LEECH RIVER AREA, VANCOUVER ISLAND
(92B/5, 12)

By G.E.P. Eastwood

INTRODUCTION

Placer gold was mined from the Leech River in quantity in 1864 and has been the object of intermittent prospecting and small-scale mining since then. The river name has been used for the metasedimentary bedrock formation on which the placer deposits rest and for a major fault which juxtaposes the Leech River Formation against the Eocene Metchosin basalt to the south. The Leech River Formation has not been dated, and suggestions as to its age have ranged from Carboniferous to Cretaceous. The formation contains numerous quartz veins carrying trace amounts of gold, and Clapp (1917) concluded that the placer gold was derived from them.

In 1981 and 1982, four placer miners continued to work sections of Martins Gulch, when the volume of water permitted. After years of prospecting, Robert Beaupre had by the end of 1981 found gold in small quartz veins in rocks of the Leech River Formation west of the upper Leech River. In 1982 Grizzly Rock Services Ltd. started to drive a water-supply tunnel for the Greater Victoria Water District. It will run from Deception Gulch toward the end of the new road along the north side of the Leech River. In 1981 the writer made a reconnaissance survey of a strip between the mouth of the West Leech River and the Sooke River. In 1982 the reconnaissance across the Leech River Formation was completed to Sooke Lake. Sections of the tunnel were mapped, and a detailed survey was made of the lower part of Martins Gulch (*see* Fig. 14).

The area may be reached from Shawnigan Lake Road via Sooke Lake Main and Leechtown Main. The former bridge over the upper Sooke River is gone, but at low water the river can be forded by truck immediately above its confluence with the Leech River. Alternatively, access was from Sooke via Pacific Forest Products' Boneyard road. As hauling was in progress on week days, a radio was borrowed from the company. The Greater Victoria Water District has locked gates at the Sooke Lake spillway, north of Macdonald Lake, and on the road along the north side of the Leech River due south of Macdonald Lake. In addition to borrowing keys, it was necessary to obtain permits for specific days to enter the watershed behind the spillway gate and the Macdonald Road gate.

The principal topographic features in the area are a ridge in the northwest, the valleys of the Leech and Sooke Rivers, and a large basin between the tunnel portal and Sooke Lake. Macdonald Lake lies on the level floor of a valley that separates the ridge from a low, irregular hill to the east. Martins Gulch is actually a V-shaped creek valley with a moderate gradient. Outcrop is semicontinuous in the lower half of the gulch and along the section of the Leech River between the end of the

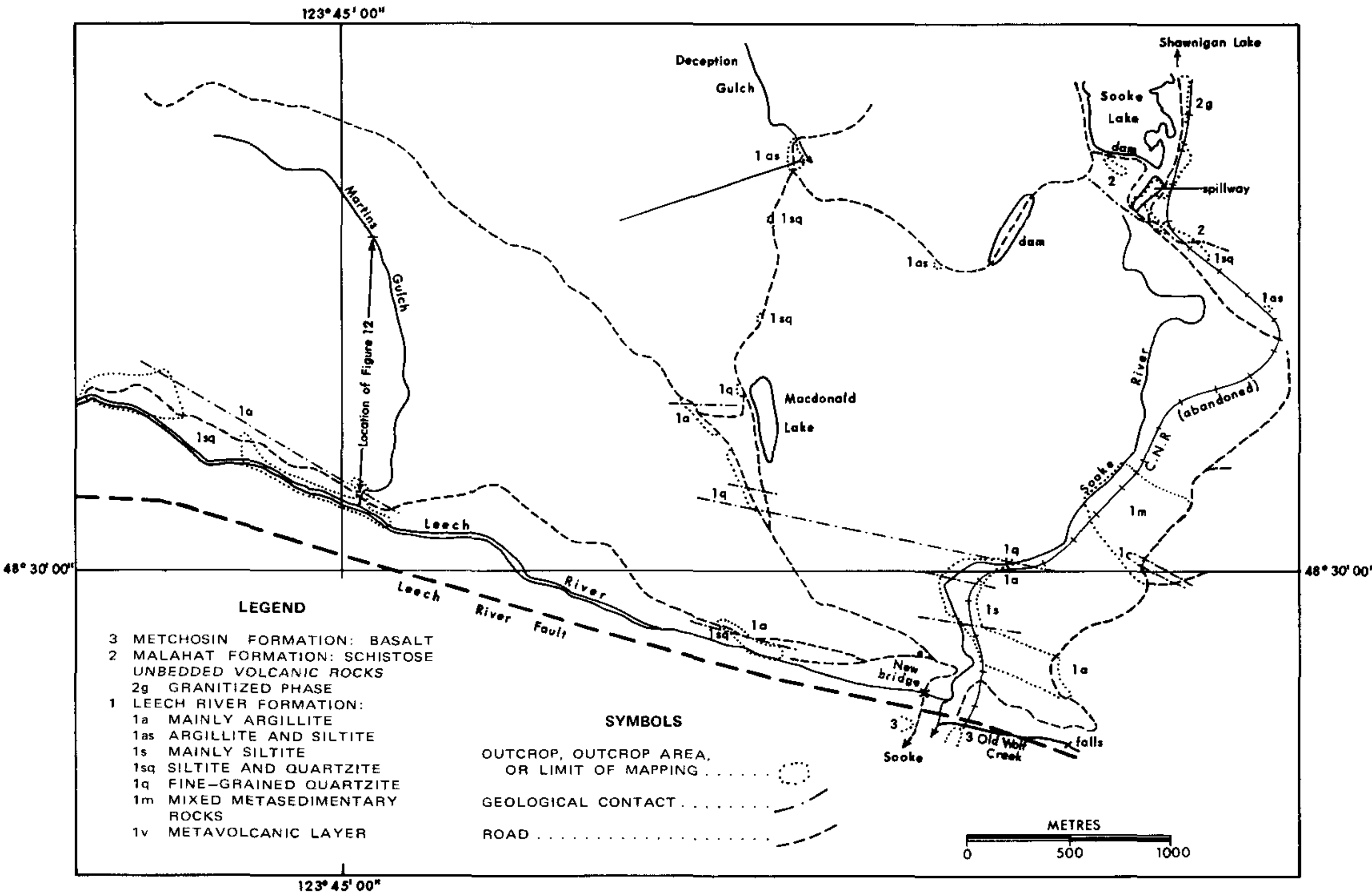

Figure 14. Geology of the Leech River area, southern Vancouver Island.

north-side road and lowest outcrop area shown on Figure 14. Exposure is fairly good to the south and east of Sooke Lake and in road cuts between the cabin and a point west of Macdonald Lake. Elsewhere outcrop is patchy or nonexistent.

GENERAL GEOLOGY

The Leech River Formation in this area consists mainly of deformed and metamorphosed mixed clastic sedimentary rocks. Distinct layers of metamorphosed tuff and volcanic breccia are exposed in Martins Gulch and on Leechtown Main. Unbedded light grey bands in the first few metres of the water tunnel and in exposures around the portal may also have been tuffs. Unbedded greenish grey schists in the spillway and north along Leechtown Main are evidently Clapp's 'Malahat volcanics.' Northward these schists are increasingly granitized and pass gradationally into granitic rocks that Clapp assigned to the Colquitz. Thin sheets of slightly gneissic granitic rock are exposed in a road cut on the north side of the Leech River about 800 metres west of the new bridge.

Mixing of the sediments was accomplished mainly by interbedding but also by incomplete or poor sorting. Definite graded bedding was not found. The rocks are described in terms of the metamorphosed end members, quartzite, siltite, and argillite. The quartzites are fine grained and medium grey to white in colour. The thicker quartzite units commonly have a massive core, with beds above and below delineated by partings of siltite or argillite. The siltites are generally dark grey to black, but are medium to light grey along the Leech River, and, in one distinctive unit in Martins Gulch, they are yellow. They are uniformly thin bedded. The argillites are black, do not show internal bedding, and are phyllitic to schistose.

The well-exposed section in Martins Gulch was mapped in detail to serve as a reference section. Numerous dragfolds indicate that the section faces uniformly to the north. Definite stratigraphic tops were not found but, assuming the whole section is not overturned, the fold pattern is that of younger beds riding southward over older toward the crest of an anticline. The rocks were grouped into stratigraphic packages referred to as units. Since the base of the Leech River Formation is not exposed and the upper part is poorly exposed, any system of designation has to be arbitrary. The distinctive volcanic unit was assigned No. 100, and the other units numbered accordingly. An inferred fault between units 75 and 76 may signify a gap, but otherwise the section appears to be mostly complete. The units are shown in plan on Figure 15 and their lithology is summarized in Table 1. The difference in elevation between the base of unit 104 and the road embankment is about 150 metres.

The contact between units 66 and 67 can be identified near the end of the north-side road and less confidently in the exposures 800 metres west of the new bridge over the Leech River. Using the traces of this contact derived on Figure 14, the quartzite unit south of Macdonald Lake should correlate with any or all of units 84, 86, and 88. Correlation of the volcanic unit on Leechtown Main with unit 100 is therefore possible, although it is not exposed on the road near Macdonald Lake. The tunnel as shown represents its position in mid-June. The inner part is mainly silty argillite and argillite, with interbands of siltite. Three quartzite units between 690 and 500 metres from the portal are comparable with quartzite units in Martins Gulch. The outer part of the tunnel is driven through argillite and siltite, and exposures around the portal are mostly argillite. A covered section northeast of this is probably underlain by recessive argillite. The volcanic rocks overlie silty argillite at the junction of the Sooke Lake and Leechtown roads, but quartzite and siltite on the Canadian National Railway line to the east, indicating a disconformity.

TABLE 1. STRATIGRAPHIC SECTION IN LOWER MARTINS GULCH

Unit	Lithology
104	Mainly black argillite, with minor quartzite interbedded in the lower part and greenish beds, probably altered tuffs, interbedded in the upper part of the exposed section.
103	Mostly thinly interbedded quartzite and argillite, with dark grey siltite at the base and interbedded quartzite and dark grey siltite at the top.
102	Interbedded light grey siltite and black argillite in the lower part, overlain by mostly argillite.
101	Mainly dark siltite and less quartzite; layers of argillite near base and in the upper third.
100	Hard light green tuff and volcanic breccia.
99	Mainly dark grey siltite.
98	Argillite, silty in lower part.
97	Mainly siltite and quartzite, both interbedded and as separate layers. Minor layers of argillite and argillite interbedded with quartzite.
96	Mainly argillite; minor interbedded siltite and quartzite.
95	Quartzite.
94	Lower part: argillite, in part interbedded with siltite. Middle part: interbedded argillite and quartzite. Upper part concealed.
93	Mainly quartzite, with siltite at base and top.
92	Sandy siltite in lower half and mainly interbedded siltite and argillite in upper half.
91	Mainly argillite, silty in part; some interbedded quartzite in middle and at top.
90	Quartzite interlayered with less silty argillite.
89	Sandy siltite interlayered with less silty argillite, argillite, and quarztite.

TABLE 1. STRATIGRAPHIC SECTION IN LOWER MARTINS GULCH (Continued)

Unit	Lithology
88	Mainly quartzite; interbedded with dark siltite in upper part.
87	Dark grey and black siltite. About 50 per cent exposed.
86	Mostly grey quartzite, with some interbedded dark grey siltite.
85	Lower half: silty argillite; upper half: thinly interbedded siltite and quartzite with an interlayer of silty argillite.
84	Quartzite.
83	Silty argillite containing interlayers of yellow quartz-siltite.
82	Mainly quartzite; some interlayered dark grey to black siltite.
81	Argillite and silty argillite.
80	Dark grey siltite containing quartzite beds and layer.
79	Argillite and silty argillite.
78	Mainly compact quartzite.
77	Mainly black argillite; some quartzite interbedded in upper part.
76	Mainly compact, cliff-forming quartzite; in part dirty and interbedded with siltite.
75	Argillite containing beds and lenses of quartzite.
74	Compact interbedded siltite and quartzite with thinly foliated siltite at base and top.
73	Interbedded quartzite and argillite in lower part, overlain by silty argillite.
72	Mixed unit, ranging from quartzite at base and top to argillite in upper half.
71	Mainly argillaceous; mainly interbedded quartzite and silty argillite in lower part; mainly argillite in middle; mainly interbedded quartzite and argillite in upper part with some interlayered quartzite and siltite.
70	Mainly quartzite, massive to slabby; siltite layer at base; minor interbedded argillite.
69	Argillite.
68	Sandy siltite and interbedded quartzite and siltite.
67	Silty argillite, with some interbedded quartzite in upper part.
66	Mainly siltite with some interlayered argillite.

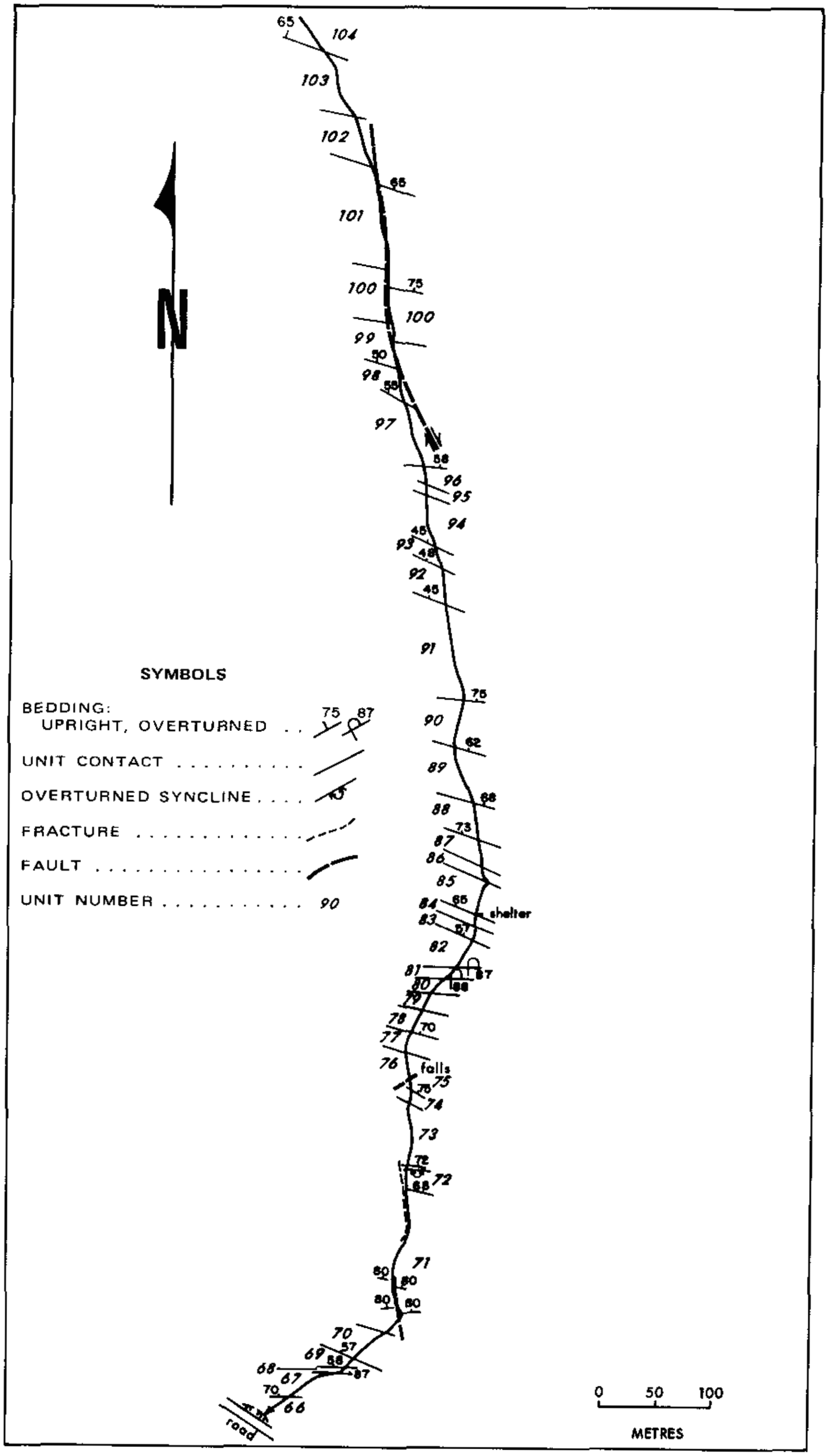

Figure 15. Geology of Martins Gulch (for location see Fig. 14).

STRUCTURAL GEOLOGY

Overall, the Leech River beds dip and face north-northeast at moderate to steep angles. Locally they have overturned, steep south dips. The structural behaviour of the rocks is well displayed in Martins Gulch. Massive quartzite does not show folding within outcrop limits. Bedded quartzite is commonly closely dragfolded, with limb dips decreasing to as little as 20 degrees in the centres of some units. The combination of low internal dips and piled-up dragfolds has greatly increased the outcrop width of many of the quartzite units. Siltites and isolated quartzite beds have been thrown into dragfolds that are approximately isoclinal, with limbs nearly parallel to an axial plane cleavage. The contact dips shown on Figure 15 are those of nearby unfolded beds. Bedding has not survived in the argillites; they show only a cleavage or schistosity parallel to the axial plane cleavage. The largest fold seen in Martins Gulch is an overturned syncline in quartzite in the upper part of unit 72. Since the lithology does not repeat north of this quartzite and quartzite beds in unit 73 show dragfolds indicating overriding to the south, it is assumed that the corresponding anticline has been sheared out along the axial plane cleavage. Some larger folds are indicated in the sections west and south of Macdonald Lake and along the Sooke River by reversals in the direction of overriding, but they do not appear to repeat whole units.

At the mouth of Martins Gulch, in the Leech River, the structural style changes. In the gulch section most dragfolds are complete, whereas in the river most have been pulled apart, leaving only rod-like thickened axial portions. Also, dragfolds are more numerous, smaller, and tighter in the river. Finally, there is a progressive change in dip of foliation and remnant bedding across the river section. Dips are steep north on the north side but steep south on the south side, near the Leech River fault. This changed style is interpreted to represent a superimposed second deformation in response to initial compression and subsequent tension caused by movement on the fault (Eastwood, 1982).

Quartz veins are common in all the rocks, but they are more abundant in argillite units. In the Martins Gulch section there appears to have been little or no movement in the argillites after deposition of quartz veins along the foliation. In contrast, quartz in the outer part of the water tunnel is in lenses and the schistose argillite has been wrapped around them, creating a wavy to curly schist. Post-quartz movement is indicated by a high polish on the schist surface against the quartz. This slick rock presents a ground-support problem. The post-quartz movement may be related to faulting. Muller (1980) has postulated a Shawnigan fault extending along Macdonald Lake Valley and under Sooke Lake, offsetting a postulated Survey Mountain fault which juxtaposes Leech River (and Malahat) rocks against Colquitz gneiss. However, as already noted, the Malahat schists pass gradationally into the Colquitz. Any fault in this part of the area would have to pass southwest of the schists and the sedimentary beds immediately underlying them, and would therefore lie within the Leech River Formation. Any movement under Macdonald Valley would have to be slight as the units appear to match up across it.

Three small faults are inferred to underlie Martins Gulch (Fig. 15). The north one is indicated by right hand offset of the contacts of unit 100, and northerly deviations in the strikes of beds can be attributed to drag on this fault. Attitudes in the vicinity have argillite of unit 75 striking into quartzite of unit 76; a fault is postulated to separate them. Movement would have to be left hand, as unit 74 is too thin to be the continuation of 76. A small fault in unit 71 is indicated by right hand offset of two fairly distinctive beds, represented by bedding symbols with 80-degree dips. An open crack in units 71 and 72 locally contains mylonite, but no offset could be detected. There are doubtless other small cross-faults in the area, which could be detected with good exposure and detailed mapping.

AGE AND CORRELATION

No radiometric ages have been obtained from the present area. The nearest dated samples (Wanless, *et al.*, 1978) are from 800 metres southwest of West Leech Falls; actinolite schist yielded a K/Ar age of 41.1±2.8 Ma and sills intruding it an age of 36.7±2.6 Ma. The actinolite represents a much higher grade of metmorphism than is found in the present area, and evidently was produced by a Tertiary metamorphic event penecontemporaneous with intrusion. A minimum age for the Leech River Formation is imposed by the fact that the overlying Malahat schists must pre-date the Colquitz. Muller (1980) quotes K/Ar dates for the Colquitz ranging from 131 to 182 Ma. The Malahat and Leech River must therefore be of Bonanza age or older. Of the various formations on Vancouver Island, they most nearly resemble the Sicker Group. Unit 100 closely resembles a common type of Sicker volcanic rock. The Sicker sedimentary beds exposed in Chemainus River are somewhat thicker than the thin Leech River beds, but their lithology is similar and they have been folded in a similar way. The volcanic-sedimentary sequence appears to be reversed, and it is suggested that the Malahat and Leech River together are correlative with Sicker volcanic rocks, the sediments accumulating distally to continued volcanism in the Sicker type area. Recent usage by Muller and others has been to include the Malahat in the Leech River, but it is much thicker than the volcanic units within the Leech River and appears to overlie it disconformably, therefore it is useful to retain it as a separate formation.

ECONOMIC GEOLOGY

The writer was shown nugget and fine gold recovered from the gravels in Martins Gulch, but no visible gold was found in the bedrock. A small proportion of the numerous quartz veins in Martins Gulch and in the tunnel contained appreciable pyrite. Of nine pyritic veins sampled, only one contained gold or silver above the detection limit, and it had only 0.3 ppm gold. Shear and gouge zones appeared barren.

In the spillway of Sooke Lake dam, under the bridge and for some distance above, the Malahat schists contain disseminated chalcopyrite and bornite. This is evidently a localized zone, as mineralization was not found in road and railway cuts. However, the schists pass out of the watershed a short distance east of the Canadian National Railway line, and prospecting there for similar zones is warranted.

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SICKER PROJECT
(92B/13)

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A radiometric age was obtained in 1982 that requires revision of the concept of the Sicker Group. The geology of the Mount Richards area is shown on British Columbia Ministry of Energy, Mines and Petroleum Resources Preliminary Map 40 and described in *Geological Fieldwork*, 1979. Briefly, Sicker volcanic and less sedimentary rocks are intruded by large dykes and irregular stocks of gabbro-like shonkinite. This is the gabbro-diorite of Clapp (1917) and evidently the diabase of Muller's (1980a, 1980b) sediment-sill unit. A CanPac Minerals Limited diamond-drill hole, drilled in or about 1972, passed through part of the dyke north of Breen Lake, and the writer logged and sampled the core. A hornblende separate was made and submitted to the University of British Columbia for K/Ar determination. J. Harakal reported an age of 363±13 Ma and commented that the material was of superb quality.

The Sicker rocks have been traced into the type area on Big Sicker Mountain, where they are similarly intruded by shonkinite. Schist belts were developed in the Sicker rocks prior to intrusion. Thus the type Sicker is Middle Devonian and/or older. The Buttle Lake limestone has been dated paleontologically as Middle Pennsylvanian or possibly Early Permian. Thus it and other Paleozoic deposits that postdate the deformation and intrusion are not Sicker. It is therefore possible that the host rocks of Westmin Resources Limited's Buttle Lake massive sulphide deposits are not Sicker.

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