



GEOLOGY OF PART OF THE CALLAGHAN CREEK ROOF PENDANT
(92J/3W)

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INTRODUCTION

Callaghan Creek roof pendant, located approximately 100 kilometres north of Vancouver, is within Vancouver Mining Division. The map-area is approximately 26 square kilometres (10 square miles) centred on latitude 50 degrees 07 minutes north and longitude 123 degrees 06 minutes west. It is bounded on the south by Highway 99, approximately 50 kilometres north of Squamish. Eastern and western margins are formed by contacts of the roof pendant with the Coast Plutonic Complex, as is much of the northern margin. Two mining operations are located within the area (Fig. 19). Northair Mines Ltd. has its minesite on the east side of Callaghan Creek at an elevation of 990 metres, approximately 10 kilometres north of Highway 99. Van Silver Explorations Ltd. has a mill 1 kilometre north of Highway 99 on the east side of Brandywine Creek.

GENERAL GEOLOGY

Callaghan Creek roof pendant is one of many northwesterly trending volcanic and volcanic-sedimentary pendants within the southern part of the Coast Plutonic Complex. The pendant rocks are variably metamorphosed and commonly are characterized by a strong northwesterly trending foliation. The Coast Plutonic Complex in the area consists of many plutons ranging in composition from diorite through quartz diorite to quartz monzonite. A western zone of intrusions is predominantly Cretaceous whereas an eastern zone is Early Tertiary. Contacts between roof pendants and surrounding plutonic rocks are sharp and commonly are narrow shear zones whose orientations are subparallel to the main foliation of the roof pendant (Woodsworth, personal communication, 1977). Several centres of Tertiary volcanic rocks form a north by northwesterly trending belt containing local flow and pyroclastic accumulations from basalt to rhyolite in composition (Mathews, 1958; Green, 1977).

Geology of the map-area is shown on Figure 19 and lithologic types are grouped into seven main divisions. No effort has been made to define separate bodies of the Coast Plutonic Complex – mapping extended only a short distance outward from the septum. Similarly, little effort has been expended on Tertiary volcanic rocks which have been the subject of a recent detailed study (Green, 1977). Our work has been directed principally to an understanding of the extensive volcanoclastic assemblage forming the bulk of the Callaghan Creek roof pendant in this area. Five main units of volcanoclastic rocks can be recognized, each of which is further divisible into less continuous members whose geometry generally is unclear due principally to the absence of outcrops in critical areas. A final definition of these members must await extended laboratory work.

Stratigraphy: A generalized structural (possibly stratigraphic) section shown on Figure 20 is based on the assumption that no significant repetitions occur in the sequence. In a number of places we have been able

to determine direction of 'tops' in tuffaceous rocks, principally using graded bedding. In all cases tops were indicated to the east in a rock sequence that strikes northerly.

Total apparent thickness of the section of volcanoclastic rocks is in excess of 5 000 metres (16,000 feet). Some units vary drastically in thickness over short distances. The crystal tuff unit for example shows an extreme variability in apparent thickness from 100 to about 1 000 metres over a strike length of 1 000 metres. On the other hand, the volcanic breccia (unit 5a) is remarkably uniform in thickness over a distance of 3 000 metres. These volcanic units may represent parts of three volcanic cycles, each dominated by products of explosive volcanism, and here referred to as cycles I, II, and III from oldest to youngest respectively. According to this suggestion unit 1 is the uppermost expression of cycle I, units 2, 3, and 4 are cycle II, and unit 5 is the lowermost part of cycle III.

Structure: Rocks in the map-area appear to have the form of a simple homoclinal sequence striking northerly to northwesterly and dipping steeply to the east with tops to the east. No evidence of significant large-scale repetitions by folding or faulting has been found during the mapping although rare minor folds were observed in some well-bedded exposures. The apparent homoclinal nature of the volcanoclastic rocks may be a too simplistic geometric form for the sequence considering the complex history of intrusion, deformation, and metamorphism that the area has undergone.

Faulting has been extensive. Numerous faults with apparent horizontal movement of a few centimetres to a few metres are apparent in the underground workings of Northair Mines Ltd. Most of these faults are steeply dipping and cut across bedding and the ore zones. Vertical components of movement are not known.

Numerous northerly trending gullies occur in the area and can be identified readily on aerial photographs as extending in straight linear fashion for hundreds of metres in some cases. These linear elements are almost certainly ground traces of steeply dipping faults that are subparallel to layering in the volcanoclastic sequence and have a significant strike-slip component. The movement picture is not everywhere clear; however, in the area immediately west of Northair mine the base of the tuffaceous agglomerate (unit 5) has been offset with right-hand displacement.

A major 'break' of uncertain nature exists at the south end of unit 4, in the vicinity of the mine access road and coincides closely with an area of possible crystal tuff feeder channels. In this zone an acid volcanic sequence (unit 4) is replaced abruptly along strike to the south by crystal tuff (unit 3). Whether or not this represents a structural break or a facies change remains uncertain due to absence of outcrop in the critical area.

Age: Age of the volcanoclastic sequence is somewhat uncertain. Lithologies and textures show a remarkable similarity to the lower volcanic member of the Gambier Group as exposed near the type area along Howe Sound where Cretaceous fossils have been found in an upper sedimentary member. Similarly, Cretaceous fossils have been found near Black Tusk Mountain in a sedimentary sequence, one member of which contains granitic cobbles and which seems to overlie the volcanoclastic sequence unconformably (Mathews, 1958). Furthermore, mapping to date has not located any granitic fragments within the volcanoclastic rocks of the Callaghan Creek pendant. Consequently, it seems fairly certain that the volcanoclastic sequence is Early Cretaceous or older. A K-Ar model age of 124 ± 4 Ma has been obtained for a hornblende 'dyke' cutting crystal tuff (unit 4) and assumed to represent a feeder to the crystal tuff. The true age may be older if partial release of argon occurred during metamorphism accompanying emplacement of the Coast Plutonic Complex.

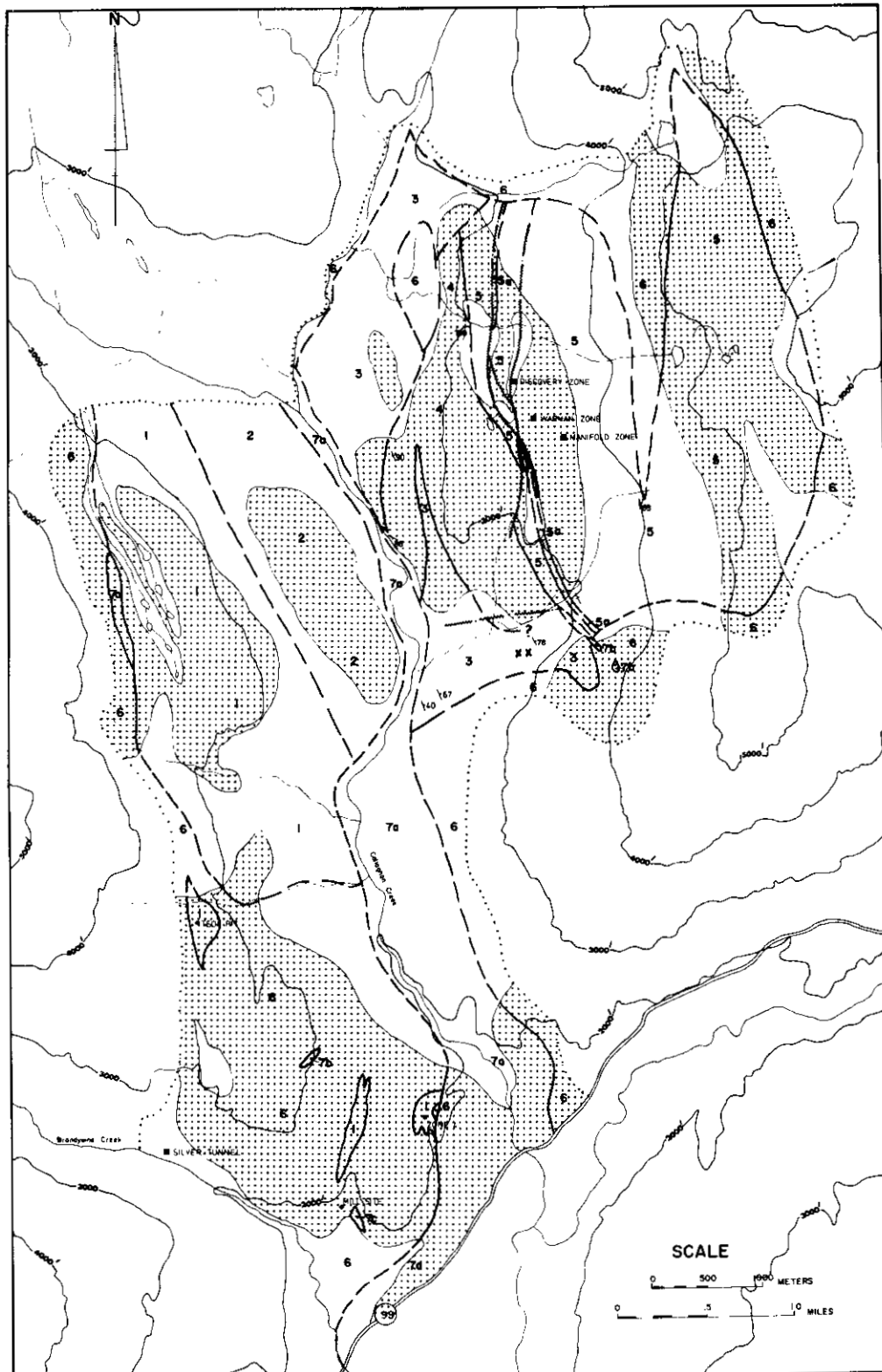


Figure 19. General geology of part of the Callaghan Creek roof pendant.

LEGEND

TERTIARY

- 7 VOLCANICS
 - a) BASALT
 - b) ACIDIC TUFF
 - c) RHYOLITE

CRETACEOUS (or earlier)

- 6 COAST PLUTONIC COMPLEX
- 5 AGGLOMERATE; 5a) VOLCANIC BRECCIA
- 4 ACIDIC VOLCANIC ROCKS
- 3 CRYSTAL TUFF
- 2 AGGLOMERATE
- 1 GREENSTONE

HORNBLENDITE CENTRES

BEDDING AND DIP

CONTACT (APPROXIMATE; ASSUMED)

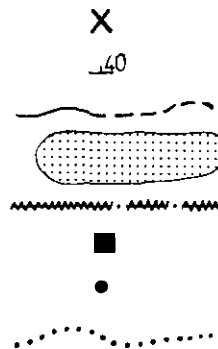
ABUNDANT OUTCROP

FAULT (APPROXIMATE; ASSUMED)

MINE ADIT

MINERAL OCCURRENCE

LIMIT OF FIELD MAPPING



BRIEF DESCRIPTION OF ROCK UNITS

These descriptions are not meant to be complete, but are intended to indicate the dominant characteristics of the principal rock units. The reader should recognize that considerable variability exists within each of the units described. Names are those used in the field. Reference should be made to Figure 19 for field locations and to Figure 20 for a rough guide to estimated thickness.

Greenstone (unit 1):	'Acidic,' fine-grained volcanoclastic rock, commonly extensively sheared, generally pale green in colour.
Agglomerate (unit 2):	Massive volcanic fragmental rock with fragments up to 50 centimetres in diameter in a tuffaceous matrix that is 5 to 40 per cent of the rock.
Crystal tuff (unit 3):	Medium-grained pyroclastic rock containing abundant plagioclase fragments and less abundant hornblende fragments. Locally well layered.
Acidic volcanic rock (unit 4):	Principally dacitic and rhyolitic tuffaceous rocks with rare large fragments. Locally contains up to 5 per cent pyrite.
Tuffaceous agglomerate (unit 5):	Massive pyroclastic unit, principally tuffaceous material near the base and predominantly rounded volcanic fragments higher in the section. Near the base this unit contains a 60-metre-thick marker bed of volcanic breccia with abundant fragments mostly 3 to 5 centimetres in diameter.
Coast Plutonic Complex (unit 6):	Includes quartz monzonite, quartz diorite, and hornblende diorite.
Tertiary volcanic rocks (unit 7):	Fresh, blocky basalt for the major flow in the map-area, and elsewhere much smaller amounts of more acidic composition. Correlations with Garibaldi calc-alkalic volcanic suites.

Two zones of small hornblende intrusions cutting crystal tuff are shown by X's on Figure 19. These intrusions are thought to represent parent material for the crystal tuff.

MINERAL DEPOSITS

Seven mineral occurrences of apparent importance are known in the map-area. All are held by two mining companies as follows:

Northair Mines Ltd.:

- Discovery zone — massive
- Warman zone — veins, massive and disseminated
- Manifold zone — veins and disseminated

Van Silver Explorations Ltd.:

- Silver tunnel — veins and disseminated
- Millsite — veins and disseminated
- Tedi pit — massive
- Zone 4 — massive skarn

These mineral occurrences are confined to units 1 and 5. Locations are shown on Figure 19.

Zone 4 is a skarn deposit containing sphalerite, pyrite, and minor amounts of chalcopyrite. This occurrence seems to be genetically distinct relative to other known deposits. All the other deposits are polymetallic containing galena, sphalerite, and pyrite as the principal sulphide minerals with significant amounts of several silver minerals and native gold, and minor amounts of chalcopyrite and pyrrotite. Two general forms of mineral deposits exist: (i) veins and (ii) massive and disseminated sulphide bodies. Veins contain abundant quartz and/or calcite gangue and undeformed sulphides. Massive and disseminated mineralized zones occur in lenticular, variously layered masses that are generally parallel to bedding and show superimposed deformation features, the most obvious of which is a pronounced gneissic structure. Some

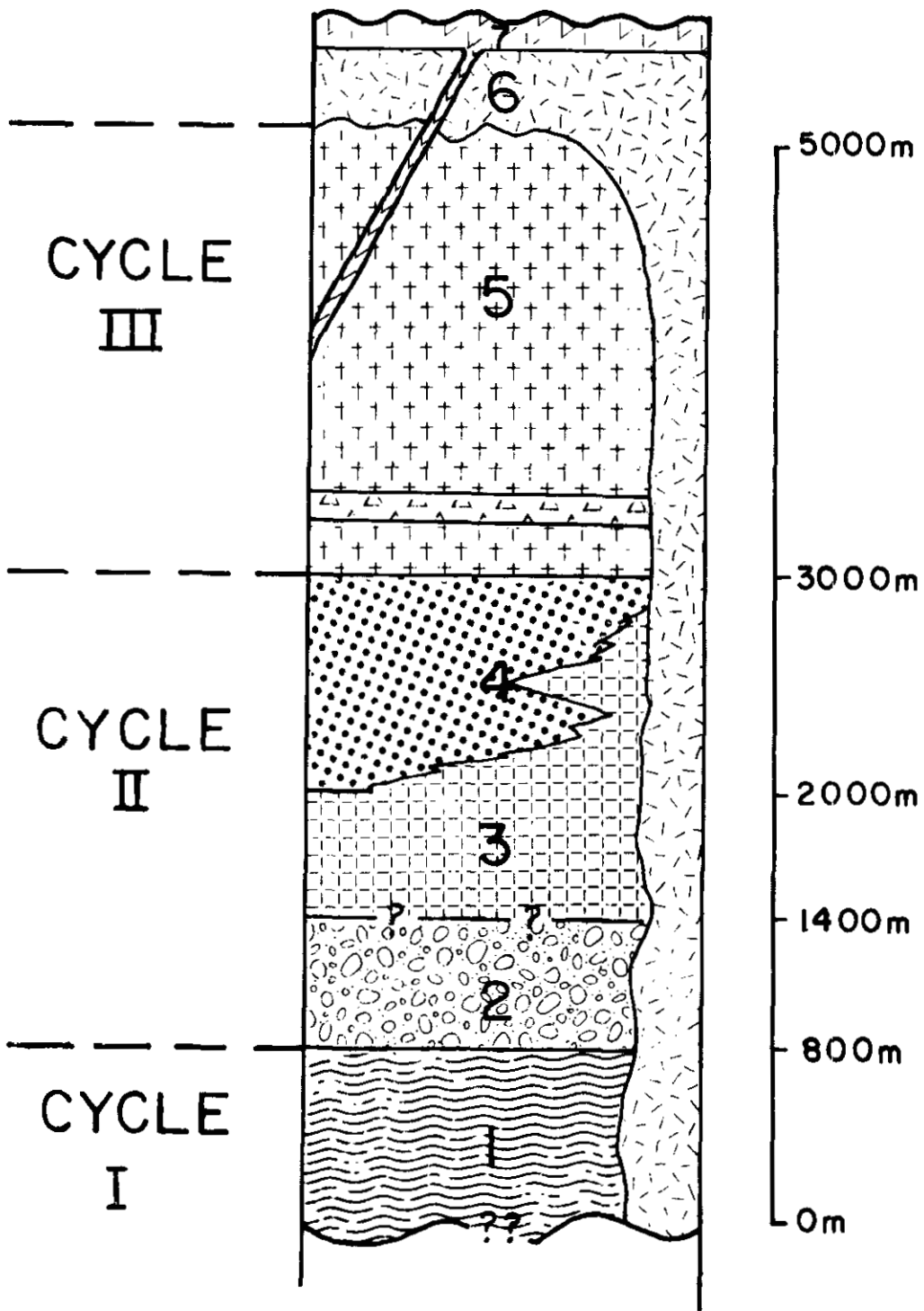


Figure 20. General structural succession in the Callaghan Creek roof pendant. The pre-Tertiary volcanoclastic rocks (units 1 to 5 inclusive) may represent as many as three volcanic cycles as shown.

disseminated ore in the Manifold zone occurs in a metamorphosed, bedded, siliceous limestone. Our impression is that sulphide-bearing veins have been derived locally during metamorphism from pre-existing concentrations of massive and disseminated sulphides that seem to be related in age and origin to the volcanoclastic rock sequence in which they occur. Veins remote from the massive and disseminated sulphides are sulphide-free (see Woodsworth, *et al.*, 1977).

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