Geological Survey
of Canada

Current Research
2000-A15

Geological setting of the Samatosum and Rea massive-sulphide deposits, Eagle Bay Assemblage, south-central British Columbia

Sean L. Bailey, Suzanne Paradis, and Stephen T. Johnston

2000

Natural Resources Canada   Ressources naturelles Canada

Canada

Catalogue No. M44-2000/A15E-IN
ISBN 0-660-18007-3

Available in Canada from the
Geological Survey of Canada Bookstore website at:
http://www.nrcan.gc.ca/gsc/bookstore (Toll-free: 1-888-252-4301)

A copy of this publication is also available for reference by depository libraries across Canada through access to the Depository Services Program's website http://dsp-psd.pwgsc.gc.ca. A list of these libraries can be consulted at this site or obtained by calling the toll-free number above.

Price subject to change without notice

Authors' addresses

S.L. Bailey *(slbailey@uvic.ca)*
S.T. Johnston *(stj@uvic.ca)*
School of Earth and Ocean Sciences
University of Victoria
P.O. Box 3055, Station CSC
Victoria, British Columbia V8W 3P6

S. Paradis *(suparadi@nrcan.gc.ca)*
GSC Pacific (Sidney)
9860 West Saanich Road
Sidney, British Columbia V8L 4B2

Geological setting of the Samatosum and Rea massive-sulphide deposits, Eagle Bay Assemblage, south-central British Columbia[1]

Sean L. Bailey, Suzanne Paradis, and Stephen T. Johnston

Mineral Resources Division, Ottawa

Bailey, S.L., Paradis, S., Johnston, S.T., 2000: Geological setting of the Samatosum and Rea massive-sulphide deposits, Eagle Bay Assemblage, south-central British Columbia; Geological Survey of Canada, Current Research 2000-A15, 10 p. (online; http://www.nrcan.gc.ca/gsc/bookstore)

Abstract: Highly deformed, low-grade metamorphic sedimentary and volcanic rocks of the Eagle Bay Assemblage host the (?)volcanogenic massive-sulphide Twin Mountain, Samatosum, and Rea deposits. The Twin Mountain deposit comprises sulphide-bearing quartz-carbonate-barite lenses in sericitized and silicified schists of volcanic origin. The Rea deposit consists of at least two massive-sulphide lenses. The Samatosum deposit is an overall stratabound sulphide-rich quartz-vein system that could be interpreted as a stockwork zone. The Rea and Samatosum deposits occur within an overturned metasedimentary sequence of sericitized and silicified argillites structurally overlain by mafic volcaniclastic rocks and flows. The stratigraphic sequences at Rea and Samatosum are very similar. We suggest that structural repetition by faulting occurred, and that the sedimentary and volcanic succession is Devonian–Mississippian.

Résumé : Les roches sédimentaires et les roches volcaniques fortement déformées et de faible degré de métamorphisme de l'assemblage d'Eagle Bay contiennent les gîtes de sulfures massifs volcanogènes(?) de Twin Mountain, de Samatosum et de Rea. Le gîte de Twin Mountain consiste en lentilles de sulfures-quartz-carbonates-barytine contenues dans des schistes séricitisés et silicifiés d'origine volcanique. Le gîte de Rea se compose d'au moins deux lentilles de sulfures massifs. Le gîte de Samatosum est un système de veines de quartz grossièrement stratoïde qui peut être interprété comme un stockwork. Les gîtes de Rea et de Samatosum sont encaissés dans une séquence métasédimentaire renversée consistant en argilites séricitisées et silicifiées, laquelle est surmontée structuralement par des volcanoclastites et des coulées mafiques. Les séquences stratigraphiques aux gîtes de Rea et de Samatosum sont très similaires; nous suggérons qu'une répétition structurale par un système de failles s'est produite et que la succession sédimentaire et volcanique remonte au Dévonien-Mississippien.

[1] Contribution to the Ancient Pacific Margin NATMAP Project

INTRODUCTION

The Samatosum and Rea massive-sulphide deposits are located in the Adams Lake area of south-central British Columbia, approximately 80 km northeast of Kamloops (Fig. 1). Highly deformed and metamorphosed rocks of the Eagle Bay Assemblage host the deposits. Cambrian to Mississippian metasedimentary and metavolcanic rocks of the Eagle Bay Assemblage in the Adams Lake area host numerous polymetallic sulphide deposits. Some of these, including Samatosum, Rea, and Homestake, have had limited production, and others, such as Twin Mountain, have been extensively explored over the years.

This paper describes the deposits and their geological settings, and addresses some fundamental structural and stratigraphic problems in the region. This study was initiated during the summer of 1999 as the M.Sc. project of the first author (Sean L. Bailey). It is included in the Ancient Pacific Margin NATMAP metallogenic study of syngenetic sulphide deposits of the Kootenay Terrane and the correlative Yukon–Tanana Terrane in northern British Columbia and Yukon Territory.

The study area is thickly vegetated, till-covered, and steeply mountainous terrain, which hampers exposure. Nevertheless, a series of logging and drill roads allow good access to the plateau of Samatosum Mountain, with the best exposures found along roadcuts, clearcuts, and trenches remaining from past exploration, and areas of rapidly changing topography.

REGIONAL GEOLOGY

Metavolcanic and metasedimentary rocks of the Eagle Bay Assemblage that are assigned to the Kootenay Terrane host the Rea and Samatosum massive-sulphide deposits. The Kootenay Terrane and correlative rocks of the Yukon–Tanana Terrane farther north comprise dominantly Paleozoic metasedimentary and metavolcanic rocks that are inferred to have been deposited on the distal western edge of ancestral North America. Major rock successions of the Kootenay Terrane include the Lardeau Group, the Eagle Bay Assemblage, eastern assemblages of the Late Paleozoic Milford Group, and equivalent rocks within the Shuswap metamorphic complex (Hoy, 1999).

The Eagle Bay Assemblage, described by Schiarizza and Preto (1987), comprises Lower Cambrian to Mississippian metasedimentary and metavolcanic rocks that are intruded by Late Devonian orthogneiss and Jurassic–Cretaceous granodiorite and quartz monzonite of the Raft and Baldy batholiths. Within the study area, the Eagle Bay Assemblage regionally consists of four west-directed thrust slices. The Eagle Bay Assemblage consists of clastic metasedimentary rocks (units EBH and EBQ of Schiarizza and Preto, 1987), mafic metavolcanic rocks and limestone (unit EBG), and structurally overlying clastic metasedimentary rocks, with minor carbonate and volcanic rocks (unit EBS), all of which are interpreted as Cambrian strata. These are in turn overlain by Devonian–Mississippian mafic to intermediate metavolcanic, and metasedimentary rocks (units EBA and EBF, respectively), which are overlain by metaclastic rocks (unit EBP).

Numerous volcanogenic sulphide occurrences of the Eagle Bay Assemblage, including Rea, Homestake, Samatosum, and Twin Mountain are hosted in mafic to intermediate metavolcanic and metasedimentary rocks of units EBA, EBF, and EBG of Schiarizza and Preto (1987) (Fig. 2). Devonian–Mississippian metasedimentary rocks, and felsic and mafic to intermediate metavolcanic rocks of units EBA, EBF, and EBP are apparently right-way-up regionally but locally overturned (Fig. 2). These units are structurally overlain by mafic metavolcanic rocks and the Tshinakin limestone of unit EBG, which has a Lower Cambrian age (Schiarizza and Preto, 1987). These stratigraphic and structural relationships led to the inference by Schiarizza and Preto (1987) of the Haggard Creek Fault between these two

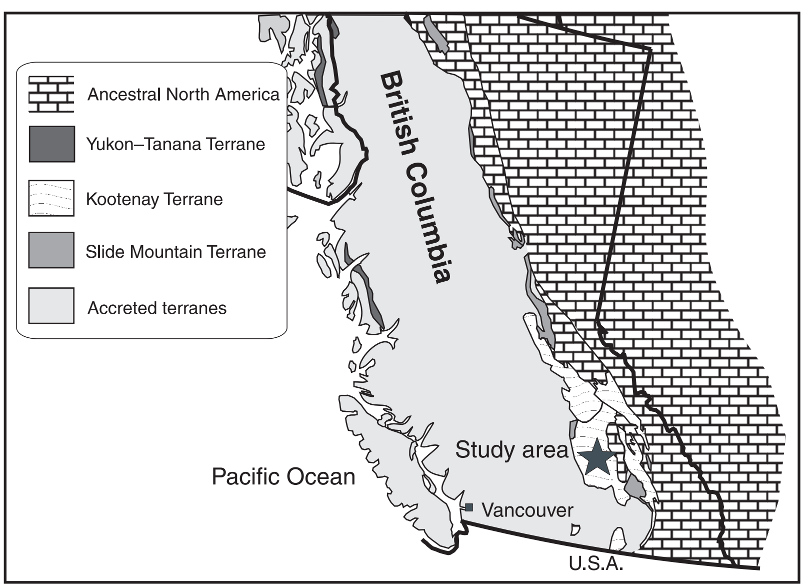


Figure 1.

*Location of the study area within the Kootenay Terrane of southeastern British Columbia (*modified from *Wheeler and Mcfeely, 1991).*

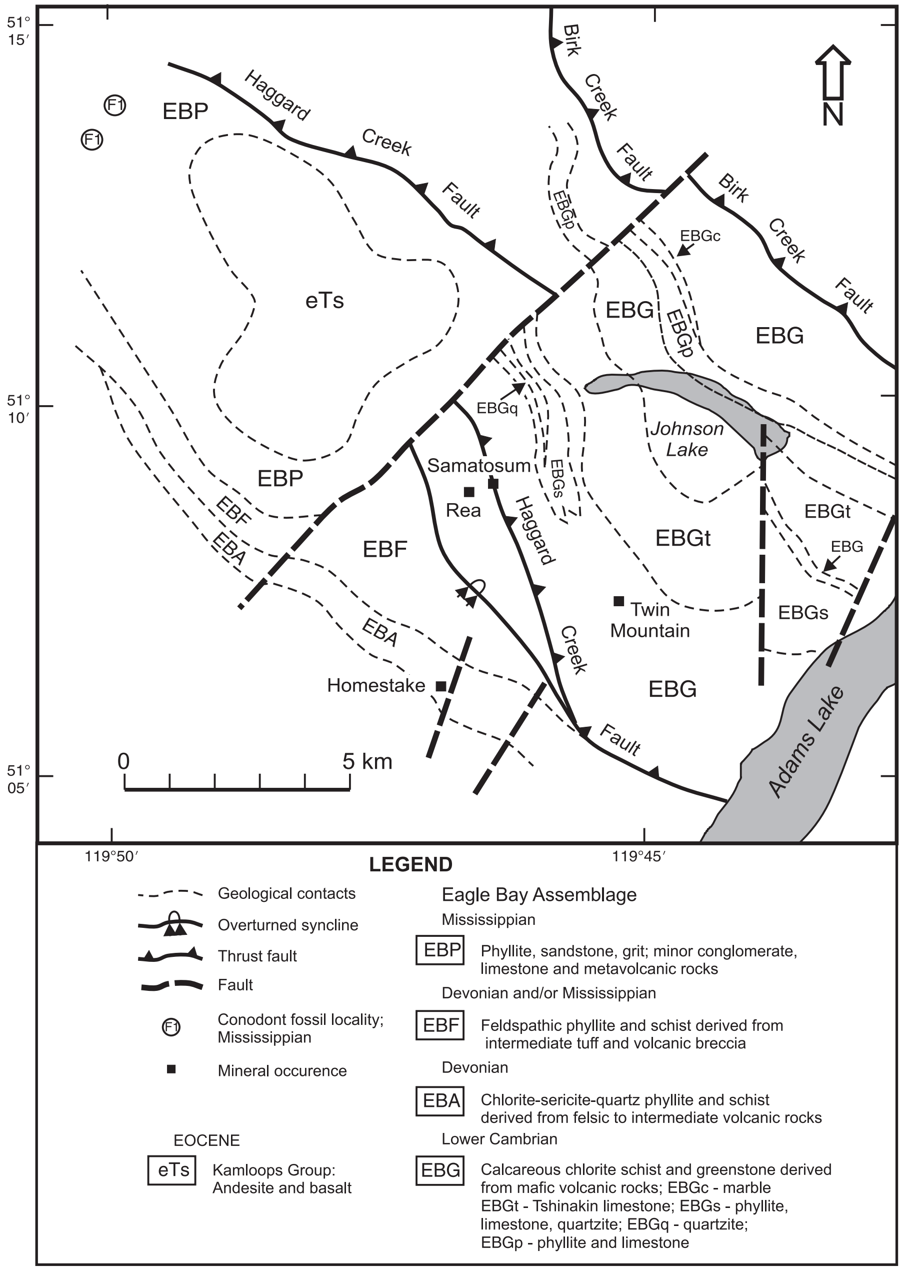


Figure 2. *Geological map of the Johnson Lake region (*after *Schiarizza and Preto, 1987).*

stratigraphic packages of different ages, i.e. Cambrian rocks structurally overlying Devonian–Mississippian rocks. The Samatosum and Rea deposits are located near the inferred trace of this fault, and much controversy exists over which package(s) of rocks the Samatosum and Rea deposits fit into, and whether or not there is a major thrust fault separating Cambrian rocks from structurally underlying Devonian–Mississippian rocks. During the course of this study, we will attempt to resolve these matters.

LOCAL STRATIGRAPHY

The main stratigraphic units encountered in the area of the deposits are described below, and their distribution is illustrated in Figure 3. An interpreted southwest-northeast cross-section through the Rea and Samatosum zones is shown in Figure 4. Lack of age control makes our interpretation somewhat preliminary and other scenarios are possible.

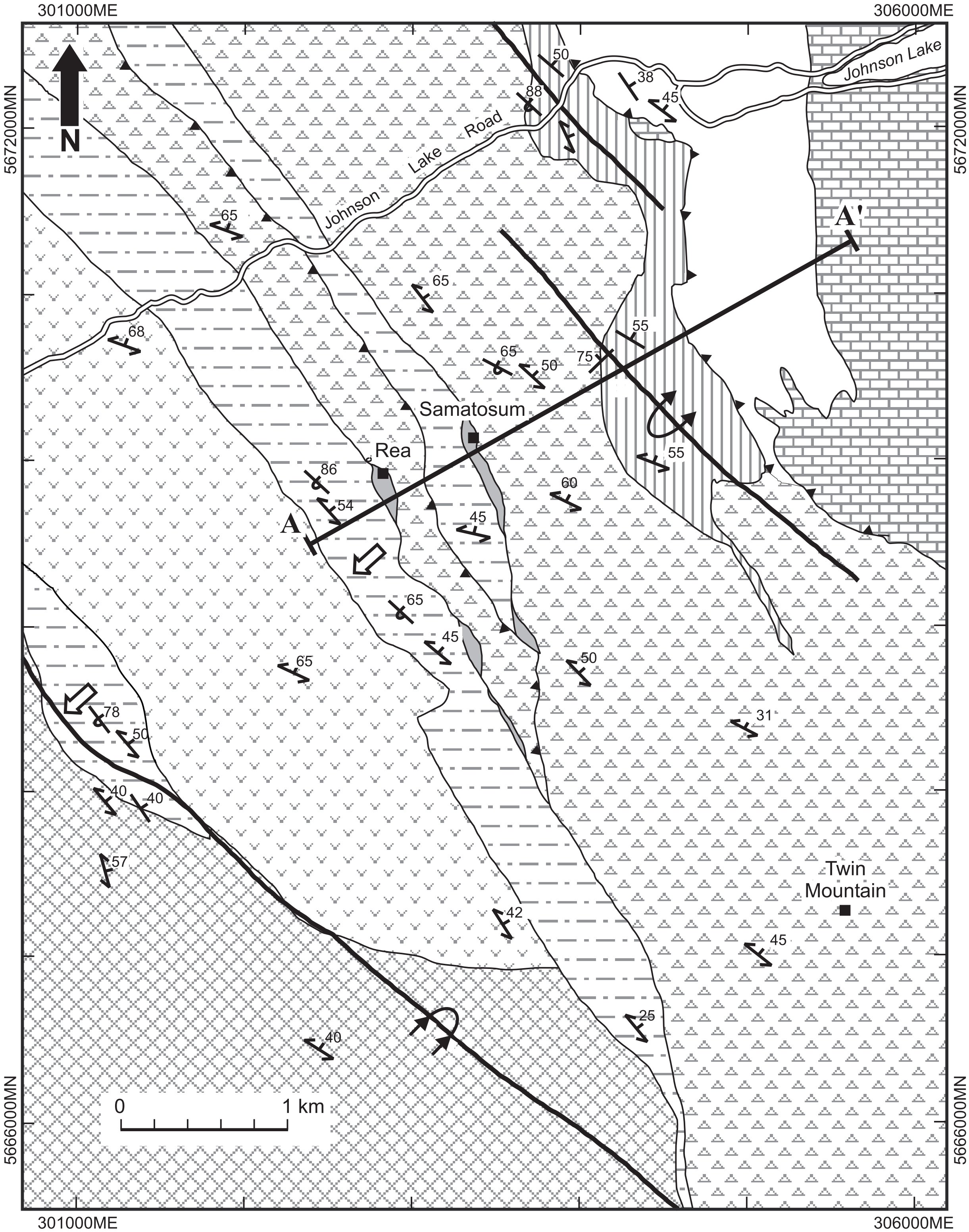
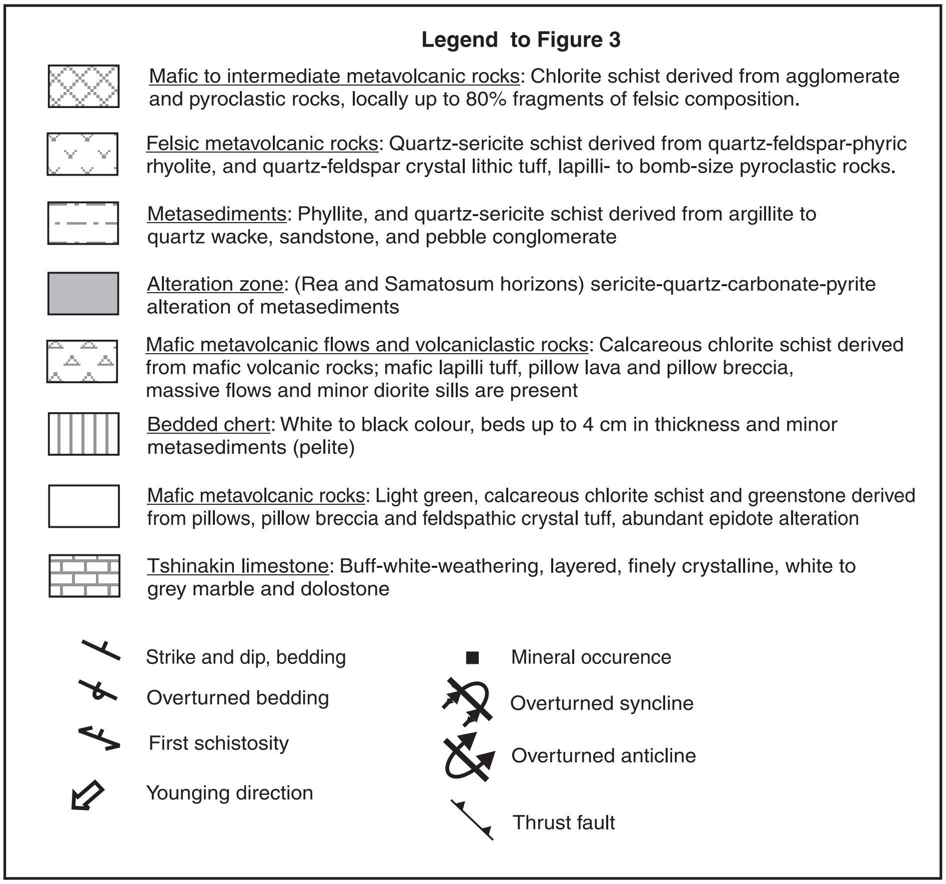


Figure 3. Detailed geology of the Johnson Lake area (this study).



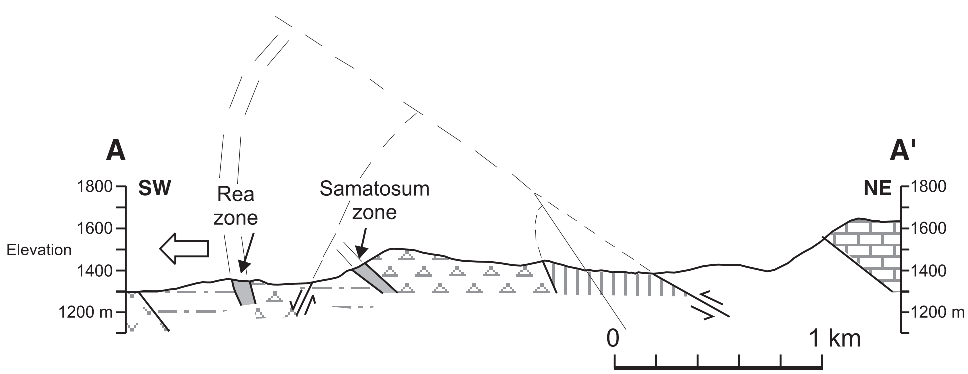


Figure 4. *Southwest-northeast cross-section through the Rea and Samatosum zones, no vertical exaggeration. Line A-A' is located on Figure 3.*

Fossil archaeocyathids were found within a limestone bed located 50 km north of the study area in a different fault panel. Correlation of this limestone with the Tshinakin limestone at Johnson Lake suggests an Early Cambrian age for this unit. Mafic volcanic rocks are locally interbedded with the limestone and consequently are interpreted to be Early Cambrian (Schiarizza and Preto, 1987). Uranium-lead zircon age dates of 387 Ma (i.e. Middle Devonian) have been obtained from felsic metavolcanic rocks of unit EBA on the east shore of Adams Lake (Preto, 1981; Preto and Schiarizza, 1985). Felsic to intermediate rocks of unit EBF are interpreted to be younger (i.e. Devonian and/or Mississippian), as they sit stratigraphically above rocks of unit EBA and below rocks of unit EBP, which contains Mississippian conodonts (Schiarizza and Preto, 1987).

The deposit area is underlain by northwest-trending, northeast-dipping metasedimentary and metavolcanic rocks that display an overall younging direction structurally downsection and toward the west (Fig. 4). It appears that much of the stratigraphy within this region has been overturned. From oldest to youngest, the units are the Tshinakin limestone, mafic metavolcanic rocks, bedded cherts, mafic metavolcanic flows and volcaniclastic rocks, metasediments, and mafic to intermediate metavolcanic rocks.

Tshinakin limestone

This unit outcrops in the eastern portion of the map area (Fig. 3) and is best exposed in the cliffs above Johnson Lake. It consists dominantly of finely crystalline, white to grey marble with minor dolostone, which produces a buff-white to grey weathering. It is usually massive; however, laminations defined by light and dark bands are locally observed (Fig. 5A). It is interbedded with calcareous chlorite schist at other locations, such as at nearby Adams Lake (Schiarizza and Preto, 1987).

Mafic metavolcanic rocks

This unit is composed of greenstone and chlorite schist derived from pillows, pillow breccia, and feldspathic crystal tuffs. Pillows locally exceed 1 m or more in length. The metavolcanic rocks have a light green colour due to abundant epidote, and commonly have a white or grey weathered surface. Tuffs contain crystals of feldspar less than 1 mm in diameter.

Bedded chert

A bedded chert unit occurs between two distinct mafic volcanic packages (Fig. 3). The chert is light coloured to black, locally graphitic, and has well defined bedding (Fig. 5B). Pelite occurs in minor amounts. The pelite units locally contain particles up to sand size and display a c-s fabric along the contact with the structurally overlying pillow breccia.

Mafic metavolcanic flows and volcaniclastic rocks

The mafic metavolcanic rocks in the central portion of the map area are dominated by calcareous chlorite-sericite-quartz schist and chlorite schist derived from mafic volcanic rocks. Abundant volcaniclastic rocks, rare mafic massive flows, and pillow basalt and breccia are also present. The most common rock type is a lapilli tuff with an average fragment size of approximately 4–5 cm. The lapilli are commonly bleached, and are thought to be of similar composition to the matrix. Locally, the fragments are up to bomb size (Fig. 5C), such as at the Samatosum mine site. Fine-grained chlorite schist units are abundant throughout the unit. The massive flows contain calcite and quartz amygdules. Pillows are approximately 1 m in size, are amygdaloidal, and have been flattened in the penetrative foliation plane. These display an outer, nonvesicular, 2–3 cm rim. The entire unit is calcareous, and locally contains disseminated pyrite.

Diorite sills or dykes were observed within this unit and may have played a role in sulphide mineralization. The Twin Mountain sulphide deposit occurs within pyritic, calcareous, chlorite-sericite-quartz schist and chlorite schist derived from mafic volcanic rocks.

Metasediments

The metasediments are phyllite and quartz-sericite schist units thought to have originally been fine-grained argillite and quartz wacke. A quartz-lithic pebble conglomerate at the stratigraphic top of this sequence is composed of clasts (commonly 2–3 cm in diameter) of chert, chlorite schist, and vein quartz. This conglomerate has been traced to the northwest, extending beyond the map area where it appears to thicken.

Around the Samatosum and Rea deposits, the metasediments are part of a structurally complex sequence called the ‘Mine Series’. The Samatosum and Rea deposits are located within the metasediments near the contact with the structurally overlying mafic volcanic rocks. There, the metasediments are highly strained and altered (i.e. sericitized±clay, silicified, and carbonatized). They consist of carbonaceous black argillite, sericitized yellowish argillite containing chert lenses, and pyrite-rich silicified greyish argillite. Some of the beds show graded bedding, and rip-up clasts. Locally distributed, amorphous, massive to brecciated chert within the metasediments appears to be spatially associated with base-metal sulphides.

Felsic metavolcanic rocks

The felsic metavolcanic unit is composed of white-weathering, beige, quartz-sericite schist derived from quartz-feldspar-phyric rhyolite, quartz-feldpar-crystal-lithic tuffs and pyroclastic rocks. The feldspar component of this unit is mainly albite. The volcanic rocks are bounded to the east by quartz-lithic pebble conglomerate, and appear to be interlayered with phyllite and quartz wacke, which commonly contain several per cent euhedral pyrite.

Mafic to intermediate metavolcanic rocks

Chlorite schist units derived from mafic volcaniclastic rocks are located in the western part of the map area. The most common rock type is mafic agglomerate containing 30 cm fragments. However, in the easternmost section of this unit, the metavolcanic rocks include fragments of felsic volcanic rocks that locally account for 65–80% of the rock.

STRUCTURE AND METAMORPHISM

The structure of the area is dominated by a series of northwest-trending, westward-verging, shallowly dipping, tightly overturned folds, associated with the presence of an axial-planar penetrative cleavage defined by lower- to mid-greenschist-grade metamorphic minerals. These folds

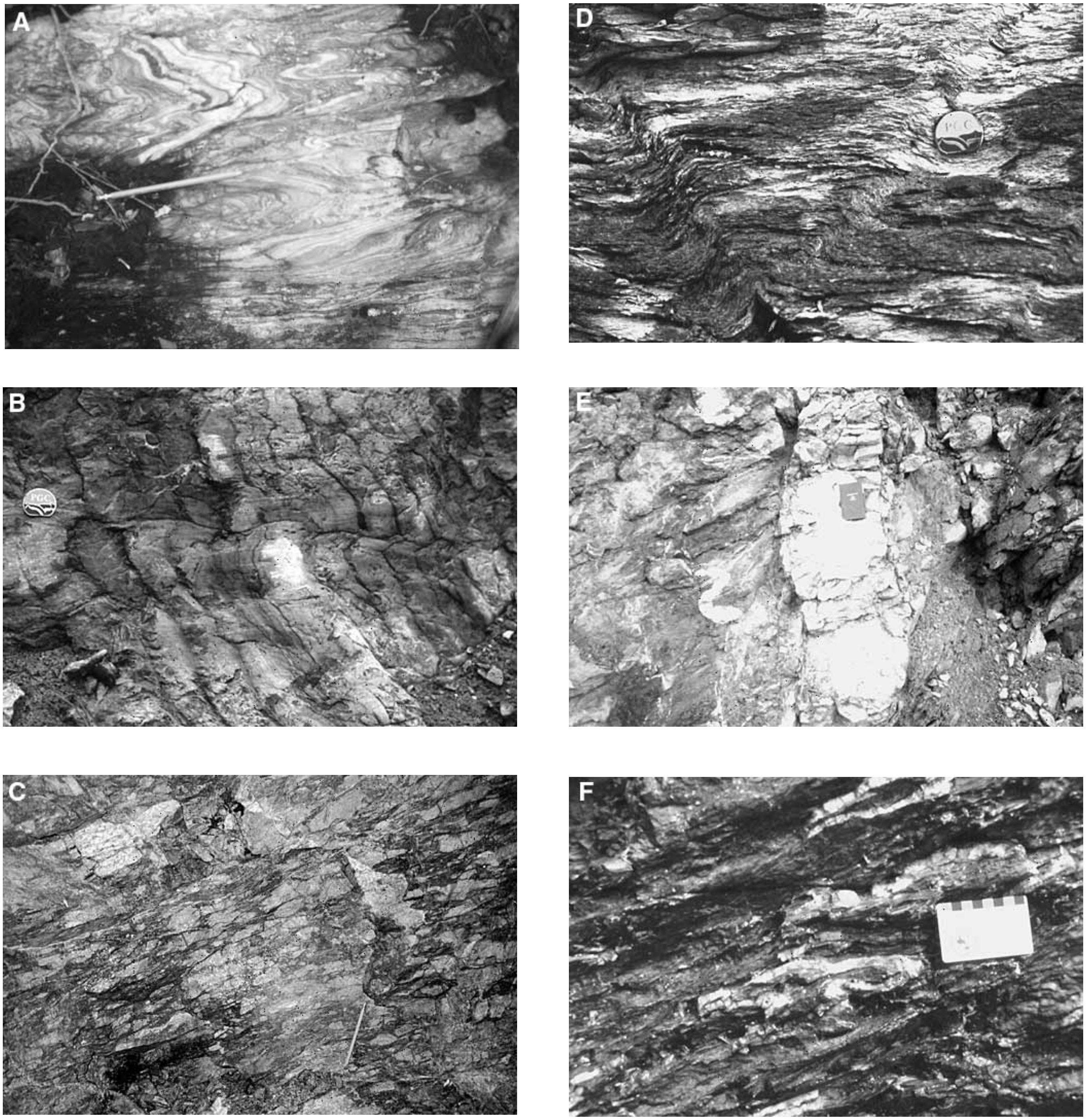


***Figure 5. A**) Parasitic folding of layers in Tshinakin limestone. **B**) Bedded chert (pin for scale is 3 cm in diameter). **C**) Mafic flow breccia, fragments are bleached and range from bomb to lapilli size. **D**) Kink bands and reverse kink bands in mafic tuff. **E**) Mineralized quartz veins at the Samatosum deposit. **F**) Quartz veins (2 cm wide) which have been folded by and transposed into the penetrative foliation, are hosted by sericitized and silicified sediments, Samatosum deposit.*

are parallel to, and are likely genetically related to, a series of southwest-directed thrust faults (Schiarizza and Preto, 1987). Bedding-cleavage relationships and stratigraphic top determinations indicate that the western limbs of these folds are overturned. Parasitic folds plunge shallowly to moderate in a northwesterly direction.

The penetrative cleavage is crenulated by a second cleavage. The crenulation lineation trends northeast, and appears to have formed in conjunction with northeastward-trending, low-amplitude folds (Schiarizza and Preto, 1987).

Graded beds are the most commonly observed indicators of stratigraphic younging directions. They are a series of fine sandy layers, which abruptly overlie muddy layers, and grade upwards into mud. In the coarser units, this gradation proceeds from pebble conglomerate to coarse-grained sand. Rare sedimentary features such as rip-up clasts, and scour-and-fill structures were also observed.

MINERALIZATION

The Johnson–Adams Lake area has long been recognized by prospectors and geologists as a favourable region for base-metal sulphide deposits. Several significant mineral occurrences including Twin Mountain, Rea, and Samatosum are located within the map area (Fig. 3). These deposits have been suggested to be of volcanogenic type (Hoy and Goutier, 1986). The Twin Mountain deposit consists of sulphide-bearing quartz-carbonate-barite lenses hosted by sericitized and silicified schist derived from mafic volcanic rocks (unit EBG of Schiarizza and Preto, 1987). The Rea deposit consists of volcanogenic sulphide lenses, whereas the Samatosum deposit appears to be a stockwork system related to stratabound volcanogenic sulphide lenses.

The Samatosum and Rea deposits are contained in a similar overturned sequence of greenschist-grade sericitized, silicified, and carbonaceous argillites that are structurally overlain by mafic volcaniclastic rocks and flows. Therefore, one may speculate regarding their structural and genetic relationships. At the present, we suggest that the sulphide mineralization at Samatosum and Rea occur within a structural repetition of the same stratigraphic sequence. Faulting most likely was responsible for this repetition. Alternatively, two distinct, but similar stratigraphic sequences may host the deposits. Lead isotopes from the two deposits are identical and have suggested a Late Devonian age (Goutier, 1986). Therefore, we speculate that rocks hosting the Rea and Samatosum deposits belong to the Devonian–Mississippian succession of the Eagle Bay Assemblage.

Rea

The Rea deposit was discovered in 1984 by local prospectors, A. Hilton and R. Nicholl, who optioned it to Corporation Falconbridge Copper (presently Inmet Mining Corporation). Subsequent exploration revealed two massive-sulphide lenses, named RG8 lens and L100 lens. The RG8 lens is the southernmost and has a surface strike of 75 m with a downdip extension of 80 m. The northern lens (L100) or discovery zone, has a surface strike of 50 metres and a downdip extension of at least 120 m. Combined reserves for the two massive-sulphide lenses are presently thought to be 376 000 t grading 0.33% copper, 2.2% lead, 2.3% zinc, 6.1 g/t gold, and 69.4 g/t silver (The Northern Miner, November 30, 1987). Sulphide minerals present are pyrite, sphalerite, galena, arsenopyrite, chalcopyrite, and tetrahedrite. These are fine to medium grained with banded to breccia texture in the massive-sulphide lenses. Gold and silver are associated with massive sulphide and barite.

The deposit occurs on the overturned eastern limb of a northwest-trending syncline (Hoy and Goutier, 1986). The stratigraphic footwall of the deposit consists of metamorphosed mafic tuff and chert, which show sericite-quartz-carbonate alteration, likely representing footwall alteration of a mafic volcanic precursor. The two massive-sulphide lenses, one of which contains a barite cap (RG8), are stratigraphically above this horizon and overlain by a thin mafic tuff (Hoy and Goutier, 1986). These are then stratigraphically overlain by a several-hundred-metre-thick sequence of argillite and minor tuff, which grades into a quartz-pebble conglomerate at the top.

Subsequent exploration of the Rea zone has shown that it can be traced along strike for 7 km and hosts at least five volcanogenic massive-sulphide lenses (Carmichael, unpub. company rept., 1991).

Samatosum

The Samatosum silver-lead-zinc-copper deposit contained 634 984 t of ore grading 1035 g/t silver, 1.2% copper, 1.7% lead, 3.6% zinc, and 1.9 g/t gold (Pirie, 1989). It was mined by Inmet Mining Corporation between 1989 and 1992.

The deposit consists of a somewhat stratabound, highly deformed, quartz vein system containing massive to disseminated tetrahedrite, sphalerite, galena, and chalcopyrite. It lies within altered, deformed, and pyritized metasediments close to the contact with structurally overlying mafic volcaniclastic rocks. According to Pirie (1989), structural evidence indicates that the sequence is inverted and that the deposit is on the overturned limb of a recumbent syncline.

In the immediate area of the deposit, the sequence is called 'Mine Series' by the mining companies. The metasediments consist of carbonaceous black argillite, sericitized yellowish argillite containing chert lenses, and pyrite-rich, silicified greyish argillite. Some of the beds show graded bedding, and rip-up clasts. The metasediments are heavily strained and highly altered; they display pervasive quartz-pyrite-sericite-fuchsite-carbonate alteration, which is most intense along the metasediment-metavolcanic contact. The protolith of these rocks is difficult to recognize because of intense alteration, deformation, and mineralization. However, we presently believe that the altered metasediments were true sediments. Future geochemical and petrographic studies will try to resolve this issue.

Mafic volcaniclastic rocks structurally overlying the sediments are most commonly tuffaceous to lapilli in texture. Some pillowed flows are present.

Folded and brecciated mineralized quartz veins crosscut the metasediments and the metavolcanic rocks in the vicinity of the deposit (Figs. 5E and F).

Twin Mountain

The Twin Mountain occurrence consists of galena, sphalerite, chalcopyrite, and pyrite within carbonate-quartz veins. The host rock consists of sericitized and silicified schists derived from mafic volcanic flows and volcaniclastic rocks. The property was explored by Camoose Mines Ltd during the 1950s, and was re-examined during the 1980s by Corporation Falconbridge Copper. A drill hole intersected 2.37 m which returned assays of 10.6 g/t gold, 335.3 g/t silver, 3.13% zinc, 2.74% lead, and 0.55% copper (George Cross Newsletter, no. 237, December 10, 1987).

DISCUSSION

Achieving some controls on the stratigraphic and structural settings of the metasedimentary and metavolcanic rocks of the Eagle Bay Assemblage in the Johnson Lake–Adams Lake region will have important implications for understanding the genesis of the sulphide mineralization.

Schiarizza and Preto (1987) inferred a major thrust fault, the Haggard Creek Fault, between the structurally overlying Cambrian mafic volcanic rocks (unit EBG of Schiarizza and Preto, 1987) and the underlying Devonian–Mississippian metasedimentary rocks (units EBF, EBA, and EBS). This thrust fault trends roughly along the Samatosum and Rea horizons, i.e. along a package of overturned metasedimentary- metavolcanic rocks referred to as the 'Mine Series'. The Rea deposit was interpreted as part of the Devonian–Mississippian volcano-sedimentary sequence, whereas the Samatosum deposit was interpreted as bedding-hosted in Cambrian strata.

The stratigraphic sequences at Rea and Samatosum are very similar. Moreover, the deposits have similar alteration, mineralogy, and identical lead-isotope signatures. At Rea, the contact between the mafic volcaniclastic rocks and the underlying metasediments is a stratigraphic one (Hoy and Goutier, 1986). All this suggests structural repetition, by faulting, of the same stratigraphic sequence. It also suggests that the sedimentary and volcanic succession hosting the Rea, Samatosum, and possibly Twin Mountain deposits, is Devonian–Mississippian. At Samatosum, the presence of quartz and carbonate veins in the structural hanging wall (i.e. mafic volcanic rocks) and the presence of stratiform mineralization within the metasediments, along with pervasive sericite-quartz-carbonate-pyrite alteration of both metasediments and metavolcanic rocks seems to indicate a stratigraphic rather than structural contact between these two units. This will be verified by geochemical analysis. At present, we have inferred the presence of an overturned thrust fault (Fig. 4.) to repeat this stratigraphy. The cleavage does not vary across the fault, which indicates that the fault predates folding and subsequent overturning of the strata. Schiarizza and Preto (1987) have noted that Devonian– Mississippian strata unconformably overlie Lower Cambrian rocks at other localities within the Eagle Bay Assemblage. It is conceivable that this relationship may apply here, although based on the overall regional stratigraphy (Fig 2), a thrust fault seems most likely. Further work will attempt to date stratigraphic units and determine their tectonic settings and geochemical signatures.

ACKNOWLEDGMENTS

The authors are very grateful to Bob Friesen of Teck Exploration Ltd. for providing pertinent information on the Samatosum deposit. Inmet Mining Corporation gave us access to the Samatosum property and the help of John and Charlene Froese, Dick Ross, and Brent Hamblin of Inmet Mining Corporation was very appreciated. Jack Marr of Geodex Minerals Ltd. and David Wilder of Remedios and Company also provided maps, plans, and sections necessary to conduct this study. We are grateful to Jennifer Porter who provided capable field assistance.

The authors would particularly like to thank Trygve Hoy and Ken Daughtry for discussions regarding the geology of the area and for providing research and field guidance without which this study could not have been done. Victor Preto graciously gave us a regional geological tour.

The following people from the British Columbia Geological Survey are thanked for their helpful suggestions: George Simandl, Jim Logan, and Michael Cathro. Paul Schiarizza reviewed the manuscript; his suggestions and comments greatly improved the manuscript.

REFERENCES

Goutier, F.G.
1986: Galena lead isotope study of mineral deposits in the Eagle Bay Formation, Southeastern British Columbia; M.Sc. thesis, University of British Columbia, Vancouver, British Columbia, 152 p.

Hoy, T.
1999: Massive sulphide deposits of the Eagle Bay Assemblage, Adams Plateau, South Central British Columbia (082 M/3, 4); *in* Geological Fieldwork 1998, British Columbia Ministry of Energy and Mines, Paper 1999-1, p. 223–245.

Hoy, T., and Goutier, F.
1986: Rea gold (Hilton) and Homestake volcanogenic sulphide-barite deposits, southeastern British Columbia (82 M/4 W); *in* Geological Fieldwork 1985, British Columbia Ministry of Energy, Mines and Petroleum Resources, Paper 1986-1, p. 59–68.

Pirie, I.
1989: The Samatosum deposit; The Northern Miner Magazine, June 1989, p. 15–18.

Preto, V.A.
1981: Barriere Lakes–Adams Plateau area (82 L/13 E; 82 M/4, 5 W; 92 P/1 E, 8 E); *in* Geological Fieldwork 1980, British Columbia Ministry of Energy, Mines and Petroleum Resources, Paper 1981-1, p. 15–23.

Preto, V.A. and Schiarizza, P.
1985: Geology and mineral deposits of the Adams Plateau–Clearwater region; *in* Field Guides to Geology and Mineral Deposits in the Southern Canadian Cordillera,(ed.) D.J. Tempelman-Kluit; Geological Society of America, Cordilleran Section Annual Meeting, Vancouver, British Columbia, p. 16.1–16.11.

Schiarizza, P. and Preto, V.A.
1987: Geology of the Adams Plateau–Clearwater–Vavenby area; British Columbia Ministry of Energy, Mines and Petroleum Resources, Paper 1987-1, 88 p.

Wheeler, J.O., and Mcfeely, P.
1991: Tectonic assemblage map of the Canadian Cordillera and adjacent parts of the United States of America; Geological Survey of Canada, Map 1712A, scale 1:2000 000.

Geological Survey of Canada Project 990002