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GEOLOGY OF THE EAGLE BAY FORMATION BETWEEN THE RAFT AND BALDY BATHOLITHS* (82M/5, 11, 12)

By Paul Schiarizza

INTRODUCTION

A 600-square-kilometre area centred near the town of Vavenby was mapped between mid-July and mid-October. This work extends the mapping of the Eagle Bay Formation and adjacent rocks carried out by the Ministry of Energy, Mines and Petroleum Resources under the direction of V. A. Preto from 1978 to 1981. The results of this year's work will be released in early 1986 as an Open File map at a scale of 1:50 000.

ROCK UNITS

EAGLE BAY FORMATION (UNITS 1 to 8)

The Eagle Bay Formation within the map-area has been subdivided into eight units. At the base of the formation is a quartzite-dominated succession (unit 1) of unknown age. This is overlain by a succession of felsic to intermediate metavolcanic rocks (units 2 and 3) and fine to coarse-grained clastic metasedimentary rocks (units 4 and 5) which are inferred to be mainly of Devono-Mississippian age based on correlations with dated Eagle Bay rocks to the south. Structurally above these rocks is a mafic metavolcanic-limestone division (unit 6) locally overlain by intermediate metavolcanics (unit 7). Fossil *archaeocyathids* from the Tshinakin limestone member of unit 6 indicate that it is Early Cambrian in age, and therefore must be in thrust contact with the underlying portion of the Eagle Bay package of Devono-Mississippian age. The structurally highest division of the Eagle Bay Formation comprises clastic metasedimentary rocks of unit 8, which sit above unit 6 in the eastern part of the map-area. This panel of rocks is overturned, however, and unit 8 may be the oldest unit within the Eagle Bay succession.

UNIT 1

Unit 1 is dominated by light to medium grey quartzite, platy chorite-muscovite quartzite, and chlorite-muscovite-quartz schist. Biotite and garnet are commonly present in the vicinity of Reg Christie Creek, where the rocks are of higher metamorphic grade (Fig. 9-1). Locally, unit 1 contains significant proportions of limestone, calc-silicate schist, dark grey phyllite, silvery sericite-quartz phyllite, and green chloritic schist. Unit 1 is the structurally lowest rock unit exposed within the map-area. It occurs in a discontinuous belt which extends along the southern margin of the Raft batholith from Mount McClennan westward to the western edge of the map-area, and from just east of Vavenby on the east side of the North Thompson River eastward along Reg Christie Creek. A thin horizon of mainly platy quartzites, siltites, and chlorite-muscovite-quartz schists, which occurs between unit 6 and orthogneiss of unit 9 north of Gollen Creek, is also included within unit 1. Rocks correlative with unit 1 along the northern margin of the Baldy batholith in the vicinity of Harper Creek (unit 1a) are intruded by large volumes of granitic orthogneiss, and are intercalated with thin horizons of 'quartz-eye' sericite schist. These horizons are probably derived from quartz porphyry sills related to overlying felsic volcanics of unit 2.

Unit 1 is lithologically similar to unit SDQ of Schiarizza and Preto (1984) in the Adams Lake-Barriere Lakes area. It also appears to correspond closely to descriptions by Campbell and Tipper (1971) of their unit 1 which consists largely of quartzite and quartz-mica schist and outcrops on the north side of the Raft batholith about 20 kilometres northwest of the map-area. The age of unit 1 is unknown, but it may be considerably older than the overlying Devono-Mississippian portion of the Eagle Bay succession.

UNIT 2

Unit 2 consists mainly of light silvery grey sericite-quartz phyllite and chlorite-sericite-quartz phyllite derived largely from felsic to intermediate volcanic and volcaniclastic rocks. The phyllite commonly contains eyes of glassy quartz to several millimetres in size, and locally includes fragmental members containing felsic clasts that are highly flattened within the plane of the schistosity. Also present within unit 2 is green chloritic phyllite derived from more mafic volcanic rock, dark grey phyllite and siltstone, light grey sericitic quartzite, and thin horizons of pyritic cherty rock that may be of exhalative origin.

Unit 2 outcrops most extensively along a much faulted belt south of the North Thompson River which extends from the western boundary of the map-area as far east as Chuck Creek. It sits above unit 1a in the western part of this belt and above orthogneiss of unit 9 to the east. Unit 2 is absent, or very thin, along the faulted extension of this belt in the vicinity of Gollen Creek, but occurs locally above unit 1 south of Reg Christie Creek where this stratigraphic level is repeated as a south-dipping panel on the north limb of the Graffunder Lakes synform (Fig. 9-2, section A-A'). Unit 2 is also exposed above unit 1 on the north side of the North Thompson River, west of Crossing Creek, but is absent just to the east, where unit 1 is directly overlain by unit 4.

Unit 2 is inferred to be Devonian in age based on correlation with felsic to intermediate metavolcanic rocks of that age in the Adams Lake area (unit EBA of Schiarizza and Preto, 1984).

UNIT 3

Unit 3a comprises pale to medium green, strongly to weakly foliated chlorite-sericite schists which commonly contain crystals of feldspar, hornblende, and quartz, as well as lithic clasts to several centimetres in size. This unit was derived largely from intermediate crystal-lithic tuffs, but may also include some porphyritic flows. These rocks overlie unit 2 between Lute and Baker Creeks as well as on the slopes west of Foghorn Creek (unit EBF of Schiarizza and Preto, 1984). This unit also outcrops between Jones and Avery Creeks where it apparently underlies unit 5.

Unit 3b comprises feldspar porphyry, feldspathic schist, sericite-feldspar-quartz schist, and metavolcanic breccia that are derived from trachytic, dacitic, and rhyolitic intrusive and extrusive rocks. It overlies unit 2 between Lute and Foghorn Creeks where it hosts the Rexspar uranium-fluorite mineralization. Originally these rocks were included within unit 2 (unit EBAf of Schiarizza and Preto, 1984); it is more likely that they are lateral equivalents of unit 3a.

* This project is a contribution to the Canada/British Columbia Mineral Development Agreement.

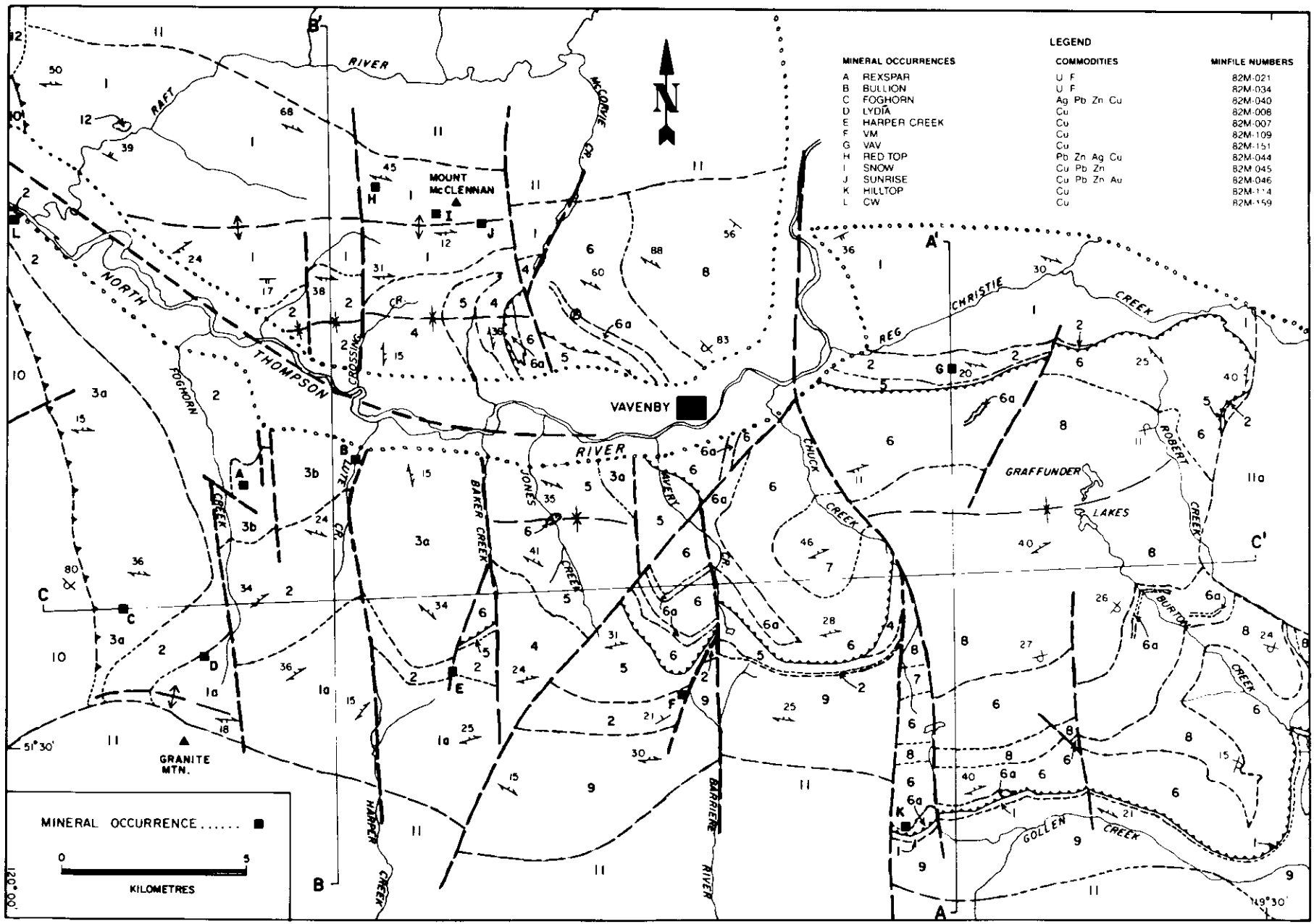

Figure 9-1. Generalized geological map of the Vavenby area.

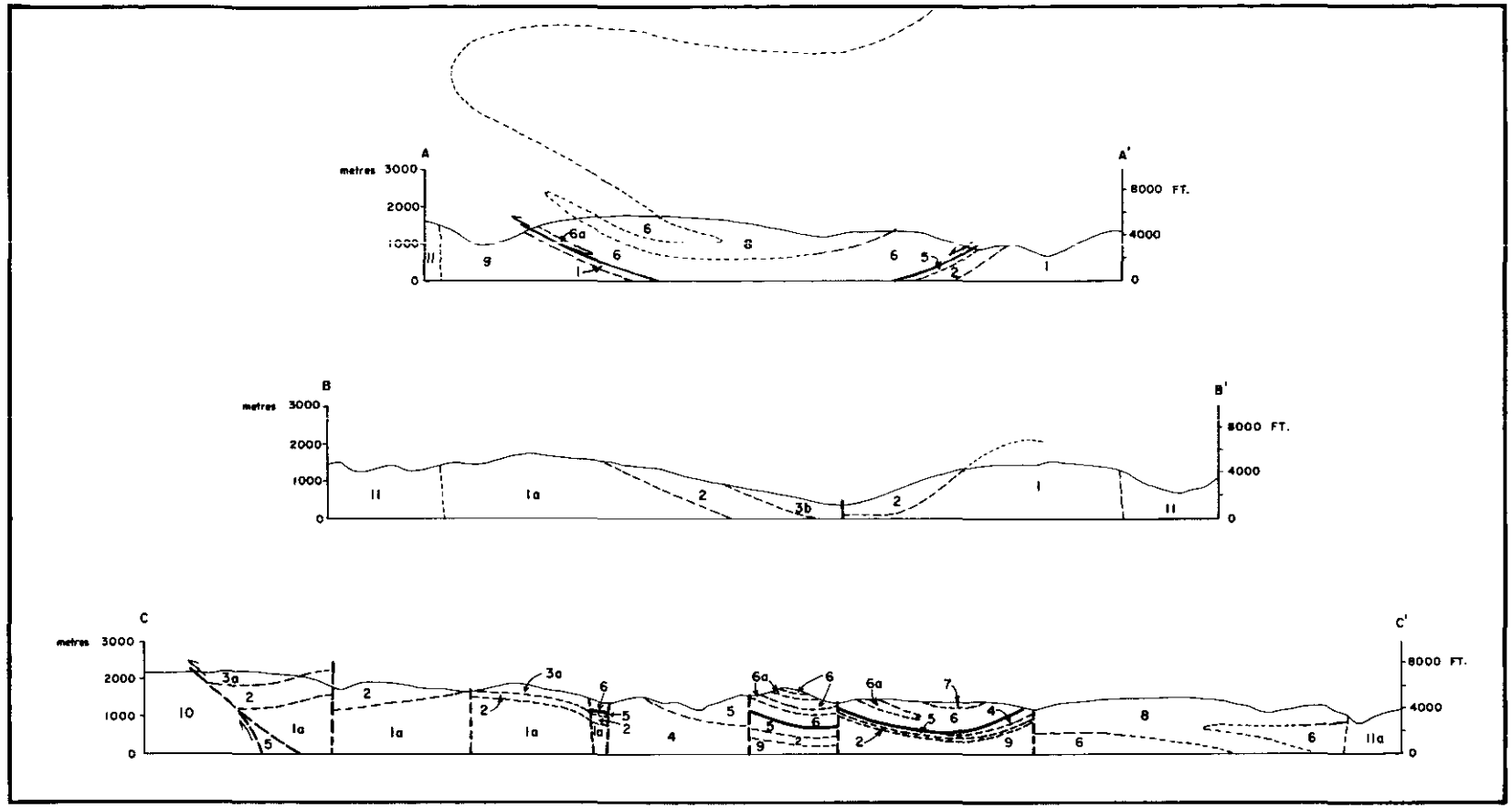

Figure 9-2. Vertical cross-sections to accompany Figure 9-1.

LEGEND

MIOCENE OR PLIOCENE

12 OLIVINE BASALT

CRETACEOUS

11 GRANITE AND GRANODIORITE, 11a INCLUDES ABUNDANT PEGMATITE

DEVONIAN TO PERMIAN

FENNELL FORMATION

10 BASALT, GABBRO, CHERT, MINOR AMOUNTS OF SANDSTONE, LIMESTONE, INTRAFORMATIONAL CONGLOMERATE

DEVONIAN (?)

9 GRANITIC ORTHOGNEISS

LOWER CAMBRIAN AND OLDER (?) TO MISSISSIPPIAN

EAGLE BAY FORMATION (UNITS 1 TO 8)

8 GRIT, QUARTZITE, CHLORITE-MUSCOVITE-QUARTZ SCHIST

7 INTERMEDIATE METATUFF, QUARTZITE, CHLORITE-SERICITE-QUARTZ SCHIST, LIMESTONE, DOLOMITE-CHLORITE SCHIST

LOWER CAMBRIAN AND OLDER (?) TO MISSISSIPPIAN *(CONTINUED)*

EAGLE BAY FORMATION (UNITS 1 TO 8) *(CONTINUED)*

6 CALCAREOUS CHLORITE SCHIST AND GREENSTONE DERIVED FROM MAFIC VOLCANIC ROCKS, LESSER AMOUNTS OF CHLORITIC DOLOSTONE AND LIMESTONE. 6a — LIGHT GREY LIMESTONE

5 DARK GREY PHYLLITE INTERCALATED WITH SILTSTONE, SANDSTONE, GRIT AND PEBBLE CONGLOMERATE, LESSER AMOUNTS OF LIMESTONE AND DOLOSTONE

4 GRIT, QUARTZITE, CHLORITE-MUSCOVITE-QUARTZ SCHIST, LESSER AMOUNTS OF LIMESTONE, CHLORITE SCHIST, AND DARK GREY PHYLLITE

3 3a — CHLORITE-SERICITE SCHIST DERIVED FROM QUARTZ HORNBLENDE-FELDSPAR CRYSTAL-LITHIC TUFFS AND (?) PORPHYRITIC FLOWS. 3b — FELDSPAR PORPHYRY, FELDSPATHIC SCHIST, SERICITE-FELDSPAR-QUARTZ SCHIST, METAVOLCANIC BRECCIA, TRACHYTE

2 SERICITE-QUARTZ PHYLLITE DERIVED LARGELY FROM FELSIC TO INTERMEDIATE VOLCANICS, LESSER AMOUNTS OF CHLORITE PHYLLITE, DARK GREY PHYLLITE AND SILTSTONE, SERICITIC QUARTZITE, AND PYRITIC CHERT (EXHALITE?)

1 QUARTZITE, CHLORITE-MUSCOVITE-QUARTZ SCHIST, LESSER AMOUNTS OF LIMESTONE, CALC-SILICATE SCHIST, LIGHT TO DARK GREY PHYLLITE, AND GREEN CHLORITE SCHIST. 1a — INCLUDES ABUNDANT ORTHOGNEISS AND QUARTZ-SERICITE SCHIST DERIVED FROM QUARTZ PORPHYRY

UNIT 4

Unit 4 consists of light to medium greenish grey grit, quartzite, and chlorite-sericite-quartz schist with minor amounts of intercalated dark grey phyllite, limestone, and chlorite schist. It sits beneath unit 5 in the vicinity of Jones Creek but both above and below unit 5 on the slopes south of Mount McClennan, possibly due to isoclinal folding of the two units. A thin wedge of grit, quartzite, limestone, and chlorite schist, which occurs between units 5 and 6 on the slopes west of Chuck Creek, is tentatively included within unit 4, but may actually be a structurally imbricated sliver of units 6 and 8. Unit 4 is lithologically similar to, and possibly correlative with, parts of unit EBS of Schiarizza and Preto (1984), which outcrops in a northwest-trending belt between Adams Lake and the Barriere River.

UNIT 5

Unit 5 consists mainly of dark grey phyllite with intercalated siltstone, sandstone, grit, and minor amounts of pebble conglomerate. It also includes medium to dark grey limestone and pale greenish grey schistose chloritic and sericitic dolostone. Unit 5 lies stratigraphically above unit 2 throughout most of the area, but locally is above (or within?) unit 4. Unit 5 is correlated with lithologically identical rocks in the Barriere Lakes area which have yielded several collections of Lower and Upper Mississippian conodonts (unit EBP of Schiarizza and Preto, 1984).

UNIT 6

Unit 6 consists mainly of medium to dark green calcareous chlorite schist, dolomite-chlorite schist, and relatively massive greenstone that are derived from mafic volcanic and volcaniclastic rocks. It also includes minor amounts of sericite-chlorite schist containing hornblende, feldspar, and rare quartz crystals which was derived from intermediate crystal tuffs and/or porphyritic flows. Thin lenses and beds of white crystalline limestone and rusty weathering schistose dolomite occur locally throughout the unit. A horizon of light grey limestone up to several hundred metres in thickness (unit 6a) forms prominent bluffy outcrops within the unit north and south of Vavenby. This limestone is clearly correlative with the Tshinakin limestone of the Adams Lake-Johnson Lake area which is also enclosed within a thick succession of mafic metavolcanic rocks (unit EBG of Schiarizza and Preto, 1984). Fossils collected from unit 6a, 4 kilometres northwest of Vavenby, were identified as *archaeocyathids* by B. S. Norford of the Geological Survey of Canada in Calgary. This indicates an Early Cambrian age for unit 6a at this locality.

Unit 6 sits structurally above unit 5 in several fault-bounded blocks on the south side of the North Thompson River between Chuck and Baker Creeks. This contact is inferred to be a thrust fault because unit 5 is thought to be of Mississippian age while unit 6 is now known to be, at least in part, Early Cambrian in age. A thrust relationship between unit 6 and underlying rocks is substantiated, on structural grounds, in the area east of Chuck Creek and on the north side of the North Thompson River south of the McCorvie Lakes. In these areas unit 6 and structurally overlying rocks of unit 8 are overturned, while the structurally underlying rocks of units 1, 2, 4, and 5 are in their regionally persistent and presumably right-way-up orientation.

Rocks correlative with unit 6 in the Barriere Lakes-Adams Plateau area (unit EBG of Schiarizza and Preto, 1984) were also inferred on structural grounds to be in fault contact with underlying Devono-Missippian rocks correlative with units 2, 3, and 5 of this report (Schiarizza, 1983; Schiarizza and Preto, 1984). The Early Cambrian age of the Tshinakin limestone established during the present study corroborates this interpretation.

UNIT 7

Unit 7 consists of light to medium green crystal-lithic metatuff, similar to that of unit 3a, with lesser amounts of intercalated limestone, dolomite-chlorite schist, platy quartzite, and chlorite-sericite-quartz schist. It occurs only in the vicinity of Chuck Creek where it sits structurally above unit 6.

UNIT 8

Unit 8 consists of light to medium grey-green quartzite, grit, and chlorite-muscovite-quartz schist with relatively minor amounts of intercalated dark grey phyllite and dolomite-chlorite schist. It sits structurally above unit 6 in the steeply dipping belt east of McCorvie Lakes and in the core of the Graffunder Lakes synform east of the Chuck Creek fault (Figs. 9-1 and 9-2). It also occurs as a belt internally within unit 6 on the south limb of the synform, where it is presumably infolded into unit 6. Graded beds at a number of places within unit 8, including the southern margin of the belt within unit 6, are overturned; therefore unit 8 actually lies stratigraphically beneath unit 6 and is inferred to be Early Cambrian and/or older in age.

DEVONIAN (?) ORTHOGNEISS (UNIT 9)

Unit 9 comprises quartzo-feldspathic orthogneiss. It is typically a weakly to moderately foliated rock consisting of lenses and augen of quartzo-feldspathic material enclosed by 'seams' of chlorite-sericite schist. Locally it grades to virtually massive granitic rock or conversely to strongly foliated chlorite-sericite schist containing large 'eyes' of quartz. Biotite is an important component of the gneiss within the thermal aureole of the Baldy batholith.

The orthogneiss occurs mainly as a north-dipping belt up to 3.5 kilometres wide, which extends along the north margin of the Baldy batholith from the east end of the map-area to the northeast-trending fault west of the Barriere River. In the east it lies beneath, and presumably intrudes, unit 1; in the west it is beneath unit 2. Farther west substantial amounts of orthogneiss occur within both units 1a and 2; there, however, it is not sufficiently well defined to be mapped separately and shown on the geological map. Similar orthogneiss also occurs within unit 2 rocks south of Reg Christie Creek.

The unit 9 orthogneiss is lithologically identical to intrusive units within felsic to intermediate metavolcanic schist exposed along the southern part of Adams Lake (unit EBAi of Schiarizza and Preto, 1984). There, the orthogneiss is believed to be genetically related and of similar age to Devonian volcanics that it intrudes. Devonian orthogneiss also occurs along a belt which extends for more than 70 kilometres between Adams and Shuswap Lakes (Okulitch, *et al.*, 1975). Unit 9 is therefore considered likely to be of Devonian age.

FENNELL FORMATION (UNIT 10)

Basalt, gabbro, chert, and related rocks of the Fennell Formation outcrop mainly south of the North Thompson River along the western edge of the map-area, where they were studied by the writer in 1980 and 1981 (Schiarizza, 1981, 1982, 1983). In this area an east-dipping thrust fault juxtaposes them against unit 3a of the Eagle Bay Formation. A small sliver of Fennell Formation chert, cherty argillite, and fine to medium-grained greenstone also occurs along the western edge of the map-area directly north of the river. There it is unconformably overlain to the north by Miocene basalt (Fig. 9-1). These Fennell rocks are inferred to be separated from unit 1 of the Eagle Bay Formation by the same east-dipping thrust fault that separates the Fennell from unit 3a further south. This relationship may persist to the northwest into the Bonaparte Lake map-area where, on the north side of the Raft batholith, Campbell and Tipper (1971) mapped an east-dipping thrust fault between the Fennell Formation and structurally overlying rocks which may be equivalent to unit 1 of this report.

CRETACEOUS GRANITIC ROCKS (UNIT 11)

Cretaceous granite and granodiorite (unit 11) of the Raft and Baldy batholiths intrude Eagle Bay rocks along the northern and southern margins of the map-area respectively. Intrusion postdated regional metamorphism and most of the penetrative deformation within the Eagle Bay succession, but appears to have been synchronous with relatively late folding about east-west-trending axes. Both batholiths are cut by northerly trending faults of probable Early Tertiary age. In contrast to the abrupt northern contact of the Baldy batholith, the southern margin of the Raft batholith is marked by a broad zone of intermixed metasedimentary and granitic rocks. Cordierite (?), andalusite, and sillimanite occur in pelitic schists of unit 1 at several localities within, and just south of, the contact zone of the Raft batholith.

Cretaceous granite also occurs along the eastern edge of the map-area, east of Robert Creek. This body (unit 11a) includes abundant pegmatite as well as distinctly foliated granitic phases.

MIOCENE BASALT (UNIT 12)

Flat-lying, undeformed basalt flows, which are well exposed along the Clearwater River to the northwest (Campbell and Tipper, 1971), extend as far east as the northwestern corner of the map-area (Fig. 9-1). A small patch of basalt which unconformably overlies unit 1 quartzites on the northwest slopes of the Raft River valley, 3.5 kilometres north of the confluence with the North Thompson River, is apparently a detached erosional remnant of these flows. These basalts are the easternmost representatives of an extensive mass of Late Miocene to Pliocene plateau lavas which cover much of the area to the west and northwest of the map-area (Campbell and Tipper, 1971).

STRUCTURE

The mesoscopic structural fabric within the map-area is dominated by the following five generations of structures:

(1) An early metamorphic foliation, axial planar to very rare small isoclinal folds, which is locally observed to be discordant to and/or folded about the dominant second generation schistosity.

(2) Variably oriented, but most commonly north to east-plunging isoclinal folds; the dominant synmetamorphic schistosity is axial planar. Throughout most of the area this schistosity is parallel to bedding.

(3) Northwest-trending folds and crenulations with axial planar crenulation cleavage. Axial surfaces generally dip steeply to the northeast or southwest, but in a small area north and south of Vavenby, northwest-trending folds display a gently northwest-dipping axial planar crenulation cleavage.

(4) East-west-trending upright folds, kinks, and crenulations that probably formed during emplacement of the Early to Middle Cretaceous Raft and Baldy batholiths.

(5) Upright, northerly trending folds, kinks, and crenulations of probable Tertiary age. The folds are often most prominently developed adjacent to northerly trending faults.

The most conspicuous macroscopic structures within the map-area are upright east-west-trending folds, and steep northerly trending faults. These folds are relatively young, and probably related to the emplacement of the Raft and Baldy batholiths. Locally they cause inversions in the predominantly northerly dip direction of bedding and schistosity within the map-area. Two such areas are across an antiform-synform pair between Mount McClennan and the North Thompson River, and across a synformal hinge that passes through the Graffunder Lakes, east of the Chuck Creek fault. The northerly trending faults cut the east-west folds as well as all other structures and rock units in the area except the Miocene basalts. The faults, and related northerly trending fractures, are often infilled by basaltic or lamprophyre dykes. They are probably Early Tertiary in age (Okulitch, 1979; Schiarizza, 1982) and related to the fifth generation of Mesoscopic structures. A northwest-trending fault which follows the North Thompson River valley in the western part of the map-area (Figs. 9-1 and 9-2, section B-B') is also a late structure, but it may be more closely related to fourth generation east-west folds.

A large overturned fold, possibly related to the second generation of mesoscopic folds, is inferred from overturned bedding in graded unit 8 grit beds in the area east of the Chuck Creek fault. Beds are overturned within both the main mass of unit 8, which structurally overlies unit 6, and in the belt of unit 8 grit and quartzite that is infolded (?) into unit 6. This relationship indicates that both unit 8 and unit 6 are overturned; together they are inferred to occupy the inverted limb of the fold. The fold may be southerly directed (Figs. 9-1 and 9-2, section A-A'), since this is consistent with the pattern of fold and thrust vergence elsewhere in the region (Okulitch, 1979; Schiarizza and Preto, 1984). The thrust fault which is inferred to separate the overturned limb from underlying right-way-up Eagle Bay rocks is probably related to the folding. This same thrust, or one of the same generation of faults, presumably separates Early Cambrian unit 6 rocks from underlying, largely Devono-Mississippian rocks elsewhere in the area. It is not known, however, whether unit 6 rocks west of the Chuck Creek fault and south of the North Thompson River are upright or overturned.

MINERAL OCCURRENCES

The locations of the most important mineral occurrences in the map area are indicated on Figure 9-1. Uranium-fluorite mineralization occurs in trachytic rocks of unit 3b at the Rexspar deposit along Foghorn Creek (Preto, 1978) and at the Bullion showing on lower Lute Creek. The Harper Creek deposit is a large, low-grade copper deposit within unit 2; inferred reserves are 90 000 000 tonnes grading 0.4 per cent copper. Similar low-grade copper mineralization occurs within unit 2 at the CW showing southeast of Clearwater, at the VM showing southwest of Avery Lake, and at several locations in the vicinity of the VAV showings south of Reg Christie Creek. The dominantly felsic to intermediate metavolcanic rocks of units 2 and 3a are considered also to be potential hosts to polymetallic massive sulphide-barite deposits such as the Homestake and Rea deposits in the Adams Lake-Johnson Lake area to the south (Schiarizza and Preto, 1984; White, 1985; Höy and Goutier, this volume). More or less stratiform lenses of pyrite and pyrrhotite with lesser sphalerite, galena, and chalcopyrite occur at the Red Top, Snow, and Sunrise showings in the vicinity of Mount McClennan. These showings occur at a similar stratigraphic level within a succession of quartzite, chlorite-muscovite-quartz schist, quartz-sericite schist, limestone, calc-silicate schist, and skarn within unit 1. There are a number of other occurrences within the map-area that are not shown on Figure 9-1; most are quartz veins containing pyrite and/or pyrrhotite with variable amounts of galena, sphalerite, and chalcopyrite.

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