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Geology of the Cradle Mountain Reserve

by I. B. Jennings *

Three main solid rock stratigraphic units comprise the big majority of the Cradle Mountain reserve area. These are:—

(1) The Precambrian basement.
(2) Permo-Triassic sediments.
(3) Jurassic dolerite.

However, the solid geology of the area is frequently obscured beneath extensive deposits of superficial material. The most important of these deposits being (in order)—

(1) Pleistocene glacial and peri-glacial deposits.
(2) Quaternary talus and screes.
(3) Recent soils and peaty soils.

Solid Geology

Basically the geology of the area is simple. It consists of a complexly folded Precambrian basement overlain with violent unconformity by gently dipping sediments of Permian and Triassic age. Later, immense sheets of dolerite were intruded into the Permo-Triassic rocks and along the Permian-Precambrian unconformity. The dolerite intrusions are overwhelmingly sill-like in character and are in excess of 1,000 feet in thickness. Originally they possibly reached a thickness of 1,500 feet.

The post-Permian structure consists of block faulting, first during the dolerite intrusions and then again during the Lower Tertiary. That is, the Permian and younger rocks have been tilted as blocks and not, except in special cases near the boundary faults, folded into anticlines and synclines.

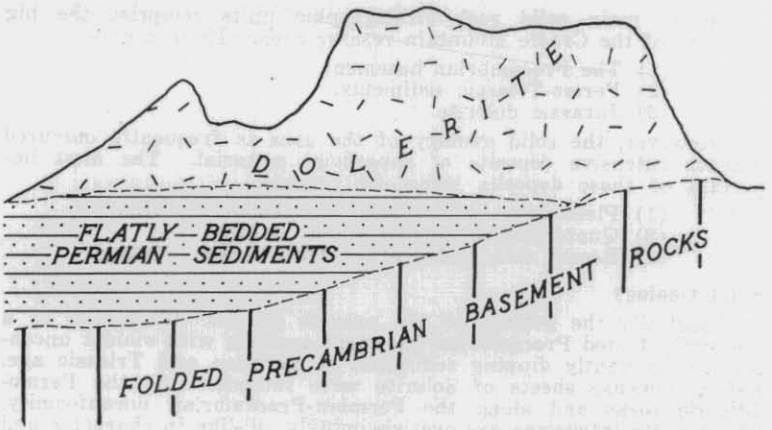
To understand the geology of the area then, it is necessary only to think of a giant sandwich consisting of at the bottom a Precambrian basement, in the middle Permo-Triassic sediments and on top thick dolerite sills.

The pre-Permian surface on the Precambrian rocks is only gently undulating. The Permian sediments and overlying dolerite sills are also only gently dipping. This whole sequence, though restricted in thickness, is exposed in a single section under the Little Horn on Cradle Mountain. This can be seen from the lookout above Crater Lake. From here you can see the steeply dipping, highly folded and schistose Precambrian basement rocks abutting against the flatly bedded Permian sediments that overlie them and which form a series of cliffs trending east and west along the north face of Cradle Mountain. The Permian sediments are here overlain by a remnant of the great dolerite sill which once covered the whole area and which now forms the summit of Cradle Mountain and the Little Horn.

In this section it can also be seen that west from the Little Horn the Permian rocks wedge out against the Precambrian basement so that under Cradle Mountain itself the dolerite occupies the stratigraphic level of the Permian-Precambrian surface. In this case

* During the compilation of this report and accompanying map the author has made extensive use of notes supplied by Mr. K. L. Burns, Geologist, Dept. of Mines.

this is due to irregularities on the pre-Permian surface and not to shelving intrusions of the dolerite itself (see sketch below).



The Precambrian Rocks

From the distribution of the basement rocks it is obvious that this basement, with its irregularities, is either tilted towards the S.S.E. or block faulted downwards in this direction. Probably both processes are involved.

This is shown by the relative levels of the pre-Permian surface at various places. At Cradle Mountain the level of the surface is about 3,500 feet. A little south of there at Barn Bluff and Mt. Emmett the level is about 3,000 feet. Further S.S.E. from Barn Bluff and Mt. Emmett, in the vicinity of the Pelion Huts, the base of the Permian sequence is at about 2,750 feet, whilst in the vicinity of Lake St. Clair it is lower than 2,419 feet, as the shores of that lake are in rocks of the Permo-Triassic sequence.

The regional fall in the level of the base of the Permian sequence is quite definite and is not due solely to undulations on the top of the old Precambrian surface, although these are certainly present, as shown in the section described under Cradle Mountain. The tilting is consistent with observations made on the pre-Permian basement many miles east and south from Cradle, all of which indicate a steady fall in these directions.

However, combined with this regional tilting is the effect of the Lower Tertiary faulting. By comparing the levels of various members of the Permian sequence throughout the area it is clear that quite a number of post-Jurassic faults cut through the area.

Generally speaking, there is a component of the Lower Tertiary faulting which downthrows consistently towards the S.S.E. although numerous other faults are present which trend and throw in other directions. This faulting, although complex in detail, has the general effect of lowering the basement of the Permian sequence towards the S.E.

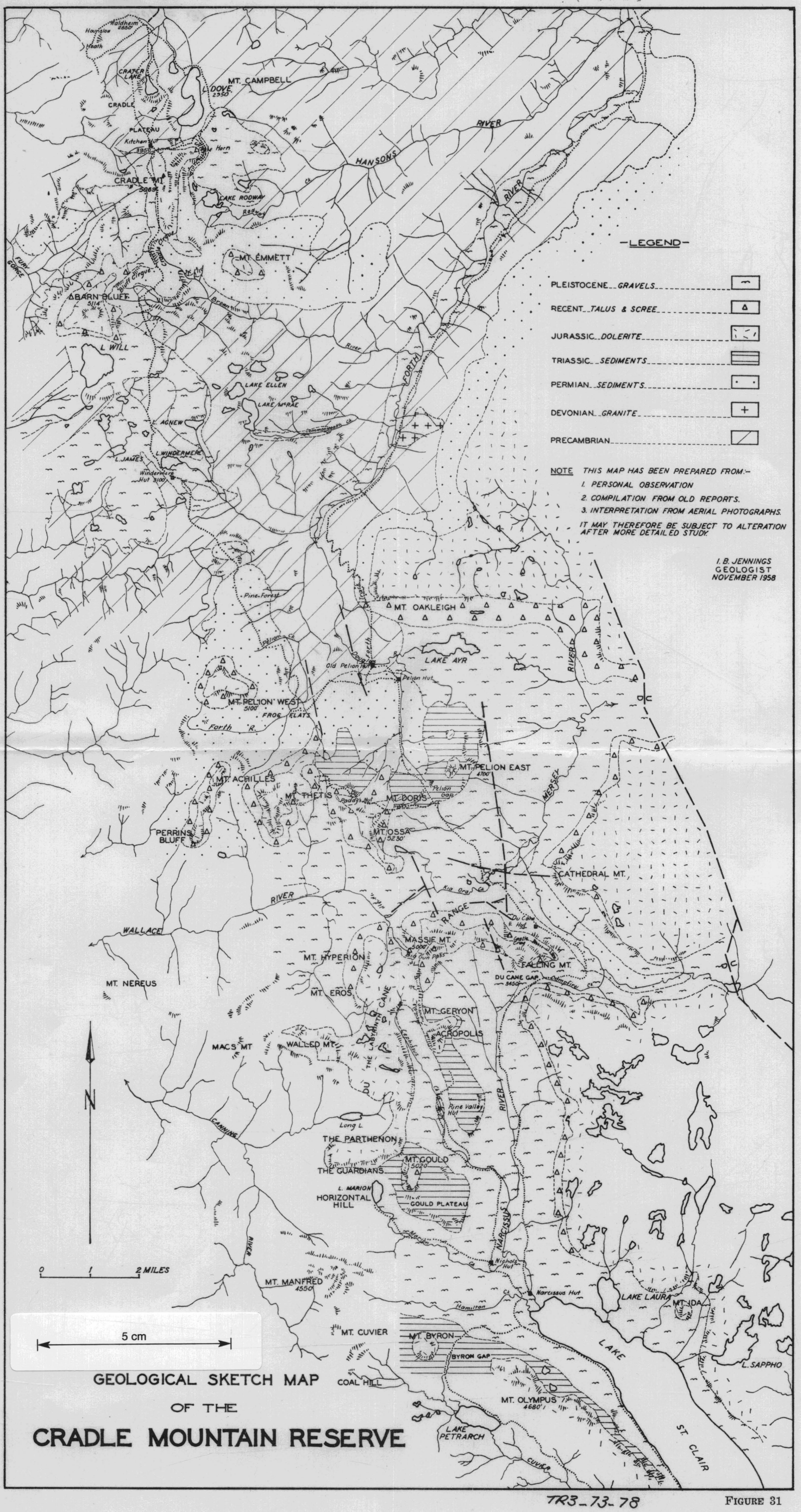


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FIGURE 31

The Precambrian rocks consist of thinly-bedded quartzite and quartz mica schists. They are crumbled, closely folded, well cleaved and intensely jointed. Detailed structure within this sequence is immensely complicated as these rocks have been folded during at least three periods and possibly by five or six periods of diastrophism. They have been intruded by granite and porphyries along the Upper Forth Valley and associated with this igneous activity is some copper, tin and wolfram mineralisation, together with pyrite and abundant quartz veining.

The Permo-Triassic Sequence

The Permian sequence commences with a coarse, basal conglomerate probably of glacial origin. The thickness of this unit is variable, it may range from only a few feet to several hundred feet; where thin it is usually not of glacial origin. This formation is exposed under the Little Horn, at Barn Bluff, Mt. Emmett and on Mt. Pelion West. In the literature it has been referred to as the " basal conglomerate " or sometimes as the Stockers Tillite.

Above the basal conglomerate is a marine sequence of mudstones, conglomerates, marls, pebbly marls, and pebbly mudstones and sandstones. Where well exposed it contains abundant fossil remains, chiefly robust brachiopods, including spiriferids, strophomenids, &c., gastropods and bryozoans such as *Fenestrellina*. Although boulders of the sequence, the " Lower Marine ", are common throughout the area, good outcrops are hard to find as the formation is usually concealed beneath extensive superficial deposits.

The Lower Marine sequence is followed by a fresh-water sequence consisting chiefly of quartz sandstones which contain coal measures. In Tasmania these are the Mersey or Preolenna Coal Measures and they are probably equivalent to the Greta Coal Measures of N.S.W. This whole sequence is locally referred to as the Liffey Group and it is usually about, or less than, 100 feet in thickness. Due to irregularities in the surface upon which the Permian sequence was laid down, the Liffey Group forms the base of the Permian sequence in the vicinity of the Pelion Chalet.

The Liffey Group is followed upwards by a marine sequence of mudstones, siltstones and impure sandstones, all with pebbly variations, several hundred feet in thickness. The marine fauna of the Lower Marine Series is well represented here but with a preponderance of bryozoans rather than brachiopods. This group has been called the " Upper Marine " and, more recently, the Woodbridge Group. In the type locality it is 265 feet thick.

Above the Woodbridge are up to 700 feet of well-bedded mudstones and pebbly mudstones with three thin sandstone bands. This is the Ferntree Group. The mudstones are characteristically laid down in beds a foot or so thick. They are strongly jointed and typically show spheroidal weathering patterns. Although it is a marine sequence the Ferntree Group contains only very rare fossils.

The Permian sequence is covered by upwards of 900 feet of alternating massive sandstones and fissile mudstones. On Mt. Pelion East at 215 feet from the base of the sequence are the Upper Coal Measures. These are probably equivalent to the Tomago Coal Measures of N.S.W. and are of Upper Permian age. In Tasmania they have been called the Cygnet Coal Measures.

The Permo-Triassic boundary cannot be fixed precisely. From the evidence of pollen analysis of the Cygnet coals, that horizon is certainly Upper Permian. The overlying sandstones elsewhere in Tasmania contain fossils of Triassic age. Thus the boundary lies somewhere above the Cygnet Coal Measures but there is no well-defined break in the sedimentation. For convenience the boundary has been tentatively placed at the base of the first massive sandstone member above the Cygnet Coal Measures, although it must be borne in mind that no palaeontological evidence has yet been found to support this.

The Permo-Triassic sediments have a widespread occurrence throughout the Cradle Mountain reserve. They can be recognised at a distance by their characteristic outcrop pattern, forming as they do horizontal benches around the slopes of all the major mountains. The sandstone cliffs around the north face of Mts. Doris and Ossa and Paddy's Nut are formed from these, as are similar cliffs under Cradle Mountain, Mt. Pelion East, Mt. Pelion West, Barn Bluff and a host of other mountains. The series of waterfalls in the Upper Mersey River near the Du Cane hut, Dalton, Cathedral, Boulder, Fergusson Falls, &c., are all over these rocks.

The total thickness of the sequence from the Pelion Hut up to the dolerite capping on Mt. Pelion East is 1,950 feet, but due to variations in the thickness of the basal formations the overall thickness varies by upwards of 500 feet.

Evidence outside of this area suggests that the sequence is thicker south and east of Cradle Mountain sympathetically with the slope in the basement. However, it is not possible to demonstrate this conclusively due to lack of knowledge of the precise stratigraphic level at which the dolerite is intruded. The fact is that we have no recognisable top to the Permo-Triassic sequence in the Cradle Mountain area. Everywhere the sequence is terminated above by immense slabs of dolerite. These are known to cut across the bedding and once the level of the intrusion rises above the Cygnet Coal Measures lack of fossil evidence prohibits the accurate assessment of the stratigraphic level at which the intrusion has been made. Nowhere in Tasmania has the upward termination of the Triassic sedimentation been recognised; the long period of erosion extending from the Jurassic until the Tertiary, together with the widespread dolerite intrusions effectively conceals the upward limit of the Triassic sedimentation. No Jurassic or Cretaceous sediments have yet been recognised in Tasmania.

The Juriassic Dolerite

This rock forms the capping of every major mountain in the Cradle Mountain reserve. The age of the intrusions is still not beyond dispute. The dolerite post-dates the Permo-Triassic cycle of sedimentation which extends high into the Triassic if not actually into the Jurassic. It antedates by a long period Tertiary sediments and laterites. The common assumption is that it is cognate with the extensive felspathic tuffs which dominate the Upper Triassic sediments and they are taken as being of probably early Jurassic age.

The form of the intrusions is generally sill-like but transgressions are apparent. For instance, on Cradle Mountain the dolerite is intruded into the Permian not far above the basal conglomerate, whilst on Barn Bluff and Mt. Pelion West it is intruded into the Triassic sediments. Discordant boundaries between the dolerite and Permo-Triassic sediments are recorded also from the area around

the Guardians, Walled Mountain and the Labyrinth and it has been suggested that this is a discordant plug centred about Long Lake.

Superficial Deposits

These are exceedingly widespread, consisting of glacial moraines and lake deposits, outwash deposits, erratics, talus, scree, and marsh deposits. The distribution is directly related to the Pleistocene glaciation.

The southern end of Lake St. Clair is fringed with terminal moraines best seen on the road to the H.E.C. pumping station. The track to Lake Petrach crosses numerous moraines, consisting of dolerite and coarse sandstone. At Narcissus Hut, at the northern end of Lake St. Clair, are widespread beds of conglomerate, consisting mainly of pebbles one to two inches in diameter in an indurated matrix.

The whole of the Narcissus Valley is occupied by glacial deposits, forming long morainal ridges from the cirques on the Du Cane Range down to Lake St. Clair. The ascent from the Narcissus Valley to Pine Valley is up a series of terraces or steps in glacial material. Behind this, Pine Valley has a flat floor of silt, possibly a moraine-damned lake deposit. Numerous dolerite erratics cover the floor of the Kia Ora Valley.

Precambrian bedrock is exposed at the western end of the Pelion Plains, but east from there to Reedy Lake and well south of Reedy Lake there is no outcrop at all except for a few boulders of Permian (Liffey and Woodbridge) at the foot of the hills on the south side of Lake Ayr.

The plains of the Mersey and Forth consist of terraced morainal or outwash deposits.

Most of the peaks are flanked by talus slopes in coarse dolerite, which is relatively open, free-draining, and supports little vegetation. Below these are scree deposits consisting of weathered dolerite or dolerite embedded in rock flour which supports vegetation. Generally this boundary can be readily picked on the aerial photographs.

The Pleistocene Glaciation

Several directions of ice flow are apparent. There was a major cirque region at the head of Frog Flat, feeding a glacier in the Forth River. At the head of the Narcissus Valley a major glacier arose, flowing south, joined by tributaries from Pine Valley and Lake Marion. These all joined together at the north end of Lake St. Clair to form an over-deepened valley at their junction. Another rose near Goulds Sugarloaf and flowed south via the Cuvier Valley to near Cynthia Bay at the south end of Lake St. Clair. Several workers have discussed previously the valley glacier in the Mersey.

As well as valley glaciers, there appears to have been an ice sheet flowing from near the Mountains of Jupiter across the Traveller Range into Narcissus Valley, and another centred on the Labyrinth which flowed into Long Lake, the Wallace River, and north through the ice-scoured U-shaped valley of Lake Helios.

Several small glaciers flowed south from the Thetis Saddle, while another on the east face of Mt. Ossa originated Lake McFarlane. Roches moutonnées at the Pelion Plains indicate that the ice moved west from Lake Ayr into the Forth Valley.

The cirque regions are characterised by the development of free faces in the Permo-Triassic sandstones, with sometimes a rock bench

cut in the dolerite a short distance above, for instance at the Acropolis, Mt. Ossa near Lake McFarlane, and Falling Mountain. On other faces the talus deposits are more extensive.

Economic Geology

Low-grade mineralisation occurs in the vicinity of the old Pelion Hut, near Lake McFarlane and east of Lake McRae. This is mostly pyrite, copper and galena.

Tin and wolfram deposits occur along the Upper Forth Valley in the general vicinity of Oakleigh Creek and at the foot of Mt. Hartnett. Most of these workings are relatively inaccessible from the walking track through the Cradle Mountain reserve except for the workings near the old Pelion Hut and those on the south bank of the Douglas River just downstream from that hut. In these workings veins of quartz carrying pyrite, galena, chalcopyrite and sphalerite can be seen, associated with quartzites and quartz mica schists.

Coal measures occur in the Liffey Group of the Permian sequence and also in the sandstones which form the passage beds between the Permian and Triassic sequences. Both those coal measures were actively prospected for a while around about the time of the first World war and small workings were located around the slopes of Barn Bluff, Mt. Thetis and Mt. Pelion West. Because of their distance from possible markets, and as the seams are thin (none over two feet), they have no present economic significance.

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