



British Columbia Geological Survey Geological Fieldwork 1979

CARIBOO MOUNTAINS PROJECT

(93A/10, 11, 14, 15)

By H. J. Greenwood, J. V. Ross, D. Klepacki, and J. Getsinger
Department of Geological Sciences, University of British Columbia

In 1978 the British Columbia Ministry of Energy, Mines and Petroleum Resources funded reconnaissance work by H. J. Greenwood and J. V. Ross in the Cariboo Mountains, and in 1979 funded the first full season of fieldwork. The goal of the work is to refine the metamorphic, structural, and stratigraphic framework of the northern Cariboo Mountains. The area is of interest because of several unresolved problems in the stratigraphy of the Cariboo Group, the base-metal content of some of the stratigraphic units, and because of the existence of numerous interesting metamorphic problems. None of these features can be adequately studied without reference to each of the others. This report takes the form of three short summaries of work completed and in progress, deriving from field seasons 1978 and 1979.

FLUID INCLUSIONS IN THE CARIBOO MOUNTAINS

In the summer of 1979 during reconnaissance and planning work 27 specimens were collected from 16 localities in the Cariboo Mountains (Fig. 46). Of these 27 specimens, 17 were taken from large and small quartz veins folded with and crosscutting the metamorphic and sedimentary structures. The remaining specimens have been studied petrographically and broadly confirm results of Campbell, Mountjoy, and Young (1973), who indicate a steadily increasing metamorphic grade from chlorite and biotite schists in the northwest to staurolite, kyanite, sillimanite schists in the southeast. The quartz veins have been examined for fluid inclusions and without exception all specimens are rich in fluid inclusions. The inclusions are small, ranging from 10 to 60 microns in diameter, and all have at least two fluid phases. Most inclusions consist of two fluids, a water-rich liquid and a carbon dioxide-rich gas, the gas amounting to 5 to 10 per cent by volume of the inclusion. One specimen from locality 9 (Fig. 46) contains three fluids, a water-rich liquid, a carbon dioxide-rich liquid, and a carbon dioxide-rich gas. This inclusion is approximately 60 per cent carbon dioxide overall, while the others range up to a maximum of 10 per cent. No inclusion was seen to contain solid daughter minerals and to date it has not been possible to determine homogenization temperatures due to the small size of the inclusions. The present limited sampling gives no clear indication of gradient in proportions of $\text{CO}_2/\text{H}_2\text{O}$ in the metamorphic fluid, but it is hoped that more extensive sampling coupled with measurements on the heating/cooling stage will show good correlation between the properties of the fluids and the conditions indicated by the metamorphic mineral assemblages.

MAEFORD LAKE AREA (93A/14, 15)

A study of the stratigraphy and structure of the Cariboo Group in the vicinity of Maeford Lake was undertaken during the summer of 1979 by D. Klepacki (Fig. 47). Detailed mapping of 85 square kilometres at a scale of 1:25 000 and later petrologic and structural analysis will form the basis of an M.Sc. thesis at the University of British Columbia.

Previous regional mapping of the area was done by A. Sutherland Brown (1963) and later by R. B. Campbell (1978). More detailed work immediately to the north has been done by Mansy (1970) and Struik (1979). The work reported here extends detailed coverage south toward Quesnel Lake.

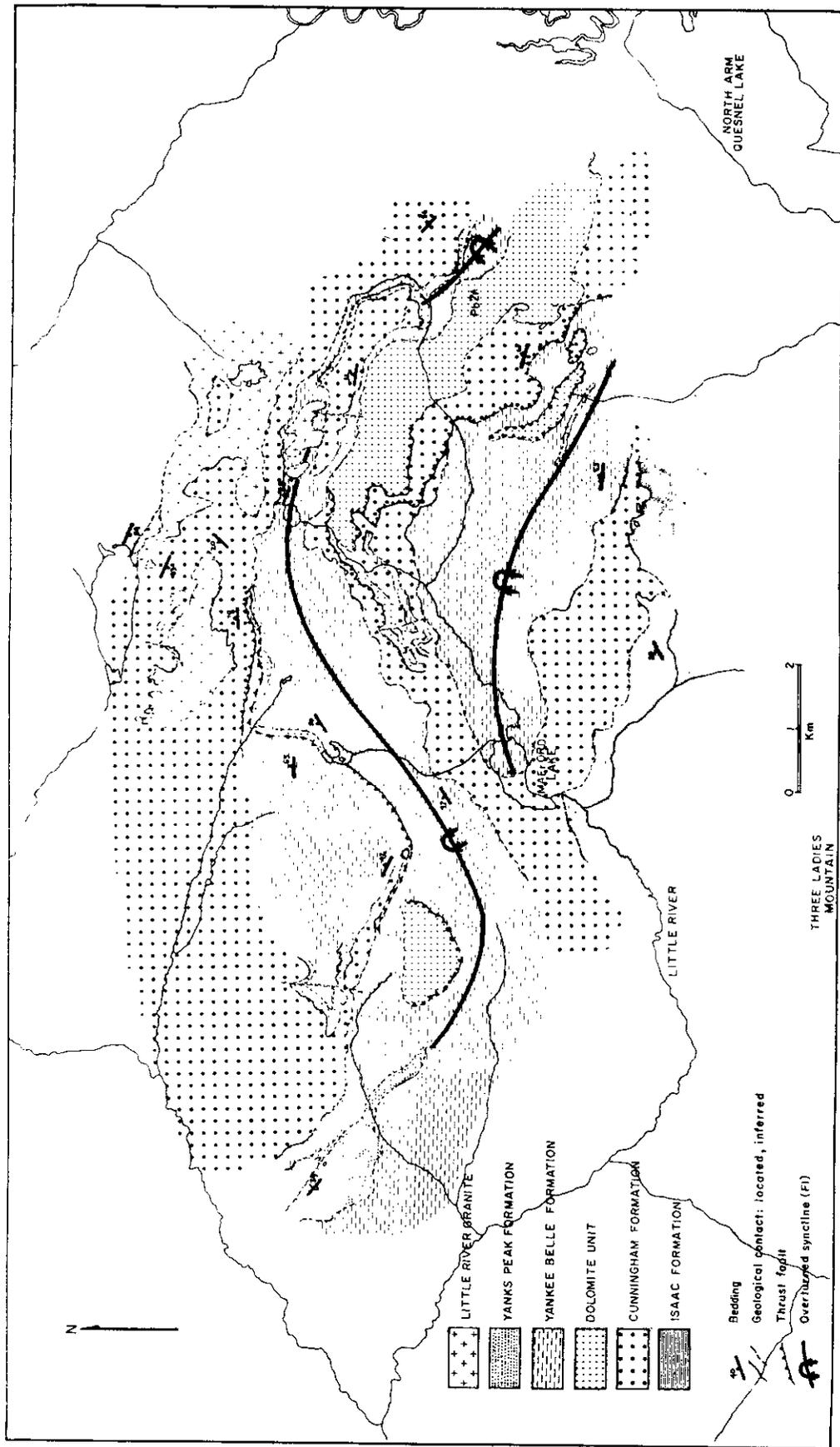


Figure 47. Geology of the Maerford Lake area.

The Cariboo Group and equivalent rocks along the Cordillera are host to lead/zinc and, farther north, gold mineralization. Lead/zinc showings in the Maeford Lake area have been examined by exploration companies using geophysical techniques and diamond drilling. The program reported on here is intended to elucidate the structural history of this area which lies between intensely metamorphosed terrain to the south and metalliferous sediments to the north. Such clarification should assist in the rational planning of mineral exploration.

STRATIGRAPHY

Rocks of the Cariboo Group comprise a sequence of schists, marbles, dolomites, calcareous phyllites, and cherts and quartzites. The stratigraphic sequence was established by correlation with named units farther north and by local determinations of 'tops' by means of graded bedding. The oldest rocks mapped in the area are grey to dark grey, slightly rusty weathering garnet schists overlying a sequence of bedded feldspathic grits and micaceous quartzites. The schists are correlated with the Hadrynian Isaac Formation of Campbell, *et al.* (1972).

Above the schists lie coarsely crystalline, white calcitic marbles with local tremolite horizons. In the northern and eastern parts of the area, this unit is much less recrystallized and is a fine to medium-grained grey marble with thin micritic laminae and easily visible stylolites. The unit is resistant, weathers light grey to white, and underlies the northwest-trending ridges of the area. This unit is correlated with the Cunningham Formation. Near the top of the Cunningham Formation lies a cream to light grey-weathering, fine-grained dolomite horizon. The dolomite is in most places brecciated, with a matrix of coarse-grained, sparry calcite or fine-grained calcite and hematite.

Stratigraphically above the Cunningham Formation is a heterogeneous unit of calcareous phyllite, calcareous biotite schist, intercalated marbles and phyllites, marbles, garnet schist, quartzites, and greenish phyllites. Locally present are thin green amphibolite horizons and dark sulphidic graphitic marbles. These various lithologies weather recessively and are collectively correlated with the Yankee Belle Formation.

The youngest unit is exposed only in the northwest part of the map-area and consists of green to white, clean quartzites. The base of the unit is interbedded with green mica phyllites. The phyllitic layers decrease in number toward the top of the unit. This unit is correlated with the Lower Cambrian to Hadrynian Yanks Peak Formation.

The 'Little River Stock' (Sutherland Brown, 1963) intrudes all stratified rocks in the map-area. The rock is a slightly porphyritic quartz monzonite to granodiorite that has been altered and in places weakly mineralized with iron and copper sulphides. It weathers light grey to greenish grey. The stock contains leucocratic veins and dykes, which are locally garnetiferous. There is local contact metamorphism, seen as a coarsening of grain sizes near the intrusion and development of skarn minerals in the marbles. The stock postdates the Yankee Belle Formation and is presumed to be of Mesozoic age similar to other granitic intrusions near Quesnel Lake.

STRUCTURE

The rocks of the Maeford Lake area are complexly deformed and faulted. The area is traversed by two early recumbent synclines trending northwest-southeast. This is evident from the map pattern, with a belt of Yankee Belle Formation in the core of each syncline, Cunningham Formation on either side, and Isaac Formation exposed in the extreme northeast and southwest of the map-area.

First stage structures control the map pattern and are seen on both macroscopic and mesoscopic scale. Isoclinal folds with northeast-dipping axial surfaces and generally northwest-plunging axes characterize Phase 1 structures. Foliation is parallel to the axial planes of these Phase 1 structures and minor structures and lineations are common. In most places foliation is parallel to bedding. Micritic layers in the marble units commonly show isoclinal folds and transposed layering associated with this event.

Second stage structures are somewhat more open with axial surfaces dipping steeply southwest and axes plunging northwest. Phase 2 minor structures deform Phase 1 foliation and have an associated lineation. In lower grade zones to the north and northwest, Phase 2 deformation is accompanied by a crenulation cleavage having west-dipping axial surfaces. Phase 2 minor structures in the micritic marble are locally isoclinal and can be separated from Phase 1 structures by means of a generally northeast sense of vergence in the Phase 2 structures. The near colinearity of Phase 1 and Phase 2 produces a 'fish hook' interference pattern which is common in outcrops of the bedded marbles. This is not readily apparent in the map pattern because of the moderate to shallow plunge of both structures. The Little River granite is involved in Phase 2 deformation and appears to cut Phase 1 structures. The granitic rocks are unfoliated in the centre of the bodies, but show some foliation near the contacts.

Third phase structures are open folds trending northeasterly with gently plunging axes and upright axial surfaces. They are better developed in the higher grade rocks in the southwestern part of the area, where kink banding exhibits Phase 3 orientations. Thin conjugate veins and fractures and several joint sets in the area are associated with brittle and extensional episodes of Phase 3 deformation. Interference of Phase 3 with Phases 1 and 2 produces an elongate dome and basin pattern seen as topographic highs of resistant marble units aligned with the north-northeast-trending antiforms of Phase 3.

Thrust surfaces dipping gently northeast and striking northwest can be seen in the field and truncated contacts and incomplete stratigraphic sequences have been confirmed by mapping. Thrusts have been folded and were probably operative during the first and second stages of deformation. High-angle reverse faults with strikes subparallel to the thrusts and southwest sides downthrown are later, as these are not folded. Some small, steep normal faults with a conjugate sense (northeast side downthrown) are probably related to this set. Displacement along these faults is measured in tens of metres. The final phase of faulting consists of north to northwest-trending, steep faults with a small right lateral displacement.

METAMORPHISM

The map-area bridges an area where metamorphic zones change from phyllitic (biotite?) rocks in the northwest to kyanite-staurolite-garnet-biotite schists near Three Ladies Mountain. The garnet isograd seems to have a complex trace, and further work on mineral assemblages will attempt to define its position. Metamorphism seems to have been most intense following the main pulse of Phase 2 deformation as porphyroblastic micas with weak preferred orientation are common and staurolite porphyroblasts appear to be randomly oriented.

MINERALIZATION

Lead/zinc mineralization occurs in the form of coarse-grained galena and amber sphalerite, locally with minor barite and scheelite, in veins in the dolomite breccia of the Cunningham Formation. The only substantial showing consists of a vein system 15 metres long and up to 10 centimetres wide in the south-

eastern part of the area. Sphalerite is far less abundant than galena. Some disseminated chalcopyrite occurs in minor amounts in sulphidic, graphitic marbles of the Yankee Belle Formation.

THREE LADIES MOUNTAIN

During the period August 12 to 30, 1979, preliminary geological mapping in the Isaac Formation was started by J. Getsinger in the area near Three Ladies Mountain (52 degrees 45 minutes north; 121 degrees 00 minutes west). The purpose of this study was to investigate the Isaac Formation as a subject for a Ph.D. project concentrating on metamorphism and structure. Previous work by Campbell (1978) shows the Isaac Formation as an undivided unit of metamorphosed pelites, with minor carbonate and some grit, underlying the Lower Cambrian Cunningham limestone.

During two weeks of mapping of a 10-square-kilometre area, it was found that the Isaac Formation is divisible into at least four mappable lithologies, including pelitic schist (garnet-kyanite-staurolite, two-mica schist), 'quartzite' (micaceous quartz-rich layers and some schist), carbonate (calcite marble with pelitic and calc-silicate layers), and 'hornblende-bearing rocks' (amphibolite, carbonate/pelite reaction zone rocks, and possible local meta-intrusive rocks).

The distinction of some of the lithologies in the Isaac Formation led to the recognition of large-scale folds (on the order of 1 kilometre) and it is presumed that others occur in the area. At least two periods of penetrative deformation are indicated by minor folds and strong pervasive foliations and lineations were noted in all rock types except pegmatites and quartz veins. Refolded folds are common in rocks that retain visible lithologic layering and in some places two foliations and/or lineations were observed. Detailed structural analyses of superimposed folds are expected to reveal much about the phases and style of deformation throughout the area.

All metamorphic assemblages observed in the field appear to be consistent with kyanite-staurolite grade of amphibolite facies metamorphism as mapped by Campbell (1978), although there is also some evidence for later retrograde metamorphism.

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K/Ar ANALYTICAL DATA FROM THE WREDE CREEK ULTRAMAFIC COMPLEX

Sample No.	Location Lat. (N); Long. (W)	Rock Unit	Mineral Dated	% K + S	$\frac{^{40}\text{Ar}^*}{^{40}\text{Ar Total}}$	$^{40}\text{Ar}^*$ (10^{-5} cm ³ STP/g)	Apparent Age (Ma)	Time
G77RW1	56° 40'; 126° 08'	hornblende diorite dyke cutting ultramafic complex	hornblende	0.959±0.007	0.790	6.740	172±6	Middle Jurassic
G77RW2	56° 40'; 126° 08'	hornblende pegmatite seg- regation within dunite	biotite (secondary)	8.98±0.18	0.967	57.258	157±5	Middle Jurassic
G77RW4a	56° 40'; 126° 08'	hornblende pegmatite seg- regation within dunite	hornblende	1.224±0.063	0.881	11.078	219±10	Late Triassic
G77RW4b	56° 40'; 126° 08'	hornblende pegmatite seg- regation within dunite	hornblende	1.188±0.088	0.881	11.078	225±8	Late Triassic

NOTES

All analyses done in the Geochronology Laboratory, Department of Geological Sciences, the University of British Columbia.

S is the range of the duplicate analyses from the mean value.

Ar* indicates radiogenic argon.

Constants used are: $\lambda_e = 0.581 \times 10^{-10} \text{ yr}^{-1}$; $\lambda_\beta = 4.962 \times 10^{-10} \text{ yr}^{-1}$; $^{40}\text{K}/\text{K} = 1.167 \times 10^{-4} \text{ yr}^{-1}$; error is one standard deviation.