AGE OF HOST STRATA VERSUS MINERALIZATION AT ERICKSEN-ASHBY: A SKARN DEPOSIT

By Mitchell G. Mihalynuk, and W. (Bill) J. McMillan, B.C. Geological Survey Branch, James K. Mortensen and Fiona C. Childe, University of British Columbia and Michael, J. Orchard, Geological Survey of Canada

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INTRODUCTION

The Ericksen-Ashby deposit is located on the sharp northern ridge of Mount Ericksen, about 64 kilometres east of Juneau, Alaska and 130 kilometres south of Atlin in northwestern British Columbia (Figure 1). It is part of a mineralized belt that contains the Tulsequah Chief and Big Bull volcanogenic massive sulphide deposits within 12 kilometres along strike to the north, and was previously interpreted as this type of deposit (e.g. Payne, 1979). Originally discovered in 1929, it has received sporadic assessment work, including surface and underground drilling programs.

Strata hosting the deposit are different from those at both the Tulsequah Chief and Big Bull deposits. However, the Ericksen-Ashby deposit has generally been thought of as correlative, with stratigraphic differences accounted for by rapid facies changes, typical in volcanic arc environments. Most of these strata were originally considered to be Late Triassic in age (Souther, 1971). Late Carboniferous (Moscovian) fossils collected by Nelson and Payne (1984) from a structural high in the Tulsequah camp were the first clear indication that rocks at the Tulsequah Chief must be Paleozoic and not Triassic. It was not until a decade later that the first definitive age of the Tulsequah Chief deposit was obtained by U-Pb dating of zircons in the coarse rhyolite breccia that is included within the orebodies (353 +14 -7 Ma, Sherlock *et al.*, 1994).

In contrast, there were no age data for hostrocks or mineralization at the Ericksen-Ashby deposit prior to this study. Some lead isotope data are reported for the deposit (Godwin *et al.*, 1988), but are interpreted based on a Jurassic age for the host strata, and no description of the sample site or material analyzed is available. Lead isotope data needed to be reevaluated and augmented in light of new age constraints.

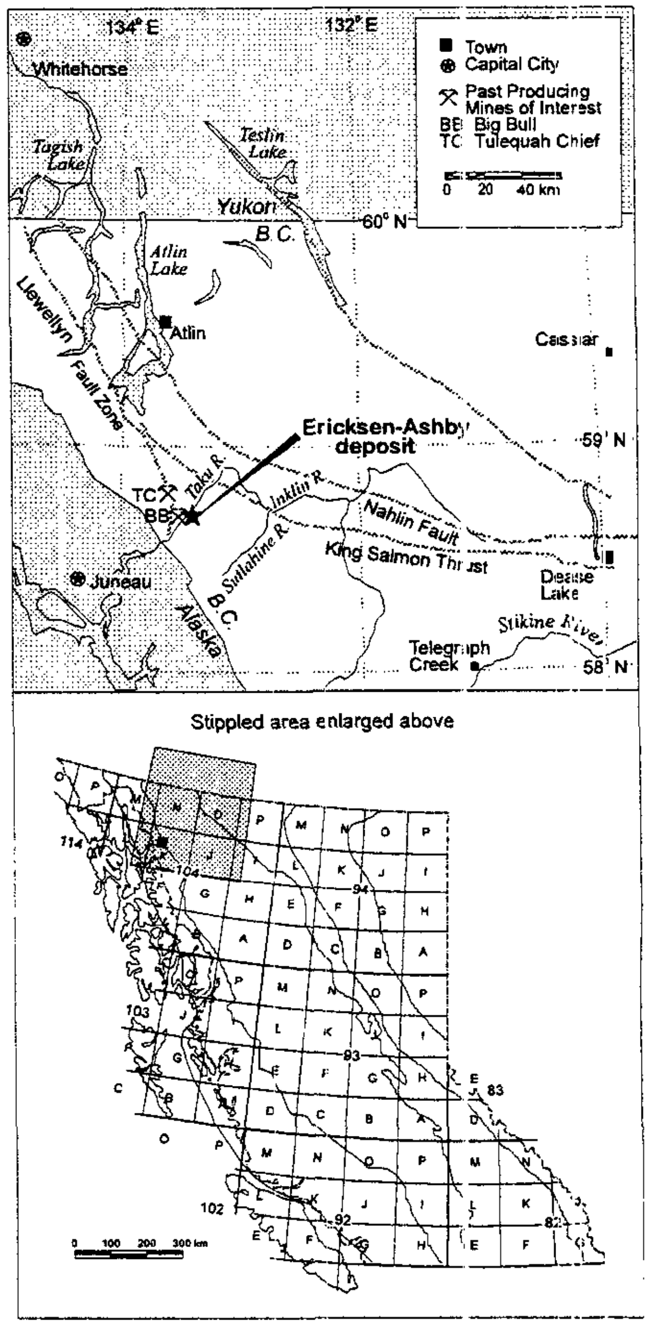

Figure 1. Location of the Ericksen-Ashby deposit in northwestern British Columbia.

ERICKSEN-ASHBY GEOLOGY

Payne (1979) produced excellent detailed geology and descriptions of mineralization textures at the Ericksen-Ashby deposit during his evaluation of the property. The generalized geology that follows is based primarily on his work as well as brief visits (six man-days in the immediate area, two at the deposit) as part of a BCGS regional mapping program in 1994 (Mihalynuk *et al.*, 1994a, b, 1995a, b).

Strata on Mount Ericksen are dominated by pyroxene-phyric andesite or basaltic andesite and gabbro. Near the north end of the ridge, the volcanic strata are interrupted by two interlayers comprised of chert and carbonate (Figure 2). They are each approximately 100 metres thick, but strong internal deformation by close to isoclinal folds does not permit estimates of original stratigraphic thickness. The structurally highest sedimentary unit bifurcates northward to envelop andesite of approximately the same thickness. It also includes a thin layer of rhyolite. A subjacent, tabular, porphyritic quartz monzonite, 50 to 100 metres thick (but in at least one place up to 350 m thick), known as the Ericksen sill, thermally metamorphoses the entire section on Mount Ericksen.

All massive sulphide mineralization of economic interest occurs in the upper sedimentary division (SED-2 of Payne, 1979). Within SED-2, sulphide layers with high zinc, lead and silver contents occur above a thin, discontinuous rhyolite layer. Some sulphide pods and lenses are discordant, clearly related to late skarn alteration and/or remobilization of the stratiform sulphides.

Field evidence predominantly points to a volcanogenic origin for the deposit. Like the volcanogenic massive sulphides to the immediate north, it is closely associated with a felsic tuff horizon. Mineralization is dominantly stratiform and mainly restricted to the single SED-2 interval (Payne, 1979). Futhermore, a lithologically similar calcareous layer between SED-2 and the Ericksen sill is unmineralized although, given its closer proximity to the intrusion, it would seem a more likely host for skarn mineralization. Thus, Payne interpreted the Ericksen-Ashby as primarily a volcanogenic massive sulphide deposit with partial late remobilization due to the Ericksen sill. While our field observations are consistent with those of Payne and his interpretation, laboratory analytical data from galena from the massive sulphide lenses are incompatible with a volcanogenic origin of the galena

BIOCHRONOLOGY

Samples were collected for microfossil determination to help clarify the question of correlation between Ericksen-Ashby and massive sulphide stratigraphy of the Tulsequah Chief and Big Bull deposits. Only one sample was productive. It was from a 12-metre section of SED-2, comprised of fine-grained grey limestone with

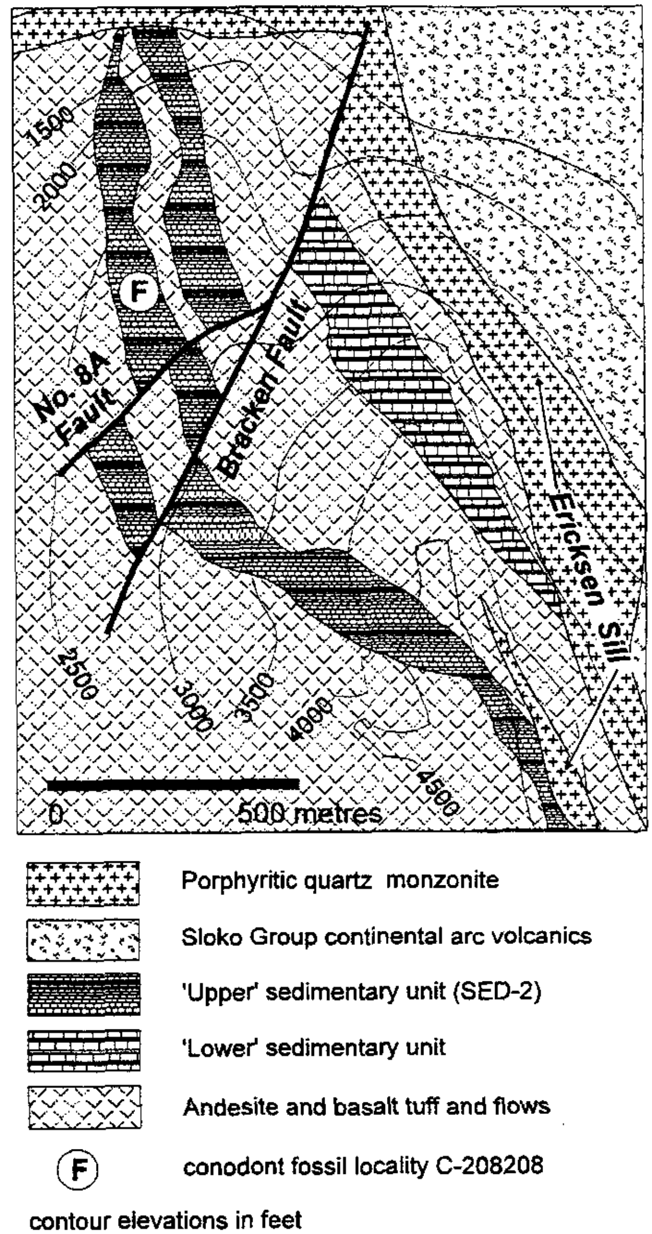

Figure 2. Stylized geology of the Ericksen-Ashby deposit, modified after Payne (1979) and Mihalynuk *et al.* (1995). For more detailed deposit geology see Figure 4 of Payne (1979). The U-Pb isotopic age determination sample site is 1.5 kilometres south of the southeast corner of the figure.

interlayered chert (sample C-208208, see location F, Figure 2). It yielded two deformed conodont fragments with a colour alteration index of 6. These suggest a Late Carboniferous to Permian age, although precise age remains elusive due to poor preservation of the conodonts and intense structural disruption. Nevertheless, the strata are definitely Paleozoic, not Triassic.

GEOCHRONOLOGY

A sample of pink, blocky to platy weathering, quartz

(15%) - feldspar (20%) porphyry was collected from near the base of the Ericksen sill for U-Pb geochronology (Figure 2). In hand sample the feldspars are zoned, displaying both twinned plagioclase (polysynthetic and simple) as well as untwinned crystals, possibly intergrowths of orthoclase and plagioclase. Mafic phenocrysts include biotite booklets (5%) and hornblende prisms (0.5%). The sample is very fresh and yields good quality zircons.

ANALYTICAL TECHNIQUES AND RESULTS

Sample preparation and U-Pb analyses were carried out at the Geochronology Laboratory of the University of British Columbia. The sample was processed using techniques as described in Mortensen *et al.* (1995). Analytical results are presented in Table 1. Two multigrain zircon fractions were analysed. Both yield concordant analyses (Figure 3), with the best estimate for the crystallization age for the unit given by the total overlap of the two error ellipses with concordia, at 53.5±0.7 Ma. This age is nearly identical to U-Pb age determinations from Sloko Group volcanic strata (Mihalynuk and Friedman, unpublished) which crop out in fault contact with older parts of the succession hosting the Ericksen-Ashby deposit.

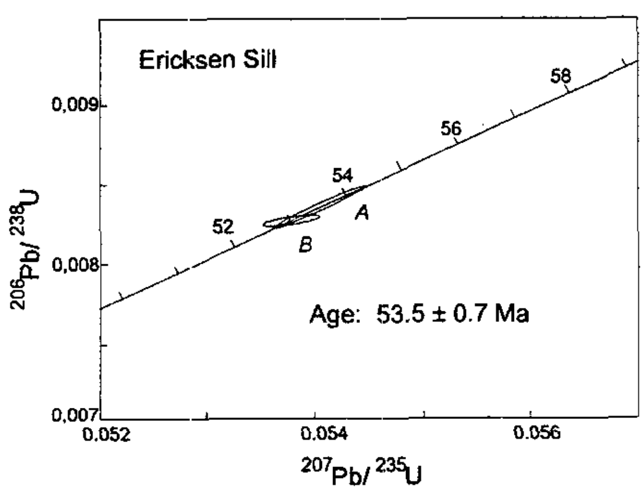

Figure 3. Concordia diagram showing the results of two zircon fractions from the Ericksen sill.

LEAD ISOTOPE SYSTEMATICS

A sample of mineralized material was collected from SED-2 about 60 metres above the fossil locality. It is fine to medium-grained, massive sphalerite (60%) and galena (20%) with unidentified, fine-grained gangue minerals comprising the remainder of the sample. Galena from this sample was analyzed for its lead isotopic composition. Analytical results of two fractions of galena

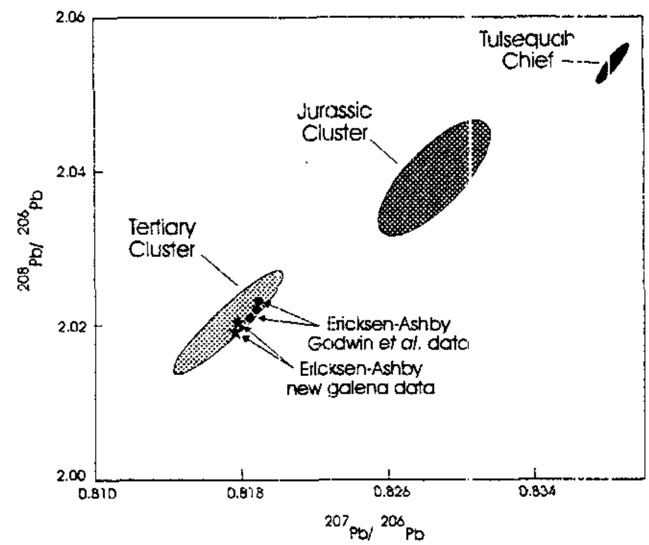

Figure 4. $^{207}Pb/^{206}Pb$ *vs.* $^{208}Pb/^{206}Pb$ diagram for galena from the Erickson-Ashby deposit, references to sources for Tertiary, Jurassic and Tulsequah Chief clusters are given in the text.

from the sample are presented in Table 2, and in a $^{207}Pb/^{206}Pb$ *versus* $^{208}Pb/^{206}Pb$ diagram in Figure 4. The lead isotopic signature of Ericksen-Ashby is compared with the signatures of Jurassic and Tertiary mineralizing epochs in the Stikine Terrane (Alldrick *et al.*, 1987, and UBC Geochronology Laboratory, unpublished data), as well as mineralization at the Devono-Mississippian Tulsequah Chief volcanogenic massive sulphide deposit (Childe, 1994). These data clusters show an increasingly more radiogenic lead signature with time in the Stikine Terrane. Late Carboniferous to Permian syngenetic mineralization in the Stikine Terrane would be expected to have a lead signature intermediate to that of Devono-Mississippian and Jurassic mineralization. However, the lead isotopic signature of galena from the Ericksen-Ashby deposit plots near the centre of the cluster defined by Tertiary mineralization.

DISCUSSION

Remobilization, metamorphism or skarn alteration of a pre-existing Paleozoic massive sulphide deposit (for example, Höy and Godwin, 1986) would not reset the lead isotopic signature of the galena within this lead-rich deposit. The lead signature is unequivocally Tertiary. In consideration of the 53.5±0.7 Ma age of the Ericksen sill which is responsible for skarn alteration at the deposit it must be concluded that most or all of the lead was deposited during a Tertiary mineralizing event. Thus, Pb-Zn-Ag mineralization at the Ericksen-Ashby deposit is primarily a Tertiary skarn hosted by Late Carboniferous to Permian volcanosedimentary strata. Despite some field evidence to the contrary, it is apparently not a syngenetic deposit.

TABLE 1. U-PB ANALYTICAL RESULTS FOR SAMPLE MMI-94-18-9

Fraction[1]	Wt. mg	U ppm	Pb^2 ppm	$^{206}Pb/^{204}Pb$ measured	Pb^3 pg	$\%^{208}Pb$	$^{206}Pb/^{238}U^4$	$^{207}Pb/^{235}U^4$	$^{207}Pb/^{206}Pb^4$	$^{207}Pb/^{206}Pb$ age[5] (Ma)
A: n5, +134, a	0.313	810	7	2009	66	10.3	0.008339±0.73	0.05414±0.77 (0.9701)	0.04709±0.19	53.7 ±8.9
B: n5, 74-134, u	0.246	858	7	537	211	10.8	0.008260±0.18	0.05362±0.49 (0.7152)	0.04708±0.38	53.2 ±18.0

1 n5 = non-magnetic at 5 degrees side tilt on Frantz isodynamic separator; grain size given in microns; u = unabraded; a = abraded
2 radiogenic Pb; corrected for blank, initial common Pb, and spike
3 common lead corrected for spike and fractionation
4 corrected for blank Pb and U, and common Pb; errors are in percent at a 1σ level; correlation coefficient in parentheses
5 errors are in Ma at a 2σ level

TABLE 2. COMMON LEAD DATA FOR THE ERICKSEN-ASHBY DEPOSIT

Sample	Mineral	$^{206}Pb/^{204}Pb$ (% error)[1]	$^{207}Pb/^{204}Pb$ (% error)[1]	$^{208}Pb/^{204}Pb$ (% error)[1]	$^{207}Pb/^{206}Pb$ (% error)[1]	$^{208}Pb/^{206}Pb$ (% error)[1]
EA a	galena	19.073 (0.010)	15.594 (0.009)	38.515 (0.011)	0.81761 (0.004)	2.0194 (0.004)
EA b	galena	19.111 (0.007)	15.627 (0.006)	38.618 (0.007)	0.81770 (0.003)	2.0208 (0.002)

1 Errors are quoted at the 2σ (95% confidence) level, values are corrected for instrument fractionation by normalization based on replicate analyses of the NBS-981 standard.

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REFERENCES

Alldrick, D.J., Gabites, J.E., and Godwin, C.I. (1987): Lead Isotope Data from the Stewart Mining Camp (104B/1); *in* Geological Fieldwork 1986, *B.C. Ministry of Energy, Mines and Petroleum Resources,* Paper 1987-1, pages 93-102.

Childe, F. (1994): Chronology and Radiogenic Isotope Studies of the Kutcho, Granduc, Anyox and Tulsequah Chief Volcanogenic Massive Sulphide Deposits; *in* Volcanogenic Massive Sulphide Deposits of the Cordillera Project, Second Annual Report, *Mineral Deposit Research Unit,* The University of British Columbia.

Godwin, C.I., Gabites, J.E. and Andrew, A. (1988): Leadtable: A Galena Lead Isotope Data Base for the Canadian Cordillera, with a Guide to its Use by Explorationists; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1988-4, 188 pages.

Höy, T. and Godwin, C.I. (1986): Significance of a Cambrian Date from Galena Lead-isotope Data for the Stratiform Cottonbelt Deposit in the Monashee Complex, Southeastern British Columbia; *Canadian Journal of Earth Sciences*, Volume 25, pages 1534-1541.

Mihalynuk, M.G., Smith, M.T. Hancock, K.D. and Dudka, S. (1994a): Regional and Economic Geology of the Tulsequah River and Glacier Areas (104K/12 & 13); *in* Geological Fieldwork 1993, Grant, B. and Newell, J.M., Editors, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1994-1, pages 171-197.

Mihalynuk, M.G., Smith, M.T. Hancock, K.D., Dudka, S. and Payne, J. (1994b): Tulsequah River and Glacier Areas

(104K/12 & 13); *B.C. Ministry of Energy, Mines and Petroleum Resources*, Open File 1994-3.

Mihalynuk, M.G., Meldrum, D., Sears, S. and Johannson, G. (1995a): Geology and Mineralization of the Stuhini Creek Area (104K/11); *in* Geological Fieldwork 1994, Grant, B. and Newell, J.M., Editors, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1995-1, pages 321-342.

Mihalynuk, M.G., Meldrum, D.G., Sears, W.A., Johannson, G.G., Madu, B.E., Vance, S., Tipper, H.W. and Monger, J.W.H. (1995b): Geology and Lithogeochemistry of the Stuhini Creek Map Area (104K/11); *B.C. Ministry of Energy, Mines and Petroleum Resources*, Open File 1995-1.

Mortensen, J.K., Gosh, D. and Ferri, F. (1995):.U-Pb Geochronology of Intrusions Associated with Cu-Au Porphyry Deposits in the Canadian Cordillera; *in* Canadian Institute of Mining and Metallurgy, Special Volume 46, in press.

Nelson J. and Payne, J.G. (1984): Paleozoic Volcanic Assemblages and Volcanogenic Massive Sulphide Deposits near Tulsequah, British Columbia; *Canadian Journal of Earth Sciences*, Volume 21, pages 379-381.

Payne, J.G. (1979): Geology Report for Semco Mining Corporation on the Ericksen-Ashby Claims; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 7707.

Sherlock, R., Childe, F., Barrett, T.J., Mortensen, J.K., Chandler, T., Lewis, P., McGuigan, P., Dawson, G.L. and Allen, R. (1994): Geological Investigations of the Tulsequah Chief Massive Sulphide Deposit, Northwestern British Columbia; *in* Geological Fieldwork 1993, Grant, B. and Newell, J.M., Editors, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1994-1, pages 373-379.

Souther, J. G. (1971): Geology and Mineral Deposits of the Tulsequah Map-area, British Columbia; *Geological Survey of Canada*, Memoir 362, 84 pages.

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