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1. Preliminary report on the geology of The Red Hills-Newton Creek area, West Coast Range, Tasmania.

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Abstract

Darwin-type potassic rhyolite at The Red Hills is flanked to the west by a feldspar porphyry sequence interpreted as being mainly lavas (dacites or quartz keratophyres). West of the Henty Fault Zone, which is a major feature marked by intense shearing and chloritisation, is a similar lava sequence, with abundant secondary albite and epidote in places, intruded by a basic dyke swarm including fine-grained chloritic basalt with abundant epidote veins (some with galena), altered and serpentinised dolerite and fresh unaltered tholeiite similar to the Jurassic dolerites. Overlying these older rocks, probably unconformably, is a correlate of the Comstock Formation, some 600 m thick, consisting of quartz-feldspar porphyry lava overlain by banded and massive tuff and agglomerate. Overlying this is the volcaniclastic Jukes Formation correlate, some 30 m thick, containing clasts of quartz-feldspar porphyry in many areas. This and the overlying Owen Conglomerate correlate transgress onto older rocks and may be disconformable on the Comstock Formation near The Gooseneck.

Conformably overlying the Jukes correlate in the Mount Julia area is a quartzwacke-siltstone-conglomerate sequence containing marine fossils of Late Cambrian (probably Franconian) age. Elsewhere the Jukes correlate is overlain by pink conglomerate typical of the Owen Formation and apparently laterally equivalent to the quartzwacke association, which is interpreted as a local turbidite facies of the Lower part of the Owen Formation and herein termed the 'Newton Creek Sandstone Member'.

The younger rocks are folded into a broad north-south anticlinal structure flanked to the west by a tight syncline with the 'Great Lyell Fault' along its axis. The west-side-up movement on this fault decreases northwards. Minor folding is present in some areas, and there is a regional NNW-trending cleavage across the area.

INTRODUCTION

This report summarises the results of field work carried out by the author mainly during the summer of 1973-1974 and of petrological work during the winter of 1974. Details of chemical analyses will be reported on when available. The study is part of an overall field study of the Mount Read Volcanics in western Tasmania commenced by the author in November 1973, and further such detailed studies of selected areas are anticipated. The area was selected because of the good exposure of the 'central lava belt' (Corbett *et al.*, 1974) at The Red Hills and of the Late Cambrian Tyndall Group and Owen Conglomerate correlates around Newton Creek, and because it covered the apparent northern termination of the 'Great Lyell Fault' and its intersection with another major structure, the Henty Fault.

Access to the area is provided by a four-wheel-drive road, constructed jointly by the Mt Lyell Mining and Railway Company and a local timber company, from the Murchison Highway near the Henty River. A shorter access road connecting Howard's timber road, south of Mt Dundas, with Henty Camp, is under construction. Four-wheel-drive tracks extend to The Red Hills and past Newton Peak to Lake Rolleston.

Appreciation is expressed to the Mt Lyell Company for the use of Henty Camp, and particular thanks are extended to Mr K.O. Reid, the Chief Geologist and Mr K. Wells, Chief Exploration Geologist, for their friendly cooperation and many helpful discussions.

DARWIN-TYPE RHYOLITE AT THE RED HILLS

Massive, pink-weathering, fine-grained rhyolite forms a belt about one kilometre wide at The Red Hills, and appears to continue northwards onto the south-west spur of Mt Murchison. A small, apparently isolated lens of similar rock occurs about 500 m west of the main body. The rock is similar to that which constitutes Mt Darwin, and similar bodies occur at Whip Spur and Mt Sedgwick (Corbett *et al.*, 1974).

A lens of *quartz porphyry* occurs within the rhyolite body on the east flank of The Red Hills. The rock is grey-green to pinkish in colour and in thin section (74-79) consists of about 80% quartz-feldspar-sericite groundmass (mainly quartz) and about 20% quartz phenocrysts, with small patches and blebs of chlorite. Feldspar phenocrysts are lacking. An apparently gradational contact between this rock and fine-grained Drawin-type rhyolite was observed on the lower north-east flank of The Red Hills, where an outcrop shows fine lava becoming porphyritic in quartz over about 60 cm then reverting back to fine lava then back into quartz porphyry again. Such a contact suggests that the porphyry may be a variant of the Darwin-type lavas rather than an intrusive body related to the Comstock Formation quartz-feldspar porphyries.

East of the quartz porphyry are poorly-exposed pale coloured *spherulitic lavas* which in thin sections (74-100, 101) consist of microcrystalline quartz-feldspar sericite groundmass (15-60%), spherulites (40-80%), rare sericitised feldspar phenocrysts, rare small quartz phenocrysts, scattered blebs of chlorite and scattered iron oxide grains. The spherulites average about 0.3 mm across, and tend to be rather poorly formed. Staining tests on 74-101 indicate that the spherulites consist largely of potash feldspar, although many have a clear core.

The main part of the rhyolite belt consists dominantly of massive, closely-jointed, pink to pale green, fine-grained lava, apparently not spherulitic in the areas sampled. There is no obvious penetrative foliation. Flow banding has been observed at three localities, and is either subvertical or dips steeply west. Near the northern end of the area the banding occurs through a stratigraphic thickness of some 15 m, but in the other localities the banded sections are only a metre or so across. A possible intrusive contact between two similar lava types was observed about 650 m SSE of the crest of The Red Hills [CP82666476] where a pink to white rock (74-95), with abundant small dark patches of intergrown magnetite and feldspar, intertongues with a purplish-brown rock (74-95) containing scattered feldspar phenocrysts and pink blebs of mosaic feldspar. An odd variety on the west flank of The Red Hills contains abundant large spherulitic structures, ranging from 3-30 mm across, which commonly have a core of green chlorite and a rim of pink potash feldspar. *Petrological features* common to all types are: an abundant microcrystalline groundmass of quartz, potash feldspar and sericite, with fine chlorite in the green varieties; scattered phenocrysts of potash feldspar, usually deeply corroded; rare quartz phenocrysts, usually corroded; patches or spherulitic structures of coarse mosaic potash feldspar, often intergrown with magnetite; fairly abundant magnetite as scattered crystals and irregular blebs, oxidation of which probably accounts for the red colour of the outcrops.

A large number of small *prospects* occur within the rhyolite at The Red Hills, including several major adits. The prospects appear to be mainly on pyrite zones or in pyrite-chalcopyrite veins, with some disseminated chalcopyrite in some areas. A small adit has been driven into the margin of the isolated lens of rhyolite, apparently prospecting small veins of galena and chalcopyrite, and near the northern end of the area a small prospect is located near a nest of hematite veins.

The *origin* of the rhyolite body is not clear, but the following factors appear relevant: the body has a transitional contact with feldspar porphyry lavas along the west flank; the flow banding suggests some of the rocks are extrusive lavas, and the uniform fine grain size also suggests this; pyroclastic rocks have not been observed within the body. An origin from quiet outpourings of lava along a fissure is suggested, but a more detailed study is obviously required.

FELDSPAR PORPHYRY SEQUENCE WEST OF THE RED HILLS

West of The Red Hills, in the Moxon Saddle area, is a sequence of cleaved, grey-green feldspar porphyry rocks, most of which appear to be lavas. Two shale lenses occur within the central part of the sequence. Flow banding and bedding within the sequence dip steeply west, and a prominent cleavage trends about 160° and dips west at 70-80°. Despite a careful search, facings have not been obtained within the sequence.

Flanking the Darwin-type rhyolite, on the lower western slopes of The Red Hills, is a belt of pale pink to grey rocks, many of which show autobrecciated or 'rubbly' textures, and some of which contain deformed 'rafts' up to 2 m long of chilled lava in a rubbly or flow-banded matrix. One variety contains abundant large spherulitic structures, up to 25 cm in diameter, consisting mainly of chlorite. These rocks appear to grade into the typical feldspar porphyries to the west. In thin sections (74-96, 97; 74-102, 103) the rocks consist dominantly of microcrystalline quartz-feldspar-sericite groundmass, with fine chlorite in some cases, and a few scattered feldspar phenocrysts. Staining tests on 74-97 suggest that much of the groundmass feldspar and about half the phenocryst feldspar is potassic.

The main part of the sequence includes, as well as good examples of flow-banded and autobrecciated lavas and a few agglomerates with bomb-like fragments, many outcrops which show a rubbly texture or an apparently clastic texture due to the presence of plates of sericite (plus or minus chlorite) but which appear to be lavas in thin section. Of fourteen thin sections taken across this belt (74-104 to 115; 74-92; 73-363), nine showed typical feldspar porphyry lava texture (as shown by the flow-banded specimens), two were spherulitic lavas (74-108, 109), one was a possible lava, one was a possible ignimbrite (74-111), and one was a probable tuff (74-107). The major petrological features are: an abundant microcrystalline to microporphyritic groundmass of quartz and feldspar with sericite, chlorite and commonly calcite, in which the micaceous minerals usually outline a penetrative cleavage; common to abundant phenocrysts, and also glomerophenocrysts, of plagioclase (albite-oligoclase); rare quartz phenocrysts (in ten of the sections); fine calcite in many of the plagioclase phenocrysts and also in the groundmass (possible decalcification of the plagioclase?).

The detailed classification of these rocks is better left until chemical analyses are available, but the presence of free quartz and the apparent lack of potash feldspar (as indicated by staining tests) indicates that they can be classed as either quartz-keratophyres (feldspar-phyric type of Schermerhorn, 1973) if the plagioclase is assumed to be dominantly albite, or as dacites, if the plagioclase is assumed to be mainly oligoclase.

The main *shale horizon* is 45-50 m thick and consists largely of grey to black shale or slate with little obvious bedding. It lenses out just north of the road near The Red Hills, but appears from geophysical evidence (K.O. Reid, pers. comm.) to continue south to connect with another exposure on the side road to Lake Westwood.

SEQUENCE WEST OF HENTY FAULT ZONE

A sequence of feldspar porphyry lavas, with lesser tuffs, agglomerates and sedimentary rocks, occurs west of the Henty Fault Zone on the lower flanks of Mt Read. The sequence is intruded by a complex of basic dykes, which are described separately. The rocks have been mapped in some detail along the main access road from Henty Camp northwards, and also along the Henty River north and south of Henty Camp, but no attempt has been made to map the dense rain forest areas because of lack of time. Reconnaissance traverses along some cut lines and creeks indicate that similar rocks are present over most of the area, but detailed mapping is unlikely to add much to the understanding of the geology because of the paucity of outcrop and the complexities introduced by the closely spaced dykes and the patchy cover of morainal material. Difficulties were experienced even in mapping units from one side of the road exposure to the other in many places.

The *lavas* range from pale greenish-grey to pink or splotchy pink and green in colour, and are generally fine-grained except for the feldspar phenocrysts, which are rare to abundant and up to 2 mm long. Flow banding is evident in a few places, sometimes as distinctive pink and green striping. Many outcrops around the Henty Camp area show prominent pink splotches composed of fine-grained secondary pink feldspar (probably albite) which replaces the groundmass and to some extent the phenocrysts also. Some examples also contain epidote as scattered crystals and as patches and irregular veins replacing groundmass and phenocrysts. One specimen (74-195) has the groundmass almost completely replaced by epidote. Primary hornblende occurs as small phenocrysts in one specimen (74-192) from the Henty River, but otherwise no primary ferromagnesian minerals have been observed.

Study of sixteen *thin sections* of the lavas (74-119, 120, 183, 184, 186, 187, 190, 191, 192, 194, 195, 196, 197, 199, 203; 72-50) reveals the following general characteristics: an abundant, usually foliated, microcrystalline quartzo-feldspathic groundmass more or less altered to sericite and in some cases chlorite, with secondary albite and carbonate common in some samples; phenocrysts and glomerophenocrysts of plagioclase (albite-oligoclase), more or less altered to sericite; scattered small quartz crystals (in a few specimens). The rocks are essentially similar to those west of The Red Hills except for the secondary albitisation and epidotisation.

Tuffs and agglomerates occur sporadically through the sequence, and are similar in composition to the lavas. They range from coarse agglomerates, with fragments up to 25 cm long, to laminated fine tuffs. A band of siltstone and greywacke crops out near Henty Camp, the greywacke (74-188, 189) containing abundant angular to subrounded quartz and feldspar grains and small shale and quartzite clasts in a sparse matrix of fine clastic material and sericite. The siltstone or shale becomes strongly cleaved and contorted as it passes into the Henty Fault Zone. A similar sequence of highly contorted cleaved shale occurs within the fault zone where it crosses the road north-west of The Gooseneck.

INTRUSIVE ROCKS WEST OF HENTY FAULT ZONE

Mafic dykes ranging in thickness from a few centimetres to several tens of metres occur abundantly throughout the sequence west of the Henty Fault Zone, and are the most common rock type in many areas. Many of the smaller dykes are very irregular in form, and small fine-grained dykes cutting larger coarser dykes can be seen in a few places. Most of the dykes are fairly deeply weathered and somewhat cleaved and altered.

Preliminary petrological work indicates that the dykes comprise a variable suite ranging from fine-grained chloritic basalt (*e.g.* 74-121) typical of the thinner dykes, to partially altered dolerites and strongly altered and serpentinised dolerites. Some of the dykes, particularly in the Henty Camp area, are heavily chloritised and contain abundant veins of epidote, along some of which are splashes of galena.

A specimen (74-182) from the Henty River about 600 m upstream of Henty Camp is described by Everard (unpubl.rep., 22.7.1974) as 'confused network of completely sausseritised feldspar laths averaging about 0.5 mm long in a groundmass of yellow-green serpentine. There is a rough general orientation of the crystals. Opaque irregular masses of leucoxene......are fairly common. The rock is a serpentinised dolerite'. Another doleritic rock (74-198) from a large body on the road 2 km north of Henty Camp (intersected by map grid line 64400mN) is described by Everard as follows: 'In thin section a pigeonitic augite is prominent with an axial angle of about 45°... The crystals are deeply corroded with the production of chlorite and serpentine. Plagioclase feldspar is present in broad laths in ophitic relationship with the augite. The feldspar also is much altered. Ilmenite largely altered to leucoxene is present in skeletal crystals and granules. The rock is an altered dolerite'.

An unusual rock occurs as blocks on the road about 100 m west of the Henty Fault Zone, north-west of The Gooseneck, and is a dark grey, completely fresh, uncleaved basaltic rock described by Everard (unpubl.rep., 31.5.1974) as follows: 'In thin section the texture is intersertal and sub-ophitic, consisting of small patches of dark glass with feldspar laths alternating with areas where the pyroxene is penetrated by or moulded on feldspar laths. The pyroxene is a colourless pigeonitic augite, giving figures with an optic axis angle estimated at about 45°. Biotite is in euhedral crystals...... The feldspar is in the andesine-labradorite range'. The unaltered, uncleaved nature of this rock distinguishes it from all others in the area, and suggests it could be much younger in age. Everard calls it a tholeiite and relates it to the Jurassic dolerites.

Associated with the above are blocks of pale yellow-green medium-grained, quartz-diorite which in thin section (Everard) 'shows what was originally a hypidiomorphic texture with euhedral and subhedral ferromagnesian crystals up to 3 or 4 mm long. These have been completely altered to aggregates of epidote crystals with minor chlorite. More chlorite occurs interstitially or outside the pseudomorphs. Other interstitial material is oligoclase in subhedral and anhedral crystals, and anhedral quartz..... The rock is an altered quartz-diorite'.

SEQUENCE SOUTH OF HENTY RIVER

The rocks underlying the Comstock Formation correlate in the area south of the Henty River are poorly exposed and have not been mapped in detail. In Newton Creek the first outcrop below the Comstock Formation is a cleaved, grey-green laminated pyritic siltstone containing sericite, fine quartz and feldspar (74-79). About 50 m west of this is a grey, cleaved feldspar porphyry lava (74-80) with good flow texture outlined by feldspar laths in the groundmass. On a logging track into Tyndall Creek, south of Newton Creek, are exposed cleaved, sericitised rocks with pale flecks of feldspar and dark flecks which may be altered ferromagnesian minerals. The texture in thin section (74-90) is similar to that of the feldspar porphyry lavas.

On the buttongrass plain north-west of Newton Creek bridge are outcrops of cleaved shale (74-76) containing sericite, chlorite, fine quartz and pyrite, and west of this are cleaved, sericitised feldspar porphyry rocks which may be either tuffs or lavas (74-74, 75). Basic intrusives such as occur near the Henty Fault Zone have not been observed.

TYNDALL GROUP CORRELATES

The Tyndall Group was defined by Corbett *at al.*, (1974) from the Queenstown area, and comprises the Comstock Tuff and the Jukes Formation. The base of the group has been dated as late Mesial or early Late Cambrian (Jago *et al.*, 1972). The present study confirms the existence of correlates of this group in the Newton Creek area, and makes several important additions to our understanding of Late Cambrian stratigraphic relationships. As in the Queenstown area there appears to be an unconformity at the base of the Comstock Formation, as indicated by the abrupt change in lithology and the difference in degree of alteration and apparent deformation, although outcrops of the contact have not been seen.

Significant new findings include the following:

(1) The Comstock Formation correlate includes a thick basal unit of quartz-feldspar porphyry lava not recognised at Queenstown.

(2) There appears to be a disconformity in some areas, but not in others, between the Jukes Formation correlate and the Comstock Formation correlate.

(3) The sequence of interbedded sandstone, siltstone and conglomerate which overlies the Jukes Formation correlate in the Newton Creek area appears to be a facies variant of the lower part of the Owen Conglomerate correlate rather than part of the Jukes Formation as was suggested by Corbett *et al.*, (1974).

(4) Fossils from this interbedded sequence (herein termed the 'Newton Creek Sandstone Member') are of Late Cambrian, probably Franconian age (J.B. Jago, pers. comm.), and this gives a minimum age for the base of the Owen Formation and an upper limit for the Jukes Formation.

Comstock Formation correlate

Newton Creek belt

The main outcrop is in a belt about 600 m wide extending from west of the Tyndall Range to north-west of Mt Julia, where it appears to be partly truncated by the Henty Fault Zone. Along this belt the rocks dip steeply east towards the axis of a large synclinal structure, and comprise a lower lava member and an upper pyroclastic member.

The *lower lava member* has a maximum thickness of about 400 m west of Mt Julia, but appears to wedge out to the south near Newton Creek and to the north near the Henty River. It is exposed mainly as low glaciated outcrops through a shallow cover of bouldery moraine. Most of the rocks are pink to red in colour, but pale lavas become dominant due west of Mt Julia and to the north of this. Quartz phenocrysts are nearly always apparent but tend to be larger and more abundant in the pink varieties. They generally average 2-3 mm in length but may range up to one centimetre or more. Feldspar phenocrysts are also common, although not as obvious. The groundmass is always very fine-grained.

Flow banding is well developed in some outcrops, and usually consists of alternating bands of slightly different colour and texture a few centimetres across. Autobrecciation textures are also common, and consist of jumbled, angular to rounded blocks of porphyry, up to half a metre or so across, in a matrix of similar porphyry. Brecciated zones or layers merge into flow-banded zones in some exposures, and elsewhere the two types occur as alternating bands a few metres thick.

In thin section the pink lavas (72-46, 47; 74-67) consist of phenocrysts and glomerophenocrysts of quartz and of plagioclase in an abundant pink groundmass of very fine feldspar with chlorite, sericite, quartz and scattered iron oxide. Much of the groundmass appears to have recrystallised into a fine mosaic of interlocking ragged pink albite(?) crystals. The groundmass of 72-46 shows a remnant spherulitic structure throughout, suggesting it was originally glass. Nearly all the phenocrysts are corroded to some extent, and some are very deeply embayed. Reaction rims are prominent on many of the quartz phenocrysts, and broken crystals are fairly common. The plagioclase seems to be mainly albite-oligoclase, and is usually partly sericitised. The pale lavas (74-68, 71) are similar except for the lack of pink colour in the groundmass and the smallness and scarcity of the phenocrysts. The groundmass in 74-68 shows a prominent irregular banding in yellowish very fine-grained material which forms halos around the phenocrysts and shows spherulitic structure and slightly anomalous birefringence, suggesting it is probably recrystallised glass.

The *upper pyroclastic member* transitionally overlies the lower lava member, and is about 200 m thick west of Mt Julia. It includes massive and banded crystal tuff, crystal-lithic tuff, agglomerate, banded cherty shale and, at Newton Creek, a thick wedge of volcaniclastic conglomerate and sandstone. Lenses of typical pink quartz-feldspar porphyry lava occur within the member, and there are also some problematic rocks with features of both the tuffs and the lavas.

The tuffs are grey-green to pink in colour, and some show splotchy pink and green colouration due to secondary albitisation. On some horizons there are pink halos of secondary albite developed around lithic fragments, and distinctive banding due to alternations of pink (albitised) and green bands up to 10 cm thick occurs in places. The agglomerates contain fragments up to 30 cm long, many of them composed of quartz-feldspar porphyry. A laharic unit, bearing deformed rafts of shale, overlies a unit of distinctively laminated grey-green cherty siltstone, with numerous small intraformational faults, on the road 1.5 km south of Henty Camp.

In thin sections (74-66, 69, 77, 83, 84, 85, 87, 88, 89; 72-48) the crystal tuffs and crystal-lithic tuffs are similar in composition to the lavas, with abundant plagioclase and quartz grains in a fine groundmass which is commonly replaced by fine secondary albite, but also contains fine chlorite, sericite, scattered iron oxide grains, and sometimes calcite. Coarse splotches of chlorite occur in some samples. The lithic types contain angular fragments consisting mainly of the fine pink albitic groundmass of the lavas. Veins of secondary albite, replacing the groundmass, occur in 74-84. The plagioclase grains are commonly cloudy or partly to completely saussuritised.

The problematic rocks include coarse breccias similar to the autobrecciated lavas, with a fine-grained tuffaceous matrix. In thin section (74-81, 86) the finer material consists of quartz and feldspar grains and small rock fragments in an abundant very fine sub-isotropic matrix showing a flow structure which wraps around the grains and has swirl structures in places, and includes fragments of brown glass which have been deformed between grains. It is possible that these rocks are either ignimbrites or frothy lava flows of some kind.

The Gooseneck area

Pink to greenish-grey quartz-feldspar porphyry forms a belt up to about 1.4 km wide on the flanks of The Gooseneck, narrowing northwards against the Henty Fault Zone. Much of the porphyry is massive lava, but flow banding is well developed over large areas, and there are some excellent exposures of autobrecciation texture. In one area, about 250 m north of the road, large blocks of flow-banded lava up to 2 m across are contained in a 'matrix' of brecciated lava. The rocks are similar in all respects to the lavas of the Newton Creek belt. Possible pyroclastic rocks occur in a few places, but a mappable pyroclastic member has not been recognised.

In thin section the flow-banded lava (74-116) consists of about 40% quartz and feldspar phenocrysts and 60% groundmass. A strong flow foliation is evident as bands and lenses of very fine-grained sericitic material which wraps around the phenocrysts.

Lake Westwood area

An outcrop of Comstock-type tuff occurs beneath the Jukes correlate on the north flank of Lukes Knob, west of Lake Westwood. The rock is pink and crudely banded, with abundant quartz and feldspar grains, green chlorite splotches, and rock fragments (largely of pink porphyry) up to 10 cm long. The tuff occurs in the core of a north-plunging anticline, and appears to have been upfaulted.

The Comstock Formation correlate also occurs about 600 m further north, where again it apparently occupies an upfaulted anticlinal core. In this area it consists of bedded quartz-rich tuff and tuffaceous sandstone, with some interbedded siliceous fine sandstone layers. It is overlain, apparently conformably, by a coarse breccia at the base of the Jukes Formation correlate.

Jukes Formation correlate

Volcaniclastic conglomerate and sandstone, usually reflecting the composition of the underlying rocks, forms a mappable unit between the Comstock Formation correlate and the overlying Owen Conglomerate correlate along the Newton Creek belt and in the Lake Westwood area. It also occurs as lenses beneath the conglomerate and unconformably overlying the older rocks around The Red Hills.

In the area west of Mt Julia the formation is about 30 m thick, and contains volcanic fragments (mainly quartz-feldspar porphyry) up to 15 cm long and a few scattered quartzite fragments in a matrix rich in quartz and feldspar grains. Bedding is apparent in most outcrops. The upper contact here is transitional into more quartzite-rich conglomerate beds. The lower contact, with the Comstock Formation correlate, is exposed in Julia Creek near its confluence with the Henty River, where interbedded tuff and tuffaceous sandstone appear to pass transitionally into volcaniclastic fine conglomerate.

On the lower western slopes of The Gooseneck, adjacent to the Henty Fault Zone, is an area of strongly-cleaved volcaniclastic conglomerate typical of the Jukes Formation, but its relationships to the rocks further south could not be determined.

At the northern end of The Gooseneck, Owen Conglomerate correlate rests abruptly on Comstock-type lava, the abrupt change in rock type suggesting a disconformity. South-west of The Gooseneck, some 20 m of Jukes Formation correlate separates the Owen Formation from the underlying quartz-feldspar porphyry, suggesting that the disconformity is at the base of the Jukes Formation correlate.

At Lukes Knob the base of the Owen Formation correlate contains scattered blocks of porphyry and has volcanic quartz in the matrix, and is underlain by some 6 m of well-bedded volcaniclastic sandstone underlain by at least 10 m of conglomerate with blocks up to boulder size of quartz-feldspar porphyry. North-west of Lake Westwood the Jukes correlate is about 40 m thick, and includes a very coarse basal breccia, about 10 m thick, with blocks of banded pink quartz-feldspar porphyry up to a metre across, overlain by about 30 m of interbedded quartzose sandstone and volcaniclastic fine conglomerate. A bed of siliceous pebble conglomerate, about 60 cm thick, occurs about 3 m below the top of the formation, and the upper contact with siliceous conglomerate is a conformable erosion surface with channels up to 40 cm deep.

North-east of The Red Hills the Jukes Formation correlate comprises some 45 m of crudely-bedded volcaniclastic conglomerate containing blocks up to 30 cm long.

OWEN CONGLOMERATE CORRELATE

The sequence above the Jukes Formation correlate varies somewhat from place to place, in some areas consisting of a marine sequence of interbedded quartzwacke sandstone, siltstone and grey siliceous conglomerate, and in other areas of thick-bedded pink siliceous conglomerate and cross-bedded red sandstone typical of the Owen Formation elsewhere. The quartzwacke association is a mappable unit and is herein termed the 'Newton Creek Sandstone Member', a name previously suggested for the sequence by geologists of the Mt Lyell Company. It is overlain by the normal pink conglomerate on the north flank of the Tyndall Range and also on Newton Peak and on Julia Peak.

That the quartzwacke association is laterally equivalent to the pink conglomerate-red sandstone association, which overlies the Jukes correlate elsewhere, and belongs to the Owen Conglomerate correlate is indicated by the following:

(1) At Lukes Knob normal pink conglomerate conformably overlies Jukes correlate which in turn overlies banded tuff typical of the Comstock Formation, whereas on Mt Julia similar banded tuff is overlain by Jukes correlate followed transitionally by the 'Newton Creek Sandstone Member'.

(2) On the north flank of the Tyndall Range a sequence of grey sandstone with interbedded siltstone and slump sheets, typical of the 'Newton Creek Sandstone Member', and an overlying sequence of grey conglomerate and sandstone, apparently pass eastwards into pink conglomerate and sandstone, and are not recognisable 1.5 km to the east.

(3) A sequence of grey conglomerate and sandstone, with some intercalated pink horizons, on the south-west spur of The Gooseneck appears to be transitional in facies between the pink conglomerate and the grey conglomerate of the 'Newton Creek Sandstone Member'.

'Newton Creek Sandstone Member'

Stratigraphy

This sequence is very well exposed on Mt Julia, on the ridge west of Julia Peak, around Newton Creek, and on the north flank of the Tyndall Range. The base conformably overlies the Jukes Formation correlate west of Mt Julia, and the top may be taken as the first appearance of pink thick-bedded conglomerate on the northern Tyndall Range. Well-bedded pale grey quartzwacke sandstone, in beds up to a metre or so thick, some of which show grading, is the dominant rock type, but is usually interbedded with laminated, fawn-weathering grey to black siltstone, and grey siliceous pebble to cobble-grade conglomerate. There are mappable units of these minor lithologies in many areas. Pebbly mudstone slump sheets up to 3 m thick are common in some sections. Marine fossils have been obtained from five localities.

Good stratigraphic sections through the lower part of the member occur on the western flanks of Mt Julia, and good sections through the upper part on Julia Peak and the north slopes of the Tyndall Range. It has not been possible, however, to link these sections across the major fault along the west flank of Mt Julia. Rapid facies changes and wedging of units appear to be characteristic of the sequence, *e.g.* a conglomerate-rich unit on the north-west end of Mt Julia becomes essentially a sandstone unit to the south, and a black shale unit at the base just north of Newton Creek bridge wedges out beneath a conglomerate to the north. It has not been possible to correlate well-exposed upper units near Julia Peak and Newton Peak with the upper part of the member on the Tyndall Range, only about 2 km away.

The main stratigraphic sections are summarised in Table 1.

Sedimentology

The sequence may be considered in terms of four major lithofacies for sedimentological analysis, although a detailed study would probably reveal many more. These are the sandstones, the silstones, the conglomerates, and the slump sheets.

The *sandstones* are white-weathering, siliceous, fine- to coarse-grained rocks which in thin section (74-70) consist largely of quartz grains and quartzite rock fragments, with muscovite-sericite flakes and scattered biotite flakes in a sparse to moderately abundant matrix now composed largely of recrystallised quartz and fine sericite. Sorting varies from very poor in some of the coarser-grained rocks to good in some of the fine-grained types. There was no feldspar or obvious volcanic quartz in the section examined.

The abundant and well-exposed sedimentary structures include graded

Table 1. SUMMARY OF STRATIGRAPHIC SECTIONS OF THE 'NEWTON CREEK SANDSTONE MEMBER' (APPROXIMATE THICKNESSES IN METRES).

	RIDGE WEST OF JULIA PEAK			NORTH TYNDALL RANGE	
	Pink conglomerate.			Pink conglomerate.	
Unit 4	Grey laminated siltstone.	100	*Unit Z*	Grey conglomerate and sandstone.	0-40
Unit 3	Grey conglomerate and sandstone.	80	*Unit Y*	Quartzwacke sandstone.	0-40
Unit 2	Quartzwacke sandstone with interbedded conglomerate, siltstone and slump sheets.	>500	*Unit X*	Grey laminated siltstone.	80
	FAULT		*Unit W*	Quartzwacke sandstone with interbedded siltstone, conglomerate and slump sheets.	>200
Unit 1	Thin bedded sandstone and siltstone	50?			

MAJOR FAULT

	WEST FLANK OF MT JULIA TO NEWTON CREEK	
Unit D	Quartzwacke sandstone	30
	FAULT	
Unit C	Thin-bedded sandstone and siltstone, many beds bioturbated.	50-100?
Unit B	Interbedded grey conglomerate, sandstone and siltstone; becomes sandier to south.	105
Unit A	Grey laminated siltstone, with a basal conglomerate unit up to 10 m thick in most areas, and one or more lenses of conglomerate above; basal black shale unit near Newton Creek wedges out to north.	70
	Jukes Formation correlate	

'NEWTON CREEK SANDSTONE MEMBER'

bedding of various kinds, including full and truncated Bouma sequences; structureless non-graded bedding; erosional soles and gradational tops; flat lamination with parting lineation; convolute lamination; ripple marks and cross-lamination; scour channels; flute marks, often filled with coarse gravelly sand, longitudinal ridge and furrow structure; load marks; pseudonodules and large-scale ball and pillow structures; water-escape cusp structures; elutriation columns; vertical sheet structures (Laird, 1970); and dish structures. Trilobite fragments occur in the sandstones in places, and the sedimentary structures indicate deposition largely by proximal turbidity currents.

The *thin-bedded sandstone sequences,* such as Unit C, are more difficult to interpret. They consist of about 60% fine sandstone, in beds a few millimetres to about 10 cm thick, and 40% micaceous siltstone. Many of the sandstone beds are bioturbated throughout the upper half, and there are irregular worm casts on the bedding surfaces. Ripple marks and cross-lamination occur in some beds. Other such sequences, possibly representing the same horizon, occur on the east flank of Mt Julia, on the saddle south of Lake Julia, and just north of Newton Creek bridge. The abundant bioturbation suggests a shallower water environment than that for the typical sandstones.

The typical *siltstone* sequences consist of pale grey to dark grey laminated sandy micaceous siltstone with interbedded fine sandstone bands. There are also units of paper-laminated black shale.

The grey siliceous *conglomerates* tend to occur in composite units up to several tens of metres thick, but single conglomerate beds and lenses of conglomerate within sandstone beds occur throughout the sequence. The major conglomerate units, which are dominantly of pebble grade but also include beds with cobbles and even small boulders, are difficult to explain, occurring as they do within marine sequences of dominantly turbidite facies. The clasts are almost exclusively of quartzite, and the matrix is dominantly siliceous with scattered mica flakes and fine sericite. Within the units, the bedding may be quite irregular, with thin discontinuous lenses of sandstone separating conglomerate beds up to a metre or so thick. Grading is not evident in most beds, although it does occur in some.

Where the bases of the composite conglomerate units are exposed, they are almost always sharp and erosional, particularly where they overlie siltstones, and there are commonly large and small scour channels and flute-like marks and grooves on the base. In one outcrop a conglomerate channel grades laterally into a graded sandstone bed, indicating an origin from a gravel-bearing density undercurrent such as deposited the graded sandstones. However, such a mechanism does not satisfactorily account for the lensing bedding of some units, which closely resembles the bedding seen in the normal pink conglomerate facies of probable shallow-marine or non-marine origin.

Slump sheets up to several metres thick are particularly well exposed on the knob 650 m east of Newton Creek bridge, and on the ridge about 800 m west of Julia Peak. They include homogeneous pebbly mudstone types and types with contorted remnants of sandstone and siltstone layers preserved. Most are clearly truncated by the overlying sandstone bed, indicating that the slumping occurred on the sea floor prior to burial.

The sequence has many features in common with the Late Cambrian Singing Creek Formation of the Denison Range, interpreted by Corbett (1970, 1972, 1973) as being a proximal turbidite facies deposited as a submarine fan complex. The extensive shallow marine sequence which separates the Singing Creek Formation from the overlying conglomerate formation on the Denison Range does not seem to be developed here, suggesting a close spatial relationship between the debris-supplying alluvial fans and the submarine fan complex. The 'Newton Creek Sandstone Member' appears to have been deposited in a basin with a north-eastern margin near The Gooseneck and Lake Julia (probably controlled by faults), but the other limits are not yet known.

Palaeontology

Poorly-preserved brachiopod-trilobite faunas have been recovered from five localities in the Newton Creek area (fig. 2). The best preserved and most abundant fauna is from a sandy siltstone at locality NC2, on the road about 800 m south-west of Newton Peak. A preliminary examination of the material by Dr J.B. Jago of Adelaide (pers. comm., 25.10.1974) indicates a high degree of fragmentation, but *Proceratopyge* and *Pseudagnostus* can be recognised, both of which are also characteristic of the Singing Creek Formation. A possible Leiostegiid trilobite is also present, as well as representatives of two brachiopod genera and numerous cystoid plates. Their age according to Jago is Late Cambrian and probably Franconian.

Pink Conglomerate Facies

The normal facies of the Owen Conglomerate correlate is represented by pink to pale purplish-brown, pebble to cobble grade, siliceous conglomerate, in beds up to two metres or so thick, commonly interbedded with cross-bedded siliceous sandstone or with thin sandstone lenses. Only rare beds contain clasts of boulder size. Dark red siliceous sandstone forms a distinctive horizon, about 75 m thick, between Julia Peak and Newton Peak, and shows trough and tabular cross-bedding, abundant worm burrows and casts, ripple marks, pseudonodules, and other deformational structures. Some beds show numerous white spots, up to 5 cm in diameter and coalesced into large splotches in places, which appear to represent 'reduction spots'. The sandstone appears to be of very shallow marine origin. A second unit, on the north flank of the Tyndall Range, comprises alternating cross-bedded sandstone and pebble conglomerate sequences, in units up to 15 m thick, and forms a marked shelf or gulley on the face of the range.

The upper part of the Owen Conglomerate correlate has not been mapped or examined, and no accurate estimate of the total thickness of the formation can be given.

STRUCTURAL GEOLOGY

Faults

There are at least two major faults in the area. The *Henty Fault Zone* forms a linear depression and is marked by a zone up to 50 m wide of intense shearing and chloritisation. The rocks in the fault zone near Henty Camp are mainly chloritised basalt and shale, and show subvertical cleavage folded into tight kink-like folds. On the road north-west of The Gooseneck the rocks are cleaved shales, but north of this are chloritic tuff and lava, tuffaceous sandstone, and conglomerate. Here also there are kink-like folds developed in the subvertical cleavage. The throw and sense of movement on the Henty Fault Zone are not known. Minor pyrite-chalcopyrite mineralisation is exposed in several old prospects within the fault zone north-west of The Gooseneck.

The west-dipping conglomerate sequence of the western flank of the Tyndall Range is cut off abruptly against Comstock Formation correlate by a major fault which is traceable southwards to near Mt Sedgwick. It appears to be a continuation of the '*Great Lyell Fault*' which forms the western margin of the conglomerate at Queenstown. The fault is offset by small cross-faults at Newton Creek, then continues northwards along the flank of Mt Julia, following the axis of a major syncline. The fault splits into two branches north of Mt Julia, one of these apparently cutting through the south-west spur of The Gooseneck and the other running along the western foot of this spur. The fault zone is covered by superficial deposits in most areas, but its position can be mapped fairly accurately because the beds on either side have opposing dips. The west-side-up movement on the fault increases southwards, and just south of Newton Creek the Jukes Formation correlate is juxtaposed against the top of the 'Newton Creek Sandstone Member', indicating a throw of at least 600 m and possibly as much as 2000 m. Near Mt Julia however, the throw could be as little as 100-200 m (fig. 4).

A series of *NE-trending faults* is indicated in the Lake Julia-Gooseneck area. Two of these are evident south of Lake Julia as an area of disturbed dips associated with topographic linears. Another has been mapped on the north flank of Lukes Knob, and others are required to uplift the Comstock Formation correlate just north of this. A major structure linking these is indicated by the abrupt contact between the 'Newton Creek Sandstone Member' and pink conglomerate north-west of Lake Julia. Probably related to this set are a series of ENE-trending cross-faults through Newton Peak and across the north flank of the Tyndall Range. These faults are difficult to trace across the latter area because of the poor outcrop and lack of marker horizons, but are indicated by areas of disturbed dips.

Several NNW-trending faults slightly offset the base of the Owen Conglomerate correlate south of The Red Hills, and larger structures of this set probably account for the swing in strikes and the major topographic lineaments near Lake Westwood. The linear eastern contact of the Comstock Formation correlate near The Gooseneck appears also to be a fault.

Folds

The younger rocks are affected by two *major north-south folds, viz.* a broad central anticlinal structure, with its axial trace extending from The Red Hills area past Lake Julia and continuing southwards as the 'Tyndall Anticline', and a tight western synclinal structure extending from The Gooseneck through Mt Julia and along the western flank of the Tyndall Range. Although complicated by cross-faults, the central anticline plunges gently southwards, but the western syncline on the other hand plunges towards Mt Julia from both the northern and southern ends. The 'Great Lyell Fault' follows the axis of the western syncline as far north as Mt Julia, but cuts through its western flank in The Gooseneck area as the syncline axis swings NNE. Dips on the western flank of the syncline are subvertical to overturned, and are significantly steeper than those on the eastern flank, indicating oversteepening from the west and suggesting some west-side-up thrust movement on the 'Great Lyell Fault'.

A series of *minor folds*, with wavelengths of the order of 100 m, occur on the north face of Mt Julia. Of these, the westernmost anticline can be seen to become monoclinal to the south and then to die out completely. Another series of minor folds on the ridge west of Julia Peak have wavelengths of 40-60 m. At least one of these folds shows small scale crenulations with a wavelength of 20-40 cm in the axial region associated with a strong axial plane cleavage at 155°, 86° west. Intense kink-like folding occurs in the thin-bedded sandstone sequence just north-west of Mt Julia. The axial planes trend 140-160°, and plunges tend to be steeply south or north, with many folds subvertical. These steep folds could be related to sub-horizontal movements on the adjacent fault. A similar thin-bedded sequence just north of Newton Creek bridge also shows abundant small folds, although here the hinges generally plunge south-east at 45-50° and appear to be related to a larger synclinal axis through the sequence.

The structure in the pre-Tyndall Group rocks is more difficult to interpret. The Darwin-type rhyolite at The Red Hills shows vertical or steeply west-dipping flow banding, and is flanked by a sequence which also dips steeply west and has a steep west-dipping cleavage. The main rhyolite body is apparently not repeated to the west, suggesting that the rocks do not form a simple large anticline. The Jukes and Owen Formation correlates overlap these rocks unconformably, but the contact with the Comstock Formation correlate is linear and roughly concordant, and is probably faulted. Only a few bedding readings have been obtained from the sequence west of the Henty Fault Zone, and no definite facings are known.

Cleavage

A strong cleavage trending NNW affects all rocks in the area except the thick-bedded conglomerate and, apparently, the Darwin-type rhyolite. This cleavage generally dips steeply west at 70-85°, but is vertical in some exposures. Observations suggest the cleavage is related to the minor folds (*e.g.* those west of Julia Peak) and probably also the major fold structures, but a detailed structural analysis has not been attempted.

REFERENCES

CORBETT, K.D. 1970. *Sedimentology of an Upper Cambrian flysch-paralic sequence (Denison Group) on the Denison Range, south-west Tasmania.* Ph.D. Thesis, University of Tasmania : Hobart.

CORBETT, K.D. 1972. Features of thick-bedded sandstones in a proximal flysch sequence, Upper Cambrian, south-west Tasmania. *Sedimentology*, 19:99-114.

CORBETT, K.D. 1973. Open-cast slump sheets and their relationship to sandstone beds in an Upper Cambrian flysch sequence, Tasmania. *J.sediment. Petrology* 43:147-159.

CORBETT, K.D.; REID, K.O.; CORBETT, E.B.; GREEN, G.R.; WELLS, K. and SHEPPARD, N.W. 1974. The Mount Read Volcanics and Cambrian-Ordovician relationships at Queenstown, Tasmania. *J.geol.Soc.Aust.* 21:173-186.

JAGO, J.B.; REID, K.O.; QUILTY, P.G.; GREEN, G.R.; DAILY, B. 1972. Fossiliferous Cambrian limestone from within the Mount Read Volcanics, Mt Lyell mine area, Tasmania. *J.geol.Soc.Aust.* 19:379-382.

LAIRD, M.G. 1970. Vertical sheet structures - a new indicator of sedimentary fabric. *J.sediment.Petrology* 40:428-434.

SCHERMERHORN, L.J.G. 1973. What is keratophyre? *Lithos* 6:1-11.

[18 December 1974]

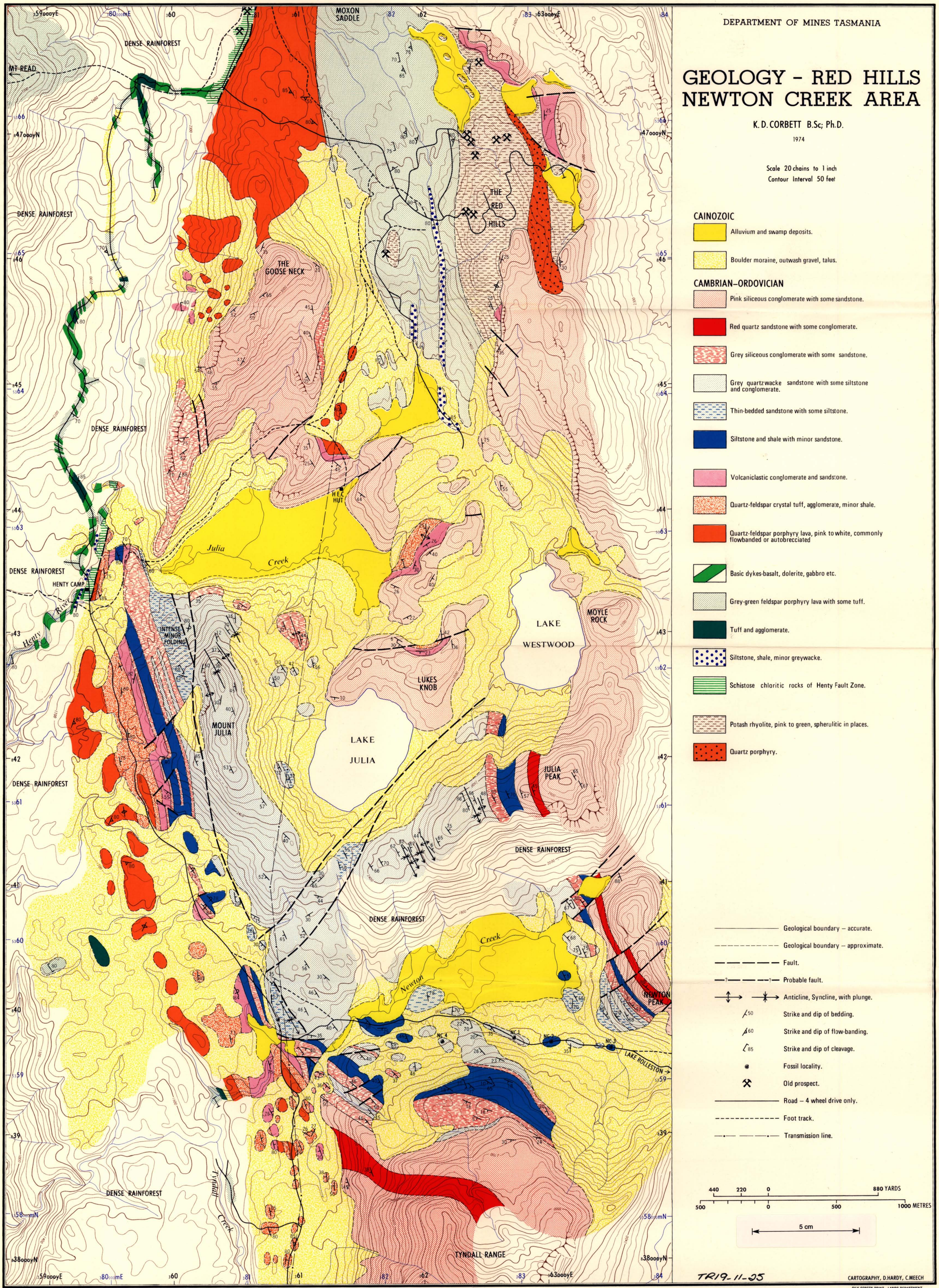
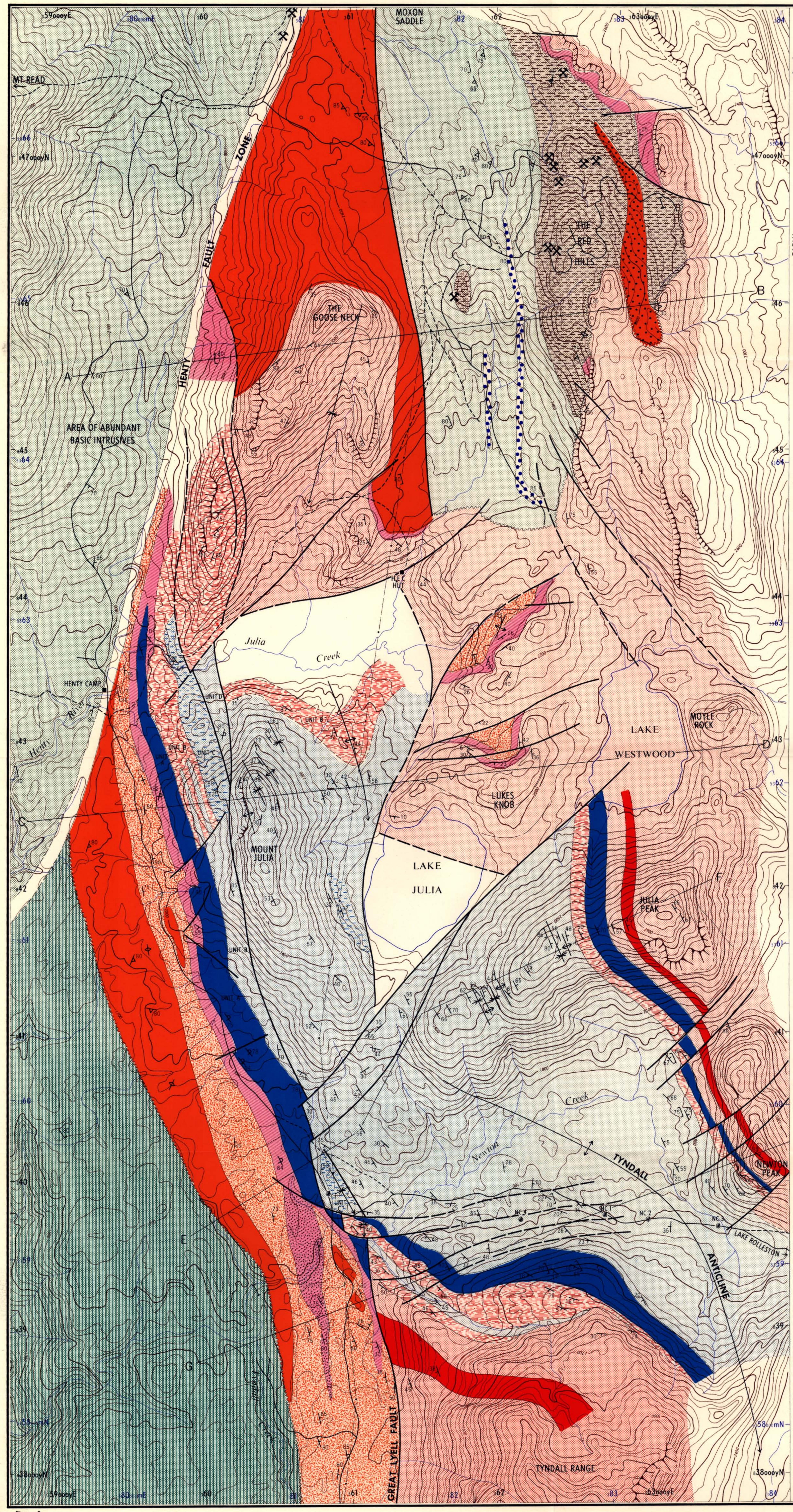

DEPARTMENT OF MINES TASMANIA
GEOLOGY - RED HILLS NEWTON CREEK AREA
K.D. CORBETT B.Sc; Ph.D.
1974
Scale 20 chains to 1 inch
Contour Interval 50 feet
CAINOZOIC
Alluvium and swamp deposits.
Boulder moraine, outwash gravel, talus.
CAMBRIAN-ORDOVICIAN
Pink siliceous conglomerate with some sandstone.
Red quartz sandstone with some conglomerate.
Grey siliceous conglomerate with some sandstone.
Grey quartzwacke sandstone with some siltstone and conglomerate.
Thin-bedded sandstone with some siltstone.
Siltstone and shale with minor sandstone.
Volcaniclastic conglomerate and sandstone.
Quartz-feldspar crystal tuff, agglomerate, minor shale.
Quartz-feldspar porphyry lava, pink to white, commonly flowbanded or autobrecciated
Basic dykes-basalt, dolerite, gabbro etc.
Grey-green feldspar porphyry lava with some tuff.
Tuff and agglomerate.
Siltstone, shale, minor greywacke.
Schistose chloritic rocks of Henty Fault Zone.
Potash rhyolite, pink to green, spherulitic in places.
Quartz porphyry.
Geological boundary - accurate.
Geological boundary - approximate.
Fault.
Probable fault.
Anticline, Syncline, with plunge.
Strike and dip of bedding.
Strike and dip of flow-banding.
Strike and dip of cleavage.
Fossil locality.
Old prospect.
Road - 4 wheel drive only.
Foot track.
Transmission line.
440 220 0 880 YARDS
500 0 500 1000 METRES
5 cm
MT READ
DENSE RAINFOREST
MOXON SADDLE
THE RED HILLS
THE GOOSE NECK
HEC HUT
Julia Creek
HENTY CAMP
Henty River
INTENSE MINOR FOLDING
MOUNT JULIA
LUKES KNOB
LAKE JULIA
LAKE WESTWOOD
MOYLE ROCK
JULIA PEAK
Newton Creek
NEWTON PEAK
LAKE ROLLESTON
Tyndall Creek
TYNDALL RANGE
TR19-11-25
CARTOGRAPHY, D.HARDY, C.MEECH
SILK SCREEN PRINT · LANDS DEPARTMENT

Figure 2



DEPARTMENT OF MINES TASMANIA

INTERPRETED GEOLOGY RED HILLS NEWTON CREEK AREA

K. D. CORBETT B.Sc; Ph.D.
1974

Scale 20 chains to 1 inch
Contour Interval 50 feet

EARLY ORDOVICIAN

LATE CAMBRIAN

EARLY TO MESIAL CAMBRIAN

OWEN CONGLOMERATE CORRELATE

- Pink conglomerate
- Red sandstone and conglomerate
- Grey conglomerate
- Grey sandstone
- Thin-bedded sandstone and siltstone
- Siltstone with one or two conglomerate units

'Newton Creek Sandstone Member'

JUKES FORMATION CORRELATE

- Volcaniclastic conglomerate and sandstone

Disconformity in some areas?

COMSTOCK FORMATION CORRELATE

- Tuff, agglomerate, minor shale and sandstone
- Volcaniclastic sandstone and conglomerate
- Quartz-feldspar porphyry lava

TYNDALL GROUP

Probable unconformity

- Dominantly feldspar-porphyry lavas, with abundant basic intrusive bodies west of Henty Fault Zone.
- Poorly known sequence of lavas, pyroclastics and shales south of Henty River.
- Major sedimentary lenses
- Darwin-type rhyolite
- Quartz porphyry

MOUNT READ VOLCANICS

- Geological boundary – proven or probable
- Geological boundary – possible
- Unconformity
- Fault – proven or probable
- Fault – possible
- Trend of bedding
- Strike and dip of bedding, cleavage, flow banding.
- Fold axis with plunge direction
- UNIT A Stratigraphic units referred to in text
- Fossil locality
- Old prospect
- Road – 4 wheel drive only
- Foot track
- Transmission line

440 220 0 880 YARDS
500 0 500 1000 METRES
5 cm

TR19-11-25

CARTOGRAPHY, D.HARDY, C.MEECH
SILK SCREEN PRINT LANDS DEPARTMENT

Figure 3

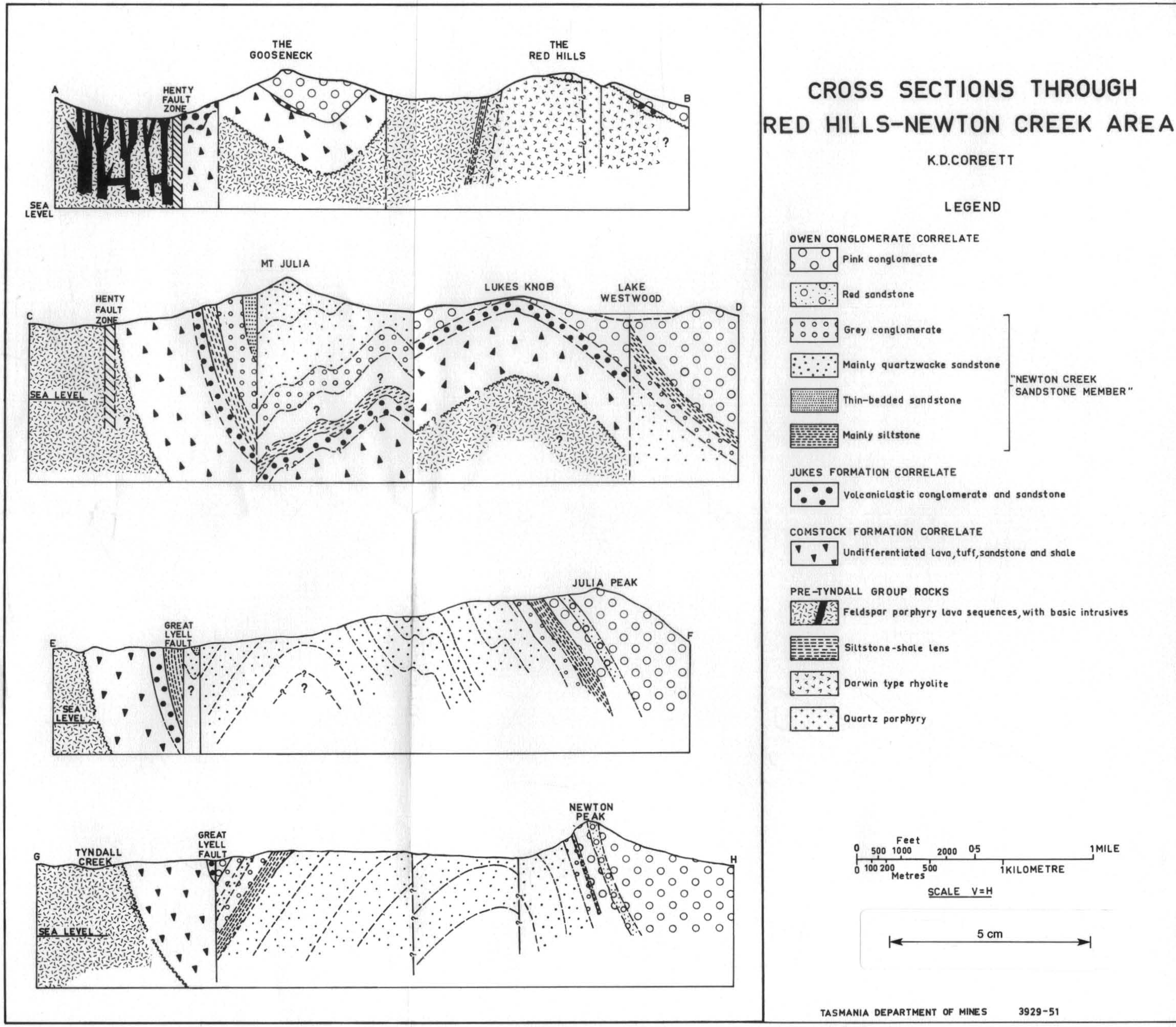


Figure 4.

TR19_11-25