NATURAL HISTORY OF THE TYNDALL RANGE AREA, WESTERN TASMANIA – SITE OF TASMANIA'S NEXT ICONIC WALK

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(with five figures and ten plates)

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The Tyndall Range, approximately 15 km north of Queenstown and part of the larger West Coast Range, has been chosen as the site for Tasmania's next 'Iconic Walk', due to open in 2029. The range is composed of siliceous conglomerates and sandstones of Late Cambrian age, within which four formations are recognised. The area was glaciated in the Pleistocene and has numerous glacial features, including large and small glacial lakes, moraines and cirque cliffs. At 1,100 m altitude, it takes the brunt of the 'Roaring Forties' weather, and the influence of ice-laden winds is apparent in the wind-pruned alpine vegetation. The large area of well-preserved alpine vegetation, including deciduous beech and pencil pine forests and cushion moorlands, has escaped the many fires which have affected the adjacent slopes and lowland areas. This is highly unusual for the western siliceous mountains. The proposed route for the Iconic Walk mainly follows the more sheltered lowland area to the east of the alpine plateau, visiting the impressive Lake Huntley and several other lakes. We suggest the management status of the Tyndall area should be reviewed to reflect its significant ecological values and effectively low mineral prospectivity.
Key Words: Tyndall Range, Iconic Walk, Tasmanian glaciation, Owen Conglomerate, alpine vegetation, deciduous beech.

INTRODUCTION

The Tyndall Range area, referred to as 'the Tyndalls', is located 10 to 20 km north of Queenstown (fig. 1). It is a sub-unit of the larger N–S-trending West Coast Range, and includes the undulating lower country to the east, with several moderate sized lakes, such as Rolleston, Huntley and Margaret. The range is bookmarked by Mt Geikie in the south and Mt Tyndall to the north, with the dolerite-capped Mt Sedgwick lying just outside the area to the south. The range is rugged and scenic, with several glacial lakes and related features, and some remarkably well-preserved alpine vegetation, including deciduous beech *Nothofagus gunnii*. The Tasmanian government has announced that the next Iconic Walk will traverse the range, and this has caused some controversy mainly due to the sensitive nature of the alpine vegetation.

The Tyndalls area is contained within the Tyndall Regional Reserve, one of several reserves along the West Coast Range. The management of these reserves allows for mineral exploration and the development of mineral deposits, and the harvesting of special timber species, while also protecting and maintaining the natural and cultural values of the land under the *Nature Conservation Act 2002*.

The authors have explored the range numerous times, and the senior author has mapped the geology in his role as geologist for the Geological Survey in the 1980s. This paper outlines the geology, glacial features and vegetation of the area, and provides context for the proposed new walking track. It also comments on the management status of the area in relation to its geology and ecological values.

GENERAL DESCRIPTION

The Tyndall Range was named in 1877 by James Reid Scott, on the advice of explorer TB Moore (Baillie 2010), who continued naming the peaks of the West Coast Range after famous British geologists/scientists of the time (e.g., Murchison, Lyell, Darwin, Huxley, Sedgwick). It was named for Professor John Tyndall (1820–1893), who made important contributions to physics, atmospheric science and glacial geology.

Like most of the West Coast Range, the Tyndall area is composed of pink- to grey-coloured siliceous conglomerate and sandstone of the Late Cambrian Owen Group (about 490 Ma), generally referred to as 'Owen Conglomerate'. It is bounded to the east and west by the Mt Read Volcanics, of older Middle Cambrian age (about 500 Ma). The area was glaciated during the Pleistocene and contains many distinctive and impressive glacial features. As the first high country from the west coast in this area, the Tyndall Range is subject to the full force of the 'Roaring Forties', with gale-force winds common and often accompanied by rain and sleet. This is evident in the vegetation on the range, much of which is heavily wind-pruned. Nearby Lake Margaret and Mt Read are among the wettest places in the state, with annual rainfall of about 3,000 mm. Frequent cloud cover on the range provides another hazard for potential visitors.

The Tyndall Range rises abruptly from a flattish plain scattered with conglomerate erratics around the Henty River area (pl. 1), at an altitude of about 500 m, to an undulating alpine plateau at around 1,100 m. The plateau is 1–2 km wide and about five km long, extending between Mt Geikie in the south and Mt Tyndall in the

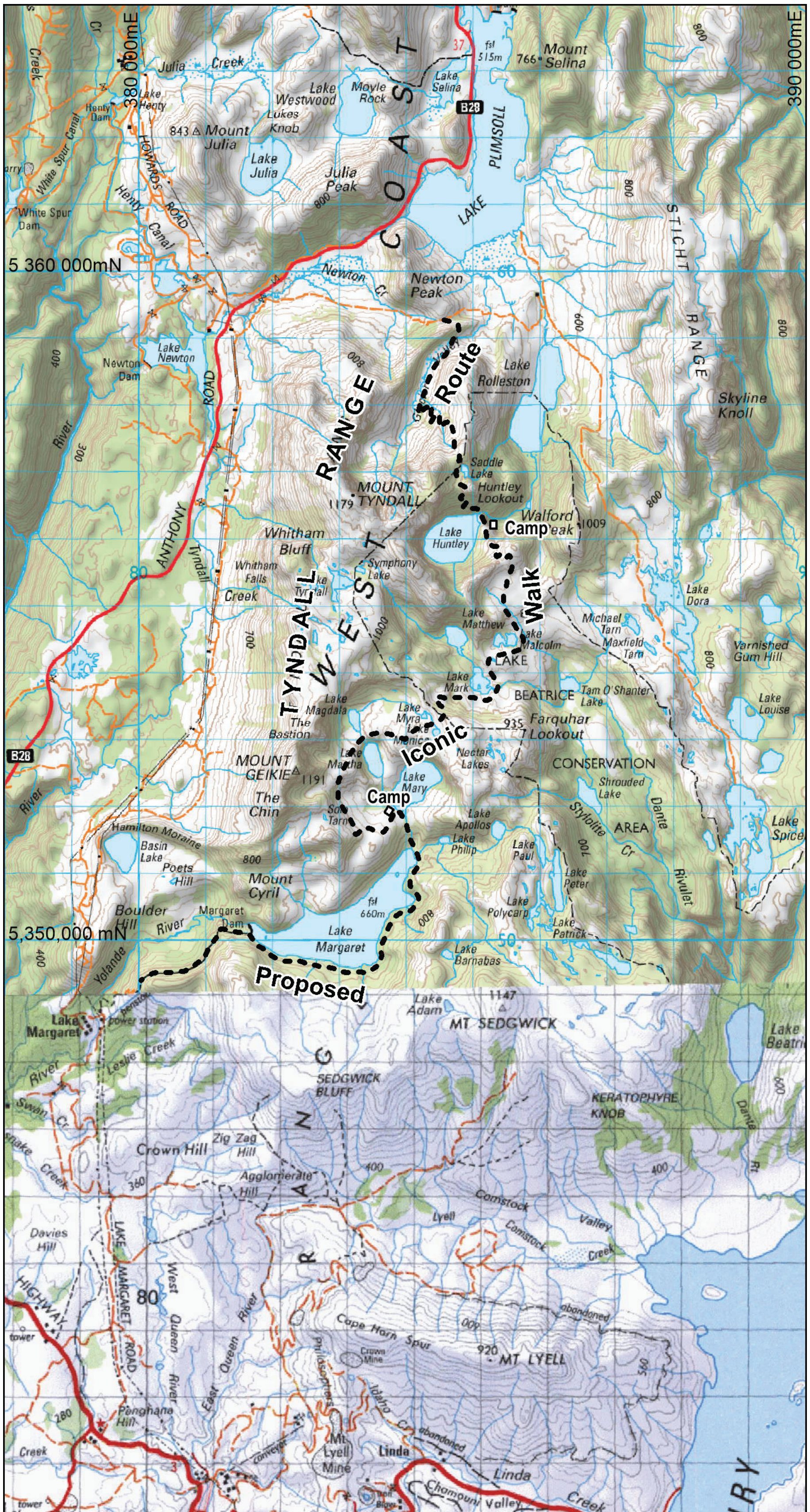

FIGURE 1 — Topographic map of the Queenstown–Tyndall Range area showing general location of proposed Iconic Walk

PLATE 1 — The Tyndall Range viewed from the NW. Whitham Bluff in middle, with trace of Whitham Fault visible. Mt Geikie on right. Glacial erratics and Lake Newton in foreground.

PLATE 2 — Tyndall plateau looking south to Mt Geikie. Lake Tyndall to right. Middle Owen Conglomerate rims foreground lake. Christine Corbett for scale.

PLATE 3 — View NW from Mt Sedgwick to Mt Geikie and Tyndall Range. Jurassic dolerite and Lake Barnabas in foreground, lakes Mary, Martha and Magdala to right. Note fire scars in vegetation.

PLATE 4 — View north from Mt Tyndall to Mt Murchison, prior to filling of Lake Plimsoll. Glacier Valley to right, with forested lateral moraine. R Hargreaves for scale.

north. Small lakes and flat-lying conglomerate strata are prominent (pl. 2), as are areas of alpine moorland and low forest. The plateau narrows to the south, at Mt Geikie, and is a narrow ridge top beyond this. This southern end of the range is delineated by a steep, glacially carved scarp along its eastern side, dropping down to an undulating lower level at around 700 m with many lakes, including Magdala, Martha, Mary and Margaret (pl. 3). This area drains westwards via Lake Margaret and the Yolande River, through a prominent gap in the range marked by two large glacial moraines which project across the lower country to the west. Lake Margaret has a small concrete dam (actually two dams joined to a conglomerate outcrop in the middle), and water is collected via a wooden stave pipeline to a power station at Lake Margaret township. This scheme was built by the Mt Lyell Company in 1914 and is now operated by Hydro Tasmania.

The western side of the Tyndall Range is formed by a single continuous slope to about 600 m high, becoming steeper to the north of Whitham Bluff to form an impressive scarp of stratified conglomerate cliffs (pl. 1). Whitham Bluff forms a hump-like eminence halfway along the slope, marked by the Whitham Fault on its northern side. Tyndall Creek and a major tributary tumble off the plateau on either side of Whitham Bluff, the northern one having a belt of rainforest along it, and the southern one forming the Whitham Falls. This western scarp marks the western limit of the great conglomerate formation, which was originally controlled by a large N–S fault, the Great Lyell Fault, which is now found running along the foot of the scarp. Glacial action through the Pleistocene has also accentuated the scarp.

A major E–W swampy valley drained by Newton Creek marks the northern end of the Tyndall Range, and the Anthony Road goes through this gap to the eastern side of the main range (fig. 1). Newton Creek feeds into Hydro Tasmania's Lake Newton just to the west, and this water is pumped up to the Henty Canal, which takes water back through the gap into Lake Plimsoll on the eastern side. The four-wheel-drive Lake Spicer exploration track runs along the northern foot of the range and provides access to the eastern side of the high country and the volcanic rocks at Lake Dora and Lake Spicer. A long gentle slope climbing southwards from Newton Creek to Mt Tyndall is broken abruptly by the deep NNE-trending Glacier Valley, which has an impressive 450-m headwall under Mt Tyndall, and a large, partially wooded moraine along its western side (pl. 4). The Iconic Walk route is planned to partly follow this valley from the vehicle track.

PLATE 5 — View NE from above Lake Huntley, showing ice-smoothed conglomerate. Saddle Lake and Huntley Lookout in background.

PLATE 6 — View west over Lake Huntley to the headwall cliffs in Middle Owen Conglomerate, with Upper Owen Sandstone above. This will be a highlight of the proposed Iconic Walk.

PLATE 7 — View NW over lakes Mark, Matthew and Malcolm from Farquhar Lookout, with Tyndall plateau at top left. Iconic Walk route crosses this view.

East of Glacier Valley is an irregular ridge falling to Lake Rolleston further east and becoming more rugged to the south as it climbs to plateau level east of Mt Tyndall. Two picturesque small lakes, Niche Lake and Saddle Lake, are nestled on the ridge, and it falls abruptly to the south into the spectacular cirque depression of Lake Huntley (pl. 5). This deep glacial lake is encircled to the west by 300-m-high conglomerate cliffs (pl. 6), smoothed and polished at the top by the ice which would have crashed over them during glacial periods. This view of the Huntley cliffs will be a highlight of the proposed walk. The vertical cliff face has attracted rock climbers since the 1990s and was first climbed in 2000 (Narkowicz 2021). A forested glacial valley extends below Lake Huntley to Lake Rolleston, the slope rising further east to the sharp eminence of Walford Peak, on the eastern edge of the conglomerate.

South of Lake Huntley, the Tyndall plateau falls via an irregular scarp to a broad undulating area at about 700 m altitude which continues eastwards to Lake Dora. Three small lakes (Matthew, Mark and Malcolm) are prominent on the ice-carved surface (pl. 7). A low E–W ridge with three small lakes (Myra, Monica and Nectar) culminates in Farquhar Lookout, and separates the area from that of Lake Mary country to the south. To the southeast of this, a low escarpment drops about 100 m to the SSE-trending limestone valley of Dante Rivulet, with Tam O'Shanter Lake at its head and Shrouded Lake further south. This valley drains to Lake Beatrice and to the King Valley further south.

Between the Dante Valley, Lake Margaret and Mt Sedgwick is an open rocky plateau area at 800–900 m altitude of smoothed conglomerate bedrock and small lakes, including Peter, Paul, Polycarp, Patrick, Apollus and Philip. Most of these lakes drain into Lake Margaret, with some drainage openings cleared for hydro-electric purposes in the early period of the Lake Margaret scheme. An exploration drill hole was drilled on this plateau, 1 km SE of Lake Peter, in 1988. Two small lakes, Barnabas and Adam, lie just west of Mt Sedgwick, as the country rises south of Lake Margaret to the Sedgwick Bluff area at around 1,000 m. Mt Sedgwick itself is an isolated peak of Jurassic dolerite, sitting on a thin succession of Permian tillite and mudstone, which in turn rests unconformably on the conglomerate basement.

GEOLOGY

Little geological work was done in the area until it was mapped at 1:25,000 scale as part of the Geological Survey's Mt Read Volcanics Project in the 1980s, in which the senior author was involved (Corbett & Jackson 1987, McNeill 1987). Most of this mapping was carried out from field camps at Symphony Lake, Lake Mary and Lake Rolleston, over several months. Most of the Mt Read belt, and the associated conglomerate range, between Elliott Bay in the south and Sheffield in the north, were mapped for this project over several years.

Regionally, the Late Cambrian conglomerates form a discontinuous band, 5–10 km wide, along the larger Mt Read belt near its eastern side, where the volcanic rocks are in contact with the large belt of Proterozoic quartzites. The volcanic succession is a complex mixture of lavas, intrusives, ash and fragmental deposits and volcano-sedimentary rocks (Corbett & Vicary 2014), dominated by light-coloured felsic rocks rather than dark basaltic rocks.

A unit of siliceous sandstone, conglomerate and siltstone, known as the Sticht Range Formation, sits directly and unconformably on the Proterozoic rocks at the eastern margin of the belt, and forms the base of the volcanic succession (Baillie 1989, Jago & Bentley 2022). The volcanic rocks underlie the conglomerates on the range, but at considerable depth (figs 2, 3). Some indication of the depth is given by a drill hole drilled to 600 m in the conglomerate east of Mt Sedgwick.

The conglomerate succession is known throughout western Tasmania as the 'Owen Conglomerate', although since its subdivision into four formations it is officially referred to as the 'Owen Group' (Corbett 2001, 2014; Noll & Hall 2003). In the Queenstown–Tyndall Range area, the conglomerates were deposited mainly as fluvial gravels, on large alluvial fans spreading out from highland areas of Proterozoic quartzites further east. A series of these large fans, up to 10 km wide, extended north for over 100 km from the D'Aguilar Range in the south to Mt Roland in the north – a huge expanse of white gravel unrelieved by greenery, since there were no land plants.

In the Queenstown–Tyndall Range area, the basin containing the fans had an abrupt western margin controlled by the then-active Great Lyell Fault. This large N–S fault, which runs through the Mt Lyell Mine workings and then northwards along the foot of the Tyndall Range, continued to subside as the gravel accumulated on its eastern side, resulting in a great thickness accumulating against the fault. At least 2 km thickness is present at the Mt Lyell Mine (Corbett 2001), and there appear to be similar thicknesses along the Tyndall Range (Noll & Hall 2005, Corbett 2014). The fault has been drilled in several places along the Tyndall Range (fig. 3) and at Mt Lyell Mine, and dips west at 65–70°. The various Owen formations, except perhaps the uppermost sandstone, all thin out to the east away from the fault, making this Owen basin a classic example of a half-graben (fig. 3).

A broad gentle anticlinal fold, the Tyndall Anticline, extends through the Tyndall Range area, and controls the outcrop distribution of the Owen formations (fig. 2). The fold is expressed in the arcuate outcrop of the conglomerate formations around Mt Sedgwick and near Lake Magdala and Lake Tyndall. The fold was produced during the Tabberabberan Orogeny, in the mid-Devonian, when all the older rocks in Tasmania were deformed (Williams 1978, Corbett 2019). Dips in the bedding are quite low in the central part (5–20°), reflecting the great thickness of hard conglomerate being folded, but become steeper (50–80°) to the east, in the Lake Rolleston area, where the formations are thinner and there are numerous secondary folds trending NNW to NW (Corbett & Jackson 1987). The limestone in the Dante Rivulet valley defines a larger synclinal fold on a NNW trend.

The coarse siliciclastic succession generally consists of a mixture of fine-grained conglomerate (clasts of granule- to pebble-size, i.e., 2–64 mm), coarse-grained conglomerate (clasts of pebble- to cobble-size, 4–256 mm, or cobble- to boulder-size, 64–>256 mm), and sandstone, all made predominantly of quartzite detritus. Four different formations have been recognised and mapped on the Tyndall Range, and on the adjacent mountains, within the general succession.

An upper sandstone-rich formation, referred to as the **Upper Owen Sandstone**, is dominated by pink sandstone and fine-grained conglomerate, with minor siltstone. It shows relatively thin bedding or layering, and much cross-bedding. The fine granule conglomerates are typically rich in small clasts of white chert (derived from the volcanic rocks) as well as quartzite. This unit forms the pink sandstone ridge above the massive conglomerates of the Lake Huntley cliffs (pl. 6), where a climbers' camp is located under a sandstone overhang. It also covers most of the plateau from Lake Tyndall southwards and forms the escarpment under Mt Geikie (pl. 3). It transgresses the underlying formations to the east, as they feather out and disappear, and rests directly on the volcanic rocks in the Lake Dora area. It is of the order of 400 m thick.

The basal contact of this formation on the underlying conglomerate is sharp and channeled in places and is marked by lenses and layers of dark red hematite and hematitic siltstone in places, as at Nectar Lakes. Prospectors have dug a small trench in this material near the lakes. The hematite indicates a strongly oxidising environment at the time. Sparse trace fossils, mainly worm burrows, occur on some horizons through the sandstone, indicating a shallow marine influence, and suggesting a general depositional environment at the downstream margins of large alluvial fans washing into the sea.

A formation of massive coarse-grained pebble- to cobble-grade conglomerate, pale pink-grey in colour, called the **Middle Owen Conglomerate,** underlies the Upper Owen Sandstone. It forms the cliffs above Lake Huntley (pl. 6) and outcrops through Mt Tyndall to the steep scarp to the west (plates 1, 2, 4). Glacially smoothed outcrops occur around the Nectar Lakes–Lake Mary area, and around Lake Mark (pl. 7). It consists of rounded pebbles, cobbles and rare boulders of quartzite in a siliceous sandstone matrix, with occasional interbeds of sandstone. Bedding is poorly developed.

The formation is of the order of 350 m thick around Mt Tyndall and the western escarpment, but thins rapidly to the east, being only about 75 m thick just east of Lake Huntley, and completely absent at Walford Peak. This eastwards-thinning and wedging out has also been mapped east of Mt Sedgwick. A unit of interbedded conglomerate and sandstone forms a gradational contact to the underlying Newton Creek Sandstone on the slope north of Mt Tyndall.

A distinctive succession of interbedded grey-green sandstone, siltstone and pebble conglomerate, with marine fossils in places, the **Newton Creek Sandstone**, underlies the Middle Owen Conglomerate. It is well-exposed around Newton Creek and on the slopes north and south of this, where it is of the order of 1,000 m thick. It is also present on the ridge running through Saddle Lake and Huntley Lookout near Lake Huntley, and around the eastern shores of Lake Margaret. Trace fossils are common, and trilobites have been found in the siltstones in several places near Newton Creek. There are also bryozoans and brachiopods

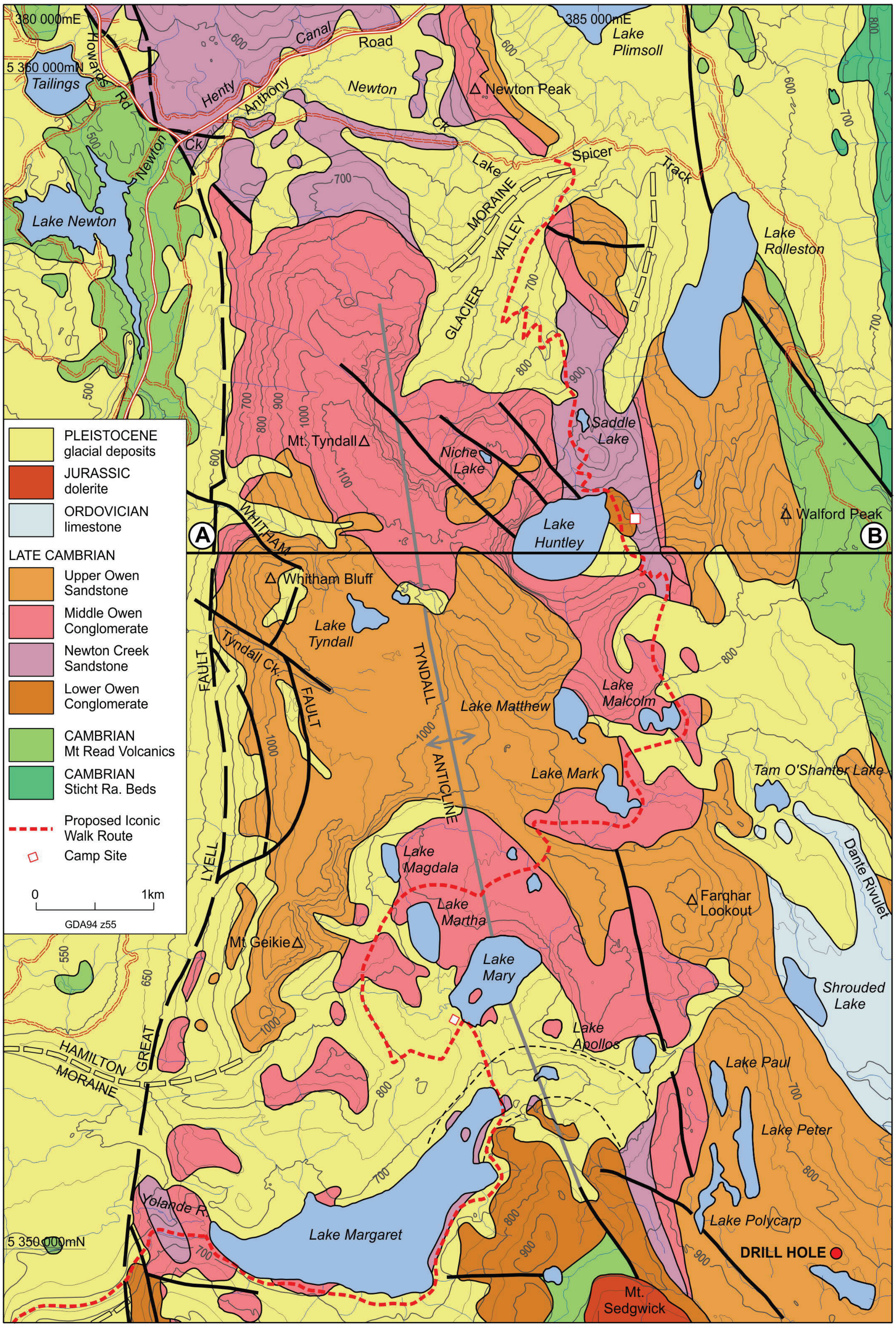

FIGURE 2 — Geological map of the Tyndall Range area, simplified from Corbett and Jackson (1987). Iconic Walk proposed route shown in red dashes.

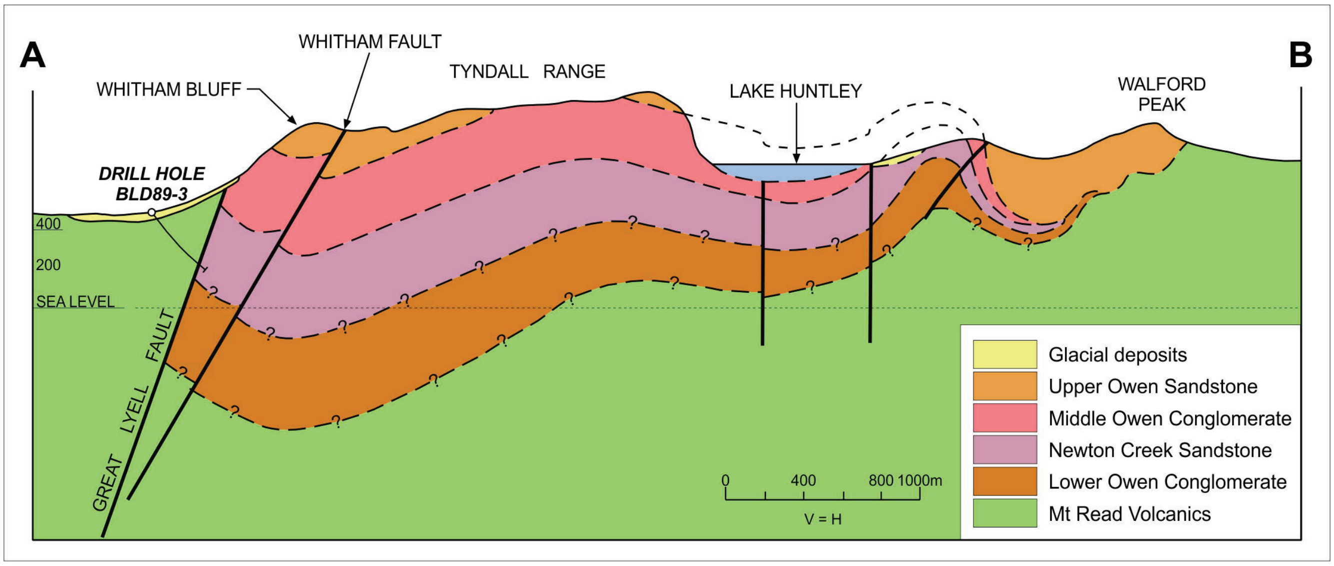

FIGURE 3 — Geological cross-section AB of the Tyndall Range. Section location shown in figure 2.

in nodular sandy limestone on the island at the NE end of Lake Margaret. The fossils indicate a Late Cambrian (late Iverian to Idamean) age (Laurie *et al.* 1995, Corbett 2014).

The formation is generally thinly bedded, and small folds are common. Sedimentary structures in the Newton Creek area include abundant graded bedding in the sandstones, slump structures, dish structures, and sole marks, all typical of proximal submarine fan deposits (Corbett 1975, 2014), while the nodular limestone at Lake Margaret indicates a shallow marine environment. Further south, on Mt Lyell and Mt Owen, the formation is represented by red cross-bedded sandstones of non-marine origin and are referred to as the Middle Owen Sandstone (Corbett 2014).

The formation represents a marine equivalent of the generally non-marine Owen sequence, deposited on a submarine fan extending seaward from the main alluvial fans, overtopping the Great Lyell Fault, and probably connecting with similar marine facies of similar age in the Dundas–Professor Range area to the west (Corbett 2014).

The **Lower Owen Conglomerate** is only seen around Mt Sedgwick and Lake Margaret in the Tyndall area, except for a glaciated outcrop at the outflow of Lake Huntley. It consists largely of thick-bedded to massive pink pebble- to cobble-grade conglomerate, like the Middle Owen Conglomerate, with a central unit of pink sandstone and a lower unit of volcaniclastic conglomerate and sandstone rich in volcanic clasts at Mt Sedgwick. The latter rests on the Mt Read Volcanics. The formation shows the pronounced eastwards thinning away from the Great Lyell Fault of the other formations and is not present at the volcanics contact to the east. It is not present in the Newton Creek area, where the marine Newton Creek facies rests directly on volcanic rocks.

Faults in the Tyndall area

The Great Lyell Fault (GLF) along the western foot of the range is mostly covered by moraine at surface, but its position is reasonably well-known from a series of diamond drill holes (e.g., fig. 3). It is offset in several places by NW-trending cross-faults, and appears to decrease in throw north of Newton Creek, where it is located within the Owen succession. Several parallel splay faults come off this fault at a shallower angle into the Owen rocks, the most obvious one being the Whitham Fault at Whitham Bluff (pl. 1; figs. 2, 3). This fault is clearly exposed on the north side of the bluff, dipping west at 40–60°, with west-side-up displacement, and can be traced about 3 km to the south, where it rejoins the GLF.

A major N–S fault affects the eastern margin of the Owen rocks in the Lake Rolleston–Lake Plimsoll area (fig. 2), and its continuation offsets the Precambrian boundary further SE. This fault postdates the Owen deposition and, like most of the other faults and folds in the area, relates to the Devonian Tabberabberan Orogeny.

The Mt Sedgwick drill hole

Drill hole 88MS1 was drilled by CRA Exploration Pty Ltd in 1988 through the Owen Conglomerate 2 km NNE of Mt Sedgwick (fig. 2, Funnell 1988). The hole was targeted on a large aeromagnetic high over the conglomerate in this area, thought to be related to a large rhyolite dome in the underlying volcanics. Such rhyolite domes, with a strong magnetic signature and some copper-gold mineralisation, are known from Red Hills to the north and from Mt Jukes and Mt Darwin to the south. Four E–W grid lines were established within the 9 km^2 Exploration License area, ground magnetic and Induced Potential surveys were conducted, and a drill rig was emplaced by helicopter.

The vertical hole was drilled to 600 m depth, but did not reach the volcanic rocks. However, the presence of volcanic clasts in the lower 150 m or so of conglomerate suggested that the hole was close to the base of the conglomerate sequence. No significant mineralisation was intersected, and no follow-up was attempted. The hole was collared in Upper Owen Sandstone and is located well to the east of the zone where the Middle Owen and Newton Creek

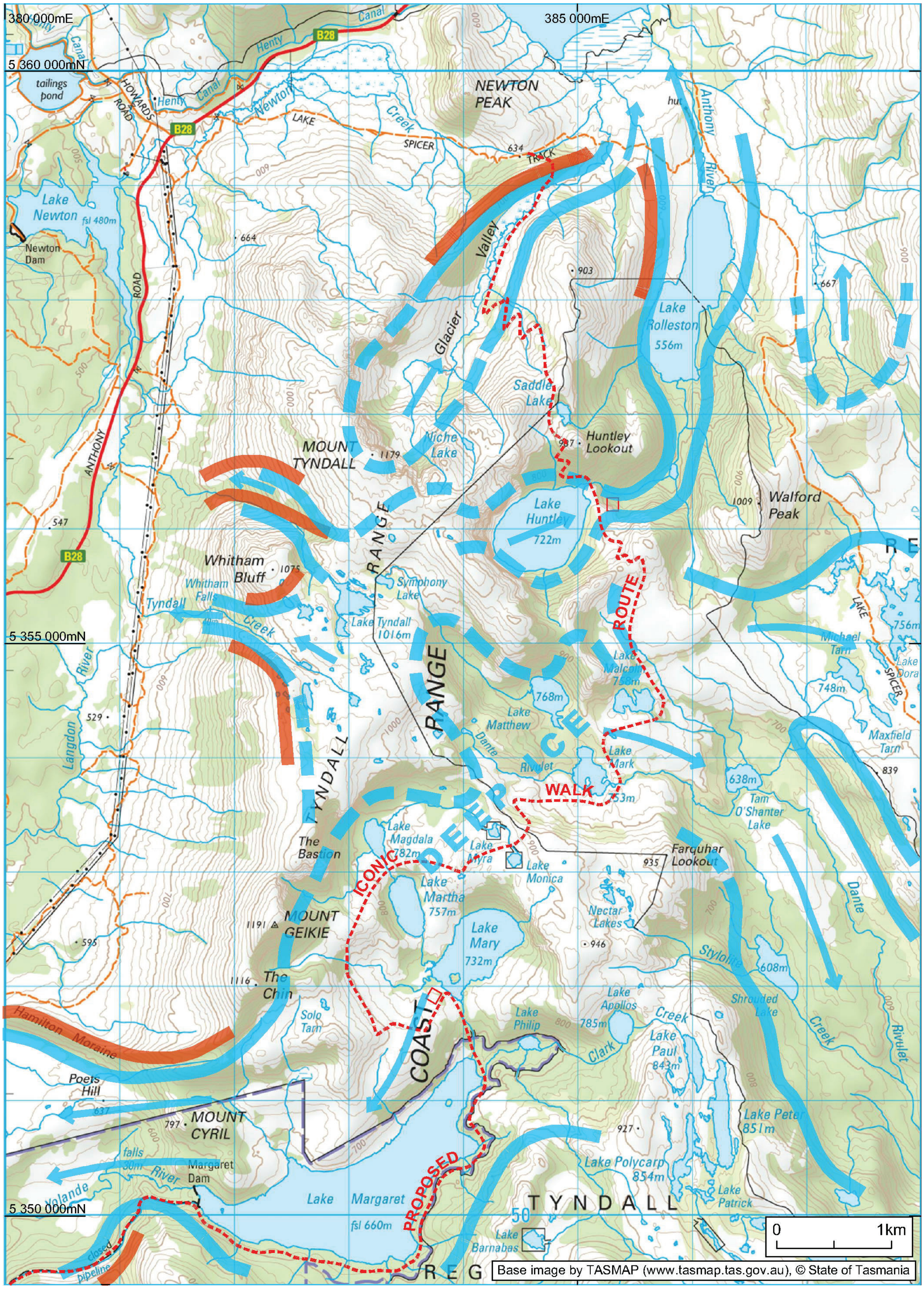

FIGURE 4 — Approximate limits and directions of flow of glacial ice in the Tyndalls area during the last Glaciation. Area of deepest ice along east edge of plateau indicated. Major moraines in brown. Iconic Walk route also shown.

formations wedge out (Corbett & Jackson 1987), so that those formations are not likely to be present. Some Lower Owen Conglomerate is likely, however. The hole penetrated some 280 m of sandstone and pebbly sandstone with siltstone interbeds (and a few beds of marly limestone), assumed to be the Upper Owen Sandstone, then some 135 m of cobble conglomerate (down to 413 m), likely to be a Lower Owen unit, then some 187 m of mainly sandy pebble conglomerate with some volcanic clasts, also likely to be Lower Owen, to the bottom of hole at 600 m.

From a regional perspective, the drill hole indicates the difficulty of exploring the possibly prospective volcanic rocks beneath such a thick cover of conglomerate. The hole is located well towards the eastern edge of the conglomerate belt, where it is likely to be relatively thin, but even here there is at least 600 m of hard conglomerate rock present. A hole located anywhere over the main part of the Tyndall Range would have to penetrate a large thickness of coarse Middle Owen Conglomerate, plus some Lower Owen, and likely to be both prohibitively expensive and impractical. The Mt Sedgwick hole was located on a distinct geophysical target – a large aeromagnetic anomaly – but did not actually reach the rhyolite dome target. Even if it had reached an interesting volcanic unit, the cost of the further exploration needed to find an orebody, if one existed, would be excessive.

GLACIAL FEATURES OF THE TYNDALLS AREA

Glacial features such as moraines, cirques, erratics, U-shaped valleys, glacial lakes, and striated and smoothed pavements, are prominent and easy to see in the Tyndalls area. These have been known for over 100 years (see summary by Colhoun 1985) with TB Moore (1894) one of the first to write about them. Much of the discussion by early workers concerned the possible number of glacial episodes, with AN Lewis (1926, 1934, 1945) suggesting there had been three glaciations, later workers suggesting just one (e.g., Jennings & Banks 1958, Ahmad *et al.* 1959, Davies 1962, Derbyshire *et al.* 1965), and later workers, with more data and accurate dates, returning to a multi-stage interpretation (e.g., Colhoun 1984, 2014; Fitzsimons & Colhoun 1991, Fitzsimons *et al.* 1993; Kiernan 1989, 1990, Colhoun *et al.* 1996). Five Glacial periods are now recognised in places, separated by warmer Interglacial periods. Features related to the last and second-last Glacial periods (less than 200,000 years) are usually best preserved and most obvious, while those related to the oldest glaciations (> 1 million years) are generally much more extensive but more weathered and less obvious. The oldest glaciation is considered to have involved a 100-km-wide ice cap extending from the Central Plateau westwards to beyond Rosebery, probably blanketing the Tyndalls area (Kiernan 1990, Corbett 2019).

As noted by Corbett (2019), the temperature record for the Pleistocene (which began 2.6 million years ago) indicates there could have been at least 20 of these Glacial–Interglacial cycles over the past million years or so. This means that

PLATE 8 — View north of glaciated conglomerate slabs with glacial debris on Tyndall plateau south of Lake Tyndall. Ice has moved from right to left.

the Tyndalls area has been subjected to many glaciations, and that each glacial feature will have a multi-phase history. This is borne out by work on the large Hamilton Moraine near Lake Margaret, where dates indicate involvement by several Glaciations prior to the most recent one (Colhoun 2014). This paper focuses on the physical features to be seen at the Tyndalls, mostly related to the more recent glaciations, rather than the glacial history.

Colhoun *et al.* (1996) give a general description of the last (Wisconsin) glacial stage in Tasmania, noting that the Tyndall area appears to have been the site of a small ice cap, with ice flowing away from this in multiple directions (fig. 4). A relatively shallow thickness of ice (< 100 m?) may have been present on the plateau area, where there is clear evidence of ice flowing west from the Lake Tyndall area down the course of the present Tyndall Creek. Large areas of gently W-sloping conglomerate slabs have been cleaned and smoothed by the ice and sprinkled with bouldery till in this area (pl. 8). Two small moraines on the plateau mark the northern and southern sides of this westerly ice flow. Ice must also have flowed westwards out of the Lake Tyndall area on the northern side of Whitham Bluff, where the western slope shows two moraines, one of which is utilised by the current walking track. Ice from the Symphony Lake area probably flowed southeast.

The deepest ice, of the order of 250–300 m, would have occupied the line of cirque depressions along the eastern side of the plateau, stretching from Mt Geikie in the south around Lake Magdala into the head of Dante Rivulet above Lake Matthew and Lake Malcolm, and including the deep cirques of Lake Huntley and Glacier Valley in the north (fig. 4). This ice flowed generally east, south and north.

The major ice flow was probably to the south and southwest, via Lake Margaret, from the large accumulation area between the foot of Mt Geikie and across lakes Magdala, Martha and Mary to Lake Apollus (pl. 7). This ice exited through the gap at Lake Margaret and produced the large 100-m-high composite lateral moraine (Hamilton Moraine) to the north and west, and its equivalent to the south of the Yolande River. Hamilton Moraine is one of the largest glacial moraines in Tasmania, and grades into

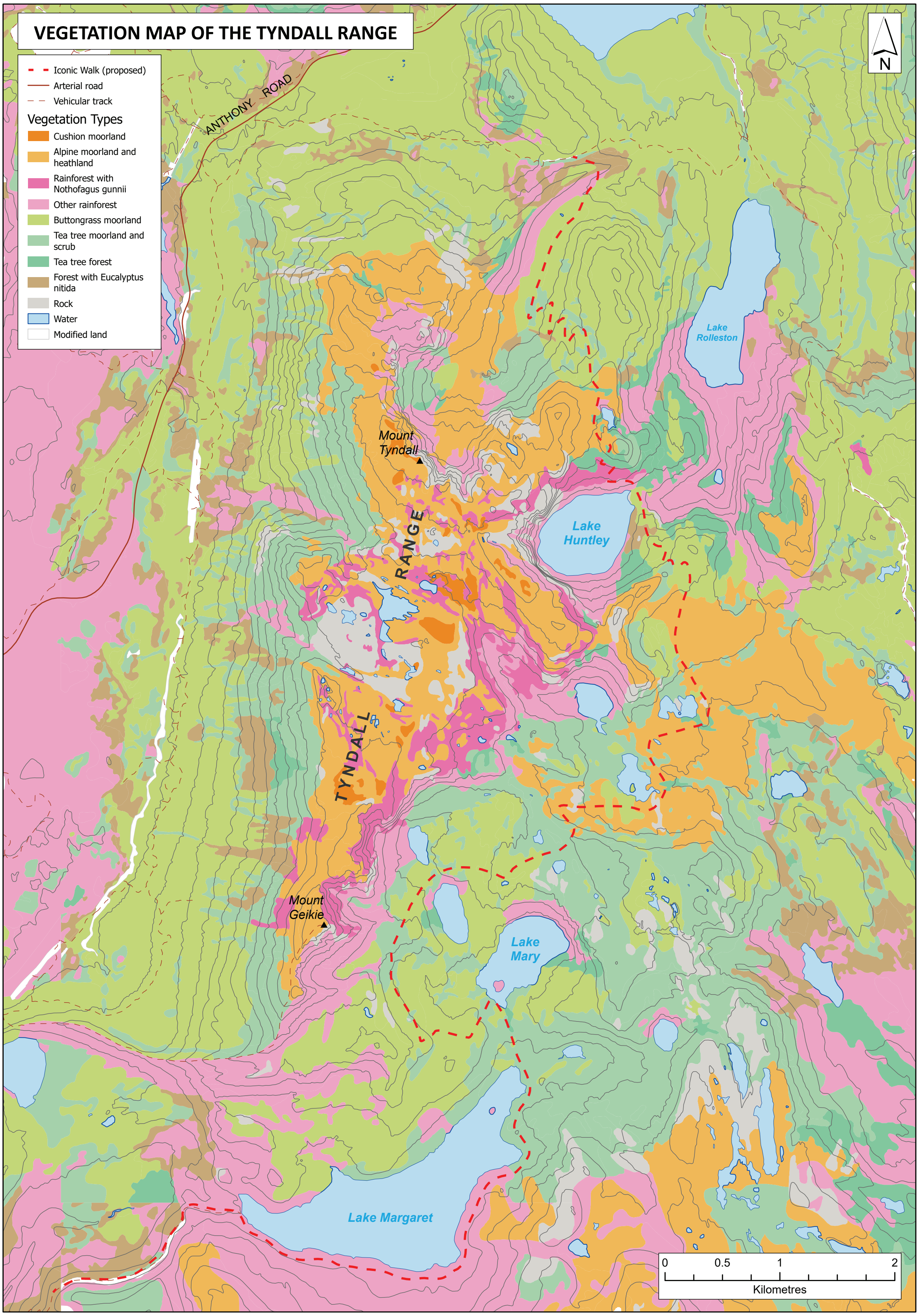

FIGURE 5 — Vegetation map of the Tyndall Range area (prepared by the TASVEG group at Department of Natural Resources and Environment, Hobart)

end moraine to the west above Lake Margaret township (Colhoun 1985, Colhoun *et al.* 1996). Boulders on this moraine have given exposure-age dates ranging from 190 to 352 kyr, suggesting that the main ridge was mainly formed during the Penultimate Glaciation, with some boulders being derived from older deposits (Barrows *et al.* 2002, Colhoun 2014).

Much of the ice from the area around lakes Matthew, Mark and Malcolm probably flowed southeastwards down the Dante Valley to the Lake Beatrice area, but some may have been confluent with ice around the Lake Dora area.

Ice from the impressive Lake Huntley cirque flowed down the now-wooded valley to Lake Rolleston and would have coalesced with ice from the valley east of Walford Peak, and with ice from Glacier Valley to the west, on the plains area of Lake Plimsoll. Extensive moraine deposits here are marked by fluting and block and tail forms (Bowden 1974, Colhoun 1985). Some ice also flowed off the plateau into the Lake Huntley cirque, smoothing and striating the conglomerate surface at the top of the cliffs (pl. 5). The deep U-shaped NNE-trending Glacier Valley has an impressive 450-m cirque headwall under Mt Tyndall and a high curving lateral moraine, 100 m high, along its western side (pl. 4).

PLATE 9 — Autumn view east over Symphony Lake on Tyndall plateau, showing areas of rainforest with *Nothofagus gunnii* and *Athrotaxis cupressoides*, and areas of open cushion moorland.

PLATE 10 — Pencil pine *Athrotaxis cupressoides* and deciduous beech *Nothofagus gunnii* at Symphony Lake showing stunted form (krummholz) and bark stripped from western side by ice-laden winds.

OVERVIEW OF TYNDALLS VEGETATION

A vegetation map for the Tyndalls area is given in figure 5, and descriptions of the many TASVEG types are given by Harris and Kitchener (2005). A general description of the vegetation on the range has been given by Kirkpatrick (1977, 1984), but much remains to be done. The map clearly shows the area of alpine vegetation on the Tyndall plateau, as defined by the combination of cushion moorland, alpine moorland and heathland, and alpine rainforest with *Nothofagus gunnii*. This area extends from just NW of Mt Tyndall to the upper slopes north and south of Lake Huntley, to Mt Geikie in the south. It is bordered to the east by a zone of 'other rainforest', i.e., mostly lacking *N. gunnii*, along the escarpment and steep slopes between Mt Geikie and Lake Huntley, and along the southern slope of the Hamilton Moraine. East of the plateau escarpments, the plains area has a mixture of buttongrass moorland, tea tree moorland and scrub, and heathland. The western and northern slopes of the Tyndall Range are dominated by buttongrass moorland and tea tree moorland and scrub, with patches of *Eucalyptus nitida* forest, all of which appear to be fire related.

Alpine vegetation

The Tyndall plateau is unusual among the western mountains in that virtually all the alpine zone is unburnt and dominated by conifers or deciduous beech (Kirkpatrick 1984). The vegetation consists largely of open alpine moorland and heathland, with large areas of bare rock, and patches of short rainforest and rainforest scrub in sheltered areas protected from the westerly winds (pl. 9). A prominent feature is the presence of espaliered shrubs of *N. gunnii* and other plants on the sheltered eastern sides of the many boulders and cliffs. Open areas of cushion moorland tend to be dominated by *Donatia novae-zelandiae*, with several other cushion species also present. There are also prostrate conifers such as *Microcachrys tetragona* and *Diselma archeri*, and small plants such as *Dracophyllum milliganii*, *Epacris serpyllifolia, Pentachondra pumila, Isophysis tasmanica*, *Astelia alpina* and *Carpha alpina*. Coniferous heaths are common, and typically include *Microcachrys tetragona* and *Diselma archeri*, with some *Athrotaxis selaginoides*.

The alpine rainforests (pl. 9) typically occur in areas sheltered from the westerly winds and show windrow development in places. They generally contain pencil pine *A. cupressoides* and deciduous beech *N. gunnii*, with King Billy pine *A. selaginoides*, *D. archeri, Richea scoparia, Orites milliganii, Richea pandanifolia*, and *Tasmannia lanceolata* commonly present. Many of the larger trees are krummholz (stunted) in form, and those at the leading edge of groups of trees commonly show stripping of bark by the ice-laden winds (pl. 10).

Much of the reproduction of the pencil pines in these harsh alpine environments is by root suckering (layering) rather than seeding, such that groups of pines tend to be clones. A study including the Tyndall Range has shown that one such group, probably near Symphony Lake (A. Darby pers. comm.), has 62 clonal stems – the largest clone reported for a root-suckering conifer (Worth *et al.* 2016).

Other rainforest

Rainforest forms an intermediate zone between the alpine flora and the fire-induced vegetation types surrounding the Tyndall Range, particularly along the eastern escarpment. It also forms a broad belt along the Henty River gorge to the west, and others along the valley of Dante Rivulet to the east, around Lake Margaret, and along the valley above Lake Rolleston. Small areas are found on fire-protected slopes at the heads of Lake Mary and Lake Martha. Although varying according to site, soil, rock type and climate, it is typically dominated by myrtle beech *N. cunninghamii*, with sassafras *Atherosperma moschatum*, celery top pine *Phyllocladus asplenifolius*, and leatherwood *Eucryphia lucida* as common associates. Scattered King Billy pine *A. selaginoides* and *N. gunnii* are present in the forests around the Tyndalls area. There is a close association with tea tree forest, (mainly *Leptospermum nitidum*) to the north and east of Lake Huntley.

Low-level moorland and scrub types

Most of the non-alpine area of the Tyndalls contains a mosaic of fire-induced vegetation types, of which buttongrass moorland, tea tree moorland and scrub are the main types, with areas of 'Tea tree forest' and 'Forest with *Eucalyptus nitida*' also present. Figure 5 shows large areas of 'alpine moorland and heathland', in the alpine area, extending east from Lake Mark and Lake Matthew, and north into Glacier Valley from Mt Tyndall. These areas are mainly 'Western alpine heathland (HHW)', and further study is necessary to clarify their composition in these areas, and the differences between the alpine and subalpine areas. It is highly unlikely that these eastern areas have not had a fire history similar to the fire-induced types adjacent to them, and their nature and classification should be checked.

The tea tree moorland and scrub vegetation include several types with both *Melaleuca* (mainly *M. squamea* and *M. squarrosa*) and *Leptospermum* species (mainly *L. lanigerum*, *L. scparium* and *L. nitidum*) as wiry low shrubs. *Banksia marginata*, *Eucalyptus vernicosa, Hakea* species and buttongrass are common associates. Tea tree forest, with tall *Leptospermum sp.*, is well-developed on the slopes east of Lake Huntley, where it forms a transitional vegetation type between rainforest and buttongrass.

Comments on fire history

The alpine flora of the Tyndall Range has survived the many fires which have clearly burnt the surrounding slopes. The western slope of the range is entirely occupied by fire-induced vegetation, particularly buttongrass and tea tree moorland, up to the edge of the plateau at about 1,000 m. The vegetation map clearly shows the finger-like fire scars of buttongrass projecting up this slope; a pattern which probably goes back to pre-European times.

There are several reasons why the fires have not continued across the plateau. The general wetness of the flattish ground, the presence of large areas of bare rock, and the general sparseness of the vegetation, are likely ones, but more research is needed. On the eastern side of the plateau, the steep cliffs of the escarpment, with the covering of rainforest, may have acted as an effective buffer for the plateau against fires.

THE PROPOSED ICONIC WALK

In 2018, the Tasmanian Parks and Wildlife Service was commissioned by the State Government to prepare a Feasibility Study for a new multi-day Iconic Walk for Tasmania, and this was released in 2021 (Parks & Wildlife Service 2021). The Tyndall Range was selected as the preferred site, and the proposed route for the three-day/two-night walking track was released (https://parks.tas.gov.au/be-involved/projects-and-programs/next-iconic-walk). This proposed route, although still subject to some variation, is shown in figures 1, 2, 4 and 5, and perhaps best seen, in relation to the topography, in figure 4. The walk is scheduled to open in 2029.

The walk begins at the Lake Spicer Track, off Anthony Road, in the north, goes partway down Glacier Valley, then climbs the slope to the east, and approaches Lake Huntley via Saddle Lake and Huntley Lookout. The first of the two hut camps is located at the eastern end of Lake Huntley. From here the route crosses open country to Lake Malcolm and then Lake Mark, before climbing the slope to Lake Myra and heading west past Lake Magdala to a second hut camp at Lake Mary. The original proposal was to follow the north shore of Lake Margaret to the dam, but a later revision takes the route around the southern shore of the lake instead. The final leg is along the existing pipeline track to Lake Margaret township. Overall, the track distance is about 28 km.

The route has been deliberately designed to follow the low country to the east of the Tyndall plateau, partly to provide some protection from the westerly weather, but also to avoid damage to the sensitive alpine area. The first section of the route will be over the large glacial moraine fringing Glacier Valley, where large erratic boulders of conglomerate are a prominent feature. This leads to a section along the flat-floored Glacier Valley for about 1 km, with views of the great rocky headwall under Mt Tyndall. A climb of about 250 m up the eastern slope brings the track to Saddle Lake, a small lake with partly forested shores. Lake Huntley is visible from here, and the nearby Huntley Lookout provides sweeping views in all directions. The bedrock formation here is the thinly bedded Newton Creek Sandstone, and some tectonic small folds are visible.

A steep descent through tea tree forest and rainforest continues to the outflow of Lake Huntley, with the view to the 300 m cliffs at the head of the lake probably being the highlight of the walk. The cliffs, in massive Middle Owen Conglomerate, are cut by several steep cross-faults with north-side-up displacement, on the northern side. The thinly bedded Upper Owen Sandstone is visible over the top of the conglomerate. The outflow is marked by a glacially smoothed outcrop of Lower Owen Conglomerate, and the first hut camp is to be located nearby.

Leaving Lake Huntley, the route climbs a short slope of about 150 m, then crosses flat buttongrass and heathy country to the conglomerate-floored Lake Malcolm and Lake Mark (pl. 7), at the head of Dante Rivulet. A recent update shows a campground at Lake Malcolm. It then climbs the low sandstone ridge to Lake Myra and Lake Monica and crosses more buttongrass country to Lake Magdala. It then skirts the slope under Mt Geikie to the next proposed hut at Lake Mary, where there is a pleasant beach. From here, the proposed track route skirts the southern shore of Lake Margaret to the dam and water intake at its western end. This shore features some very dense wet rainforest; however, the northern shore, currently used by bushwalkers, is relatively open. A floating log of Huon pine was found by the authors at the Lake Margaret dam some years ago, but a search of the shores could find no other evidence of this species. We surmised that there may have been Huon pine growing at the original lake, but that it was inundated when the lake was dammed.

The final section of the route follows the existing wooden stave pipeline from the lake as it snakes around the conglomerate cliffs and along the moraine to the township. This picturesque section is renowned for its abundance, in season, of Christmas bells *Blandfordia punicea* and climbing heath *Prionotes cerinthoides*.

CONCLUDING COMMENTS

Botanically, the Tyndall Range is important because of the unique preservation of a large area (approximately 6 km^2) of remarkable alpine flora featuring forests and thickets of deciduous beech, pencil pines and King Billy pines, and floriferous cushion moorland. Its preservation is highly unusual among the western siliceous mountains, where most of the alpine vegetation has been destroyed by fires over a very long period (Kirkpatrick 1977, 1984). The pristine alpine flora is enhanced by its setting amongst small glacial lakes rimmed by stratified conglomerate outcrops.

The range consists of Cambrian conglomerate, part of the 'old-folded rocks' of Corbett (2019), and the scenery is dominated by tilted sedimentary strata. This is quite distinct from the Jurassic dolerite country of the two other Iconic Walks – the Overland Track in central Tasmania and the Three Capes Track on the Tasman Peninsula – in the 'middle aged rocks', where columnar dolerite cliffs are the dominant feature. The range also has an impressive array of glacial features, which will form a large part of the attraction to walkers. Glacier Valley with its huge cirque headwall, the cliffs at Lake Huntley, and the many glacial lakes along the eastern lowland, from Lake Malcolm to Lake Margaret, will make for interesting walking.

The Tyndall Range, given its significant natural features, only has low-level Regional Reserve status. This classification allows for mining and timber harvesting, presumably because of the proximity of the prospective Mt Read Volcanics both adjacent to and beneath the conglomerates. However, the knowledge we now have of the geology of the area suggests this status should be reviewed.

The drill hole near Mt Sedgwick shows at least 600 m of conglomerate above the volcanics. This hole is located towards the eastern side of the conglomerate belt, where two of the formations (Middle Owen Conglomerate and Newton Creek Sandstone) have wedged out and are not present, and the overall thickness is therefore much reduced.

Any potential drilling on the Tyndall plateau alpine area would have to penetrate at least 350 m of Middle Owen Conglomerate and probably a similar thickness of Newton Creek Sandstone and Lower Owen Conglomerate, i.e., probably a km or more of conglomerate, to reach the volcanic rocks (fig. 3). This would seem to be prohibitively expensive and impractical, considering the number of drill holes normally required to locate, define and prove up a viable mineral deposit.

Finding a target through this much conglomerate, by whatever geophysical or other means, also seems improbable.

Accessing a target from the side, i.e., coming in under the conglomerate after getting to the base in the softer volcanic rocks, would involve possibly a kilometre of shaft before a long horizontal drive, which also seems prohibitively expensive and impractical.

It is recommended that the natural values of the Tyndall Range deserve better statutory recognition and given the challenges of mineral exploration in the area, the conservation status of the range should be reviewed and strengthened. The preservation of the Tyndall alpine vegetation from fire, despite the obvious evidence of fires having burnt up the nearby slopes for a very long period, seems almost miraculous, and the area should be managed to ensure its continued survival.

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REFERENCES

Ahmad, N, Bartlett, A & Green, DH (1959). The glaciation of the King Valley, western Tasmania. *Papers & Proceedings of the Royal Society of Tasmania* 93: 11–16.

Baillie, PW (1989). Stratigraphy, sedimentology and structural setting of the Cambrian Sticht Range Formation, western Tasmania. *Tasmania Geological Survey Bulletin* 65: 34 pp.

Baillie, P (2010). The West Coast Range, Tasmania: mountains and geological giants. *Papers and Proceedings of the Royal Society of Tasmania* 144: 1–13.

Barrows, TT, Stone, JO, Fifield, LK & Cresswell, RG (2002). The timing of the Last Glacial Maximum in Australia. *Quaternary Science Reviews* 21: 159–173.

Bowden, AR (1974). The glacial geomorphology of the Tyndall Mountains, western Tasmania. Unpublished PhD Thesis, Geography Department, University of Tasmania, Hobart.

Colhoun, EA (1975). A Quaternary climatic curve for Tasmania. Unpublished manuscript presented at the *Royal Meteorological Society Conference on Climate and Climate Change*, Monash University.

Colhoun, EA (1984). The glacial stratigraphy of Australia: An assessment. *Bureau Mineral Resources, Geology and Geophysics Record* 14: 47–58.

Colhoun, EA (1985). Glaciations of the West Coast Range, Tasmania. *Quaternary Research* 24: 39–59.

Colhoun, EA (2014). Quaternary glaciation and landscape development. *In* Corbett, KD, Quilty, PG & Calver, CR (eds). Geological Evolution of Tasmania. *Geological Society of Australia Special Publication* 24: 511–530.

Colhoun, EA, Hannan, D & Kiernan, K (1996). Late Wisconsin glaciation in Tasmania. *Papers and Proceedings of the Royal Society of Tasmania* 130(2): 33–45.

Corbett, KD (1975). Preliminary report on the geology of the Red Hills–Newton Creek area, West Coast Range, Tasmania. *Tasmanian Department of Mines Technical Reports* 19: 11–25.

Corbett, KD (2001). New mapping and interpretations of the Mount Lyell Mining District, Tasmania: a large hybrid Cu-Au system with an exhalative Pb-Zn top. *Economic Geology* 96: 1,089–1,122.

Corbett, KD (2014). Late Cambrian to Early Ordovician siliceous sequences. *In* Corbett, KD, Quilty, PG & Calver, CR (eds). *Geological Evolution of Tasmania*. Hobart, Geological Society of Australia (Tasmania Division) Special Publication 24: 211–240.

Corbett, KD (2019). *Child of Gondwana: The Geological Making of Tasmania*. Forty South Publishing Pty Ltd, Hobart: 208 pp.

Corbett, KD & Jackson, JC (1987). Geology of the Tyndall Range area. *Geological Survey of Tasmania, Mt Read Volcanics Project Map 5.*

Corbett, KD & Vicary, MJ (2014). Middle Cambrian post-collisional volcanism and sedimentation. *In* Corbett, KD, Quilty, PG & Calver, CR (eds). *Geological Evolution of Tasmania*. Geological Society of Australia Special Publication 24: 145–183.

Davies, JL (1962). Geomorphology and glaciation. *Journal Geological Society of Australia* 9(2): 243–250.

Derbyshire, E, Banks, MR, Davies, JL & Jennings, IB (1965). *Glacial map of Tasmania*. Royal Society of Tasmania Special Publication No 2.

Fitzsimons, SJ & Colhoun, EA (1991). Pleistocene glaciation of the King Valley, Western Tasmania. *Quaternary Research* 36: 135–156.

Fitzsimons, SJ, Colhoun, EA, Van de Geer, G & Pollington, M (1993). The Quaternary geology and glaciation of the King Valley. *Tasmania Geological Survey Bulletin* 68: 47 pp.

Funnell, FR (1988). E.L. 5/85 Lake Margaret. Mt Sedgwick East prospect. Report on activities for the period November 1987 to August 1988. CRA Exploration Pty Ltd. *Department of Mines Report* TCR 88–2870.

Harris, S & Kitchener, A (eds) (2005). *From Forest to Fjaeldmark. Descriptions of Tasmania's Vegetation*. Department of Primary Industries, Water and Environment, Printing Authority of Tasmania: 432 pp

.Jago, JB & Bentley, CJ (2022). The stratigraphically lowest known Cambrian trilobites from the Dial Range Trough, northwest Tasmania, and from western Tasmania. *Alcheringa* 46(1): 33–42.

Jennings, IB & Banks, MR (1958). The Pleistocene glacial history of Tasmania. *Journal of Glaciology* 3(24): 298–303.

Kiernan, KW (1989). Multiple glaciations in the Upper Franklin Valley, Western Tasmania Wilderness World Heritage Area. *Australian Geographical Studies* 27: 208–233.

Kiernan, KW (1990). The extent of late Cainozoic glaciation in the Central Highlands of Tasmania. *Arctic & Alpine Research* 22: 341–354.

Kirkpatrick, JB (1977). Native vegetation of the West Coast region of Tasmania. *In 'Landscape and Man'. A Symposium arranged and published by the Royal Society of Tasmania, November 1976*: 55–80.

Kirkpatrick, JB (1984). Altitudinal and successional variation in the vegetation of the northern part of the West Coast Range, Tasmania. *Australian Journal of Ecology*, 9(2): 81–91.

Laurie, JR, Jago, JB & Bao, JS (1995). Review of Tasmanian Cambrian biostratigraphy. *Australian Geological Survey Record 1996/69*: 30 pp.

Lewis, AN (1926). Report on observations of glaciation in Tasmania since 1920. *Report of the Australasian Association for Advancement of Science* 17: 85–90.

Lewis, AN (1934). A correlation of the Tasmanian Pleistocene glacial epochs and deposits. *Papers & Proceedings of the Royal Society of Tasmania (1933):* 75–86.

Lewis, AN (1945). Pleistocene glaciation in Tasmania. *Papers & Proceedings of the Royal Society of Tasmania (1944)*: 41–56.

McNeill, AW (1987). Geology of the Mt Murchison area. *Geological Survey of Tasmania, Mt Read Volcanics Project Map 4.* Minerals Resources Tasmania.

Moore, TB (1894). Discovery of glaciation in the vicinity of Mt Tyndall in Tasmania. *Papers & Proceedings of the Royal Society of Tasmania (1893)*: 147–149.

Narkowicz, G (2021). Climb Tasmania. Selected Best Climbs. 3rd Edition. Climb Tasmania Incorporated.

Noll, CA & Hall, WDM (2003). Stratigraphic architecture and depositional setting of the coarse-grained Upper Cambrian Owen Conglomerate, West Coast Range, western Tasmania. *Australian Journal of Earth Sciences* 50: 835–852.

Noll, CA & Hall, WDM (2005). Great Lyell Fault, western Tasmania: a collage of Middle and Late Cambrian growth faults reactivated during Devonian orogenesis. *Australian Journal of Earth Sciences* 52: 427–442.

Parks & Wildlife Service (2021). *Tasmania's next Iconic Walk Feasibility Study*. SGS Economics & Planning Pty Ltd: https://parks.tas.gov.au/be-involved/projects-and-programs/next-iconic-walk (accessed 1 Aug. 2024).

Williams, E (1978). Tasman Fold Belt System in Tasmania. *Tectonophysics* 48: 159–206.

Worth, JRP, Sakaguchi, S, Rann, KD, Bowman, CJW, Motom, IL, Jordan, GJ & Bowman, DMJS (2016). Gondwanan conifer clones imperiled by bushfire. *Scientific Reports* 6, 33930; doi:1038/srep33930.

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