali feldspar laths, biotite flakes and zeolite. It closely resembles the rock forming the southern plug at Old Mans Head.

The second type underlies the main capping flow on the south side of Lake Crescent at elevations of between 820 and 860 metres. This is a dense rock which contains rare sedimentary inclusions. Microphenocrystic olivine lies in a partly flow-banded groundmass of clinopyroxene crystallites, granules of opaque iron oxide, and coarser segregations of zoned sodic plagioclase, nepheline and late-stage alkali feldspar laths, zeolites, analcime and biotite flakes. This segregated texture is reminiscent of the volcanic fragments found in the flow-banded contact rock in the southern plug at Old Mans Head.

The third type is a mafic dense rock containing abundant lherzolite xenoliths up to 100 mm diameter, and disaggregated olivine and pyroxene grains. There are rare clinopyroxene megacrysts up to 40 mm diameter with reaction rims and pieces of sediments and quartz. Abundant olivine and zoned clinopyroxene phenocrysts with sieved cores are held in a groundmass of prismatic clinopyroxene, granular opaque oxides, small biotite flakes, nepheline, zoned feldspar and zeolites. The rock is nepheline hawaiite in chemistry (Table 1, analysis 8), and shows many features found in the northern plug at Old Mans Head. This type forms the lowest flow outcroppings on the south-west shore of Lake Crescent at an elevation of between 810–860 metres.

The flow sequence of rock types, when compared with the Old Mans Head rocks, suggest the following magmatic history for this centre.

1. Crystallisation of cumulate nepheline hawaiite in an underlying chamber.
2. Eruption of lherzolite-bearing mafic nepheline hawaiite from the northern plug.
3. Eruption of partially segregated nepheline hawaiite from the margin of the southern plug.
4. Eruption of nepheline-rich hawaiite from the southern plug.

SOUTHERN FAULT MARGIN VOLCANICS

These rocks include some isolated flow remnants lying on Triassic sediments, and a centre formed of several lavas which flowed southwards, infilling the old courses of Green and Exe Rivulets and extending through Bow Hill in the Oatlands Quadrangle.

Wild Pig Tier flows

The highest flow forms a flat-topped ridge up to 840 m a.s.l. on the western side of the tier. The flow lies above a conglomerate, composed mostly of rounded dolerite, on the eastern side. Magnetic traverses over the ridge show profiles consistent with a flow cap (R. E. Pogson, pers. comm.). The rock is a hackly to columnar-jointed dark rock with an abundant xenolith and megacryst assemblage. The majority are lherzolites up to 60 mm but mostly about 10 mm diameter. Dolerite fragments are common, but sparse clinopyroxene and spinel megacrysts, and rare clinopyroxene-spinel composites, suggest spinel pyroxenites within the assemblage.

Olivine and zoned clinopyroxene form microphenocrysts in a groundmass dominated by clinopyroxene needles, with granular opaque oxides and small segregations of nepheline, clear glass and minor alkali feldspar(?). Some clinopyroxene megacrysts contain olivine inclusions suggestive of cumulate wehrlites. The rock is olivine nephelinite (Table 1, analysis 4), and noticeable Lc in the norm suggests the groundmass glass is potassic.

The other flow remnants lie at lower levels around 780–800 metres. The easternmost basalt is crowded with small sandstone xenoliths and rare dolerite and lherzolite. Sparse olivine microphenocrysts lie in a fluidal groundmass of abundant zoned sodic plagioclase and interstitial feldspar, typical of an hawaiite or mugearite. The rock contains small ocelli rimmed with prismatic clinopyroxene–alkali feldspar intergrowths, a feature seen in a similar remnant lying to the south-west and extending into the Oatlands Quadrangle (Sutherland, *in* Forsyth, 1984*a*).

Table 1. *ANALYSED ROCKS, CLASSIFICATION, Mg NUMBER, AND LOCALITIES*

Analysis	1	2	3	4	5	6	7	8
SiO_2	37.97	39.03	39.41	41.67	42.28	42.93	43.94	42.23
TiO_2	2.77	2.49	2.79	2.75	2.65	2.73	2.87	2.74
Al_2O_3	11.19	11.16	11.60	11.57	10.81	12.95	11.67	10.82
Fe_2O_3	4.08	3.74	3.57	4.80	3.94	3.65	3.20	4.22
FeO	9.37	9.10	9.64	8.80	8.61	9.92	9.54	8.66
MnO	0.21	0.22	0.20	0.19	0.20	0.21	0.17	0.19
MgO	11.43	12.28	11.14	9.74	11.35	9.01	11.06	12.22
CaO	14.47	13.10	13.58	10.15	9.83	9.49	9.71	8.90
Na_2O	3.70	2.79	3.09	5.91	4.03	4.69	3.06	4.13
K_2O	1.43	0.99	1.63	2.17	2.06	1.44	1.39	1.64
P_2O_5	1.07	1.06	1.03	1.40	1.30	0.93	0.87	1.24
CO_2	0.30	0.19	0.12	0.06	0.28	0.04	0.09	0.05
H_2O^+	2.05	3.28	2.09	1.00	2.49	1.59	1.91	2.31
Total	100.04	99.43	99.89	100.21	99.83	99.58	99.48	99.35
Or	-	-	-	0.43	12.51	8.68	8.42	9.99
Ab	-	-	-	-	4.50	8.82	14.13	7.99
An	9.90	15.60	13.26	-	5.47	10.24	14.35	6.33
Lc	6.76	4.77	7.72	9.80	-	-	-	-
Ne	17.31	13.30	14.48	25.90	16.54	17.16	6.72	15.29
Di	20.60	30.01	27.10	33.55	27.56	25.59	23.14	24.62
Hy	-	-	-	-	-	-	-	-
Ol	24.58	23.19	21.54	17.20	21.39	18.58	22.22	24.33
Mt	3.32	3.23	3.26	2.17	3.12	3.35	3.16	3.21
Il	5.37	4.92	5.42	5.26	5.17	5.29	5.59	5.36
Ap	2.59	2.61	2.49	3.34	3.16	2.25	2.11	3.03
Cs	8.93	1.98	4.49	-	-	-	-	-
Cc	0.70	0.45	0.28	0.14	0.65	0.09	0.21	0.12
Ac				2.29	-	-	-	-
Zn	120	115	120	185	175	150	140	155
Cu	140	71	100	55	57	72	72	55
Ni	180	195	170	230	341	260	300	410
Cr	270	310	240	290	550	260	460	540
Co	66	58	58	54	ND	53	55	55
Sc	33	31	32	24	ND	28	29	21
V	330	300	340	200	112	190	230	190
Ba	560	560	720	660	625	510	390	660
Y	27	25	25	35	38	39	28	35
Sr	1220	940	830	1550	1269	1150	980	1300
Zr	250	240	250	540	460	410	360	490
U	<5	<5	<5	<5	<2	<5	<5	<5
Rb	50	40	46	43	32	31	39	34
Th	<4	<4	<4	12	9	6	4	5
Pb	4	4	11	14	27	8	11	9
Ga	18	17	18	25	24	21	19	20
Nb	120	115	115	135	115	110	82	120
La	ND	ND	ND	ND	98	ND	ND	ND
Ce	ND	ND	ND	ND	187	ND	ND	ND
Nd	ND	ND	ND	ND	100	ND	ND	ND
As	12	<10	<10	<10	ND	<10	<10	<10
Mg No.	64.5	67.2	64.3	60.5	65.9	58.7	65.0	67.0
D.I.	24.1	18.1	22.2	36.1	33.6	34.7	29.3	33.1
An Plag%	100	100	100	-	54.9	53.7	50.4	44.8

1. Olivine melilite nephelinite. Flow (?), logging track, SW Alma Tier, 920 m level [EP041328]
2. Olivine nephelinite. Lower flow outcrop, Whites Flat, 8 km WSW of Interlaken, 805 m level [EP074316]
3. K-rich olivine nephelinite. Flow, Silver Plains (South), 810 m level [EP094352]
4. Olivine nephelinite. Flow cap, Wild Pig Tier, 760 m level [EP175222]
5. K-rich olivine nephelinite. Plug, 0.7 km east of Round Lagoon, 15 km north of Lake Sorell, 1000 m level [EP177484]
6. Basanite. Flow cap, Headlam Top, 700 m level [EP256273]
7. Basanite. Small plug (?), 1 km south of Round Lagoon, 1040 m level [EP170473]
8. Nepheline hawaiite. Lower flow, SW Lake Crescent, 830 m level [EP118287

Table 1. *(continued)*

Analysis	9	10	11	12	13	14	15	16
SiO_2	44.03	44.32	46.90	45.63	48.31	43.38	46.81	45.95
TiO_2	2.35	2.61	2.52	2.38	1.23	2.90	2.72	2.50
Al_2O_3	12.97	12.87	13.76	14.32	15.18	11.57	14.15	13.03
Fe_2O_3	4.75	5.26	5.22	3.51	5.67	2.75	3.33	4.92
FeO	7.88	7.21	7.32	10.15	5.21	10.69	8.85	4.57
MnO	0.18	0.19	0.16	0.18	0.21	0.24	0.17	0.15
MgO	8.34	7.81	8.67	5.77	5.26	10.35	7.03	7.95
CaO	8.21	9.17	7.22	6.99	5.95	8.65	7.65	12.67
Na_2O	3.82	5.59	4.21	5.71	6.89	2.91	3.22	3.89
K_2O	2.21	2.58	1.74	2.19	2.58	1.42	1.81	2.41
P_2O_5	1.38	1.25	0.89	1.11	0.62	1.16	0.95	1.26
CO_2	(	0.06	(	0.04	0.11	(	(	0.37
H_2O^+	(3.11	1.24	(1.04	1.40	2.17	(3.55	(2.70	0.14
Total	99.23	100.16	99.65	99.38	99.39	99.57	99.39	99.81
Or	13.59	15.41	10.43	13.21	15.68	8.74	11.06	14.29
Ab	16.38	5.53	25.10	19.62	21.87	18.92	28.18	6.58
An	12.19	2.43	13.70	7.12	2.95	14.91	19.45	11.01
Lc	-	-	-	-	-	-	-	-
Ne	9.35	22.91	5.97	16.09	20.64	3.64	-	14.33
Di	17.00	28.54	13.63	17.10	18.66	17.78	10.95	33.50
Hy	-	-	-	-	-	-	2.64	-
Ol	20.36	14.06	21.15	16.17	13.36	24.10	17.04	9.45
Mt	3.18	3.05	3.07	3.37	2.70	3.38	3.04	2.30
Il	4.64	5.01	4.85	4.61	2.40	5.74	5.34	4.76
Ap	3.40	2.99	2.14	2.68	1.51	2.86	2.33	2.99
Cs	-	-	-	-	-	-	-	-
Cc	-	0.14	-	0.09	0.26	-	-	0.84
Ac	-	-	-	-	-	-	-	-
Zn	154	165	148	185	165	159	168	93
Cu	95	51	37	36	41	44	37	70
Ni	230	120	219	98	115	267	118	125
Cr	216	220	242	175	160	338	153	86
Co	ND	41	ND	45	39	ND	ND	55
Sc	ND	19	ND	19	16	ND	ND	35
V	80	95	97	110	125	139	105	290
Ba	532	780	409	720	165	448	395	1100
Y	42	39	34	35	22	40	34	38
Sr	1240	1750	905	1350	1000	985	1000	1850
Zr	513	650	426	550	730	499	425	520
U	3	<5	2	<5	<5	4	2	<5
Rb	54	53	38	56	24	39	36	68
Th	10	6	5	<4	6	8	6	<4
Pb	6	5	3	10	6	8	7	8
Ga	27	25	21	25	30	22	25	19
Nb	ND	140	ND	125	130	ND	ND	210
La	ND	ND	ND	ND	ND	ND	ND	-
Ce	ND	ND	ND	ND	ND	ND	ND	-
Nd	ND	ND	ND	ND	ND	ND	ND	-
As	ND	<10	ND	<10	<10	ND	ND	<10
Mg No.	58.5	57.3	59.7	47.5	50.8	62.2	55.2	64.2
D.I.	39.3	43.9	41.5	48.9	58.2	31.3	39.2	35.2
An Plag%	42.7	30.6	35.3	26.6	11.9	44.1	40.8	62.6

9. K-rich nepheline hawaiite. Plug, east of The Nipples, 3.5 km WSW of Antill Ponds, 580 m level [EP297262]
10. Nepheline hawaiite. Plug, south side Old Mans Head, 920 m level [EP179270]
11. Nepheline hawaiite. Upper flow, east of Tunbridge Tier Road, 3.5 km E of Interlaken, 860 m level [EP185342]
12. Nepheline mugearite. Flow cap, 7 km SE of Interlaken, 860 m level [EP198286]
13. Nepheline mugearite. Plug or small flow remnant(?), east Sand Bank Shore, 3 km SE of Interlaken, 840 m level [EP166313]
14. Hawaiite. Small flow tongue or dyke(?), intruding Tertiary sediments, 2 km WSW of Antill Ponds, 310 m level [EP316265]
15. K-rich hawaiite. Meaghers Bay, SW side Dogs Head, Lake Sorell, 810 m level, [EP162378]
16. Mafic K-rich sodalite-nepheline syenite. Inclusion in Round Lagoon olivine nephelinite plug, 15 km N of Interlaken, 1000 m level [EP177484]

Analyses 1–4, 6–8, 10, 12–13 and 16 by Tasmania Department of Mines Laboratories, Launceston - major and trace elements analyses.

Analysis 5 by School of Earth Sciences Laboratory, Macquarie University, J. Bedford analyst.

Analyses 9, 11, 14–15 by Research School of Earth Sciences Laboratory, Australian National University, E. Kiss and P. Beasley, Analysts - major element. School of Earth Sciences Laboratory, Macquarie University, F. L. Sutherland, Analyst - trace elements. CIPW Norms, Mg No., D.I. and An Plag% calculated by R. E. Pogson, Australian Museum, Sydney.

Wild Pig Tier centre

Basalts here form a spur which encloses small, swampy, crater-like depressions on top, and extend from 780 m to below 600 m above sea level. The top basalt contains conspicuous lherzolite fragments and their debris, and sparser clinopyroxene megacrysts. Phenocrysts of olivine and clinopyroxene with sieved cores lie in a felted base of clinopyroxene needles with coarser veinlets of zoned feldspar and sporadic ocelli lined by clinopyroxene and alkali feldspar. An outcrop on the eastern side between 740–760 m a.s.l. is distinctive in showing paler colour and much fewer lherzolites. It contains abundant laths of zoned sodic plagioclase. Under this a finer-grained dark basalt appears, showing more abundant lherzolites and large clinopyroxene and spinel megacrysts. The groundmass shows nepheline and zoned feldspar.

These three rock types resemble variations observed in the Bow Hill cappings to the south in the Oatlands Quadrangle. The lower Wild Pig Tier rock is similar to the unusual garnet lherzolite-bearing basal nepheline hawaiite described from Bow Hill (Sutherland *et al.*, 1984). However the peridotitic upper rock at Wild Pig Tier is similar to the middle part of the Bow Hill inclusion basalt sequence. The inclusion-poor feldspathic rock resembles the top of the Bow Hill sequence, so it may fill a breach in the Wild Pig Tier centre. The Wild Pig Tier centre, dated at 24.1± 0.2 Ma in its top part (Table 2), contributed several flows into the old course of Exe Rivulet, which was already partly filled by basanitic and hawaiitic lavas erupted from other nearby centres.

SOUTH-EAST FAULT MARGIN VOLCANICS

These basalts are associated with some ten centres, many being located on faults or on steep intrusive dolerite contacts. The flows reach their most substantial area and thickness around 80 m at Headlam Top.

Headlam Top flows

These flows form a flat-topped residual at an elevation of between 670–760 metres. Three distinct rocks are recognised. The lowest, at 670 m a.s.l., is a uniform rock in which glomeroporphyritic olivine is set in a subfluidal and intergranular groundmass of zoned plagioclase, clinopyroxene and granular opaque oxides, and resembles an hawaiite or mugearite. A distinct olivine nephelinite lava in the sequence on the south-west side of Headlam Top shows sporadic xenocrysts and phenocrysts of olivine in a groundmass of nepheline, clinopyroxene crystallites, and granular opaque oxide.

The main capping of Headlam Top is a massive, dense, dark rock containing scattered lherzolite up to 60 mm diameter and rare clinopyroxene up to 100 mm diameter. This flow becomes more slabby in the upper part, with only sparse lherzolites present. The rock is basanite (Table 1, analysis 6).

A similar rock to the lherzolite-rich lower level at Headlam Top is found two kilometres south-west at 720 m a.s.l., and may represent an eroded extension. The source for the massive capping of Headlam Top is not apparent, and may underlie it. The lava descends east, infilling an old higher level of the Blackman River. The massive upper outpouring probably diverted the Blackman River north out of the down-rifted Triassic beds to cut a gorge through the more resistant dolerite of the uplifted side.

Mike Howes Marsh centres

Flows from these centres infill old channels of the Blackman River where it flows out of Mike Howes Marsh. The flows are now recut by the river to just below its former base. The lowest flow is exposed below 600 m a.s.l. and contains sporadic lherzolite and sedimentary xenoliths. Olivine microphenocrysts and zoned clinopyroxene phenocrysts with sieved cores and olivine inclusions lie in a subfluidal groundmass of zoned plagioclase laths, felted clinopyroxene, and minor glass. The source is uncertain; it may lie on the fault scarp two kilometres west where similar basalt, but containing cumulate composites of clinopyroxene, olivine and opaque oxides, is found amongst talus at an elevation of 740–760 metres. These rocks resemble alkali basalt or hawaiite.

A second basalt overlies the lower flow in places, shows a scoriaceous base, and reaches an elevation of 620 metres. It is a uniform platy rock with microphenocrysts of olivine and clinopyroxene amongst zoned sodic plagioclase, and resembles an hawaiite. Its source is located by the Blackman River, 2.8 km north-east of the Interlaken Road bridge over the river where agglomerate, with fragments of country rock and scoriaceous blocks of basalt, is exposed below the flow.

A third flow infills the Blackman River further west from 600–640 m a.s.l., north of Mike Howes Marsh. The flow contains lherzolite and sedimentary inclusions. Olivine

Table 2. *POTASSIUM-ARGON DATING OF INTERLAKEN QUADRANGLE VOLCANIC ROCKS*

Sample	%K	$^{40}Ar^*$ ($\times10^{-10}$ moles/g)	$^{40}Ar^*/^{40}Ar$ Total	Age❖
DR11440	0.727	0.3057	0.745	24.1±0.2
Total rock	0.727			
Round Lagoon	0.869	0.3775	0.610	24.9±0.2
Total rock	0.869			

DR 11440—Nepheline hawaiite, Wild Pig Tier, 775 m a.s.l. (42°15'S, 147°12.7'E)

Round Lagoon - Olivine nephelinite, plug, 1020 m a.s.l. (42°00.9'S, 147°13.7'E)

* Denotes radiogenic ^{40}Ar.

❖ Denotes age in million years with error limits for the analytical uncertainty at one standard deviation.

Constants: $^{40}K = 0.1167$ atom%
$\lambda\beta = 4.962\times10^{-10}y^{-1}$.
$\lambda\varepsilon = 0.581\times10^{-10}y^{-1}$.

Dating by AMDEL Geochronological Laboratories, Frewville, South Australia, from research grant funds from the Australian Museum Trust, Sydney, N.S.W.

xenocrysts and phenocrysts are abundant, with rare zoned clinopyroxene phenocrysts. The groundmass shows prismatic clinopyroxene, zoned feldspar, nepheline and opaque oxides. Late-stage segregations contain coarser nepheline, alkali feldspar, clinopyroxene, opaque oxide, biotite and zeolite. The source may be a plug-like peak of such rock between 720–760 m a.s.l., sited on the fault bounding the north side of the Blackman valley.

North-West Blackman centre

Restricted volcanic rocks are found on the scarp bounding the Blackman River, north of the Mike Howes Marsh centres. Poorly-exposed basalt and weathered tuffs around 700 m a.s.l. lie near a depression drained by a tributary of the Blackman River, 3.5 km north of the Interlaken Road bridge at Mike Howes Marsh. Fine-grained, uniform, platy rock shows microphenocrysts of olivine in a fluidal groundmass of strongly zoned sodic plagioclase, and is an hawaiite or mugearite.

This may be a vent for the lowest flow at 670 m a.s.l., 2.7 km to the east below the Headlam Top cappings. Similar rock also forms a peak at 810–860 m a.s.l. five kilometres NNE of the Interlaken Road bridge at Mike Howes Marsh. However its altitude 120 m above the north-west Blackman vent position may indicate either considerable erosion of this centre or a separate source. This high-level capping is nepheline mugearite (Table 1, analysis 12).

Rockton Sugarloaf centre

This centre is sited on a down-faulted block south of Headlam Top, at an elevation between 580–640 metres. Two rock types are found. Basal outcrops on the south side are fine-grained, dense rock in which olivine microphenocrysts and rare Cr spinel xenocrysts lie in a fluidal groundmass dominated by small, zoned plagioclase laths. The rock resembles hawaiite.

The main and upper parts of the exposure are fine to coarse textured and partly banded rocks containing rare lherzolite and pyroxene inclusions, and locally common sedimentary fragments. In the fine-grained rock, partially altered olivine phenocrysts are scattered in a groundmass of prismatic clinopyroxene, zoned sodic plagioclase, rare nepheline, opaque granular oxide and minor biotite flakes, apatite, interstitial zoned feldspar and amygdales of zeolite. Coarser varieties, also found in talus blocks, show elongate late-stage crystallisations of sodic plagioclase zoned to anorthoclase. These poikilitically enclose the groundmass minerals and are associated with patches of biotite flakes. Rare clinopyroxene phenocrysts enclose grains of opaque oxides and small altered olivines. The rock is petrologically akin to the nepheline hawaiites in the Old Mans Head and north Mike Howes Marsh centres, and is probably the source for related rock at Rockton Sugarloaf in the Oatlands Quadrangle (Sutherland, *in* Forsyth, 1984*a*).

The Nipples plug

This isolated peak exposes 15 m of large blocky, crudely columnar, jointed rock. The rock contains common lherzolite xenoliths up to 100 mm diameter, numerous megacrysts of pyroxene, olivine and opaque oxides, and sporadic fragments of baked sediments which show reaction coronas of coarse segregations of green sodic pyroxene and feldspar. The megacrysts (Table 3, analyses B) form part of a cumulate spinel wehrlite-pyroxenite suite, as some clinopyroxene megacrysts contain inclusions of olivine and opaque oxide.

The host rock contains olivine phenocrysts, clinopyroxene grains, zoned sodic plagioclase laths, analcimised nepheline, interstitial zoned alkali feldspar, granular opaque oxides, apatite and minor brown glass. It is a K-rich nepheline hawaiite (Table 1, analysis 9).

Vincents Hill centre

The northern peak at 700 m a.s.l. extends southwards as a flow in the Interlaken Quadrangle and descends to below 480 m a.s.l. in the Oatlands Quadrangle. The petrology and analysis of the basanite is given by Sutherland (*in* Forsyth, 1984*a*).

A small, poor exposure of similar rock is found between 480–500 m a.s.l. associated with Tertiary sediments 2.5 km WNW of St Vincents Peak. The rock contains numerous small xenoliths of lherzolite and pyroxene megacrysts. Some pyroxenes show sieved or reacted cores, and others small inclusions of green spinel and orthopyroxene which may relate them to metawebsterites found amongst the Vincents Hill xenoliths. The host rock shows olivine phenocrysts within a dense groundmass containing small zoned feldspar laths, a glassy base, and microamygdales of zeolite and analcime. It may represent a flow tongue from Vincents Hill which overtopped the dolerite divide at St Peters Pass.

Antill Ponds flows and vent(?)

Two flow remnants descend mostly over dolerite from 420 to 340 m a.s.l., 2–3 km west of Antill Ponds. The dense dark rock contains sparse lherzolite xenoliths up to 50 mm diameter, but considerable related debris. Sporadic clinopyroxene megacrysts range up to 30 mm diameter, some with reaction rims, and there are scattered inclusions of sedimentary rocks, quartz pebbles and felsic gabbro. Olivine phenocrysts, and clinopyroxenes with sieved cores and inclusions of olivine, lie in a subfluidal groundmass of zoned plagioclase laths, clinopyroxene needles, opaque oxides and interstitial pale brown glass. Slightly more crystallised variants develop interstitial analcime and amygdales with zeolites and carbonate. The rock resembles the upper basanite

Table 3. *REPRESENTATIVE ANALYSES OF MEGACRYSTS, INTERLAKEN QUADRANGLE*

Host rock	A. Olivine nephelinite			B. K-rich nepheline hawaiite					C. K-rich hawaiite		D. Hawaiite
Megacryst	Cpx	Spl	Amp	Cpx	Olv	Spl	Mgt	Ulv	Opx	Spl	Opx
SiO_2	49.93		41.46	49.29	38.95				54.44		55.38
TiO_2	1.30	0.50	4.05	1.08		0.60	7.16	11.49	0.15	0.43	
Al_2O_3	8.72	62.77	15.13	8.87		61.06	2.79	5.62	3.16	61.79	3.85
Cr_2O_3		0.20					0.12		0.36		0.36
Fe^{2+}		(14.43				(13.96	(35.56	(40.19			
FeO^+	6.30	(	8.71	6.34	18.72	(	(	(	11.11	19.05	6.80
Fe^{3+}		(5.81				(6.54	(52.68	(40.24			
MnO		0.14			0.18	0.11	0.75	0.53			0.12
MgO	13.76	18.67	14.03	13.83	42.15	18.11	1.10	1.12	28.63	18.41	32.75
CaO	18.66		10.67	19.09			0.08		2.15		0.74
Na_2O	1.33		2.40	1.50		0.59	0.21			0.31	
K_2O			2.27								
Total	100.76	102.52	98.72	98.36	99.41	100.97	100.45	99.19	100.06	102.75	100.53
Si	1.823		5.992	1.806	0.995				1.928		1.917
Ti	0.036	0.010	0.440	0.030		0.012	0.200	0.319	0.004	0.009	
Al	0.376	1.867	2.577	0.383		1.850	0.122	0.245	0.132	1.900	0.157
Cr		0.004					0.004		0.010		0.010
Fe^{2+}		(0.305				(0.300	(1.105	(1.240			
Fe^+	0.192	(	1.053	0.195	0.400	(	(	(	0.329	0.451	0.197
Fe^{3+}		(0.110				(0.127	(1.474	(1.118			
Mn	0.003	0.003			0.004	0.003	0.024	0.017			0.004
Mg	0.749	0.708	3.021	0.756	1.606	0.694	0.061	0.062	1.512	0.715	1.689
Ca	0.730		1.652	0.750			0.003		0.081		0.028
Na	0.094		0.674	0.107		0.029	0.015			0.016	
K			0.418								
Cations	4.003	3.007	15.827	4.027	3.005	3.015	3.008	3.001	3.996	3.055	4.002
Mg%	44.8	62.3	52.8	44.5	80.1	61.3	2.1	2.3	78.6	62.8	88.3
Ca%	43.7		28.8	44.1					4.2		1.4
Fe%	11.5	36.8	18.4	11.4	19.9	37.7	90.8	86.1	17.1	36.4	10.3
Ti%		0.9				1.0	7.1	11.6		0.8	

A. Plug, west side, Lake Crescent, 4.8 km SW of Interlaken. Cpx (Al-augite with augite rims; $Mg_{44-47}Ca_{42-44}Fe_{10-12}$; Al_2O_3 2.2–8.7%; TiO_2 0.5–1.3%; Na_2O 0.2–1.3%), Spl (pleonaste-Fe pleonaste; Fe_{37-41} $Mg_{58-62}Ti_1$), Amp (pargasitic kaersutite, $Mg_{53}Ca_{29}Fe_{18}$).

B. Plug, east of The Nipples, 3.5 km WSW of Antill Ponds. Cpx (Al augite; $Mg_{44-45}Ca_{44}Fe_{12}$; Al_2O_3 8.7–8.9%, TiO_2 1.1–1.2%), Olv (chrysolite olivine, $Mg_{80}Fe_{20}$), Spl (Fe pleonaste, $Mg_{57-61}Fe_{38-42}Ti_1$), Mgt (Ti magnetite—Ulvospinel series, $Fe_{91}Ti_7Mg_2$, Usp 22.8), Ulv (Ulvospinel, $Fe_{86}Ti_{12}Mg_2$, Usp 36.8).

C. Flow, Dogs Head Point, NE Lake Sorell. Opx (bronzite; $Mg_{77-80}Fe_{16-19}$ Ca_4; Al_2O_3 2.8–3.6%), Spl (pleonaste; $Mg_{63}Fe_{36}Ti_1$).

D. Intrusion (?), 2 km WSW of Antill Ponds. Opx (enstatite; $Mg_{88}Fe_{10}$ Ca_1; Al_2O_3 3.9%).

Electron microprobe analyses by F. L. Sutherland, using non-disperive X-ray unit, School of Earth Sciences, Australian National University. Cpx, Olv, Opx cation contents based on 6 oxygens; spinel, magnetite-ulvospinel cations based on 4 oxygens; Amp cation content based on 23 oxygens.

Analyses express Fe as total FeO, except where Fe^{2+} and Fe^{3+} are recalculated from stochiometric re-allotment.

capping Headlam Top to the west. If these rocks are remnants of those flows, which descended an old course of the Blackman River before its diversion northwards through Tunbridge, then this indicates considerable erosion and a relatively older Tertiary age for the Headlam Top flows.

Small basalt bodies are exposed under an old creek fill of Currajong Rivulet, 1.7 km south-west of Antill Ponds at an elevation of around 310 metres. These bodies appear to intrude clastic beds of coarse and fine grain size, slightly baking the latter. The coarse clastic beds contain rounded dolerite and basalt in a sand-size matrix, and crude bedding shows steep dips of 70–80° NE at the south end. The deposit represents an old Tertiary stream deposit or possibly a local agglomerate. The intrusive bodies are dense dark rock with numerous lherzolite and large pyroxene inclusions which include enstatite of a typical composition found in lherzolite (Table 3, analysis D). Glomeroporphyritic microphenocrysts of olivine, clinopyroxene and opaque oxides lie in a fine felt of plagioclase laths and some interstitial brownish glass. There are scattered fragments of aphanitic basalt containing abundant olivine, pyroxene and plagioclase crystals and associated composites, and amygdales of yellowish opal(?) and carbonate. These seem to represent fragments derived from volcanic lithic-crystal tuff. This, and the apparent intrusive nature of the basalt, suggest a small eruptive vent. The rock matches an hawaiite in composition (Table 1, analysis 14).

Mill Brook intrusive rocks

A small exposure of dense black basalt one kilometre north of 'Mill Brook' property probably marks a small plug. The exposure lies in a fault paralleling the Western Tiers scarp, and downthrowing dolerite against Permian beds. The rock contains numerous dolerite and sedimentary fragments. It is flow banded, with abundant microphenocrysts of olivine and sparse clinopyroxene in a fine, felted groundmass. Rare fragments of coarser rock show larger feathery blades of clinopyroxene in a base of zoned plagioclase, clinopyroxene prisms, euhedral squarish grains of opaque oxide, nepheline and analcime in small amygdales. These seem to be more crystallised variants of the host rock, and suggest a basanite composition.

Very similar, but even finer grained rock, was examined from the Tunbridge Tier drill hole from a depth of 551 metres. This site lies 0.8 km NNW of the Mill Brook plug, and intersects a related intrusion within the Permian beds. At this depth the rock shows abundant amygdales of pale yellowish chalcedony.

EASTERN VOLCANIC ROCKS

These rocks include exposures around Ross and Tunbridge. A minor higher level occurrence lies west of Ross near Burburys Sugarloaf, at an elevation around 350 metres. Most exposures form low-level flows at around 200–220 metres. North of Ross these rocks overlie Permian beds and dolerite, and rest on restricted Tertiary sediments. East of Tunbridge they overlie more extensive Tertiary beds deposited mainly over Triassic beds.

South Burburys Sugarloaf

This small outcrop, 8.7 km WNW of Ross and 0.5 km south of Burburys Sugarloaf [327500], is probably a small flow remnant or related intrusion of the main plug, which rises to over 420–480 m a.s.l. in the Lake River Quadrangle. The Sugarloaf is made of lherzolite-bearing nepheline hawaiite, which contains phenocrysts of olivine and clinopyroxene with small olivine inclusions in a base dominated by large elongate plates of zoned sodic plagioclase-anorthoclase, which poikilitically enclose other groundmass minerals.

Tunbridge–Ross flows

These rocks were studied in small remnants ENE of Tunbridge, where three types of basalt were recognised. The largest outcrops consist of glomeroporphyritic olivine tholeiite with an intergranular groundmass of zoned labradorite-andesine laths, clinopyroxene, irregular squarish to bladed opaque oxides, and some interstitial darkish mesostasis. Amygdales contain greenish or yellowish to orange opal and chalcedony, carbonate and hematitic material (oxidised siderite?).

Similar basalt forms Dunns Battery, a small residual six kilometres ENE of Tunbridge [407364]. However olivines are partly chloritised, opaque oxides are largely bladed, and green opal is dominant in amygdales. The base overlies tachylytic breccia, which represents a flow-foot breccia formed by extrusion of the basalt into water. This quenched basalt shows olivine and small plagioclase crystals trapped in an abundant yellowish glassy base forming over 70% of the rock.

A distinctive basalt caps Flag Hill, lying north of the olivine tholeiites. This basalt is characterised by glomeroporphyritic orthopyroxene prisms set in a groundmass of small olivine grains, partly skeletal laths of plagioclase, scattered opaque oxide grains, acicular sheaf-like clinopyroxene, and darkish glassy mesostasis. Vesicles and amygdales are lined or filled with chalcedony. The rock represents a quartz tholeiite.

An almost identical rock is found in a narrow dyke system intruding Triassic beds four kilometres ESE of Tunbridge, and extending five kilometres northwards to a position 1.5 km west of Flag Hill. This is mapped with dyke associates of the Jurassic dolerite intrusions, and raises the problem whether some of the chilled dolerite dykes are, in fact, feeders for Tertiary quartz tholeiite flow cappings like Flag Hill.

PETROLOGY

The Interlaken volcanics are undersaturated rocks over most of the field, with olivine nephelinites and nepheline hawaiites being the most common types. These two main compositions were selected for more detailed mineralogical analysis by electron microprobe work.

Mineralogy

The Round Lagoon K-rich olivine nephelinite was taken as an example of a highly undersaturated assemblage. The olivine is chrysolite ($Mg_{74-76}Fe_{23-24}Ca_1$) and the main groundmass phases are zoned Ti salite ($Mg_{41-49}Ca_{40-99}Fe_{10-11}$; Al_2O_3 3.0–4.0%, Ti 2.1–3.0%), nepheline ($Na_{82-85}K_{13-14}Ca_{1-4}$), sanidine ($Na_{47}K_{52}Ca_1$), and ulvospinel ($Fe_{72-79}Ti_{15-19}Mg_{6-10}$). This can be compared with the K-rich nepheline hawaiite in The Nipples plug, which is higher in SiO_2 and alkalies, and is a more fractionated rock. The olivine is more Fe-rich and hyalosiderite in composition ($Mg_{67}Fe_{33}Ca_{0-1}$), the nepheline is largely analcimised (Na_{100}), and feldspar is zoned from K-oligoclase to Na anorthoclase ($Na_{65}K_{26}Ca_{10}$). There is little change in composition in the clinopyroxene ($Mg_{40}Ca_{48}Fe_{12}$; Al_2O_3 3.5%, TiO_2 1.7%) or in the opaque oxide ulvospinel ($Fe_{74}Ti_{20}Mg_6$, Usp 57.0), but Ti phlogopite appears as a late-stage phase ($Mg_{75-78}Fe_{22-25}$; TiO_2 7.6–8.2%).

Some of the rocks, particularly the nepheline hawaiites, are notable for coarse-textured variations. In the rock from The Nipples the coarse material consists of olivine ($Mg_{81}Fe_{19}$), clinopyroxene zoned from salite cores ($Mg_{40}Ca_{47}Fe_{13}$; Al_2O_3 2.8%, TiO_2 1.7%) and altered on rims to an amphibole of Ti richterite composition ($Mg_{62}Ca_{16}Fe_{23}$; TiO_2 4.07%). The feldspar is a soda sanidine ($Na_{50}K_{49}Ca_1$), and opaque oxide appears as ilmenite ($Fe_{48}Ti_{48}Mg_4$, Hm 5.6).

Chemistry

Major and trace element data on Interlaken basalts, excluding the eastern tholeiitic lavas, are given as Analyses 1–15 in Table 1, together with CIPW norms, Mg number ($Mg^{2+}/Mg^{2+}+Fe^{2+}$ calculated at Fe_2O_3/FeO=0.2), Differentiation Index (sum of qtz, or, ab, ne, lc) and Normative An% (An/An+Ab×100). Most are nepheline normative rocks when plotted in the Ne–Di–Ol–Hy quadrilateral diagram (fig. 15). They generally fall within the established fields for olivine nephelinite-melilitite, basanite and alkali basalt lineages in Tasmania. However, they pass into Hy normative rocks as in the Dogs Head K-rich hawaiite. The Interlaken undersaturated and transitional rocks include a range of fractionated types (fig. 16), which pass from low DI (15–20) and calcic normative plagioclase ratios, to higher DI (30–60) and sodic normative plagioclase ratios.

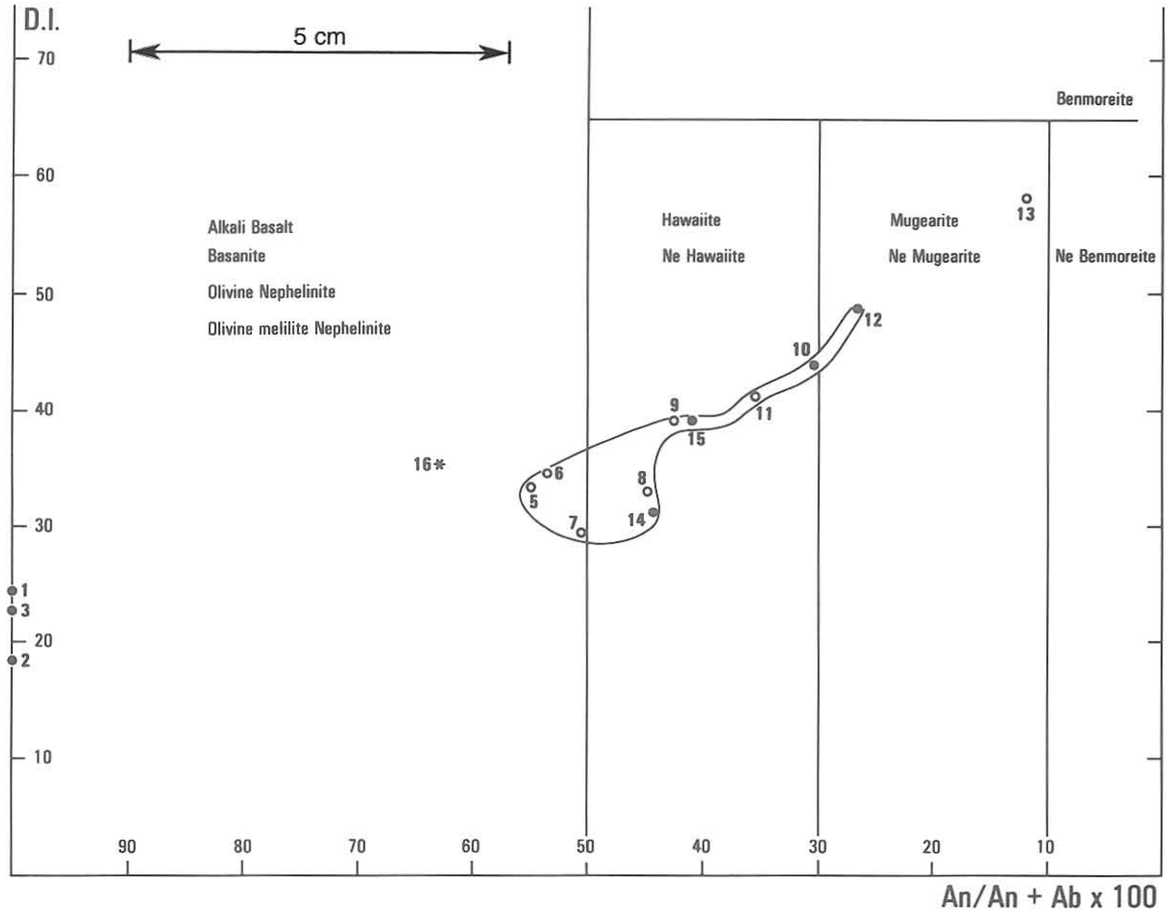

Figure 15. *Differentiation Index (Σ Or, Ab, Ne, Lc) v Normative feldspar An% diagram, showing plots of the Interlaken basalts in relation to classification fields. Numbers refer to analyses listed in Table 1, and circled plots represent rocks which contain mantle inclusions.*

Nephelinites

The more undersaturated nephelinites show normative calcium silicate (Cs) and leucite (Lc), but melilite only was seen modally in the south-west Alma Tier rock. Lc reaches nearly 10% in the Wild Pig Tier olivine nephelinite, but K_2O (2.2%) and Rb content (43 ppm) are lower than in typical olivine leucitites in eastern Australia (K_2O 2.8–7.3%, Rb>80 ppm; Cundari, 1973; Birch, 1979). The olivine±melilite nephelinite flows of the western plateau are probably related to a common source region, and all show normative Cs and plot at An_{100}%. The Whites Flat olivine nephelinite (Mg Number 67, Ni 195, Cr 310 ppm) shows the closest criteria for a parental melt amongst Interlaken rocks as defined for Tasmania (Brown and McClenaghan, 1982; Sutherland, 1989), but Ni is slightly depleted. This is consistent with some fractionation and the presence of glomerophenocrysts of olivine and clinopyroxene, a feature of most of the nephelinites of the area. The K-rich nephelinite from Silver Plains is the most depleted in Ni and Cr and enriched in Ba, and probably involves additional crustal fractionation. The Round Lagoon nephelinite is near parental in Mg number, Ni and Cr, but shows higher DI and normative Ab% than the western nephelinites, suggesting slight fractionation. However, the unexpectedly high Sr (1269 ppm) and Zr (460 ppm) probably indicates contamination by the partially melted mantle and crustal nephelinitic inclusion suites. The Wild Pig Tier nephelinite shows lower Mg number (61), Ni (230 ppm) and Cr (290 ppm), and higher Sr (1550 ppm) and Zr (540 ppm), so that it represents the most fractionated of the nephelinites.

A cumulate sodalite malignite inclusion from the Round Lagoon nephelinite (Table 1, analysis 16) plots outside of the main basaltic fields in Tasmania in the normative quadrilateral (fig. 15), and is significantly higher in Ba (1100 ppm), Sr (1950 ppm), Rb (68 ppm) and Zr (520 ppm) compared to the host nephelinite. This suggests a fractionated product, but the fairly close match in DI and normative An% of inclusion and host (fig. 16) probably indicates additional introduction of these incompatible elements (plus chlorine for the sodalite) with build up of a volatile component.

Nepheline–Feldspar rocks

None of the analysed basanites and nepheline hawaiites appear to be truly parental, as even those with high Mg numbers (65–67), Ni (300–410 ppm) and Cr (460–540 ppm) also show high Zr (360–490 ppm). This suggests some degree of contamination of fractionated lava by abundant lherzolites and related debris carried with them. Comparisons of the South Lake Crescent–Old Mans Head lherzolite-bearing and late inclusion-free nepheline hawaiites show that the latter is more enriched in Si, Al, Na, K, Ba, Sr, Zr, Rb and further depleted in Mg, Ni, Cr, Co, V. This suggests crustal fractionation during this centre's eruptive period.

Lherzolite-bearing nepheline hawaiites from separate centres (Old Mans Head and The Nipples) also show significant differences. The Nipples rock is relatively enriched in Si, Al, K, Rb, Cu and depleted in Mg, Na, Ni, Cr, V, Ba, and these variations can be attributed to high-pressure mantle crystallisation of wehrlitic phases such as sodic clinopyroxene, olivine and spinels found within this rock. The lherzolite-bearing nepheline hawaiite from north-east Interlaken continues this trend of increasing Si, Al and some incompatible elements, but becomes more deficient in Ca, Na, K, P, Ba, Rb, Sr and Zr. This may indicate initial

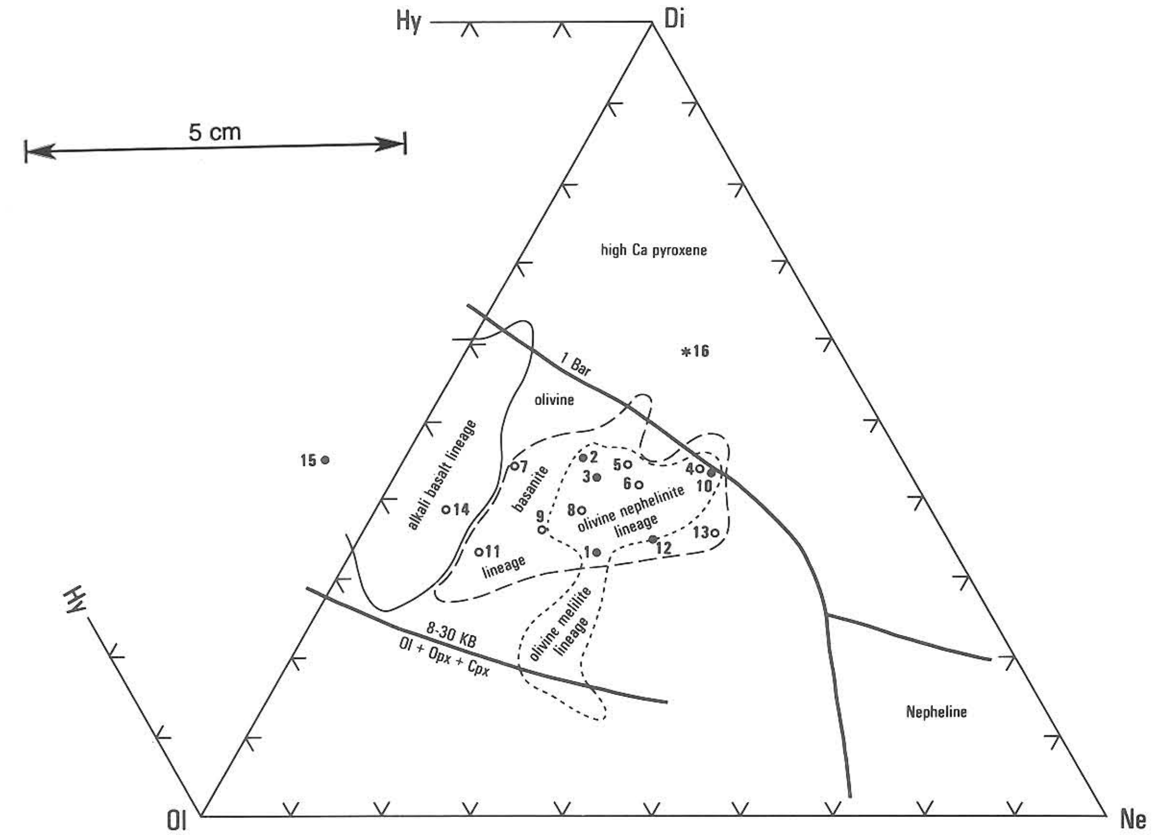

Figure 16. *Normative Ne–Di–Ol–Hy quadrilateral plots of Interlaken basalts from numbered analyses listed in Table 1. They are shown in relation to the alkali basalt, basanite and olivine melilitite-nephelinite lineage fields of Tasmania, and low and high pressure experimental cotectic compositions (after Sutherland, 1988). Circled plots represent rocks which contain mantle inclusions. The sodalite–malignite segregation (16) from the Round Lagoon olivine nephelinite (5) is plotted as an asterisk. Note that these coarse assemblages are now regarded as late-stage pegmatoid bodies rather than cumulate inclusions, after more detailed work (F. L. Sutherland, R. J. Barron and D. Hendry, unpublished data).*

crystallisation and removal of phases rich in these elements such as K oligoclase-anorthoclase, which is found as microphenocrysts in the rock.

The most fractionated rocks are the nepheline mugearites. The east Lake Crescent rock continues the high pressure Ol, Cpx, Sp trend observed in The Nipples rock, but shows an increase of Na over K and considerable depletion in Ti, Fe, Rb, Ba, and Sr. This suggests that phases such as Ti micas, amphiboles and Ti, Fe oxides may have crystallised out at high pressures. The presence of biotite and amphibole as late-crystallising phases in some nepheline hawaiites lends support to this. As a nepheline mugearite lacking evidence of any high pressure inclusions, the north-west Blackman River rock continues the crustal fractionation trend shown by the south Old Mans Head nepheline hawaiite. However Na, K, Ti, Ba, Rb, Zr remain fairly constant or slightly down. This may reflect crystallisation of feldspar, Fe-Ti oxides, and zircon on the low pressure fractionation path as it trends to a felsic end member, with the feldspar Na/K ratio remaining close to that of the evolving melt.

Feldspar-Bearing rocks

The hawaiites at Antill Ponds and Dogs Head (Mg number 52–66) represent fractionation of mildly alkaline to transitionally saturated melts. Such melts arise from moderate degrees of partial melting of mantle source regions (mostly between 11–17%; Frey *et al.*, 1978). The more fractionated Dogs Head rock contains orthopyroxene and minor spinel as megacryst phases, which could be involved in modifying the melt. This rock is noticeably deficient in Ni and Cr, and quite high in Sr and Zr. However the K-rich nature of the rock cannot be due to crystallisation of K-poor phases such as Opx±sp alone. It is either an original feature retained from the parental melt, or is due to a Na-bearing phase, possibly a high pressure clinopyroxene, being removed at an earlier stage.

The tholeiitic rocks of the eastern basalt plains are not categorised chemically, but by analogy with detailed studies of similar rocks in south-east Australia, would be expected to form by over 20–25% partial melting of the mantle source rock (Frey *et al.*, 1978).

Regional Distribution

The Interlaken volcanic rocks can be assigned to alkaline, alkali basalt and tholeiitic associations of Tasmania, as mapped in the Oatlands Quadrangle to the south (Sutherland, *in* Forsyth, 1984*a*). These associations (fig. 14) represent different orders of partial melting and fractionation. In the Interlaken Quadrangle the alkali basalt association is marked, in parts, by the sole presence of nephelinitic rocks. These regions could be separated into a nephelinitic sub-association of the alkali basalt association, and represent regions of particularly low mantle melting.

Lherzolite-bearing rocks are prominent amongst the alkaline and alkali basalt associations, and the analysed rocks plot between the 1 Bar and 8–30 kb experimental cotectic lines for the Di-Ol-Ne system (fig. 15). In some centres (e.g. Old Mans Head), mantle melts appear to have risen into the crust and fractionated after initial eruption. Those rocks which are considered to represent crustal fractionated rocks (Table 1, analyses 3, 10, 12, 15) tend to plot towards the low pressure cotectic. Sodalite-malignite, found as an inclusion in the Round Lagoon nephelinite (Table 1, analysis 16), plots well above the low pressure cotectic, consistent with a fairly high level crystallisation. However, for the bulk of the Interlaken volcanic rocks, most of the melts fractionated within the mantle before eruption.

STRUCTURE

The folded rocks underlying the Parmeener Supergroup are not exposed, but were intersected in two deep boreholes. In the westernmost bore, on the Tiers escarpment near Tunbridge Tier, the folded rocks belong to the broad spectrum of rocks which occur west of the inferred crustal structure named the Tamar Fracture System by Williams (1976). The rocks intersected in the Tunbridge Tier bore are described by Williams (see p.14), and show greatest similarity with rocks of the Precambrian Badger Head Group. Other recent deep bores, for example the bore in the adjacent Tooms Quadrangle at The Quoin [EP554331] (Clarke and Farmer, 1983) and the bore at Eaglehawk Neck [EN760382] (Gulline and Clarke, 1984), have intersected rocks referable to the Mathinna Beds lying east of the Tamar Fracture System. If the Tamar Fracture System is an approximately linear feature, it is constrained to pass close to Ross in the north-eastern corner of the Interlaken Quadrangle. Unfortunately folded rocks intersected in a deep bore near Ross are intruded by a major dolerite mass, and have been altered to a uniform dark grey hornfels with rare thin arenaceous laminae. Based on their structural features, these rocks cannot unequivocally be related to rocks either east or west of the Tamar Fracture System. However no sequences of a similar composition are known within the Mathinna Beds of north-eastern Tasmania (Williams, p.15).

The Parmeener Supergroup forms an essentially flat-lying sequence, possibly up to about 1700 m thick, which unconformably overlies the folded basement. The thickness of the Lower Parmeener Supergroup is well known at Tunbridge Tier, where drilling indicates a thickness only slightly in excess of 900 m, but the thickness of the Upper Parmeener Supergroup is a composite estimate, based on the thickness of units outside the quadrangle. The Lower Parmeener Supergroup is notably thinner at Ross compared to the thickness at Tunbridge Tier. This is basically a result of thinning of both the basal tillite sequence and the overlying correlate of the Quamby Mudstone. Landscape irregularities at the unconformity, such as glaciated valleys, may account for the thinning but the trend may be a regional one passing into the much attenuated Lower Parmeener successions found further north-east up the valley of the South Esk River towards St Marys (Turner *et al.*, 1984; Blissett, 1959). Thickness variations of the Lower Parmeener Supergroup, based on regional trends, are illustrated by Banks and Clarke (1987). In a general way, the thickest Lower Parmeener succession coincides with the Tamar Fracture System. The Upper Parmeener Supergroup is also attenuated in the South Esk Valley area but the degree to which the attenuation is expressed in the north-eastern part of the Interlaken Quadrangle is unknown, but is unlikely to exceed 10%.

Tectonic influences during sedimentation of the Parmeener Supergroup within the quadrangle are more clearly expressed by the sedimentation pattern rather than by the structural features. It is difficult to distinguish climatically-controlled transgressions and regressions during deposition of the glaciomarine Lower Parmeener Supergroup from global or more local tectonic influences. Tectonic influences during sedimentation of the terrestrial Upper Parmeener Supergroup are indicated by the breakdown in consistent palaeocurrent directions which prevailed during deposition of the Late Permian sequence and Early Triassic quartz sandstone sequence; by the synchronous change in provenance resulting in the change from quartzose to lithic then volcanic lithic sandstone composition; and by the deposition of clasts eroded from the Lower Parmeener and other sources. The subtle structural expression of the tectonism at the outcrop scale is illustrated by a regional angular discordance of 0.3° between units outside the Interlaken Quadrangle near St Marys (Calver, *in* Turner and Calver, 1987).

The most obvious dislocation of the Parmeener Supergroup has occurred during intrusion of tholeiitic magma in the mid-Jurassic and during faulting which, in most cases, post-dated the major dolerite intrusions. The major dolerite intrusions are gently discordant sheets with abrupt, steeply discordant segments, and probably occur in all areas. The sheets are commonly 300–400 m thick but are inferred to be thicker (about 600 m), particularly at low stratigraphic horizons near feeder structures. Feeders are considered to be dykes or pipes (Leaman, 1975). Thinner dolerite sheets, down to a few metres thickness, also occur, and some sheets are considered to split to intrude at different horizons up to several hundred metres apart. The lower surface of major sheets is considered to be more regular than the upper surface, which may show a variety of bosses, dykes or indentations. Large polygonal indentations are considered to have formed where large masses of strata have settled into the magma before rigid crystallisation.

Inferred changes in sheet thickness may be gradual, leading to tilting of overlying strata; or possibly abrupt, being expressed in the overlying strata by a fault-like fracture reaching the land surface and perhaps intruded by dolerite. Dykes of various trends are numerous. Dykes tens to hundreds of metres broad, and vertical to steeply inclined, may in places be steeply-inclined segments of sheets or feeders to sheet splits. Thinner dykes (less than one metre to about 10 m), generally near-vertical, intrude both strata and older dolerite intrusions, and occur discontinuously for distances of up to several kilometres with offset and sygmoidal sections. Many fine-grained dolerite dykes in dolerite are highly irregular and diverge around joint-free areas.

The major dolerite sheets and their host strata have been broken by steeply-dipping normal faults with throws ranging from less than one metre to several hundred metres. The faults are linear for distances of a few hundred metres to several kilometres but with notable changes of trend between segments, and usually occur in families of faults with similar trends. The net topographic throw of fault families may exceed one kilometre, for example across faults bordering the Tiers escarpment between the relatively downthrown lowlands bordering the escarpment and the Central Plateau in the northern part of the quadrangle. The downthrown block frequently dips at a few degrees towards the fault, and as the sense of throw on subparallel faults is usually the same, series of half grabens occur in some areas, although occasional full grabens also occur. Locally steeper dips are found (10–25°), and near-vertical beds may be found near fault zones. Such steeply-dipping strata in the Blackman River valley may previously have been attributed to folding (Nye, 1921), whereas an anticline reported by Nye from the Currajong Rivulet may have been caused by arching of strata over a dolerite intrusion, or by faulting.

Uplift of the Central Plateau relative to the lowlands is greater in the northern part of the quadrangle, and this is interpreted as regional tilting. At discontinuous localities, a marker bed (Blackwood Conglomerate correlate Pb) beneath the Central Plateau dolerite sheet falls with an average gradient of about 1:55 over a distance of about 20 km in a SSE direction.

Although the faulting post-dates the cooling of major dolerite sheets there is some inconclusive evidence suggesting faulting may have been initiated before the intrusion of other dolerite bodies. Faults and dolerite dykes, and to a limited degree dolerite dykes intruding dolerite sheets, show some similarity in their preferred trends. The major fault movement may be as young as Early Tertiary but little movement probably occurred after the Eocene. The half graben structure of the underlying rocks influenced the geometry and sedimentation of the thickest known (111 m) Tertiary sequence but the possibility of faulting continuing during middle–late Eocene sedimentation cannot be ruled out. Tertiary basalts occur primarily as flat-topped or inclined flows infilling sub-basaltic topographic irregularities, although some plugs and other minor intrusions are known. Where determinable, basalt flows post-date faulting and erosion of hundreds of metres of strata from host blocks.

Descriptions of major dolerite intrusions

ROSS AREA

A deep bore near Ross intersected two dolerite masses. One intersection was the top of a major intrusion in the folded basement rocks, with the second intersection being a sill?-like body 20 m thick occurring in the basal tillite formation (Pt) of the Lower Parmeener Supergroup. Some 38 m of tillite and 55 m of folded basement separate the two intrusions. The dilational effect of the two intrusions is considered to be the major cause of the relative uplift of the Lower Parmeener rocks exposed west of Ross (fig. 17*c*).

Dolerite reaches the surface along a north-trending, steep intrusive contact, about 1.5 km west of the bore hole at Kitchener Ridge. Further west are numerous upper-surface sheet contacts with overlying strata of the Upper Parmeener quartz sandstone sequence (Rp). The north-trending structure is considered to be the structure along which magma rose from near the basal Parmeener unconformity to intrude over 0.5 km stratigraphically higher. To the north of the bore, a similar steeply-transgressive segment of the sheet, striking ENE, occurs at Sugarloaf Spur and then levels out further north on Abbots Hill at about the same topographic height, and probably the same stratigraphic level as at Kitchener Ridge. The occurrence of quartz sandstone, probably of the quartz sandstone sequence (Rp), near the intersection of Kitchener Ridge and Sugarloaf Spur, may be interpreted as indicating that the sheet intruding that sequence (Rp) is thinner than the segment intruding beneath the bore hole [347483]. Although down-faulted east of Sugarloaf Spur, the ENE-trending transgressive segment may still be recognised in part, possibly as a dyke rising above the sheet and extending almost to Ashby Road [375493]. North of the 'dyke', the sheet intrudes quartzose sandstone of the Upper Parmeener Supergroup. The magnetic profile supports the dyke interpretation of the low dolerite ridge, and the associated magnetic anomaly indicates that the dyke crosses Ashby Road before trending more variably to pass through the dolerite outcrop east of the Macquarie River [386493], and probably to extend several hundred metres further east to the most easterly magnetic traverse undertaken.

Dykes and other irregular dolerite masses intrude the quartz sandstone sequence, and less commonly the Bogan Gap Group correlate, east of the Macquarie River and south through Ross. A long magnetic profile from north of the borehole to the Macquarie River south of the new bridge [396476] only detected small anomalies, and in particular the dolerite intrusion at 378480 did not yield a recognisable anomaly. Intense and broad positive anomalies were located, especially approximately in the triangle defined by Ashby Road and the old Midland Highway east of the current Ross deviation, and the mirror reflection of the triangle west of the deviation to bore RG31 [392462]. The most intense anomalies appear to trend parallel to the highway deviation, or trend north. Some are coincident with the highway. All nearby bores (RG19, 20, 28, 31, 32, 37) intersected Upper Parmeener strata, and the anomalies are interpreted to indicate the existence of an underlying massive dolerite body with possible dyke projections. The anomalies do not appear to be caused by lateritic road foundations, irrigation pipes, Quaternary doleritic cobble beds, or lateritic clays intersected in RG19, but all features do occur in the area.

South from the deep bore, the dolerite sheet is considered to extend subsurface to reach the surface as a sheet intruding the quartz sandstone sequence (Rp) near Oakden Hill [365420]. Several thin dykes in the intervening area may be rooted in the underlying sheet. To the east of this area, much closer to the deep bore, dolerite is found at the surface and forms the White Kopje–Horton Hill area. Although this area could be uplifted, and is faulted on its north-eastern side, the other boundaries are probably intrusive, and traces of hornfels were found in the talus west of White Kopje. A dyke in a fracture between strata south-west of White Kopje appears to thicken towards White Kopje [370445]. A broad but irregular dyke separates Bogan Gap Group correlate strata from relatively uplifted, poorly-exposed fossiliferous strata (Pl) north of White Kopje. The cause of this uplift is not clear, unless the outcrops of fossiliferous strata are individual rafted blocks set in the dolerite; or increased dilationary uplift has been caused by thickening of the sheet, perhaps near a feeder structure; or an additional sheet is present. The small area of dolerite almost entirely surrounded by the Palmer Sandstone correlate may be a local thin sill remnant, small pipe or boss [374466]. To the east, dolerite metamorphoses Bogan Gap Group correlate strata, probably passing beneath the strata.

South of Oakden Hill–Horton Hill, increased dilationary uplift is evoked to explain the occurrence of Bogan Gap Group correlate strata. This block of strata is bounded by steeply-dipping intrusive dolerite boundaries on the western and north-western side, dips south-easterly opposed to the regional dip, and has a second thin sheet just above the base of the Upper Parmeener Super Group. This thin sheet appears to merge with a more massive intrusion at Grimes Sugarloaf [400400]. The sheet was intersected in bore RG35 at White Lagoon, and subsequently an underground water bore at the same locality penetrated the underlying strata. The thin sheet is probably a split from the major sheet. The increased dilationary uplift of the underlying major sheet, and its lower stratigraphic position relative to the area further north, may be related to the proximity of a second feeder. The transgressive step in the sheet coincident with the north-trending structure at Kitchener Ridge is considered to extend SSE, and to be marked by the dykes extending towards White Lagoon. The isolated dyke segment west of White Lagoon has been shown, by magnetic anomalies, to be part of the dyke exposed further north [367390]. Dolerite is inferred to underlie the quartz sandstone sequence (Rp) north-west of White Lagoon but was not intersected in deep underground water bores [353397, 363389].

The Kitchener Ridge–White Lagoon structure may extend south along the Midland Highway to Tunbridge. To the east, numerous thin dolerite dykes and larger structures suggest that a dolerite sheet may occur at a relatively shallow depth within or beneath the quartz sandstone sequence (Rp), or near Grimes Lagoon, within or beneath older strata (Pj) [395385]. West of the Midland Highway, where the dolerite is topographically high, a higher stratigraphic level of intrusion appears to be indicated; for example at Knobby Ridge the intrusion appears to be above the quartz sandstone sequence [352390].

KITCHENER RIDGE–HURRICANE OPENING AREA

From Kitchener Ridge west to the Tiers scarp the major dolerite sheet shows numerous contacts with overlying quartz sandstone (Rp). On the Tiers scarp, from the northern map boundary south to Isis Creek, the intruded horizon may be slightly lower, near the Upper/Lower Parmeener boundary above the Blackwood Conglomerate correlate [214435] (fig. 17*c*). A similar horizon is probably intruded west to Hurricane Opening [090470] (fig. 17*c*).

Irregularities are known in the upper surface of the sheet. For example a steeply-dipping intrusive boundary of predominantly north trend crosses the Auburn Road at 317454. Other NNW-trending boundaries between the dolerite and quartz sandstone (Ꞧp) closer to Kitchener Ridge may be intrusive or faulted boundaries. Dolerite exposed near Ellinthorp Plains is considered to be a separate sheet intruding at a higher stratigraphic horizon [245490 to 260473]. An unusual boss-like feature at Hanging Sugarloaf is not obviously faulted against rocks on its western side [297485]. This dolerite may be related to dolerite interpreted to be a thin sheet intruding the Upper Parmeener lithic sequence (Ꞧl) in the inferred extension of the graben three kilometres south of Hanging Sugarloaf [311449].

REGENTS PLAIN AND SURROUNDING AREAS

The geological structure of the general area north of Regents Plain in the Lake River Quadrangle (Matthews, 1974) suggests that a large dolerite feeder is present. Dolerite from the feeder is inferred to form a thick sheet beneath the Quamby Mudstone correlate flooring Regents Plain, accounting for the relatively high topographic occurrence of the correlate (fig. 17*b*). South-west of Regents Plain, an approximately NW-trending steep-intrusive boundary occurs between the correlate and the dolerite. This dolerite intrusion shelves to the west, intruding the Bogan Gap Group correlate, but the stratigraphic separation of the two correlates exceeds their topographic separation, and relative uplift of the Quamby Mudstone correlate is indicated. This uplift could be due to pre-intrusive faulting but is adequately modelled by assuming that the sheet in the Bogan Gap Group correlate is several hundred metres thinner than its corresponding inferred occurrence below Regents Plain. Some fossiliferous calc-silicate hornfels occurs along the steeply transgressive segment south-west of Regents Plain. These may be fault slithers or xenoliths [058465]. The sheet continues to rise along steep transgressive segments which extend north and east from the south-west corner of the dolerite shelf area to intrude horizons in the Upper Parmeener Supergroup (fig. 17*b*) [015465].

East of Regents Plain, the dolerite scarp (over 300 m) is considered to be a further transgressive segment which shelves high in the Lower Parmeener Supergroup, as indicated in the Lake River Quadrangle (Matthews, 1974).

South of Regents Plain, the sheet has intrusive contacts with overlying calcareous fossiliferous strata (Pl) in Micks Creek. These strata are uplifted in excess of 250 m relative to the Bogan Gap Group correlate strata on the shelf west of Regents Plain [065450]. If pre-dolerite faulting has not been operative, then the area of thickened dolerite may be inferred to extend from beneath Regents Plains, further afield beneath Micks Creek, and through to Lake Sorell, where the fossiliferous strata (Pl) occur near St Georges Island, and on the north-east shore of the lake at Mountain Creek and in Holes RG51 and RG52.

Immediately east of Woods Lake the dolerite has an exhumed, steeply transgressive segment, in places associated with Upper Parmeener strata [013440]. The occurrence of Upper Parmeener lithic sandstone in the Woods Lake area, relatively downthrown compared to surrounding areas, suggests a decreased dilationary effect from underlying dolerite or that the strata underlies the sheet. The possibility that the base and not the upper part of a sheet is exposed near shore level at Woods Lake is worthy of consideration but the preferred interpretation for the area is that an immense block of Upper Parmeener strata became depressed into the sheet surface whilst the magma was still fluid.

GREAT WESTERN TIERS

Where Isis Creek descends the Tiers escarpment, the sheet transgresses from the horizon which it intrudes from the northern map boundary (just above the Blackwood Conglomerate correlate) to ascend to a higher level, perhaps 120 m above the base of the Upper Parmeener Supergroup [214435 to 214400]. East of Gilwell Peak, the sheet descends abruptly to return to a similar horizon just above the Blackwood Conglomerate correlate [220366]. The transgressive segment is probably marked by the WNW-trending dolerite edge [215389]. The zone between Isis Creek and Gilwell Peak, where the base of the sheet intrudes the quartz sandstone sequence (Ꞧp), contrasts strongly with the occurrence of Lower Parmeener calcareous fossiliferous strata (Pl) from an horizon several hundred metres stratigraphically lower in the succession, which is inferred to occur above the sheet less than two kilometres away in bores RG51 and RG52 at Lake Sorell (fig. 17*a*). The relative uplift of the fossiliferous strata is of the order of 600 m, giving an approximation of the thickness of the underlying sheet.

The transgressive step in the sheet base east of Gilwell Peak is considered to be reflected (but with increased transgression) in the upper surface of the sheet by the approximately WNW-trending scarp north of Lake Sorell, extending perhaps as far as Hurricane Opening [087470]. Along this scarp the transgressive segment rises through, or from, the calcareous fossiliferous strata to through a possible occurrence of the Blackwood Conglomerate correlate [172427]. Similarly, the elevated spur of dolerite extending through Gavins Tier appears to correspond, in a general way, to the higher level of intrusion between Isis Creek and Gilwell Peak [250390]. Question marks have been omitted from the 'fault' extending east out of Isis Creek to pass north of Tiger Spur [230433]. There is no definite field evidence requiring such a fault to be present, and the northern face of Tiger Spur could be related to transgression. The north-trending belt of Upper Parmeener strata between Gavins Sugarloaf and Snobs Point to the north-west is not fully understood, as not all faulted or intrusive boundaries with dolerite were distinguished, and the locations of faults displacing strata within the strip were not found. From the eastern margin of this strip, the dolerite appears to transgress upwards to the east, and in the southern part of the strip the western margin may also be intrusive.

Gilwell Peak may mark the area where dolerite at Lake Crescent, beneath bore RG52, transgresses upward in a south-easterly direction to intrude above the Blackwood Conglomerate correlate on the Tiers scarp.

South of Tunbridge Tier Road, the base of the Central Plateau sheet has risen from an intrusive level just above the Blackwood Conglomerate correlate to horizons in the Cygnet Coal Measures correlate or slightly above until Mill Brook, whereafter the intrusive level gradually ascends higher into the quartz sandstone sequence (Ꞧp), to be at least 80 m above the base north of the Blackman River [260308]. The structure is not as clear where the Blackman River enters the lowland plain and further south to Green Spur, but the intrusive contact between the quartz sandstone (Ꞧp) and dolerite west of Green Spur may be interpreted to be the gently transgressive basal boundary of the sheet. This interpretation may be extended south of Stringy Bark Rivulet to infer that the sheet transgresses above the quartz sandstone sequence (Ꞧp) to intrude younger quartz sandstone (Ꞧls") and lithic sandstone (Ꞧls') horizons [299275, 302272]. This interpretation is consistent with the regional pattern and the location of possible lithic sandstone sequence rocks (Ꞧls') two kilometres further north, but there is no clear indication that the strata near Green Spur do, in fact, underlie the sheet, nor is there irrefutable evidence that the strata are bounded to the north-east by a post-dolerite fault. The interpretation of the inferred fault is confused by the presence of some contact metamorphic effects in the strata adjacent to it in Stringy Bark Rivulet, and also areas of fine-grained dolerite (f) adjacent to the 'fault'.

The intruded horizons, indicated by the sheet base along the Tiers scarp, are similar to those indicated by the sheet top in adjacent areas on the Central Plateau, other than across the transgressive features near Gilwell Peak. The thickness of the Bogan Gap Group correlate (about 250 m), in the absence of marker beds, prevents a precise comparison being made. The Bogan Gap Group correlate (Ps) and the underlying fossiliferous strata (Pl) may be intruded beneath the northern half of the Lake Sorell to south of St Georges Island, but further south only contacts with the Bogan Gap Group correlate are found, and in the southern corner of the lake the intrusive level is near the Blackwood Conglomerate correlate [148338]. Further south at Agnews Marsh, the intrusive horizon is in the Upper Parmeener Supergroup [172324]. This is also probably the case at the northern end of Racecourse Marsh, where soft quartz sandstone (Rp?) occurs near very fine-grained dolerite with orthopyroxene phenocrysts [210353]. The origin of hornfels pieces inferred to be derived from Lower Parmeener rocks and found in the dolerite talus further south at Racecourse Marsh is not certain, but the hornfels could be derived locally if the intrusive level is near the Upper/Lower Parmeener boundary. This is supported by the occurrence of granule or coarse-grained sandstone outcrops nearby [200328]. The general structure at Lake Sorell–Lake Crescent is therefore consistent with a sheet gradually transgressing into younger strata in a southerly direction. On a local scale, the sheet on the south-east side of Lake Crescent transgresses gently to the south end to rise above the Upper/Lower Parmeener boundary, if not by Racecourse Marsh, then certainly at the Tiers escarpment.

CENTRAL PLATEAU WEST OF LAKE SORELL–LAKE CRESCENT

Fine-grained dolerite and contact metamorphism of Bogan Gap Group correlate strata along parts of the linear boundaries of the dolerite west of Lake Sorell indicate that these margins are intrusive features (fig. 17*a*). The margin has a prominent magnetic anomaly compared with that on possible dolerite outcrops east of the margin a little over one kilometre north of the Interlaken Road [093354]. The topographically high dolerite between Lake Sorell and Woods Lake is considered to be high because of intrusive form rather than subsequent faulting (fig. 17*a*). It is noteworthy that Woods Lake is about 80 m lower than Lake Sorell, yet strata exposed on the shorelines of both lakes is stratigraphically hundreds of metres higher at Woods Lake. As noted above, the appealing explanation that the strata at Woods Lake lie below the dolerite has been rejected in favour of sinking of young strata into the upper surface of the sheet, although other mechanisms, such as pre-dolerite faulting extending from Regents Plain, could be used in models to explain, in part, the rock distribution. Similarly, a depressed area in the sheet, bounded by linear scarps and floored in places by Upper Parmeener lithic sandstone (Rls'), is interpreted as a large (1×1.5 km wide) polygonal indentation in the sheet caused by the sinking of strata. The best exposed strata dips WNW at 9° but has been omitted from the map [034247]. Further north, dolerite underlies metamorphosed strata [042251] indicating (in the absence of more than one intrusion) that erosion has not revealed strata underlying the sheet. Xenoliths of fine-grained dolerite in coarse-grained dolerite on the western scarp support Jurassic movement along the scarp prior to complete crystallisation [025242]. A similar feature may be aligned along Bushrangers Creek nearby. On air photos, this feature looks like a NW-trending graben about one kilometre wide.

Other irregularities in the sheet are of positive relief. For example a broad dyke-like feature rises in excess of 120 m above the fine-grained upper sheet surface to the north and shows some exhumed intrusive boundary effects on its northern margin at Soldiers Marsh Hill [005305]. Such features of various scales normally consist of coarse-grained or granophyric dolerite, and resemble the Red Hill Dyke (McDougall, 1962).

Additional information relevant to the sheet structure in the south-west of the quadrangle comes from the adjacent Lake Echo Quadrangle. Only a few kilometres west of the Interlaken Quadrangle, Bogan Gap Group correlate rocks overlie the dolerite sheet, forming a large tract of lower country separated from the Interlaken Quadrangle by a steep escarpment. As the escarpment is approached from the west, a succession of concordant strata is revealed, including the Blackwood Conglomerate correlate, the Cygnet Coal Measures correlate, and the quartz sandstone (Rp), dipping possibly with increasing angle towards the escarpment, where vertical quartz sandstone beds abut a vertical, broad, dyke-like dolerite mass. The 'dyke' appears to intrude the vertical strata, and additional minor dykes in quartz sandstone occur west of the major structure. East of the major dyke, approximately flat-lying siltstone and lithic sandstone (Rls') form the outcrops, but are ringed and probably underlain by dolerite. The surrounding dolerite of higher topographic expression merges with the dolerite of the Interlaken Quadrangle. The relationships between all dolerite and lithic sandstone outcrops are not known, and some lithic sandstone may possibly underlie dolerite. Thus just outside the quadrangle, and in the River Clyde and at Woods Lake, and possibly in intervening areas, the dolerite sheet intrudes above the base of the Upper Parmeener predominantly lithic sequence (Rl).

TABLE MOUNTAIN AREA

Table Mountain is capped by a relatively thin sill (about 40–60 m thick) which in places is separated from lower dolerite outcrop by in excess of 200 m of Upper Parmeener strata [120250]. Although strata may partly obscure the continuity of the lower dolerite, the rather irregular dolerite forms about Table Mountain are considered to be part of the Central Plateau sheet. The occurrence of dolerite intrusions at two separate stratigraphic horizons at Woods Quoin to the south has already been indicated (Forsyth, 1984*a*). The possibility that there are two dolerite masses of separate ages, one intruding the other, was investigated routinely in the course of normal field mapping at Table Mountain. Based on the evidence found, two distinct intrusions could not be substantiated, and instead the two levels of intrusion appear to merge with each other. The upper sill appears to be a split from the Central Plateau sheet. Some veins of very fine-grained dolerite with large hydrothermal crystals in fine-grained dolerite were found north-east of Table Mountain at about the level of the base of the upper sill but this is probably due to the cracking of a normal dolerite intrusive margin [128254].

A broad tract of sandstone country extending south-east from the southern shore of Lake Crescent appears to be underlain by dolerite which transgresses steeply upwards to delimit the sandstone area along its south-west boundary. This inferred transgression is probably related to the sheet splitting at Table Mountain. The structure east and south-east of Table Mountain is difficult to resolve because of poor outcrop in areas of dolerite talus. A NE-trending fault has been inferred in this area to separate fine-grained dolerite intruding downthrown volcanic lithic sandstone (Rlg) [132229 to

142249] from dolerite of more variable grain size north-west of the inferred fault. The possibility that the dolerite masses on either side of the inferred fault merge together could not be entirely dismissed. The dolerite contact with the volcanic lithic sandstone (Rlg) dips north-easterly at 45° [142238]. This higher level sheet intrudes at a higher stratigraphic level than the sheet capping Table Mountain, and unless undetected faulting intervenes, only 50–80 m of strata separate this higher level sheet from a lower sheet [140230]. The two sheets occurring here need not correspond with the two sheets occurring at Table Mountain.

MIKE HOWES MARSH AREA

From Boggy Marsh [160250] through to Headlam Top, the down-faulted Central Plateau sheet has contacts with, or intrudes below, the quartz sandstone sequence (Rp). Younger strata, including the volcanic lithic sandstone (Rlg), are downthrown at Mike Howes Marsh and are intruded by smaller scale, generally fine-grained dolerite bodies. The smaller intrusions are too irregular to be simple sills but may be sheet-like forms, perhaps the erosional remnants of a sheet which once covered the marsh area.

CURRAJONG HILLS–BLACK TIER–RED RIDGE AREA

Through most of this area, major sheets of dolerite intrude the predominantly lithic sequence (Rl) near or slightly below the base of the volcanic lithic sandstone sequence (Rlg). Minor sheets intrude within the sequence Rlg. Quartz sandstone (Rls") overlies the major intrusion at some localities, for example near Currajong Hills [263235, 270256, 287266, 312227 (Rls)], and more extensively near the Sorell Springs Road, for example at 365235, indicating more accurately the intruded horizon. Sheet splitting? may give rise to higher, thin sheets near Currajong Hills, for example at 280230 and at Little Flinty [283225], and it is possible that irregular intrusions near York Plains may also be part of a higher-level intrusion [392233]. Other sheet-like intrusions stratigraphically high in the volcanic lithic sandstone sequence occur near Antill Ponds [332256], Red Ridge [390320], Nessie Rise [390307], Brents Sugarloaf [412295], and at various localities south of Glen Morey Road south to the inferred fault, for example at 401281. The minor dolerite bodies south of Glen Morey Road are complex in form and include both sheet and dyke-like parts, and in places may be composite intrusions composed of both columnar fine-grained dolerite (Jdlc) and platy-jointed fine-grained dolerite. The intrusions are considered to be down-faulted but they may possibly post-date the fault. Their abrupt northern margins may be fault related. The easternmost occurrence at the quadrangle boundary is probably a broad NE-trending dyke. Some narrow dykes parallel the margins of larger dolerite masses and may be narrow dyke feeders [265291, 267293]. No dolerite was detected by magnetic profiling immediately east of Tin Dish Rivulet between Glen Morey Road and the fault one kilometre to the south [260295]. Magnetic profiles over fine-grained dolerite north of Glen Morey Road suggest the outcrops may be part of a thin intrusion underlain by metamorphosed siltstone and some lithic sandstone [342307, 343308]. If this is the case, then the fine-grained outcrops may correlate with the minor intrusions south of Glen Morey Road but insufficient data were collected to prove this interpretation. An alternative interpretation is that the fine-grained dolerite outcrops north of Glen Morey Road are the top of a major sheet dipping to the north-east.

The number of major sheets in the south-eastern part of the quadrangle is not clear but one only is assumed. A north-trending fault extends from the Oatlands Quadrangle to just south of Headlam Top [250240], and separates a major dolerite intrusion in the quartz sandstone (Rp) from dolerite intruding the lithic sequence (Rl) to the east. The fault may be considered to approximately coincide with a transgressive segment of the sheet where the dolerite ascends from the quartz sandstone sequence (Rp) into the overlying lithic sequence (Rl). This is supported by the rising transgressive sheet segment east of Headlam Top, and is consistent with the interpretation noted earlier of the dolerite structure near Green Spur. The north-trending fault does not terminate south of Headlam Top but abruptly trends north-easterly and becomes difficult to locate once it enters dolerite terrain. It is unlikely that two separate, major intrusions are present in the dolerite terrain unless erosion has bevelled their upper surfaces close to the same topographic level.

The concept of a single major intrusion can be extended east from Currajong Hills to the dolerite mass forming Rockwood Hill [320270], Bellvue Hill, and Black Tier [405255], implying that extensive areas of hornfels overlying dolerite near Sorell Springs Road in the intervening area is, in part, a graben superimposed on an irregular sheet top. The base of a minor, stratigraphically higher sheet is exposed in a cutting on the Midland Highway [338255]. This may be the same sheet as that intruding very high in the volcanic lithic sandstone sequence (Rlg) 600 m further west. Murray Sugarloaf is interpreted as an irregular boss from the main sheet [275263].

The fault south of Glen Morey Road is interpreted to downthrow the major dolerite sheet so that it underlies the extensive area of volcanic lithic snadstone (Rlg) to the north. The occurrence of underlying dolerite is supported by occasional dolerite dykes, contact metamorphic effects, and magnetic anomalies. Relatively shallow dolerite is especially indicated east of Red Ridge and Nessie Rise, and extending south from the mapped outcrops of dolerite west of Red Hill to almost as far west as the Midland Highway. Shallow water bores (see Appendix 1) generally did not intersect dolerite, except for one bore east of the quadrangle which intersected dolerite at 66.5 m near Gaffs Hill (Scott, 1930). Magnetic anomalies also suggest that dolerite underlies part of Glen Morey [403304], and that the edge of a tabular dolerite body occurs approximately 200 m north of water bore RG143 [409287]. In other areas, for example between Nessie Rise and Red Ridge, the magnetic field appears very uniform, and shallow dolerite is not indicated. Magnetic profiles which cross Glen Morey Road west of Tin Dish Rivulet also suggest that the underlying sheet is not shallow but rises gradually in a northerly direction. A narrow dolerite dyke, not indicated on the map, may merge with the higher level sheet forming the north-west corner of Red Ridge.

An approximately east-trending structure north of Red Ridge appears to separate the area of volcanic lithic sandstone to the south from the area of quartz sandstone (Rp) with numerous dolerite dykes further north. Features possibly related to the east–west structure include southerly-dipping quartz sandstone strata [393332–410330]; the east-trending dolerite dyke [390327–396326], and the associated magnetic anomaly which extends a further 0.5 km to the east of the exposed dyke; the linear dolerite margin [406324–413323]; and possibly the very steep southerly-dipping metamorphosed younger quartz sandstone (Rls") strata intruded by dolerite south of Tunbridge [357325] or the dipping strata further north [367334]. The east-trending structural feature could be related to a sheet transgression into younger strata towards the south, with corresponding sheet thinning and possible splitting mimicking, through different dilation effects, the same rock distribution which could be formed by pre-dolerite or post-dolerite faulting.

BELLS LAGOON AND SURROUNDING AREAS

Dolerite is exposed almost continuously from Kitchener Ridge, west of Ross, south almost to Woodbury. Fine-grained dolerite along the western margin of this dolerite area is interpreted as the upper margin of the sheet dipping gently beneath Tertiary and Quaternary deposits which obscure the sheet further west. Magnetic profiles and the water bore RG122 suggest that the sheet may extend at shallow depth for over one kilometre west of the outcrop along Tunbridge Tier Road. There are very few indications of the stratigraphic level at which the sheets intrude in the Bells Lagoon area, and from north of Tunbridge Tier Road south to the Midland Highway, no Parmeener strata are known to crop out. Dolerite further west from Gavins Tier to She Oak Ridge is considered to be uplifted along one or more faults. West of Bells Lagoon, near the foothills of Gavins Tier, dolerite intrudes or is overlain by rocks of the lower lithic sequence (Ꞧls), for example at 266405. Further south, quartz sandstone (Ꞧp?) may be intruded [277389], and further north horizons with silicified bioturbated quartz sandstone (Ꞧpc') appear to overlie the intruded horizon [251431]. East of Bells Lagoon, laminated quartz sandstone (Ꞧls") overlies the intruded horizon [311418].

Closer to Bells Lagoon it is difficult to distinguish fine-grained minor sheets from the fine-grained top of major sheets. Many of the minor sheets are associated with the predominantly lithic sandstone sequence (Ꞧl), and some are associated more specifically with the upper part of the volcanic lithic sandstone (Ꞧlg). Closely-spaced megajoints in the dolerite east of the access road to Bells Lagoon suggest that the outcrop is part of a minor sheet, and not part of the major sheet inferred to underly the area [300395]. This is supported by closely associated dolerite and lithic sandstone outcrops exposed in a water hole, and the lack of dolerite intersections in a water bore at the same site [297397]. Further north, water bore RG112 [296404] failed to intersect dolerite, and a new bore (about 100 m to the east) penetrated about ten metres of dolerite enclosed between carbonaceous strata. A thin sheet is also indicated at a waterhole almost surrounded by dolerite but excavated in Upper Parmeener mudstone [303402]. Other water bores failed to intersect nearby surface dolerite [306400, 311404]. At the latter locality, exposed deeply-weathered lithic sandstone with montmorillonite clay and biotite-quartz intergrowths, determined by X-ray defraction (R. N. Woolley, pers. comm.), is probably Upper Parmeener strata, and Upper Parmeener mudstone cuttings were obtained from the bore (W. L. Matthews, pers. comm). Various isolated outcrops of dolerite to the north and north-east of this locality, and possibly some granophyric outcrops to the north-west, may belong to the major underlying sheet, however the possibility of granophyric phases occurring in minor sheets, especially near feeder dykes or splits from major sheets, prevents complete certainty. Magnetic profiling indicates that most of Bells Lagoon is shallowly underlain by dolerite, the eastern edge of which coincides with the mapped spur of dolerite occurring on the eastern side of Bells Lagoon and west of the augered lithic sandstone indicated Ꞧl [295403]. This dolerite approaches medium grain size (m), and is probably a thicker intrusion than minor sheets to the east.

Dolerite dykes

Dolerite dykes intrude strata and other dolerite intrusions. The widest dolerite dykes probably interconnect with dolerite sheets as steep, transgressive sheet segments or dyke feeders, and intrude between stratal blocks which may have undergone significant relative movement. An example of a dyke of this type occurs north of White Lagoon [366400]. Other narrow dykes intrude between stratal blocks which have undergone little or no relative displacement, other than the dilation caused by the dyke itself. The origin of such dykes is generally uncertain. Some may arise from underlying sheets as horns, for example a dyke east of Table Mountain [142232], but others could be related to intrusive periods post-dating the intrusion of major sheets. In the Oatlands Quadrangle some long, straight, narrow dykes were considered to be derived from elbows in underlying major sheets (Forsyth, 1984*a*). Spur dykes may extend from major, steeply-dipping intrusive boundaries [451400]. Some dykes are discontinuous, with sigmoidal and offset sections which probably unite at depth [240245].

Several types of dolerite dykes intrude dolerite. Those of granophyric composition, with diffuse or sharp structural boundaries, are late-stage dykes of the same period of intrusion as their host dolerite, and are confined to the top part of dolerite sheets. Such dykes need not be vertical, and grade into irregular masses which develop around cooling columns and horizontal joints. South of Glen Morey Road, columnar to blocky-jointed glassy, fine-grained dolerite forms distinct, steeply dipping zones in platy fine-grained dolerite. These zones are associated, in places, with intense magnetic anomalies and are probably dykes [395282]. Many fine-grained dolerite dykes intrude medium-grained or coarse-grained dolerite. These dykes tend to be found in the upper part of major sheets, although this may be a function of the intrusive levels exposed and not their actual distribution within sheets. A very straight dyke east of Murray Sugarloaf extends up into overlying hornfels [380258]. A very prominent linear, many kilometres long and visible on air-photos, extends from west of St Peters Pass into the Oatlands Quadrangle. Dyke segments coincide with the linear [310228], and in the Oatlands Quadrangle the dyke segments extend up into overlying strata, and may intrude a small fault downthrowing rocks on its southern side by a few metres. Many dykes intruding dolerite are far less regular at the outcrop scale but maintain an overall general trend. Abrupt changes in trend and thickness make these dykes difficult to map but good examples occur east of Gilwell Peak [214380] and east of Woods Lake, where outcrops may extend for over one kilometre east of the segment indicated [046391].

In general, dykes tend to contain less common orthopyroxene phenocrysts than the intrusive boundaries of major sheets, suggesting that some dykes may not be related to the initial intrusion of magma. Others, including dykes in coarse-grained dolerite, contain orthopyroxene phenocrysts and therefore appear to have formed during a completely separate intrusive phase.

Magnetic methods have proved suitable for detecting small concealed dykes, for example magnetic anomalies connect the dolerite intersected in bore RG8 at Ross with the dyke mapped to the north-east along a trend opposed to the trend of exposed segments. Spur anomalies suggest dyke off-shoots occur below the Ross recreation ground. A magnetic profile across a dyke exposed on the Midland Highway did not indicate any accompanying anomalies contrasting with enclosing Bogan Gap Group correlate [387423]. The northern boundary of the dyke strikes 125° and the southern boundary strikes 110°, but the dyke has been omitted from the map.

Faulting

Superimposed on the structures produced during intrusion of dolerite magma, the Parmeener strata and their contained major dolerite intrusions have been faulted and tilted.

EVIDENCE FOR FAULTING

Some faults were recognised by clear disjunctures between strata of different age or dislocation of strata of the same age, but many faults separate strata from areas of dolerite where no outcrops of host strata were found. In the latter case, faulting was recognised by dolerite boundaries (often linear scarps) with no indications of intrusive contacts with adjacent strata, and by inferred displacement of strata necessary to conform to the local model for intrusive form and the unlikely possibility of irregularities of intrusive form providing an alternative explanation to faulting. Faults mapped between dolerite masses were based on continuity of faults observed elsewhere, supported by air-photo linear or observed scarps, or abrupt textural changes of dolerite across the fault trace.

Some inferred faults in some Lower Parmeener rock intervals on the Great Western Tiers scarp are based on the apparent anomalous reduced thickness of the intervals. The locations of such faults are usually poorly defined.

The evidence for the east-trending fault mapped north of Tiger Spur is not good [220434]. Question marks have been omitted from this fault on the map. This area proved difficult to interpret, as changes of fault trends appear to coincide with, and may have been induced by, a transgressive segment of the dolerite sheet. Nearby, the linear McGhies Gully and adjacent subparallel NE-trending faults are conspicuous on air photos. These faults appear to transfer throw components between different faults of the main NNW-trending fault system.

A more-or-less consistent pattern of faults, trending approximately north to north-west, is present in the northern part of the quadrangle across the lowlands and extends up the Tiers escarpment. Many of the faults are subparallel, and the strata between the faults usually dip towards the south-west at low (less than 10°) angles. The faults are usually downthrown on their north-east side, although rarely the sense of throw is reversed [412360]. Near the Tiers escarpment the faults have throws of the order of several hundred metres but major faults do not appear to be common west of the Tiers escarpment. The linear valley of Mountain Creek, north of Lake Sorell, may indicate a fault trace. The lack of detected faulting on the Central Plateau may be due to difficulties in recognising faults in dolerite terrain but it is probable that the Tiers escarpment does, in fact, form the western limit of common faulting. Most scarps on the plateau surface appear to be related to irregularities in dolerite intrusions.

The topographic height of the Blackwood Conglomerate correlate exposed beneath the Central Plateau sheet along the Tiers escarpment indicates a fairly regularly falling gradient of about 1:55 over a distance of about 20 km from the northern quadrangle boundary SSE to Mill Brook. South of Tunbridge Tier, part of this falling gradient may be contributed to by downthrowing faults further west, but generally the gradient appears to be due to regional tilting of the Central Plateau area. If the structure proposed earlier for the dolerite structure near Regents Plain is correct, a westward-falling gradient of similar magnitude is indicated, suggesting the strata underlying the plateau area north-east of Lake Sorell probably have a regional dip approximately to the south-west. Progressively younger strata are exposed at lake level north to south across Lake Sorell and Lake Crescent, and may indicate the direction of regional dip of strata above the sheet in that area, but rare measured dips do not conform to such a dip.

The dominant NNW trend of faults in the northern part of the quadrangle does not persist through to the southern boundary. Instead the fault system 'appears' to swing to a more ESE or almost easterly trend, and is intersected by faults of various trends between NNE and ENE, producing a triple junction-like feature. The word 'appears' is used, as continuity of the faults has not been demonstrated and some inferred faults are based on structural interpretation, and alternative interpretations may be possible, particularly in the Stringy Bark Rivulet area. Fault systems may be of differing ages. Between the two arms of the southern fault systems, some north-trending faults occur near the southern boundary of the quadrangle.

The western arm transfers a component of the throw of the Tiers scarp system to more westerly situated fault systems in the Oatlands Quadrangle (Moore, 1968; Forsyth *et al.*, 1976). The dip of downthrown strata is rarely measurable at exposures but dip indications from bedding traces, and the dips of dolerite/strata intrusive contacts and exhumed intrusion boundaries (assumed to be sill-like), suggest downthrown strata dip towards the responsible fault. For example, the strata downthrown by the fault south-east of Lake Crescent appear to dip westerly and north-westerly towards the fault. Some measured dips are opposed to the general sagging of strata towards the faults, and may be due to more local effects [190240]. Very steep dips (e.g. 88°) are probably measured on rotated blocks in the fault zone [246271].

In some areas, relatively steeply-dipping strata or narrow grabens parallel to and abutting the main faults are inferred. The inference is based on the locally low topographic position of relatively high stratigraphic horizons, such as the horizon with bioturbated, silicified and fossiliferous sandstone (₧pc') [221469]; laminated quartz sandstone (₧ls") at 267314 and other outcrops nearby; and the horizon with extrabasinal clasts in the volcanic lithic sandstone sequence (₧lg) [330257]. A bounding graben fault may also produce the linear northern boundary of irregular dolerite sheets and dykes intruding between Glen Morey Road and the dolerite forming Bellvue Hill and Black Tier [380291]. Similarly, the eastern boundary of the area downfaulted at Racecourse Marsh may be a second (unmapped) fault, or perhaps an intrusive feature which influenced the trend of later faulting [198310].

Faults with the sense of throw opposed to the regional trends result in grabens, for example a graben crossed by Auburn Road [310460] and a graben at Mike Howes Marsh [218245].

A nett downthrow of over one kilometre occurs between the Central Plateau north of Lake Sorell and the strata underlying Tertiary sediments flooring the lowlands at the foot of the escarpment. This nett downthrow is contributed to by unmapped concealed faults or fault systems inferred to delimit, to the west, the area of thick Tertiary sequences. Based on the limited knowledge of rock distribution, supported by magnetic anomaly profiling and by analogy to mapped faults, the concealed fault or fault system is considered to extend from the northern boundary of the quadrangle, to pass between two distinct dolerite intrusions [241475], to pass near 245450, and to extend SSE to cross the Midland Highway north of Woodbury. A parallel fault probably downthrows the Upper Parmeener strata north-east of Gavins Tier relative to the tier itself. Similarly, fine-grained dolerite is probably downfaulted relative to coarser-grained dolerite nearby to the south-west [244426]. Such concealed and inferred faults could be considered to trend more easterly near Woodbury, parallel to the main fault systems which have been mapped, but the exact relationship to mapped faults near Woodbury is unknown. Magnetic anomaly profiles supporting the occurrence of a concealed fault bordering the area of thick Tertiary sequences were obtained from three kilometres south of the northern map boundary to near the Isis River and near Tunbridge Tier Road, but no magnetic traverses were undertaken between Tunbridge Tier Road and Woodbury.

A further fault system, largely concealed, is inferred to be apsproximately coincident with the Macquarie River valley near Ross. The youngest Parmeener strata located in this structure have undergone a nett downthrow of several hundred metres. Mapped fault segments west of the Midland Highway near Ross are considered to be part of this system. A concealed fault is inferred to cross the Auburn Road, passing between the coarse-grained dolerite intersected in bore RG1 and Upper Parmeener quartz sandstone intersected in bore RG20 [383464]. Magnetic anomaly profiles indicate that the edge of the dolerite area is abrupt. A further fault may separate the small dolerite outlier near RG1 from the main mass of dolerite north of Horton Hill. This possibility is suggested by the form of magnetic anomalies south of the dolerite outlier [383460]. Further south a fault has been indicated along the eastern edge of the dolerite forming Horton Hill. The fault location is supported by magnetic anomalies and the occurrence of Upper Parmeener volcanic lithic sandstone intersected in bores RG32 and RG37 drilled east of the fault. Other shallow bores (RG2 and RG39) situated south of RG37 on the Midland Highway intersected weathered dolerite and may lie west of the fault. Dolerite intersected in these bores appeared to be too substantial to be entirely alluvial deposits associated with the Macquarie River, and too coarse-grained to be minor intrusions within the lithic sequence (₨l).

In the south-eastern part of the quadrangle, the nett downward displacement from Mount Pleasant (in the Oatlands Quadrangle) to Brents Sugarloaf is approximately 200 m (Nye, 1921) [403216 to 412295]. This displacement is contributed to by the more easterly-trending fault system south of Glen Morey Road but other faults, tilting and dolerite dilationary effects may also contribute. The hornfels-floored valley along Sorell Springs Road east of the Midland Highway is assumed to be a graben but the evidence for faulting along the southern margin of the valley, and the sense of downthrow, is not conclusive.

West of the Midland Highway and immediately south of Rockwood Hill hand augering indicated that hornfels [330264] and volcanic lithic sandstone (₨lg) [322267] occur further west than surface exposures indicated on the map. The sedimentary rock flooring this valley (graben?) could conceivably continue further north-west beneath Tertiary basalt but possible westward extensions of mapped faults defining the structure could not be traced unambiguously through the dolerite and other terrain. If the structure persists north-westwards, it may narrow to a single fault. A key to the structural interpretation of this area is the stratigraphic position of strata near Green Spur relative to the dolerite sheet to the west [283290]. Unfortunately the relative stratigraphic position of the strata could not be determined with certainty but the strata were interpreted to underlie the dolerite sheet, inferring that a major fault occurred further east. Evidence collected for such a fault is ambiguous. The nature of the south-western boundary of the strata south of Stringy Bark Rivulet is also uncertain, and the boundary may be a basal sheet contact, minor or major fault. A further uncertainty in this area is the position of the extension of faults mapped in the Oatlands Quadrangle. A major north-trending fault system which crosses the Oatlands Quadrangle extends into the Interlaken Quadrangle, passing beneath basalt to emerge south of Headlam Top [250240]. Although a sharp eastward deflection in the fault trend has been mapped, the location of the fault further eastward in dolerite terrain is uncertain. The deeply eroded linear valley segments of the Currajong Rivulet and the position of Tertiary volcanic plugs at The Nipples [297261] may be related to the fault trace.

AGE OF FAULTING AND COMPARISON OF TRENDS OF FAULTS AND DOLERITE STRUCTURES

No conclusive evidence was found for faulting pre-dating the onset of Jurassic dolerite intrusion. Certain structures can be interpreted as pre-dolerite faults, but alternative, usually more satisfactory interpretations are possible, involving differential dilation over dolerite sheets or feeder structures of differing vertical thickness. An example of such a structure occurs in the north-west corner of the quadrangle west of Regents Plain, where a dolerite-intruded structure occurs between correlates of the Quamby Mudstone and Bogan Gap Group.

Many steeply-transgressive dolerite intrusions have linear segments and may have been influenced by pre-existing faults or joints but such fractures may have been generated during intrusion.

Differential vertical dilation of dolerite intrusions probably caused fractures to extend from the upper surface of intrusions to the ground surface, with corresponding displacement of strata. Some fractures of this type may have been depicted as faults; other possible examples are intruded by dolerite and have been depicted as dykes.

A prominent ENE-trending linear crosses the Interlaken–Oatlands Quadrangle boundary. This is in part a fault displacing a dolerite sheet and overlying strata, and in part a dolerite dyke intruding the dolerite sheet and overlying strata. Movement of Jurassic age is clearly indicated but the mechanism is unknown.

Many faults displace major dolerite sheets. Post-intrusive faulting is clearly indicated, for example where both the Central Plateau dolerite sheet and the underlying Blackwood Conglomerate correlate have been step-faulted down the Tiers scarp in the northern part of the quadrangle. Post-intrusive faulting is better illustrated where strata beneath the dolerite intrusion, and the sheet itself, undergo equal displacement. Where displacement is determined from strata above the intrusion and the intrusion upper surface, a further degree of uncertainty may be introduced because the effect of unequal intrusion dilation may not be known. Nevertheless most faults are considered to post-date the major dolerite intrusions. The time interval between dolerite crystallisation and subsequent faulting may be short.

Minor quantities of very fine-grained dolerite occur along some of the faults along the Tiers scarp. It was not possible to determine if the fine-grained dolerite pieces were parts of fault slithers, or were derived from minor intrusions in the fault planes. Elsewhere, an inferred fault which appears to displace a major dolerite intrusion [292500] also coincides with what appears to be an intrusive margin of an irregular dolerite intrusion [298481]. If the structures are correctly interpreted, two periods of dolerite intrusion are indicated and the fault is of Jurassic age. East of Woodbury and near St Peters Pass, pods of fine-grained dolerite intrude coarse-grained dolerite adjacent to faults separating the coarse-grained dolerite from finer grained intrusions and host strata [404278, 332253]. The pods may be pre-fault intrusions fortuitously intersected by the fault, or may be later intrusions which accessed the fault plane, or extensions of finer grained intrusions which crossed the 'fault' plane. If the latter interpretation is valid it is noteworthy that the finer-grained intrusions were subsequently faulted, as is evident in a cutting on the Midland Highway where the base of a sill is cut by small faults trending approximately 85° [338255]. The dyke east of Murray Sugarloaf may continue further west, where small dyke segments of the same trend as the main dyke segment were found but not indicated on the map [372254]. If the inferred fault west of Murray Sugarloaf is projected to cross the dyke, it is noted that the point of projected intersection corresponds with an inflection of the dyke to align with the fault trend.

Middle to late Eocene sedimentary rocks may have undergone limited post-sedimentation subsidence, possibly caused by faulting, but an upper age limit to some faults is indicated by unfaulted Tertiary basalt flows overlying fault traces and basalt plugs on fault lines. No evidence was found for faults cutting Tertiary basalt or duricrusts.

Fine-grained dolerite dykes which intrude older dolerite intrusions and overlying host rocks may have been derived from residual magma in the intrusions but in some examples the dykes contain orthopyroxene phenocrysts and therefore are probably related to a younger period of intrusion [e.g. 032392]. The trends of segments of these dykes have been analysed in two groups; dykes intruding dolerite and dykes intruding strata. Faults and steep igneous contacts were considered in one kilometre segments, and each dyke segment has been given a weighting of unity, irrespective of length. Trend diagrams (fig. 18, 19) were constructed by giving each trend a 4° equal field of influence symmetrical about the measured trend, or a wider field of influence appropriate for some curved sections.

It may be argued that dykes intruding the major sheets should not be influenced in a precise way by the strain pattern imposed prior to the major intrusions, unless joints from the host strata have propagated into the intrusion after crystallisation. The frequency of dyke segments (N=44) of similar trend increases slightly between 277–283°, 335° to about 005°, 025–048°, and 070–090° but otherwise show a uniform value except between 299–334°, in which interval only one dyke was recorded (fig. 18). The widest angle for which no dyke trends were recorded lies between 314–334° but otherwise an almost continuous spectrum of dyke segment trends occurs.

Dyke segments intruding strata (N=75) show an even greater number of trend directions, the widest gap in directions being between 309° and 321° (fig. 18). In some respects the frequency of dykes in certain directions increases in a parallel fashion to dykes intruding dolerite but differences do occur. The main directions are 279–309° (18 dyke segments), 321–353° (19 dyke segments), and various separate clusters between 40–84°.

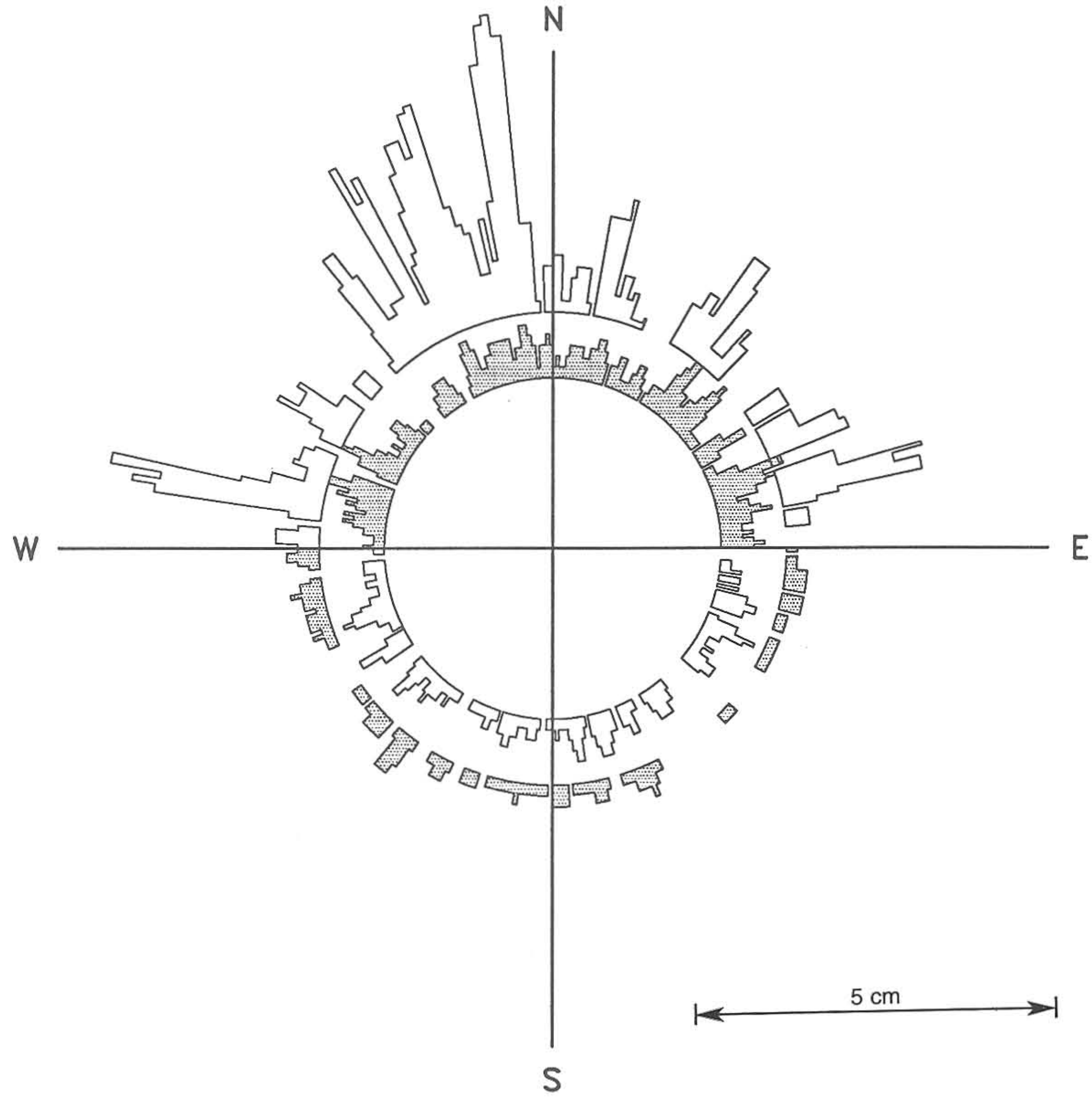

Figure 18. *Trends of faults and dykes. In the lower part of the diagram the trends of dolerite dykes intruding strata are shown in the inner circle, and dykes intruding dolerite are shown in the outer circle. In the upper part of the diagram trends of all dyke segments are shown in the inner circle, and trends of faults, excluding some doubtful inferred faults, are shown in the outer circle (length weighted).*

Summing the data for dyke segments intruding both media reinforces the noted clustering of trends between 334° and 0° and various clusters between 34–115°, and the noted less frequent occurrence of trends between 309–334°, for which only six dyke segments were found compared to an expected frequency of about sixteen.

Dyke systems (narrow dykes only) occur with the following approximate trends (±4°); 280°, 308°, 330°, 352°, 16°, 26°, 54°, 74°. The trends both overlap with and differ from trends of different groups of dyke systems in the Oatlands Quadrangle.

Some steeply-dipping transgressive segments of major sheets are well exposed, and reliable trend directions are determinable. Precision is frequently much less, and only a general trend is determinable, or the intrusions may curve in the horizontal plane preventing unique trend measurements. Trend data derived from transgressive steps of low amplitude have been indicated separately (fig. 19), as the possibility of confusion with post-dolerite faulting is increased as the step amplitude decreases. Trend directions have been length weighted (fig. 19). The data of various levels of confidence indicate that the preferred trend of steeply-dipping segments lies between 340°–003°, in contrast to the preferred NE to ENE trend in the Oatlands Quadrangle (Forsyth, 1984*a*).

As is readily evident from the map, faults (length weighted) are most commonly of trend 320–353°. Faults of trends close to 280° occur predominantly in the Sorell Springs–Woodbury area, and faults in the north-east quadrant appear to cluster into sub-groups. The faults of approximately NNW trend belong to the structural provence which coincides with the Longford and Tamar Basins which accumulated predominantly Tertiary sediments further north (Matthews, 1983; Longman, 1966). The general coincidence of the approximately NNW to north trends of post-dolerite faults, dolerite intrusive margins, and dykes is apparent. Various explanations for this parallelism of trends are possible: pre-dolerite or syn-dolerite jointing may have influenced all later structures; basement structures, including the Tamar Fracture system, may have controlled fracturing of overlying rocks at different times; or the structural features may have developed almost synchronously under the same stress field, i.e. faults described as post-dolerite may only post-date the major intrusive phase by a short time interval and may have continued to move during later periods.

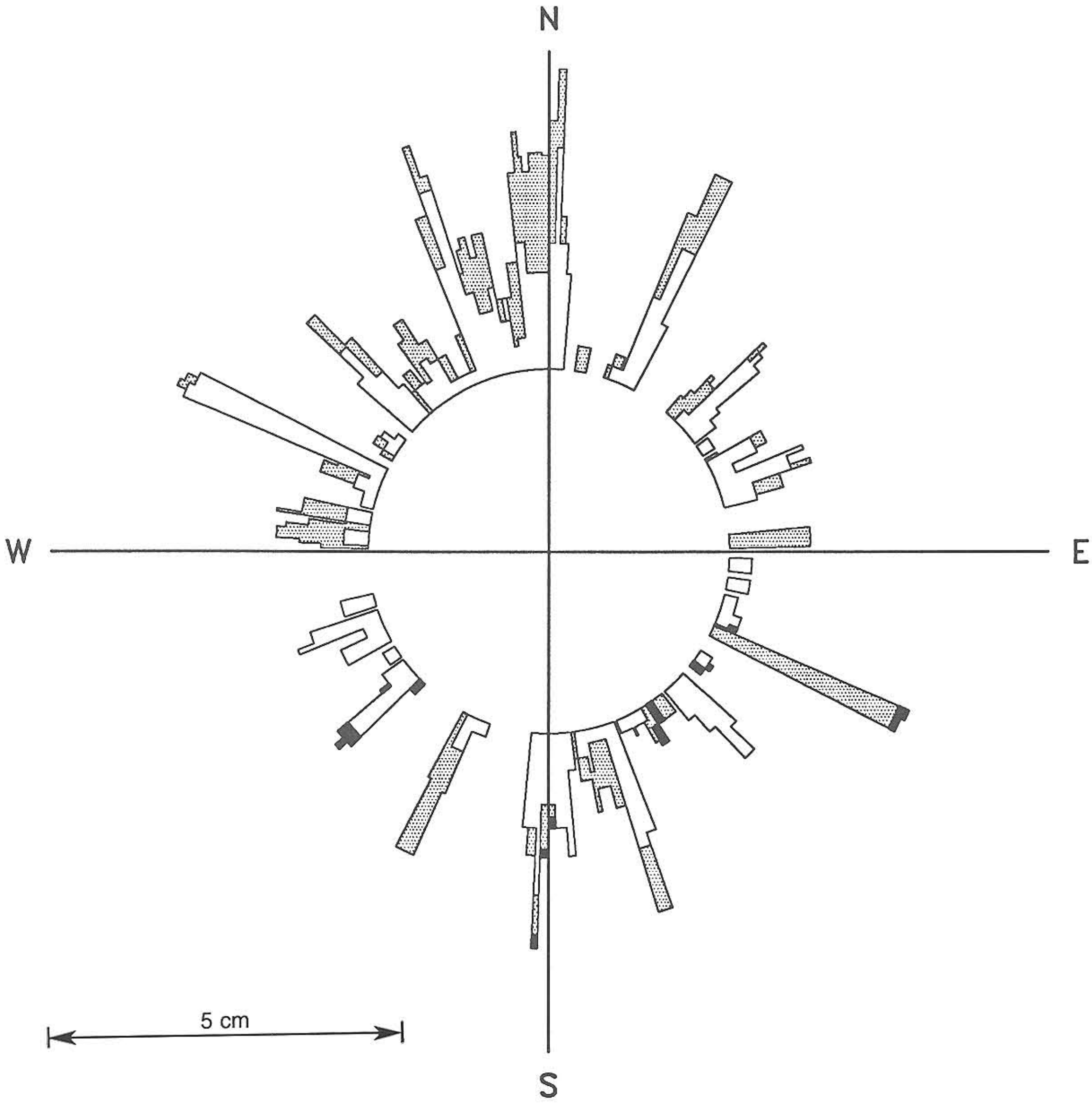

Figure 19. *Trends of steep intrusive contacts. In the lower part of the diagram are shown the trends of well defined straight or curved sections (hollow), poorly defined structures (stipple), and bosses (black). In the upper part of the diagram the combined data from the lower part are shown (hollow), and exhumed inferred igneous boundaries have been added (stipple).*

ECONOMIC GEOLOGY

C. A. Bacon

The economic mineral resources of the Interlaken Quadrangle are quite meagre. However, there are some occurrences of coal, building stone, and salt which are of some historical interest.

Coal

THE MIKE HOWES MARSH COALFIELD

Introduction

The Mike Howes Marsh Coalfield is situated in central Tasmania. Apart from samples taken during prospecting activities late last century no coal has been mined in this area. The coalfield has limited potential for further exploration.

Location and access

The coalfield is confined to a marsh around part of the Blackman River situated north-west of Mike Howes Lookout, a 740 m high hill at 211216. Access is gained from the Interlaken Road, which branches off from the Midland Highway at Oatlands.

General geology

The geology of the area has been examined by Twelvetrees (1902) and Nye (*in* Hills *et al.*, 1922). The coalfield lies partly within both the Oatlands (Forsyth *et al.*, 1976) and Interlaken (Forsyth, 1986) Quadrangles.

The coal is of Triassic age, and the seams occur as a minor component of a dominantly lithic sandstone sequence, the upper part of the Upper Parmeener Supergroup. The coalfield is of limited lateral extent.

Previous mining history

Apart from a few prospecting activities, no coal has been mined from this coalfield. The marsh from which the coalfield is named, and a hill immediately to the south of the marsh, Mike Howes Lookout, are named after the particularly callous and brutal bushranger Mike Howe, who used the area as a base. His bushranging career lasted from 1815–1817.

Coal quality

The only analyses available from this area are of an historical nature.

	1	2
Moisture (%)	25.4	8.4
Ash (%)	21.0	10.8
Fixed carbon (%)	33.0	62.4
Volatile matter (%)	20.21	8.4

1. Weathered and waterlogged sample collected by Twelvetrees (1902) from the short prospecting adit.

2. Drier sample collected from same seam (Twelvetrees, 1902).

Recent exploration

Twelvetrees (1902) visited the Mike Howes Marsh Coalfield in 1902, when an outcrop of coal on the northern side of Mike Howes Lookout [211216] had been opened up by a series of test pits and a short drive. The seam was noted to be 1.07 to 1.22 m thick, with a sandstone roof and clay floor. The test pits and short drive were all full of water at the time of Twelvetrees visit.

Two chip holes have been drilled in the coalfield in recent years as part of coal exploration programmes by two companies. The first hole (0-04) was drilled in 1982 by Capricorn Mining, with the second (JC-01) being drilled in 1984 by CRA. Both holes were drilled to a depth of fifty metres. One 0.12 m thick coal seam was intersected in hole 0-04.

Future potential

Due to the restricted lateral extent of the coalfield, and the thin nature of the seam exposed, the inferred reserves of this area are very small. The coalfield is of minimal interest for further exploration.

THE WOODBURY COALFIELD

Introduction

The Woodbury Coalfield, in the Midlands area of Tasmania, is located 12 km north of York Plains, where a small coal mine successfully operated for some years. The Woodbury deposit was evaluated by company exploration in the 1980–1984 period, and is currently held under mining leases and retention licence. The coal is of Triassic age. Mining of this deposit would be by open cut methods.

Geology

The area covering the Woodbury Coalfield has been examined by Nye (1921), and more recently mapped in detail by Forsyth (1986).

The host rock in which the coal seams occur is lithic sandstone belonging to the Upper Parmeener Supergroup. The coal is of Triassic age. The geology of the area is discussed in detail by Forsyth (this volume).

Previous mining history

No mining activity has yet taken place in the Woodbury Coalfield, although coal was mined on a small scale from about 1883–1947 at York Plains, 12 km south of Woodbury.

Coal quality

Some analyses are available from the early phase of exploration:

Moisture (%)	1.9	4.1	5.6	5.1	2.3
Ash (%)	39.2	27.8	26.0	39.5	34.6
Volatiles (%)	13.0	19.8	20.0	18.1	7.9
Fixed carbon (%)	45.9	48.3	48.3	37.3	55.2
Specific energy (MJ/kg)	18.7	22.1	22.8	17.6	20.2
Sulphur (%)	0.25	0.46	0.45	0.43	0.38
Chlorine (%)	0.03	0.04	0.01	0.03	0.03
Seam thickness (m)	0.78	2.86	1.05	0.57	1.28

1. W36A seam A, samples 1, 2 (Summons, 1982)
2. W39, seam D (Summons, 1982)
3. W38, seam D (Summons, 1982)
4. W25, seam C, sample 2 (Summons, 1982)
5. W47, seam C, samples 1 and 2 (Summons, 1982)

Beneficiation by washing, with yields in excess of 40%, will produce a washed product with the following characteristics:

Moisture	12%
Volatile matter	18%
Ash	24%
Fixed carbon	46%
Specific energy	21.5 MJ/kg
Sulphur	<0.5%

(*Register of Australian Mining, 1985/86*)

Recent exploration

A scout drilling programme was begun by Victor Petroleum and Resources Ltd in 1980 in an exploration licence area held by the North West Bay Company Pty Ltd, covering a large part of central Tasmania. At this time, initial mapping for the Interlaken Quadrangle was being done by S. M. Forsyth of the Tasmania Department of Mines.

From the preliminary mapping and examination of water bore records, Forsyth delineated potential target areas near Woodbury in which coal seams may have occurred. These areas were subsequently drilled by Victor Petroleum, with encouraging results. Mining leases and a retention licence for coal are currently held over the Woodbury Coalfield by a Victor Petroleum and Resources Pty Ltd/Costain Australia Ltd/North West Bay Pty Ltd joint venture partnership.

Future potential

The Woodbury Coalfield is currently held under a series of mining leases (1070P/M—1078P/M) and a retention licence (RL873), all in the name of Costain Australia Ltd, Victor Petroleum and Resources Limited, and North West Bay Co. Pty Ltd. The area has potential for further development. Reserves have been given as 12 million tonnes measured *in situ*, with a further 10 million tonnes indicated *in situ*, all suitable for extraction by open cut means.

Building stone

MIKE HOWES MARSH [231239]

Only one mining lease for building stone is currently held in the Interlaken Quadrangle. This is 1189P/M held by G. N. Howard for building stone. The sandstone is part of the Rp sequence, described by Forsyth (this volume) as 'freshwater cross-bedded quartz sandstone'. A sample was examined by Sharples *et al.* (1984) to determine the suitability of the stone for use as a building material. The stone was noted to split easily along bedding planes, forming slabs rather than blocks, and showed the following physical characteristics (Sharples *et al.*, 1984):

colour:	largely ironstained
water absorbtion:	4.47 (weight% at 96 hours)
effective porosity:	10.15 (volume% at 96 hours)
bulk density:	2270 (kg/m^3, dry basis)
dry point load strength:	2.89 MPa perpendicular to bedding 1.96 MPa parallel to bedding
clay content:	23.0% by volume
illite:	6.0% by volume
kaolinite:	17.0% by volume

The stone was classed as having good durability and had been used in the construction of one house at Ross. The potential of this stone is in the provision of paving slabs or small blocks.

ROSS

Numerous small quarries, mostly still accessible and workable, occur on a low sandstone ridge south-east of Ross township (Sharples *et al.*, 1984). These quarries were used to provide building stone for numerous local buildings, including the local church; for the Ross Bridge, the oldest bridge in Australia (built in 1836); and for building St Johns Anglican Church, Launceston, in 1825.

Four quarries, located at 405465 (one quarry) and around 415460 (three quarries), were sampled by Sharples *et al.* (1984). These samples showed the following physical characteristics:

colour:	grey, yellow-orange where ironstained
water absorbtion:	6.96 (av. weight% at 96 hours)
effective porosity:	15.01 (av. volume% at 96 hours)
bulk density:	2169 (average kg/m^3 dry basis)
dry point load strength:	0.64 MPa (average all directions)
clay content:	33% (volume%)
illite:	26.4 (volume%)
kaolinite:	6.6 (volume%)

The stone was noted to be susceptible to salt attack, but the absence of swelling clays means that the stone would be quite durable.

MINOR SOURCES

A number of very small quarries exist within the quadrangle, from which one or two nearby buildings (usually homesteads) were built. Most of these quarries are in Triassic sandstone, but one barn near 339342 has been constructed from Permian siltstone.

Fine-grained examples of the local sandstone have been used extensively as tombstones in the Ross and Oatlands cemeteries.

Gravel

'Buckshot' gravel, used as road base and road surfacing material, has been and still is quarried from a number of pits around 265450, 281481 (on the Verwood Estate), and around 284337 (on the Annandale Estate). The gravel is composed of pisolitic ironstone nodules, described in detail by Forsyth (this volume).

Dolerite talus and dolerite rock are quarried for use in road construction from several pits in the area. The larger pits are located at 259367 (on the Annandale Estate); 076230 (on Dennistoun Road); 089285 (southern side of Lake Crescent); 074346 (near Interlaken); 131348 (near Interlaken); and 337240 (near St Peters Pass). The reserves of all these sites are classed as 'medium' (10 000 to 1 000 000 t), with the exception of the St Peters Pass occurrence, which is small (1000–10 000 t). Granophyre is quarried at 115301, also for use in road construction.

Additional information, such as grain size analyses, chemical analyses and other physical parameters of these gravels, are available from the Department of Mines' Construction Materials Register.

Numerous small dolerite quarries opened up for farm road maintenance do exist. These are all very small and used only occasionally to supply a trailer load or two of gravel for local road/track maintenance.

Hornfelsed Permian siltstone (Ps) is quarried at 190350 (near Interlaken), and hornfelsed Triassic sandstone is quarried at 291279. Both are used in road building and maintenance.

Shingle, derived from Permian siltstone, is quarried on a minor scale from the shore of Lake Sorell [at 087377] also for use in road building.

Salt

Saltpans, or small lakes and ponds, the surfaces of which are encrusted with salt when dry, occur east of Tunbridge, in the area known as Saltpan Plains. Samples of this salt were collected by the mineralogist Humphrey and sent to Collins in 1810 (*Historical Records of Australia* 111(1) p. 431). The discovery was described by Macquarie, in a letter to Collins dated 8 March 1810, as being 'of the very first importance'. Governor Macquarie visited Saltpan Plains in December 1811 and examined two of the salt pans, which are shown on maps drawn by Evans in 1821 and Frankland in 1837.

An example of this salt was given to the Tasmanian Museum in 1889 by Joseph Barwick and discussed at the Royal Society meeting in April of that year. Mr Barwick recalled seeing salt being bagged in the area 'well over' fifty years ago (*circa* 1840) when 'many hundreds of tons' were scraped up for domestic use. The salt pans were examined by Twelvetrees (1917), in connection with a search for oil in Tasmania, and by Reid (1919*a*), to ascertain their suitability as a source of alkali.

The most 'salty' pans, from which considerable quantities of salt have been gathered, occur on the Ballochmyle and Mona Vale Estates. A detailed description of the salt pans can be found in Nye (1921).

Currently no use is made of the salt. A sustainable yield is most unlikely to be obtained from any of these pans.

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APPENDIX 1

Summary of drilling, Interlaken Quadrangle

The drilling results presented in this Appendix fall into three main categories; underground water bores; coal exploration bores; and geological investigation bores. No records of engineering geology bores were sought, and the results of a large number of coal exploration bores near Woodbury are not publicly available.

Bores RG1–RG53 are mainly shallow diamond-drill holes put down as part of the mapping program for the Interlaken geological map. Superficial deposits intersected in the upper part of many of these bores were augered, rather than diamond drilled. Bores RG100–RG144 are underground water bores, and are indicated on the map. Bores RG145–RG146 are deep, diamond-drilled stratigraphic bores.

The remaining bores listed are underground water bores, coal exploration bores and shallow (<6 m) hand-augered bores put down during mapping. Bores listed Y are indicated on the map and bores listed N are not indicated on the map.

The oldest water bores were diamond drilled. The logs of more recent water bores are driller's logs based on cuttings. Where possible, geologists' comments on cuttings have been indicated in brackets following the drillers log. Most bores have been accurately located, and co-ordinates are listed; the entry "Co-ordinates?" indicates that the bore has not been located accurately and drillers co-ordinates have been listed; "Co-ordinates??" indicates that the bore is accurately located but the drilling details and log may not correspond to the listed bore. "DOM Ref" is the Interlaken Quadrangle card reference number in the Department's underground water bore register.

BRAES No. 1 BORE, 1925

Interval (m)		*Lithology*
From	*To*	
0	3.0	friable buff mudstone
3.0	33.5	blue-grey feldspathic sandstone
33.5	34.4	very poor coal
34.4	39.0	friable black mudstone
39.0	43.3	blue-grey feldspathic sandstone
43.3	45.7	friable dark grey to black mudstone
45.7	76.2	blue-grey feldspathic sandstone with very thin mudstone bands and coal markings
76.2+		black carbonaceous mudstone with pyrite

TUNBRIDGE TIER–RG145 — Summary log

Interval (m)		*Lithology*	
From	*To*		
3.47	4.34	Ps	
4.34	6.86	Pb	
6.86	139.4	Ps	
139.4	143.5	Pp	
143.5	249.9	Ps (includes basal fossiliferous sandstone)	
249.9	352.68	Pl	
352.68	390.98	Pa	
390.98	≈466	Pg	
		430.61–432.83	Billop Formation correlates
466	484	Pg/Pq transition	
484	489.89	Pq	
489.89	496.27	Tb contacts included ≈5°	
496.27	547.61	Pq	
547.61	547.64	Tb green basalt, subhorizontal contacts	
547.64	549.29	Pq	
549.29	549.35	Tb grey basalt with chilled? contact and white material	
549.35	549.51	Pq	
549.51	549.70	Tb	
549.70	550.59	Pq	
550.59	550.605	Tb? green vein	
550.605	550.62	Pq	
550.62	551.30	Tb basalt with brecciation, and carbonate and montmorillonite infill	
551.30	706.53	Pq	
706.53	905.68	Pt	
905.68	914.45	Precambrian? strata	

ROSS–RG 146

Interval (m) From	To	*Lithology*
?	36.8	Ps
36.8	133.20	Pl
133.20	172.80	Pa
172.80	214.8	Pg
214.8	216.15	Billop Formation correlates
216.15		Pg
		Pg/Pq transition
	418.30	Pq
418.30	481.90	Pt
481.90	502.76	Jdl
502.76	540.8	Pt
540.8	615.44	Precambrian? strata
615.46	652.80	Jdl

MISCELLANEOUS HOLES

To assist in bore identification, drilling contractors have been indicated as follows:

DOM	Department of Mines	TD	Tasmanian Drillers
Rick	Rickards (R. S. & B. J.)	G & G	G. & G. Gleason
Stack	H. J. Stackpoole	Overl	Overland
Mono	Mono Pumps	AGP	Austral Geoprospecting
IBC	Intercontinental Boring Company	Victor	Coal exploration bore (EL 31/80)

ASL is the bore collar height above sea level in metres.

Map	AMG Ref	Location	Driller	DOM Ref	Log (depths in metres)
N	271495	Auburn Road	Victor		Closed file
N	273493	Auburn Road	Victor		Closed file
N	366479	J. Cameron, Williamwood	DOM		0–30.0, includes fossiliferous siltstone (Pl).
N	362463	J. Cameron, Williamwood	DOM		0–32.0 siltstone and sandstone (Ps). Drilled 23.11.1983
N	25534617	-	Auger		Coarse-grained sandstone (Tc)
N	25134523	-	Auger		Claystone (Tc)
N	2669145503	Verwood Road	Victor		Closed file. 243.0 m ASL
N	28144528	Verwood	Auger		Bottomed in weathered lithic sandstone (Tl?).
N	35754507	J. Cameron, Williamwood	Rick	31	Victor. Closed file
N	27034434	Verwood	Auger		0–1.3 brown fine-grained sand (Qd); 1.3–2.3 red and yellow sand; 2.3–3.4 stiff grey clay with red stains (Tc)
N	2866344781	-	Victor		Closed file
N	335445??	A. Cameron		27	
N	35644419	J. Cameron	Rick	30	Victor. Closed file. 227.5 m ASL
N	26244305	Verwood	Auger		Sand (Tc)
N	26434290	Verwood	Auger		Orange clayey silt (Qd), over ferricrete pisoliths (Qlb?)
Y	35604281	H. O. C. Gillett, Wetmore	Mono		0–0.3 topsoil, 0.3–1.8 clay, 1.8–2.9 mudstone (mudstone, sandstone, end in dolerite). Drilled 12.3.1980
N	370423?	H. Gillett, Wetmore	G&G		0–11.7 clay, sandstone, 11.7–25.9 dolerite (very hard) Drilled 16.12.1984
N	36204207	H. Gillett, Wetmore	G&G		0–16.7 sand, various colours (mostly sand, sandstone grey mudstone, green mudstone, dolerite pebbles). Drilled 17.2.1984
N	363420?	H. Gillett, Wetmore	G&G		0–4.7 clay and broken dolerite, 4.7–16.7 solid dolerite . Drilled 17.2.1984
N	27504104	Verwood	Auger		Plastic salmon-pink claystone over hard layer (Tc)
N	27554103	Verwood	Auger		Plastic salmon-pink claystone over hard layer (Tc)
N	27624100	Verwood	Auger		Plastic salmon-pink claystone over hard layer (Tc)
N	29884118	P. Burbury	Stack		0–0.3 soil, 0.3–2.16 brown clay, 2.16–4.6 brown and grey clay, 4.6–10.0 brown clay, 10.0–15.2 grey clay, 15.2–15.8 brown sand, 15.8–16.5 lignite, 16.5–21.3 black clay (Tertiary ?—W. L. Matthews). Drilled 2.1973
N	29904145	P. Burbury	Flood		No log. Drilled 1962?
N	37674167	H. Gillett, Wetmore	G&G		Mostly mudstone (Ps),some sandstone (Pb). Drilled 2.1984
N	37964176	H. Gillett, Wetmore	G&G		Drilled 2.1984

Map	AMG Ref	Location	Driller	DOM Ref	Log (depths in metres)
N	37324176	H. Gillett, Wetmore	G&G		0–3.1 white mudstone, 3.1–30.5 grey mudstone and "Tasmanite" (Ps) 16.2.1984
N	267?402?	Verwood	Auger		Powdery yellow sandy sediment (Tc?)
N	269?403?	Verwood	Auger		Firm pink and white clay (Tc)
N	27584090	Verwood	Auger		Plastic salmon-pink claystone over hard layer (Tc).
N	2937140928		Victor		Closed file
N	29294029		Auger		Bottomed in lithic sandstone (Rl)
N	29534025	R. Riggall	Mono	63	28.2.1980 (fine-grained dolerite chips).
N	34344026	H. Gillett, Wetmore	Mono	37	11.3.1980
N	358407	H. Gillett, Wetmore	G&G	93	14.1.1984
N	28783911	R. Riggall	G&G	98	21.2.1984
N	29453922	R. Riggall	Mono	62	28.2.1980
N	29453923		Victor		Closed file, 2nd bore 20mE, 20mN
N	29683966	R. Riggall	Mono	61	27.2.1980
N	2970396				Same bore as above?
Y	30563996	R. Riggall			Same bore as below?
N	30642983	R. Riggall	Mono	60	27.2.1980
N	31833945	R. Riggall	Mono	59	27.2.1980
N	36073948	H. Gillett, Wetmore	Mono?	36	10.3.1980?
N	2949238853	Victor			Closed file
Y	29893853	R. Riggall	Mono	65	29.2.1980
Y	30123850	R. Riggall	Mono	64	29.2.1980
N	31243860	A. Cameron	G&G	89	28.2.1984
N	32353877	A. Cameron	G&G	87	
Y	36353894	H. Gillett, Wetmore	DOM	32	2nd? 1956 . May be 33
N	3021437582		Victor		Closed file
N	30253773	R. Riggall	Mono	66	1.3.1980
N	28713698	R. Riggall	Mono	68	4.3.1980
N	29413677	Tunbridge Tier Rd	Victor		Closed file
N	351353	A. Cameron, Fassiefern	G&G	85	15.1.1984
N	38313509	A. B. Cummings, Ballochmyle	DOM	78	1929
N	-	A. B. Cummings, Ballochmyle	DOM	77	1929
N	3234	D. Munnings, Melrose	IBC	51	5.8.1967
N	3525034350	F. Johnson	DOM	47	15.12.1949
N	31803312	Hazelwood, The Plains	IBC	40	1.7.1967
N	35783302	C. E. Triffitt	DOM	84	0–30.4, 1925–26
Y	29913248	A. Burbury, Cheam	Mono	22	5.3.1980
Y	28183192	Old Tier Rd	Victor		see Summons (1981)
N	28583157?	Old Tier Rd	Victor		see Summons (1981)
N	41263127	Burbury Bros, Saltpan	DOM	74	1925–26
N	31593041	Old Tier Rd	Victor		see Summons (1981)
N	38783027	J. V. Burbury, Glenmorey	DOM	2	13.3.1951
N	33292996	P. Burbury, Kuranda	Stack	10	2.1973
N	37672927	Burbury Bros	DOM	17?	0–0.5 soil, 0.5–14.0 sandstone, 14.0–22.6 shale, 22.6–25.6 carbonaceous shale, 25.6–29.0 shale, 29.0–38.1 sandstone. 6.2.1951
N	38102975	H. P. Hood, Braes	DOM	79	0–45.7 ,1925–26
N	38782927	P. Burbury, Kuranda	Stack	7	February 1973
N	40572934	J. V. Burbury, Glenmorey	DOM	3	13.3.1951
N	40682929	A. F. Burbury, Glenmorey	DOM	75	1922–24
N	39852925	H. P. Hood, Braes	DOM	80	1925. See page 77 for log (Braes No. 1 bore)
N	331282 ?	Flood			
N	369283 ?	P. Burbury, Kuranda	Mono	11	25.2.1980
N	38762884	P. S. Burbury, Kuranda	DOM	13	19.9.1960
N	388288	P. Burbury, Kuranda	Stack	9	2.1973
N	39302878	Burbury Bros	DOM	18	6.2.1951
N	40002890	S. L. Burbury	DOM	16	28.9.1960
N	32152661	Middle Park	Auger		Bottomed in lithic sandstone (Rl)
N	32472664	Middle Park	Auger		Bottomed in lithic sandstone (Rl)
N	32832648	Middle Park	Auger		Green clay above doleritic gravel (Qu)
N	33012634	Middle Park	Auger		Bottomed in hornfels (Ru)
N	368268	R. J. & H. J. Nicholas, Brooklands		TD	0–0.6 ?, 0.6–4.6 clay, 4.6–7.0 dolerite boulders (Jdl?)
N	332254	Middle Park	Auger		Weathered dolerite?
N	33322538	Middle Park	Auger		Bottomed in lithic sandstone (Rl)
N	3335252	Middle Park	Auger		Weathered dolerite?
N	34 25		Victor		Closed file
N	34222573		Victor		Closed file

Map	AMG Ref	Location	Driller	DOM Ref	Log (depths in metres)
N	3234	D. Munnings, Melrose	IBC	50	31.7.1967
N	34802550	H. J. Nicholas	DOM	52	24.7.1952
N	37252541	Victor			Closed file
N	375240	H. J. & R. J. Nicholas	TD		(dry bore)
Y	20952378? 210236	CRA, Interlaken Rd	Overl	JC-01	0–3.0 (Qa?) 3.0–50.0 Interbedded lithic sandstone (#80%) and mudstone (Rl). For details see Summons (1984).
N	20802376	Capricorn Mining	Stack	O–04	0–2.00 (Qa), 2.00–50.73 dominantly light grey siltstone interbedded with sandstone 15% and mudstone 14%, thin coal seam (Rl?). For detailed log see Glenie *et al.* (1981).
N	380236	H. J. & R. J. Nicholas	TD		0–0.5 ?, 0.5–2.4 clay, 2.4–7.0 sandstone. 7.0–7.3 dolerite. Poor bore. 18.3.1966
N	37672314	H. J. & R. J. Nicholas	TD		0–6.1 clay, 6.1–18.2 mudstone. 14.3.1966
N	387233?	D. Munnings	DOM		0–2.9 broken dolerite, 2.9–3.7 solid dolerite. 23.12.1948
N	38712320	D. Munnings	DOM		0–0.5 soil, 0.5–2.4 clay, 2.4–4.6 coaly matter, 4.6–23.2 shale, sandstone, 23.2–23.8 dolerite. 5.1.1949
N	37292249	D. W. Headlam, York House		66	0–0.9 topsoil, 0.9–6.1 clay, 6.1–36.6 sandstone.
N	38562241	D. W. Headlam			no log
N	38732251	D. W. Headlam, York House	DOM		0–0.46 surface, 0.46–3.34 clay, 3.34–7.60 sandstone, 7.60–9.73 mudstone, 9.73–17.33 sandstone, 17.33–18.24 mudstone, 18.24–25.84 sandstone. 25.6.1948

HOLES RG01–RG53

RG01 — *3830446430, Auburn Road. 187.8 m ASL. Drilled 28.11.1982*

Depth (m) From	*To*	*Log*
0	2.8+	(Qu)
7.05	10.40	dolerite (Jdl)

RG02 — *3980044067, Midland Highway. 184.5 m ASL. Drilled 30.11.1982*

Depth (m) From	*To*	*Log*
0	4.80	(Qu)
4.80	6.00	20% recovery rounded clasts of dolerite, silcrete, etc. (Qa)
6.00	9.40	15% recovery, brown doleritic sand? (Qu?), soft very weathered dolerite (Jdl)
9.40	10.50	36% recovery fresh and some hard dolerite pieces (Jdl)
10.50	11.50	50% recovery as above
11.50	12.40	friable dolerite (Jdl)

RG03 — *4070347347, C305. 180.3 m ASL. Drilled 1.12.1982*

Depth (m) From	*To*	*Log*
0	14.30	(Qu) 1.3–2.6 khaki clayey fine-grained sand 6.0 cream coloured clayey fine-grained sand 12.0 light khaki clayey silt
14.30	16.40	cross-bedded medium-grained feldspathic micaeous quartz sandstone (Rp).

RG04 — *40044869, Chiswick. Drilled 6.12.1982.*

Depth (m) From	*To*	*Log*
0	2.20	(Qu) 1.0 brown sandy clay with dolerite chips 1.2 grey sandy silt with dolerite and sandstone chips 2.0 similar to 1.0 but lighter coloured
2.20	3.80	fine-grained dolerite (Jdl).

RG05 — *3983448590, Chiswick. 180.2 m ASL. Drilled 6.12.1982*

Depth (m) From	To	Log
0	8.50	sand clay (Qu) 0–1.3 brown medium-grained sand (Qd) 1.3–3.9 dark brown sandy clay with caliche (Qd?) 3.9–5.2 brown sandy clay.
8.50	11.30	43% recovery medium and medium to coarse-grained micaeous feldspathic quartz sandstone, arkosic? layers with garnet (Pj?). Thin section at 9.8 m—poorly-sorted silty sandstone, ≈20% feldspar and lithic grains, common garnet, clay rims on sand

RG06 — *4057048105, C305. 181.0 m ASL. Drilled 14.2.1983*

Depth (m) From	To	Log
0	5.50	(Qu)
5.50	6.90	mustard-coloured clayey sand with granules (weathered Ps?)
6.90	8.50	siltstone with foraminifera (Ps)

RG07 — *4141746959, Waterloo Street. 183.3 m ASL. Drilled 15.2.1983*

Depth (m) From	To	Log
0	4.00	(Qu)
4.00	4.15	gravel of dolerite and ferricrete some enclosed in matrix (Qu)
4.15	6.00	fine-grained dolerite with orthopyroxene phenocrysts (Jdl)

RG08 — *4140046864, Waterloo Street. 183.5 m ASL. Drilled 15.2.1983*

Depth (m) From	To	Log
0	6.60	sand, clay and dolerite clasts (Qa)
6.60	8.85	66% recovery
6.60	≈7.80	fining up, ripple laminated, fine-grained sandstone
≈7.80	8.55	cross-bedded, glistening, medium-grained micaeous feldspathic quartz sandstone (Ꝛp?)

RG09 — *4130847065. 182.6 m ASL. Drilled 16.2.1983*

Depth (m) From	To	Log
0	4.70	(Qu)
4.70	6.20	60% recovery glistening medium-grained quartz sandstone with mud pellets (Ꝛp)

RG10 — *4117247258, The Boulevards. 182.2 m ASL. Drilled 16.2.1983*

Depth (m) From	To	Log
0	3.0	(Qu)
3.00	4.05	yellow slightly glistening medium and fine-grained micaeous quartz sandstone with feldspar or matrix.

RG11 — *4098247538, Chiswick. 180.5 m ASL. Drilled 16.2.1983*

Depth (m) From	To	Log
0	3.00	(Qu)
3.00	4.00	fine to medium-grained micaeous matrix? rich sandstone.

RG12 — *4107447645, Chiswick. 183.5 m ASL. Drilled 17.2.1983*

Depth (m) From	To	Log
0	1.00	(Qu)
1.00	2.00	iron-stained, cross-bedded? medium-grained quartz sandstone (Ꝛp?).

RG13 — *4037048183, Midland Highway. 179.5 m ASL. Drilled 21.2.1983*

Depth (m) *From*	*To*	*Log*
0	7.50	(Qu) 0–2.6 brown sandy clay 2.6–4.5 grey-brown sandy clay 4.5–7.5 stiff grey clay
7.5	8.30	(Qu)
8.30	13.50	sandstone (Pj) 8.30–9.3 ripple laminated beds enclosing cross-bedded bed, micaeous carbonaceous laminae 9.3–10.0 massive mottled sandstone overlying cross-bedded sandstone 10.0–10.3 coarsely ripple-laminated sandstone with carbonaceous micaeous laminae 10.3–11.4 ripple-laminated sandstone overlying mottled massive sandstone 11.4–11.8 coarsely ripple-laminated medium-grained sandstone 11.8–12.5 cross-bedded medium to coarse-grained sandstone with garnet-rich laminae 12.5–13.5 cross-bedded and mottled massive medium to coarse-grained sandstone with pebbles and granules in basal 150mm
13.5	17.3?	siltstone (Ps)
17.3	19.1?	medium coarsening-up to coarse-grained sandstone granules, basal layers with pebbles, top layers with pebbles and muddy matrix (Pb)
19.1	25.00	siltstone (Ps). Thin section from 12.4 m—arkosic sandstone with garnet, some authigenic feldspar.

RG14 — *4017248387, Chiswick. 179.0 m ASL. Drilled 22.2.1983.*

Depth (m) *From*	*To*	*Log*
0	6.00	(Qu) –5.2? blue-grey cohesive clayey sand with orange-brown and fine-grained dolerite clasts
6.00	6.80	mottled ripple-laminated fine to medium-grained arkosic sandstone (Pj). Thin section from 6.70 m—fine-grained very micaeous sandstone; biotite, some arkosic laminae.

RG15 — *4006648623, Chiswick. 181.0 m ASL. Drilled 22.2.1983*

Depth (m) *From*	*To*	*Log*
0	7.00	(Qu)
7.00	7.50	20% recovery, mottled carbonaceous arkosic sandstone (Pj).

RG16 — *4029748595, Chiswick. 182.0 m ASL. Drilled 23.2.1983*

Depth (m) *From*	*To*	*Log*
0	3.0	(Qu)
3.0	4.0	60% recovery pebbly sandstone (Pj)
4.0	8.9	siltstone with foraminifera and pyrite cube 15mm (Ps)
8.9	10.70	(Pb)
10.70	11.20	(Ps).

Thin section of clast 3.8 m: very fine to fine-grained micaeous matrix-rich sandstone, feldspar 5%.

RG17 — *4007348350, Chiswick. 179.0 m ASL. Drilled 23.02.1983*

Depth (m) *From*	*To*	*Log*
0	5.00	(Qu)
5.00	6.50	poorly glistening cross-bedded micaeous feldspathic (15–20%), quartz medium-grained, and medium to coarse-grained sandstone.

RG18 — *398492, Chiswick. Drilled 28.2.1983.*

Depth (m) *From*	*To*	*Log*
0	3.0	(Qu)
3.0	4.00	15% recovery yellow micaeous coarse-grained siltstone and sandstone
4.00	5.50	soft friable feldspathic quartz sandstone cf. RG17. Friable garnet-rich layers (Pj?). Thin section from 5.5 m—sandstone with granules, quartz ≈50–60%, feldspar ≈40%, garnet.

RG19 — *3956546320, Williamwood. 181.1 m ASL. Drilled 1.3.1983*

Depth (m)		*Log*
To	*From*	
0	7.0	(Qu, Tu)
		0–2.6 brown clayey sand, pebbles at base
		2.6–5.0 light brown clayey sand, red clay (Tc)
7.0	8.50	30% recovery.

Thin section from 15.8 m—bioturbated? sandstone, quartz in muddy matrix.

RG20 — *3841146485, Williamwood. 186.5 m ASL. Drilled 1.3.1983.*

Depth (m)		*Log*
To	*From*	
0	5.0	(Qu)
5.0	6.00	creamy white slightly feldspathic medium-grained quartz sandstone (Ruq).

RG21 — *3689548696, Ashby. 187.0 m ASL. Drilled 2.3.1983.*

Depth (m)		*Log*
To	*From*	
0	3.0	(Qu)
		0–2.6 soil, rounded cobbles (Qa) over orange-brown sand
3.0	4.2	50% recovery orange ferruginous and white clayey sandstone with granule layers (Rp?).

RG22 — *3638348170, Ashby. 189.0 m ASL. Drilled 2.3.1983.*

Depth (m)		*Log*
To	*From*	
0	3.0	(Qu)
3.0	5.50	bryozoal siltstone and subordinate poorly fossiliferous sandstone (Pl).

RG23 — *3703648343, Ashby. 183.6 m ASL. Drilled 2.3.1983.*

Depth (m)		*Log*
To	*From*	
0	6.20	(Qu)
6.20	7.20	25% recovery strongly ferruginous sandstone with ferricrete lamina at 7.20
7.20	8.50	sandstone less ferruginous than above, brown at top, white at base
7.20	7.45	medium grained
		below 7.45 micaceous matrix rich, very fine-grained (R?)

RG24 — *3753750310, Ashby Road. 177.1 m ASL. Drilled 3.3.1983.*

Depth (m)		*Log*
To	*From*	
0	4.50	(Qu)
4.50	5.80	23% recovery conglomerate with black hornfels clasts (Tc)
5.80	7.00	50% recovery white slightly silicified? quartz sandstone with clayey matrix and heavy mineral concentrations (Ruq). Thin section from 6.7 m—sandstone of quartz and chert, quartz grains intergrown or separated by recrystallised matrix

RG25 — *3737147601, Williamwood. 184.0 m ASL. Drilled 8.3.1983.*

Depth (m)		*Log*
To	*From*	
0	5.0	(Qu)
5.00	6.50	creamy yellow ferruginous fine and fine to medium-grained sandstone (Rp?).

RG26 — *3734747487, Williamwood. 186.1 m ASL. Drilled 8.3.1983.*

Depth (m)		*Log*
To	*From*	
0	3.0	(Qu)
3.00	4.20	white medium-grained quartz sandstone (Rp). Thin section from 4.0 m—sandstone, mostly quartz, some chert, little feldspar, some layers almost solely quartz.

RG27 — *3729047390, Williamwood. 186.6 m ASL. Drilled 8.3.1983.*

Depth (m)		*Log*
From	*To*	
0	3.0	(Qu)
3.00	4.05	weathered soft silstone with pink stains (Ps).

RG28 — *3911947284, Ashby. 180.3 m ASL. Drilled 8.3.1983.*

Depth (m)		*Log*
From	*To*	
0	8.0	(Qu)
8.00	9.50	uniform olive-green very micaeous siltstone, some steeply dipping very fine-grained sandstone laminae, plant debris and small faecal? pellets, Early Triassic microflora P835 (Rpc).

RG29 — *4084847170, Chiswick. 184.3 m ASL. Drilled 9.3.1983.*

Depth (m)		*Log*
From	*To*	
0	1.50	very baked sandy siltstone (Ps?)
1.50	3.45	fine-grained dolerite with orthopyroxene phenocrysts (Jdl). Thin section from 1.50 m—bioturbated? poorly-sorted siltstone with quartz and feldspar sand grains.

RG30 — *3652048549, Ashby. 190.1 m ASL. Drilled 10.3.1983.*

Depth (m)		*Log*
From	*To*	
0	5.0	(Qu)
5.00	10.20	bioturbated siltstone (Ps).

RG31 — *3916346230, Williamwood. 183.4 m ASL. Drilled 10.3.1983.*

Depth (m)		*Log*
From	*To*	
0	10.50	(Qu)
0	2.0	grey-brown clayey sand
2.0	3.5	brown clayey sand
3.5	5.4	gravel (Qa)
5.4	6.5	yellow-brown slurry
6.5	7.8	mustard coloured slurry
10.5	13.0	steeply cross-bedded creamy white quartz sandstone.

RG32 — *3897645465, Williamwood. 195.0 m ASL. Drilled 14.3.1983.*

Depth (m)		*Log*
From	*To*	
0	9.20	(Qu)
9.20	10.50	grey mudstone with fossil plants dips 15°, overlies silty fine-grained lithic sandstone (Rl–poorly preserved microflora P825). Thin section from 10.3 m—quartz-poor (5%) lithic medium to coarse-grained sandstone with felsic volcanic grains.

RG33 — *3663547972, Ashby. 188.0 m ASL. Drilled 14.3.1983.*

Depth (m)		*Log*
From	*To*	
0	3.0	(Qu)
3.0	5.50	bioturbated siltstone (Ps).

RG34 — *3649047890, Ashby. 189.0 m ASL. Drilled 15.3.1983.*

Depth (m)		*Log*
From	*To*	
0	3.0	(Qu)
3.0	4.00	fossiliferous siltstone and calcareous layers (Pl).

RG35 — *3663547972—see RG33.*

RG35 — *369387, H. Gillett, Wetmore. Drilled 14.1.1984*

Depth (m)		Log
From	To	
0	1.2	sand
1.2	3.1	clay
3.1	9.1	soft clay and sandstone
9.1	18.3	claystone
18.3	25.9	sandstone.

36933868, Wetmore. Drilled 15.3.1983.

Depth (m)		Log
From	To	
0	1.5	(Qu)
1.5	2.50	50% recovery, light brown sand with caliche? (Qd?)
2.50	4.00	20% recovery, rounded dolerite cobbles and clasts of ferricrete and sedimentary? rock (Qa)
4.00	6.00	brown, weathered, hard dolerite (Jdl).

RG36 — *36903815, Wetmore. Drilled 15.3.1983.*

Depth (m)		Log
From	To	
0	3.2	(Qu) ≈0–1 orange-brown clayey silt
3.2	5.85	tan cross-bedded micaeous sandstone (Rp).

RG37 — *3949244830, Williamwood. 191.0 m ASL. Drilled 21.3.1983.*

Depth (m)		Log
From	To	
0	7.50	brown sandy clay, includes occassional dolerite chips and calcareous intervals (Qd?)
7.50	9.00	20% recovery hard brown clay with pebble clasts (Qa or Qt)
9.00	10.50	67% recovery including 0.5 m dolerite cobbles (Qa or Qtd)
10.50	19.50	medium to coarse-grained lithic sandstone (Rlg?)

Thin section from 18.1 m—quartz poor (5%) medium-grained lithic sandstone, mostly chert with felsic volcanic and green biotite.

RG38 — *36544611. Drilled 23.3.1983.*

Depth (m)		Log
From	To	
0	2.0	(Qu)
2.0	5.00	light to medium grey muddy siltstone, dropstones
5.00	8.60	sandy siltstone grading into light grey silty sandstone below 7.0 m, bioturbated below 6.0 m, small granules become numerous in siltstone 6.0–7.0 m, sandstone medium to coarse-grained with pebbles below 7.9 m, coarse-grained with pebbles below 8.5 m
8.6	10.0	medium to coarse-grained sandstone with some silty laminae, top 200 mm coarsens up with pebbles, basal 400mm very coarse-grained with pebbles
10.0	11.2	coarsening-up silty sandstone, fine grained at base, medium grained at top, silty laminae more common in medium-grained sandstone with some granules and pebbles. 20mm scale cross lamination towards top, shelly fossils at 10.5 m
11.2	22.00	sandy siltstone and siltstone

2.0–22.00 (Ps), 7.0–11.2 (Pp). Thin section from 7.6 m—sandstone with matrix; calcite cement, quartz ≈70%, feldspar and lithic grains.

RG39 — *3975044563, Midland Highway. 183.3 m ASL. Drilled 24.3.1983.*

Depth (m)		Log
From	To	
0	6.0	(Qu)
6.0	8.50	weathered broken medium-grained dolerite, 6.0–7.00 m 10% recovery, 7.00–8.50 40% recovery
8.50	9.30	broken weathered medium-grained dolerite (Jdl).

RG40 — *304462. Drilled 28.3.1983.*

Depth (m)		*Log*
From	*To*	
0	3.0?	(Qu)
3.0	10.00	medium-grained lithic sandstone 5.45–5.00 medium grey mudstone with fossil leaves and *Semiretisporis denmeadi* microflora P820 (Rl). Thin section from 10.0– ?? quartz-rich (≈50%) lithic sandstone, biotite and chlorite.

RG41 — *307471. Drilled 28.3.1983.*

Depth (m)		*Log*
From	*To*	
0	4.50	(Qu)
4.50	7.10	fining-up lithic sandstone, fine-grained at top, medium-grained at base (Rl). Thin section from 6.1 m—chert-rich lithic sandstone with calcite cement, quartz <40%, feldspar 10%.

RG42 — *312354, Frankston. Drilled 29.3.1983.*

Depth (m)		*Log*
From	*To*	
0	11.50	(Qu)
11.50	13.30	medium grey siltstone. Microflora with *Annulispora folliculosa* P823.

RG43 — *314354, Frankston. Drilled 29.3.1983.*

Depth (m)		*Log*
From	*To*	
0	2.0	(Qu)
2.0	3.60	matrix-rich fine to medium-grained quartz sandstone (Rp). Thin section from 2.6 m—matrix-rich quartz sandstone.

RG44 — *299351, Frankston. Drilled 30.3.1983.*

Depth (m)		*Log*
From	*To*	
0	4.50	0% recovery (Qu, Tu)
4.50	13.30	coarse-grained to very fined-grained sandstone layers with pink ferruginous quartz grains, fine-grained above 5.50 m (Rls'). Thin section at 9.4 m
13.30	17.0	interbedded mudstone, siltstone and sandstone
13.30	13.43	micaeous pale green siltstone
13.43	13.66	sandstone
13.66	13.78	siltstone
13.78	13.88	sandstone, below 15.0 m including dark grey mudstone with *Dicroidium*, white sandstone laminae, and Early Triassic *Aratrisporites* microflora P825 (Rpc).

RG45 — *273498. Drilled 30.3.1983.*

Depth (m)		*Log*
From	*To*	
0	4.50	(Qu)
4.50	7.00	interbedded siltstone and sandstone with thin bed of silicified sandstone with microfossils above 5.00 m (Rpc'). Lithologies—medium to pale blue-green siltstone grading down to purple-grey mudstone, interlaminated medium grey mudstone and buff fine-grained sandstone, medium to dark steel-grey micaeous siltstone with sandstone laminae, slightly silicified cross-bedded quartz sandstone, red stains on joints.

RG46 — *2406546838. 237.7 m ASL. Drilled 18.6.1984.*

Depth (m)		*Log*
From	*To*	
0	7.00	0% recovery clay and cobbles (Qa, Tc?)
7.00?	40.00	Tc—ferricrete siltstone sandstone; 31–40 m doleritic conglomerate. Thin section at 36.0 m—dolerite clasts in matrix.

RG47 — *2506346366. 230.4 m ASL. Drilled 19.6.1984.*

Depth (m)		*Log*
From	*To*	
0	16.00	(Qu, Tc)
16.00	33?	Tc
33?	41.50	Rl, microflora with *Annulispora folliculosa* P822 at 37.50 m. Thin section 41.4 m—quartz-poor lithic sandstone with biotite.

RG48 — *2650046202. 227.5 m ASL. Drilled 20.6.1984.*

Depth (m)		*Log*
From	*To*	
0	9.00	0% recovery (Qu, Tc?)
9.00	15.00	Rls?, barren palynology sample P833 with abundant zircon. Thin section from 11.4 m—volcanic lithic sandstone with felsic grains.

RG49 — *2711943418, Verwood. Drilled 5.9.1984*

Depth (m)		*Log*
From	*To*	
0	8.50	0% recovery 0–1.3 light grey clay and sand 1.3–8.50 light grey clay (Tcc).

RG50 — *2602644744, Verwood. 266.4 m ASL. Drilled 4.9.1984.*

Depth (m)		*Log*
From	*To*	
0	111.20	Tertiary ferricrete over sedimentary rocks, conglomerate below 74.40 m
111.20	122.06	Coal measures (Rl). Microflora with *Annulispora folliculosa* P834 at 116.9 m.

RG51 — *187403. Drilled 16.3.1983?*

Depth (m)		*Log*
From	*To*	
0	3.0	0% recovery (Qtd)
3.0	8.20	richly fossiliferous silty sandstone (Pl).

RG52 — *193400. Drilled 16.3.1983?*

Depth (m)		*Log*
From	*To*	
0	4.50	0% recovery (Qtd)
4.50	8.50	sandy siltstone, fossiliferous with bryozoa and molluscs 7.30–7.60 Pl

RG53 — *286379. Drilled 8.7.1987*

Depth (m)		*Log*
From	*To*	
0	1.30	brown, burgandy and yellow ferricrete (Tf)
1.30	2.40	45% recovery–300mm ferricrete grading down to partly laminated tan ferricrete, 200mm soft tan claystone
2.40	8.40+	Tc 2.40–3.90 60% recovery–450mm laminated limestone (some lost, Tcd), 450mm brown, medium-grained sandstone 3.90–5.40 40% recovery creamy to very light brown sand and sandstone 5.40–6.90 cream sandstone with granule layers and subordinate siltstone, orange stains near joints 6.90–8.30 0% recovery, sand 8.30–8.40 coarse-grained sand.

HOLES RG100-RG146

Hole No.	AMG Ref	Location	Driller	Log
RG100	29464642	N. Whelan, Frankston	Rick	no log
RG101	29604640	N. Whelan, Frankston	Rick	no log
RG102	31184555	J. Bennett		No log. Chips of carbonaceous mudstone (Rl).
RG103	32834497	R. Bennett, Ellinsworth	G&G	0–13.7 sand, clay, sandstone 13.7–30.4 sandstone. Drilled 29.2.1984
RG104	33404452	J. Cameron, Ross	Rick	0–0.15 topsoil 0.15–0.4 clay 0.4–6.0 broken dolerite 6.0–26.2 dolerite (about 50% sandstone and 50% dolerite). Drilled 11.2.1981
RG105	33574417	J. Cameron, Ross	Rick	0– sandstone/dolerite
RG106	30604200	P. Burbury	Flood	Drilled 1962?
RG107	31544232	P. S. & C. W. Burbury	IBC	0–0.3 topsoil 0.3–5.5 5.5–13.7 sandstone 13.7–17.1 grey mudstone. Drilled 20.6.1967
RG108	32144220	Phil Burbury, Tunbridge	Mono	0–1.2 soft dolerite, 1.2–35.1 dolerite. Drilled 31.1.1980
RG109	27613924	R. Riggall, Tunbridge	G&G	0–36.6 clay-orange-red-brown-green-grey (chips include brick-pink, salmon coloured, light and medium grey Tertiary claystone). Drilled 21.2.1984
RG110	27833855	R. Riggall Tunbridge	G&G	0–16.7 Clay (chips of brick-red and tan claystone). Mainly weathered dolerite—W. L. Matthews. Drilled 22. 2.1984
	27873860			0–22.8 Clay (mainly weathered dolerite, chips include orange and red claystone and weathered and leached dolerite).
RG111	27223722	R. Riggall, Tunbridge	Mono	0–0.3 topsoil 0.3–5.2 clay 5.2–10.7 decomposed dolerite 10.7–12.2 hard dolerite (lithic shale and coarse-grained dolerite at site). Drilled 4.3.1980
RG112	29534025	R.Riggall, Tunbridge	Mono	0–0.3 topsoil 0.3–6.7 decomposed dolerite (fractured with iron oxide stains). Drilled 28.2.1980
	29614033		G&G	0–9.1 buff muddy siltstone 9.1–18.3 fine-grained dolerite 18.3–27.4 lithic sandstone 27.4–27.7 coal (very carbonaceous black mudstone) 27.7–30.5 sandstone. Drilled 23.2.1984
RG113	31044032	R. Riggall, Tunbridge	Mono	0–0.3 topsoil 0.3–19.8 grey clay (soft sandstone at site). Drilled to 33.5 m, 26.2.1980
RG114	32603990	A. Cameron, Tunbridge	G&G	0–6.1 clay, dolerite floaters 6.1–18.3 assorted clay 18.3–13.5 soft rocks (grey, green) 30.5–38.1 dolerite. Drilled 20.2.1984
RG115	33234073	H. Gillett, Wetmore	Mono	0–0.3 topsoil 0.3–4.3 clay 4.3–21.3 "decomposed basalt" (baked shale ?) 21.3–29 "basalt" (dolerite) (hornfels present). Drilled 11.3.1980

Hole No.	AMG Ref	Location	Driller	Log
RG116	37154039	H. Gillett, Wetmore	TD	0–0.15 sand 0.15–2.1 clay 2.1–36.6 mudstone (Ps). Drilled 21.6.1967
RG117	37213957	H. Gillett, Wetmore	MD	Drilled February 1956
RG118	33403938	H. Gillett, Wetmore	AGP	0–0.9 sand 0.9–5.2 sandy clay 5.2–17.7 decomposed rock 17.7–36.6 shale (chips of baked siltstone and fine-grained dolerite). Drilled 24.2.1968
RG119	31873910	A. Cameron, Tunbridge	G&G	0–1.5 sand 1.5–9.1 broken dolerite 9.1–12.2 mudstone? (brown rock) 12.2–18.3 green rock 18.3–29 dolerite. Drilled 27.2.1984
RG120	33123897	A. Cameron, Tunbridge	G&G	0–0.3 dolerite 0.3–1.5 sand 1.5–9.1 clay 9.1–29 dolerite (hard with broken seams). Chips include coarse-grained dolerite some with weathered joint faces with crystal rosettes. Quartz granules and ferricrete may be derived from hole. Drilled 29.2.1984
RG121	29893733	T. Burbury, Cheam	Mono	0–0.3 topsoil 0.3–6.1 decomposed dolerite 6.1–9.1 dolerite. Drilled 4.3.1980
RG122	30693642	T. Burbury, Cheam	Mono	0–0.3 topsoil 0.3–3.1 clay 3.1–6.1 decomposed dolerite 6.1–11.3 sandy clay. Drilled 5.3.1980
RG124	32763683	A. Cameron, Tunbridge	Mono	0–0.3 topsoil 0.3–6.4 clay 6.4–24.4 dolerite (decomposed) 24.4–33.5 dolerite. Drilled 6.3.1980
RG125	32833766	A. Cameron, Tunbridge	Mono	0–0.3 topsoil 0.3–10.4 clay 10.4–38.1 basalt. Drilled 6.3.1980
RG126	33913766	W. Vaughan, Tunbridge	TD	0–12.2 clay 12.2–12.8 mudstone (hard). Drilled 25.2.1966
RG127	33673782	A. Cameron, Tunbridge	Mono	0–0.3 topsoil 0.3–5.8 decomposed dolerite 5.8–15.2 dolerite (chips include very fine-grained dolerite). Drilled 7.3.1980
RG128	32683822	A. Cameron, Tunbridge	G&G	0–12.2 clay 12.2–16.7 green rock, coal seams? 16.7–22.8 dolerite (chips include grey clayey siltstone Tc or Ru, fine-grained and coarser? dolerite). Drilled 28.2.1984
RG129	31764035	R. Riggall, Tunbridge	Mono	0–0.3 topsoil 0.3–29.0 grey clay (shale and lithic sandstone at site). Drilled 26.2.1980
RG130	36203768	A. Hazelwood, Home View	Mono	0–0.3 topsoil 0.3–12.2 dolerite. Drilled 7.3.1980
RG131	36403741	A. Hazelwood, Home View	Mono	0–0.3 topsoil 0.3–2.1 decomposed dolerite 2.1–12.2 dolerite. Drilled 10.3.1980

Hole No.	AMG Ref	Location	Driller	Log
RG132	36273726	A. Hazelwood, Home View	Mono	0–0.3 topsoil 0.3–1.5 decomposed dolerite 1.5–51.8 hard dolerite. Drilled 10.3.1980
RG133	34633390	C. E. Triffitt, Tunbridge	DOM	0–10.4 m. Drilled 1925-26
RG134	33933666	A. Cameron, Tunbridge	Mono	0–0.3 topsoil 0.3–10.1 clay 10.1–24.4 dolerite. Drilled 7. 3.1980
RG135	40153266	J. V. Burbury, Glenmorey	DOM	0–2.0 soil, clay 2.0–24.4 sandstone. Drilled 23.2.1951
RG136	40223134	S. Burbury, Glenmorey	DOM	0–33.5 feldspathic sandstone, mudstone, shale. Drilled 1929
RG137	3955307	J. V. Burbury, Glenmorey	TD	0–0.3 topsoil 0.3–1.1 clay 1.1–25.9 sandstone (location uncertain). Drilled 31.3.1967?
RG138	37963140	C. L. Headlam	DOM	0–1.4 soil clay 1.5–5.9 dolerite boulders 5.9–12.2 shale 12.2–27.4 sandstone, shale, sandstone. Drilled 18.5.1951
RG139	36733035	E. R. Oldmeadows, Lowes Park	DOM	0–30.5 m. Drilled 1925–26.
RG140	35042990	C. L. Headlam	DOM	0–0.8 soil clay 0.8–30.5 sandstone. Drilled 11.5.1951
RG141	34433116	C. L. Headlam	DOM	0–1.4 soil, clay 1.4–8.5 sandstone 8.5–14.6 shale 14.6–27.4 sandstone. Drilled 15.2.1950
RG143	40892857	Burbury Bros.	DOM	0–3.8 soil, clay 3.8–12.2 pug 12.2–39.6 sandstone. Drilled 21.1.1951
RG144	39452848	S. L. Burbury	DOM	0–0.6 soil 0.6–3.1 clay 3.1–5.2 dolerite.
RG145	24513487		DOM	410.9 m ASL. Drilled 1983. See page 77 for log.
RG146	3628247165		DOM	199.8 m ASL. Drilled 1.11.1983. See page 78 for log.

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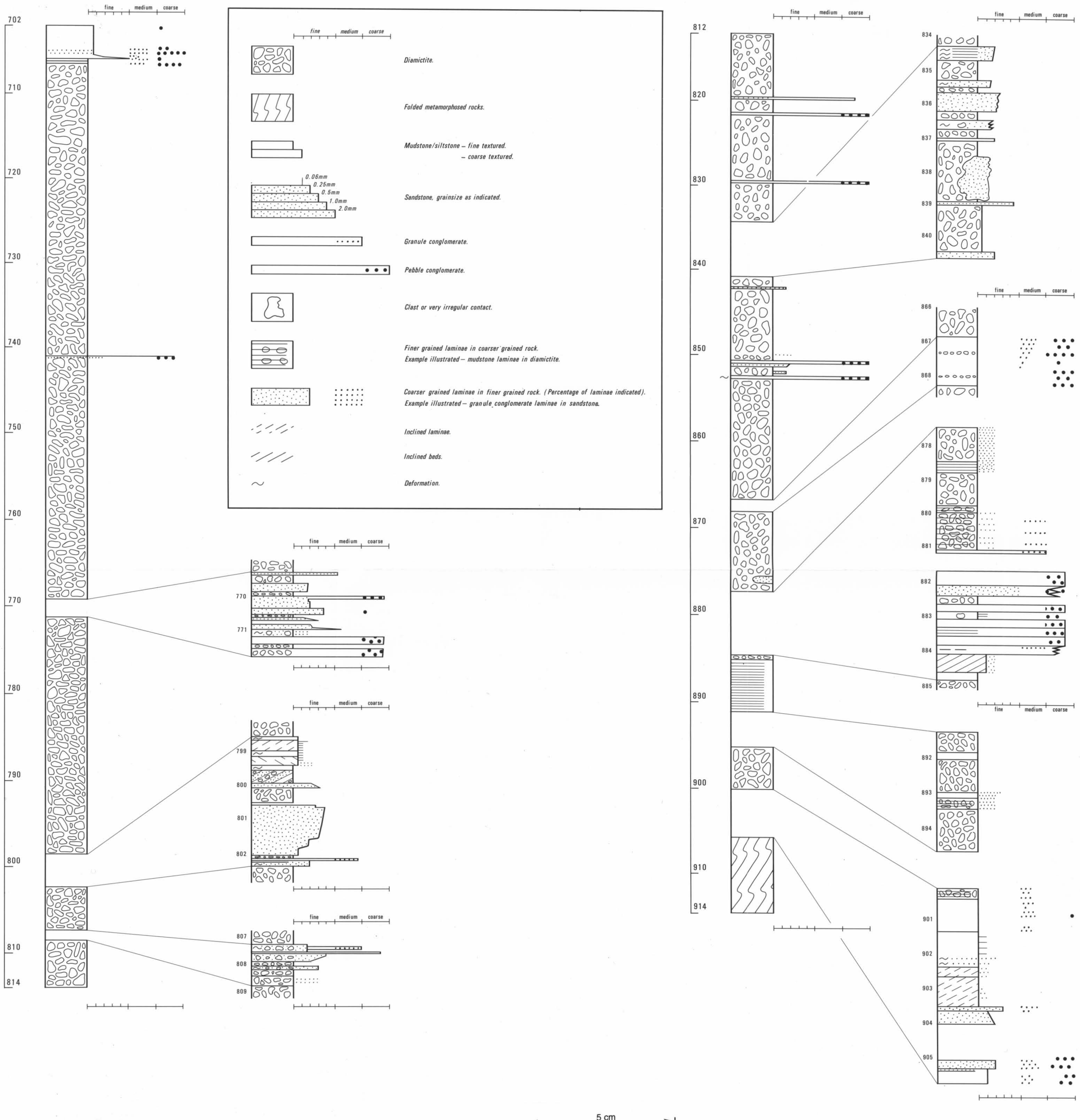

Figure 5. *Detailed lithological log of Tunbridge Tier borehole.*

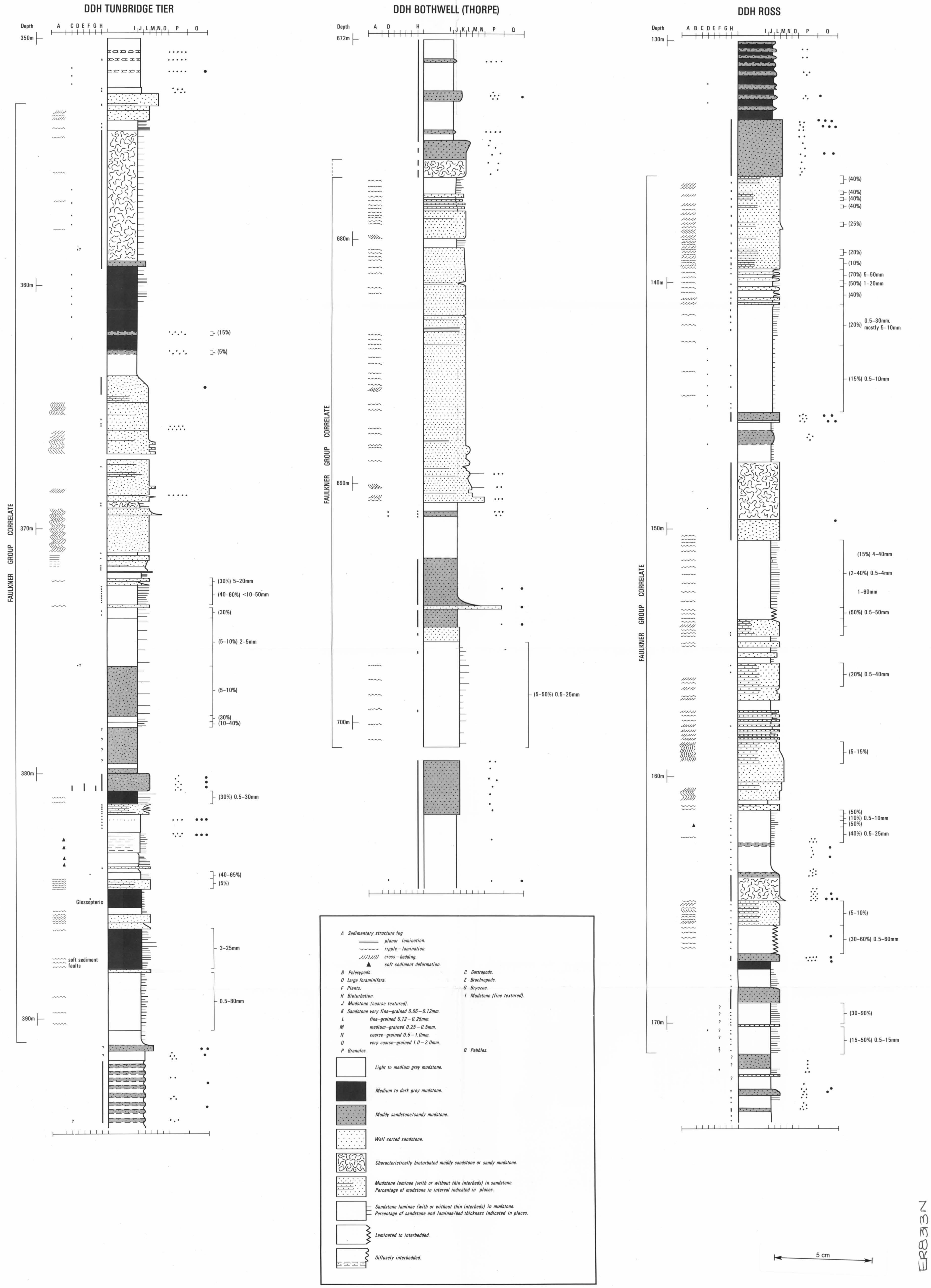

Figure 6. *Comparative sections through Faulkner Group correlate.*

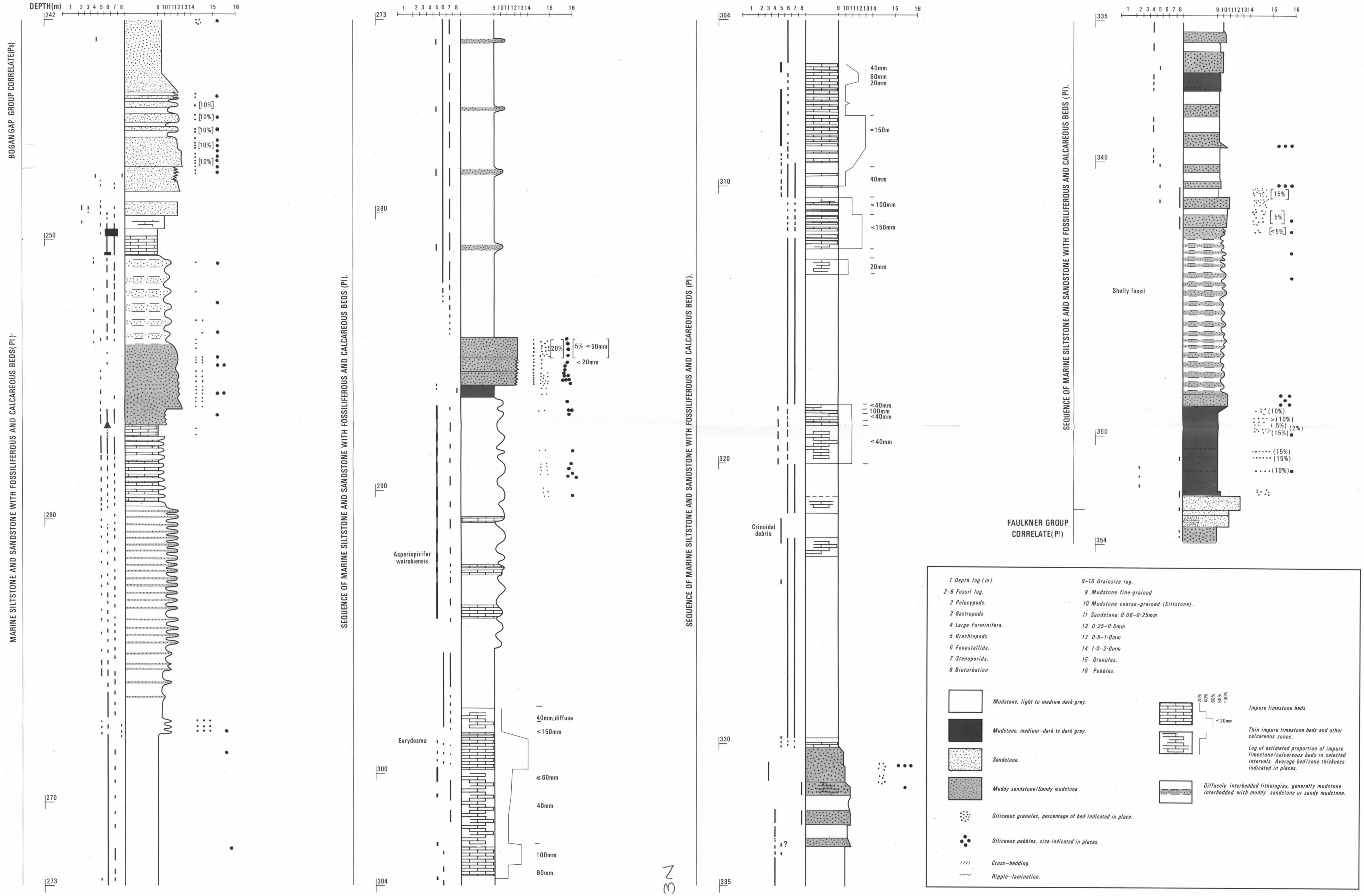

Figure 7. *Lithological log of marine siltstone and sandstone with fossiliferous and calcareous beds (Pl), Tunbridge Tier.*

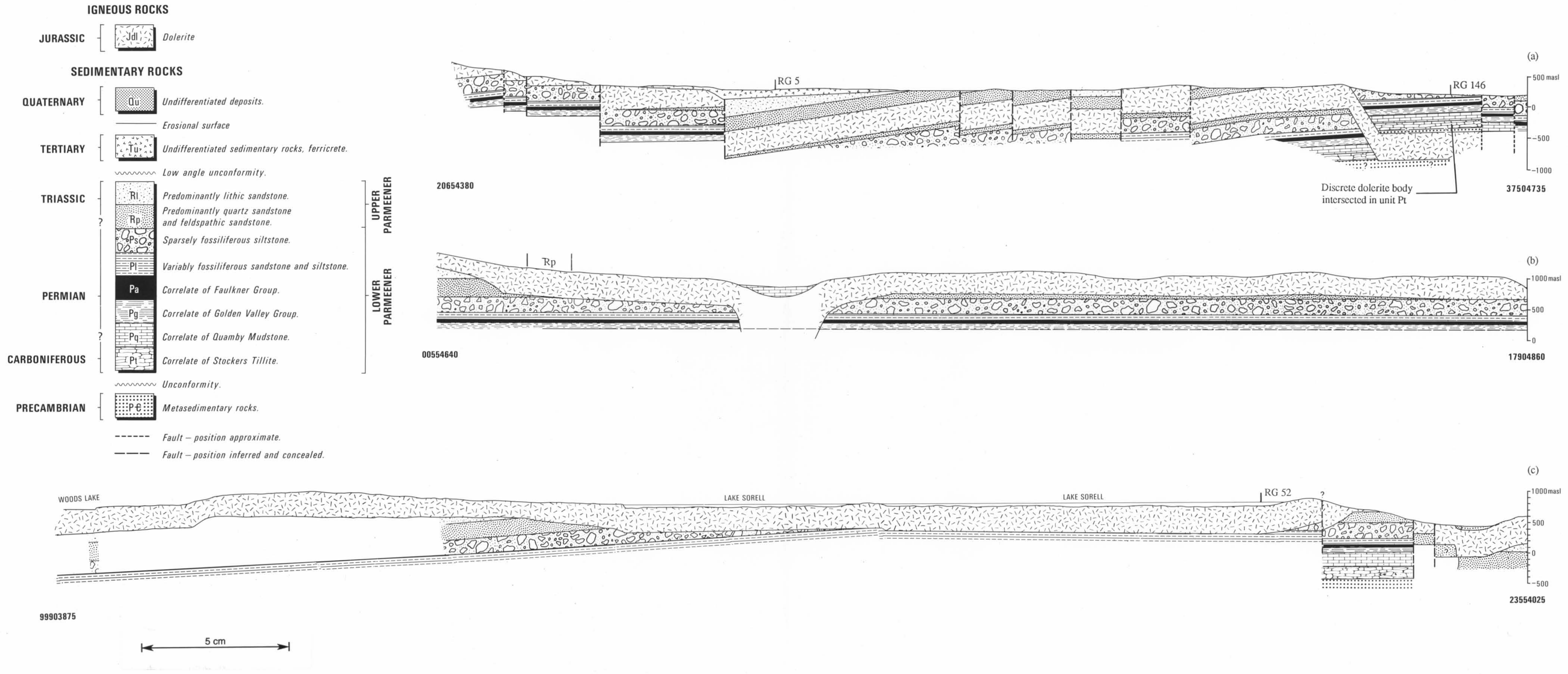

Figure 17. *Geological sections across the Interlaken Quadrangle*