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Ministry of Energy, Mines & Petroleum Resources
Mining & Minerals Division
BC Geological Survey

Assessment Report
Title Page and Summary

TYPE OF REPORT [type of survey(s)]: Geologic report, map & sections

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AUTHOR(S): Jack A. Morton

SIGNATURE(S): Jack A. Morton

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PROPERTY NAME: Libby

CLAIM NAME(S) (on which the work was done): Libby 1 (403418), Libby 2 (936954)

COMMODITIES SOUGHT: Zn, Pb

MINERAL INVENTORY MINFILE NUMBER(S), IF KNOWN:

MINING DIVISION: Nelson

NTS/BCGS: 82F

LATITUDE: 49 ° 00 ' 29 " LONGITUDE: 117 ° 11 ' 19 " (at centre of work)

OWNER(S):
1) Guinet Management Inc
2)

MAILING ADDRESS:
46349 Hope River Road
Chilliwack, BC V2P 3P4

OPERATOR(S) [who paid for the work]:
1) Same as above
2)

MAILING ADDRESS:
Same as above

PROPERTY GEOLOGY KEYWORDS (lithology, age, stratigraphy, structure, alteration, mineralization, size and attitude):
Metaline, Nelway, Ledbetter, Active, Maitlen, Laib, Salmo, Middle Cambrian - Middle Ordovician, Kootenay Arc, Lead Hill fault, Slate Creek fault, Slate Creek thrust zone, Boundary anticline, MVT, carbonate-hosted Zn-Pb, dolostone, breccia, silicification, deep-water carbonates debris flows, synsedimentary, Yellowhead, Josephine, vertically coincident

REFERENCES TO PREVIOUS ASSESSMENT WORK AND ASSESSMENT REPORT NUMBERS:
Libby & Lead Hill Property, E.G. Olfert, 1994

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TYPE OF WORK IN THIS REPORT	EXTENT OF WORK (IN METRIC UNITS)	ON WHICH CLAIMS	PROJECT COSTS APPORTIONED (incl. support)
GEOLOGICAL (scale, area)			
Ground, mapping	469.46 Ha	Libby 1 / Libby 2	US$6058.67/3422.34
Photo interpretation			
GEOPHYSICAL (line-kilometres)			
Ground			
Magnetic			
Electromagnetic			
Induced Polarization			
Radiometric			
Seismic			
Other			
Airborne			
GEOCHEMICAL (number of samples analysed for...)			
Soil			
Silt			
Rock			
Other			
DRILLING (total metres; number of holes, size)			
Core			
Non-core			
RELATED TECHNICAL			
Sampling/assaying			
Petrographic			
Mineralographic			
Metallurgic			
PROSPECTING (scale, area)			
PREPARATORY / PHYSICAL			
Line/grid (kilometres)			
Topographic/Photogrammetric (scale, area)			
Legal surveys (scale, area)			
Road, local access (kilometres)/trail			
Trench (metres)			
Underground dev. (metres)			
Other			
		TOTAL COST:	

Geologic Report, Map and Sections
Libby Claim Block 1 and 2
Salmo Pb-Zn Area
Nelson Mining Division
Southeastern British Columbia

NTS 82 F

Latitude 49° N
Longitude 117° W

prepared for

Guinet Management Inc.
46349 Hope River Road
Chilliwack, British Columbia
V2P 3P4
CANADA

by

Jack A. Morton
714 13th Avenue NE
Olympia, Washington 98501
360-352-3727
jackamorton@comcast.net

31 July 2012

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SUMMARY

The geologic map and sections constructed for this investigation did not reveal surface expression of Yellowhead mineralization on Libby Claim Blocks 1 and 2, but they do suggest that there is an excellent potential for the discovery at depth of any of several vertically coincident Yellowhead zones known to occur along a SSW-NNE trend of orebodies that includes the Pend Oreille mine and Washington Rock in the Metaline mining district to the south. Historic soil geochemistry and geophysics have not proven useful and it is recommended that exhaustive detailed geologic mapping be completed before drilling is attempted.

INTRODUCTION

The location, access, physiography, property and history, including historic mining, geophysics, geochemistry, drilling and trenching are well described by Olfert (1994) and Christopher (1991). Only those aspects that pertain to the geology of the Metaline Formation and the accompanying geologic map and sections are considered further here.

Purpose and Scope

The purpose of this investigation was to map the surface geology of the Libby claims based on my experience in the Metaline mining district immediately to the southwest. I had previously mapped large portions of the Metaline district at 1"=200', including portions of Lead Hill immediately south of the Libby claims and the Bluebird claim group farther south. I had also mapped much of the east side workings of the Pend Oreille mine, including the decline from the Josephine workings to the East Side Yellowhead workings in the uppermost Yellowhead zone. I have also logged the core of several thousand feet of core drilling in the district, reviewed the logs of many thousands of feet of additional drilling and written numerous geologic reports over a span of 40 years working in the district. It was anticipated that this experience would help further the interests of Guinet Management in exploring for and developing similar ore on the Libby Claim blocks by identifying stratigraphic and structural elements that help identify mineralized zones and in determining the stratigraphic association of known mineralized zones and possibly in locating others.

Field Conditions

Field work was conducted from 8 through 20 June, 2012 and, with the exception of one clear day, weather conditions varied from intermittent to steady rain. Progress was also slowed somewhat by logging activity in the map area and occasional blockage of the main road by logging equipment and road reconstruction. The operator, Sunshine Logging Co., however, was very accommodating. Many of the old mining/drill roads leading to the southern portions of the claims and the US border were rendered impassable to vehicles due to the high flow of Lead Creek, water bars, and deadfall. After access by vehicle on the main Lead Creek road, most areas were reached on foot.

A new logging road has been constructed that crosses Lead Creek and the west branch of Lead Creek and heads northerly almost to the confluence with the South Salmo River.

Much of the bedrock in the area is obscured by unconsolidated alluvial and glacial sediments. Most of the rest is covered by soil and colluvium, which made mapping float and reliance on previously published and unpublished maps necessary. Travel on foot through the area is also hampered locally by an abundance of cedar dog-hair, deadfall and steep slopes. Initially, the map was intended to be an outcrop map showing all of the outcrops within the claim blocks. The limited available time, however, combined with less than ideal field conditions necessitated that many areas that probably held outcrops were not visited. The resulting map shows large areas mapped as float or inferred from the work of others which were not reached during this study but in which outcrops surely occur.

Methods

The base map of the Libby claim group and nearby area, an AutoCAD 2000 drawing with a 20' contour interval, was subdivided and printed out at 1"=200' as individual 8½"x 11" field sheets. Positions in the field were located with a Garmin XL12 GPS device in the UTM Zone 11 NAD83 system, but the process was rendered slower and less accurate than hoped for by the combination of cloud cover and tree canopy. When completed, the field sheets were scanned, the scanned images inserted into the AutoCAD drawing, and the field data then digitized by hand onto the drawing.

GEOLOGIC BACKGROUND

A lengthy section is provided here because articles published over the past two decades could have considerable affect on how exploration and development are conducted for Zn-Pb ore deposits hosted by the Metaline Formation. Some of this information and its ramifications have not been widely disseminated in the geologic community. In particular, the spatial localization of some of the lithofacies in both the Metaline and Ledbetter formations became apparent through district-wide exploration drilling in the Metaline district from the 1960s through the -90s. Even with this newer information, however, the continued use of time-stratigraphic terms and the connotations they carry, combined with the use of genetic terms for descriptive purposes have probably done as much to hinder a clearer understanding of Metaline geology as the limited exposure. Unfortunately, this has also carried over into perceptions of the Zn-Pb mineralization that is thought to occur in these lithofacies.

For nearly half a century, the Metaline Formation was considered by many geologists to represent carbonate deposition in very shallow-water environments along the passive margin of Middle Cambrian western North America. Metaline rocks were widely thought to lie directly below a Middle Cambrian-Ordovician unconformity that separated them from overlying deep-water black argillites of the Ledbetter Formation. This was, in large part due to the influential work of Mills and Eyrich (1966) and Schuster (1976). But even when published evidence suggested that this might not be accurate, the general idea persisted that the depositional environments of Metaline sediments were shallow and the terms used to describe Metaline rocks, particularly core, carried strong connotations of shallow-water origin. Some of the published work that should have caused a re-evaluation of stratigraphy and depositional environments were:

1. McConnell and Anderson (1968) - the mining of Zn-Pb orebodies in the upper portions of the Metaline Formation in the Pend Oreille mine for more than 40 years had given mine geologists an exceptionally good view of the upper portions of the Metaline Formation and most described the host rocks as dolostone breccias irregularly intercalated with unbrecciated dolostone sediments. McConnell and Anderson interpreted many of these to be mass-gravity deposits and described them as belonging to the Josephine unit of the Metaline Formation.

2. Graptolite fossils collected from many localities in NE Washington, including the Pend Oreille mine, led Carter (1989a and –b) to conclude that there was no biostratigraphic hiatus between the top of the Metaline Formation and the bottom of the Ledbetter Formation and that the transition between the two occurred in the early Middle Ordovician in the Metaline district and the Lower Ordovician to the west in Stevens County. The contact was, therefore, diachronous, implying that portions of both formations were deposited simultaneously and were coeval.

3. Schuster and others (1989), Bush and others (1992) and Morton (1992) concluded that the Ledbetter/Metaline contact was a depositional transition. Evidence of erosion at the contact (and in abundance below it), that had been used to support an unconformity, was also recognized as a common characteristic of deep-water mass-gravity deposits.

4. Schuster and others (1989) noted that the Metaline conodont assemblage reflects deposition in the cool/deep environments of the North Atlantic faunal realm. Similarly, Finney and Berry (2003) indicated that the graptolite assemblage apparent in upper Metaline and lowermost Ledbetter rocks reflects deposition in deep-water environments along the outer shelf and slope of the Middle Ordovician North American craton.

These geologic interpretations suggest that while the Metaline-Ledbetter transition reflects an abrupt change in sediment supply, it does not necessarily indicate a drastic change in the depth of the depositional environment. These changes in interpretation of depositional environments and stratigraphy can have a significant effect on the context in which Metaline Zn-Pb ores are considered (or reconsidered).

Names and geologic terms used in this study

American stratigraphic nomenclature is used here because I am most familiar with it and because it is more commonly known in association with Zn-Pb deposits and production in the Metaline mining district immediately adjacent in NE Washington, particularly the Pend Oreille mine. The formational names used are (Canadian equivalents in parentheses): Ledbetter Formation (Active Formation), Metaline

Formation (Nelway Formation), and Maitlen Phyllite (Laib Formation). I also try here to avoid the use of genetic terms in favor of descriptive ones and, wherever possible, to use terms in their most restrictive sense. “Horizon”, which implies a single isochronous surface reflecting a short-lived geologic phenomena of great lateral extent, is not used because recognizable biostratigraphic features or marker beds have never been identified in either the Metaline or Ledbetter formations. Even the abrupt and readily identifiable contact between them cannot not be considered a horizon because it is known now to range in age from at least Lower Ordovician through early Middle Ordovician. The somewhat vague, but much more appropriate term “zone” is applied here to Yellowhead mineralization and ore in preference to “horizon”. The term “lithofacies” is used here for the assemblages of lithologies that had previously been called stratigraphic “units” or “members” of the Metaline Formation. Bush and others (1992) initiated the use of the term, in part in an attempt to remove the “time-stratigraphic” or “layer-cake” connotations that many had given the original terms. Likewise, “upper”, “middle” and “lower” are avoided for the same reasons and because they tacitly imply that a lithologic assemblage has widespread geographic distribution and occurs in the same stratigraphic succession in all areas.

Stratigraphy

Dings and Whitebread (1965) initially subdivided the Metaline Formation into the three major units recognized regionally: “lower”, thin-bedded limestone-shale, intermediate (commonly called “middle”) light gray bedded dolomite, and “upper” gray massive limestone units. Stratigraphic data developed since then suggests that the stratigraphy of the Metaline Formation varies considerably from one area to another and some lithofacies show marked localization. The following assemblages have been recognized: bedded lime mudstone lithofacies gradational downward into the Maitlen Phyllite; light gray bedded dolostone lithofacies - the most widespread and readily identifiable assemblage; gray massive lime mudstone lithofacies that is sharply localized in the Metaline district; varied dolostone lithofacies of Bush and others (1992); Fish Creek Breccia lithofacies of Fischer (1981), previously called the “intraformational breccia unit” by Yates and Robertson, 1956); Josephine lithofacies (McConnell and Anderson, 1968) of dark, variably siliceous dolostone and dolostone breccia that grades upward into the Ledbetter Formation; and an unnamed interbedded carbonate-argillite unit whose, “…contact with the overlying Ledbetter is conformable and gradational through a short distance.” (Yates, 1970, p29). Bush and others (1992, Figure 2) illustrated that the stratigraphy of the Metaline Formation is complex and varies throughout the region, includes the localization of some assemblages and may have been influenced by syndepositional faulting. Their work indicated that absence of a lithofacies in one area does not indicate its removal.

With respect to the Josephine and varied dolostone lithofacies, Zieg and others (2000), Zieg and Otto (2001), Rhodes (2001), and Telford (2001), in a admirable display of scientific vigor, wholeheartedly rejected many of the stratigraphic observations and interpretations of Bush and others (1992), Morton (1992), McConnell and Anderson (1968) and most of geologists who preceded them at the Pend Oreille mine with respect to the varied dolostone and Josephine lithofacies. They concluded that there was, “…an utter lack of unequivocal synsedimentary features . . .” and “…no evidence of synsedimentary breccia in the Metaline of the Pend Oreille mine area.” On the origin of the breccias that make up a large part of these lithofacies, they concluded that, “Josephine-type breccia developed through multiple episodes of solution and collapse, generally without a great deal of open space development though filled vugs and cavities are ubiquitous throughout the Josephine horizon and similar breccia occurrences.” They arrived at this interpretation in much the same manner as Mills (1977) had done, by lumping all of the breccias apparent in Josephine and varied dolostone rocks into a single genetic category - “dissolution-collapse breccias”. They noted that, “Because paleontological evidence suggests that much of upper Metaline is Ordovician and numerous outcrop and drill hole observations lead to interpretation of a continuous depositional transition for the Metaline-Ledbetter contact toward deeper water conditions of sedimentation, a meteoric karst genesis for the solution-collapse breccia seems inadequate.” (p14). They circumvented the dilemma of meteoric karstification *sans* unconformity and asserted that all of the breccias formed by intrastratal dissolution-collapse through a process of “hydrothermal karsting”.

Although many of the characteristics of modern karst caverns and their internal deposits and the processes through which they form are readily observable, those purported to be “hydrothermal karst” and there genetic processes are largely interpreted. However, in their zeal to advance the science of Metaline stratigraphy through “…a more rigorous and careful interpretation of this complex and challenging geology.”, Zieg and others (2000) overlooked a sizeable body of evidence contravening a “hydrothermal karst” origin for all or most Josephine and varied dolostone breccias. Because it has a significant impact on the geologic context in which the Libby claims are considered, this evidence is presented in the following paragraphs.

Evidence against a dissolution-collapse origin of Josephine and varied dolostone breccias

The Metaline-Ledbetter transition occurs through the Josephine lithofacies. In all of the unfaulted occurrences of which I am aware, the Metaline-Ledbetter transition occurs through dark, fine-grained dolostones and dolostone breccia of the Josephine lithofacies or the transitional unit of Yates (1970). It does not occur through the gray massive limestone, the light gray bedded dolostone nor the varied dolostone lithofacies. This being the case, the Josephine lithofacies cannot be a unit consisting almost entirely of breccias that post-date the transition itself.

An origin for Josephine rocks through meteoric or intrastratal dissolution-collapse is irreconcilable with the large proportion of the Josephine that is bedded but not obviously “fragmental”, and that is strikingly dissimilar to other Metaline lithofacies. The interlayering of graptolitic black argillite with other Josephine lithologies and the local interdigitation of dark Josephine lithologies with the bottom of the Ledbetter suggest that Josephine deposits were not formed by discordant, post-lithification processes, but rather by submarine deposition. Similarly, the lateral and vertical gradation between Josephine lithologies and other Metaline lithofacies contradict an origin by the in-filling of karst cavities.

In many Metaline breccias, the heterogeneity of clast lithologies is in marked contrast to the homogeneity of the rocks within which the breccias occur and suggests that fragments did not originate by collapse from nearby "cavity walls or roofs". The angular character of most clasts also suggests mechanical fragmentation rather than dissolution, which would have yield predominantly ragged clast boundaries. The heterogeneity of clast lithology is not compatible with the dissolution and collapse of such homogeneous units as the gray massive lime mudstone lithofacies or the bedded dolostone lithofacies. Rather, these suggest that either the fragment source was lithologically heterogeneous, or that considerable mixing occurred during transport and deposition, or both.

Irregular, but sharply defined floors, roofs and walls of filled cavities are generally apparent in karst deposits. Although some Metaline breccias have clearly defined, discordant boundaries, others are markedly conformable and have no apparent "cavity walls" at all. If, as interpreted by Zieg and others (2001), the "Josephine Breccia" and the varied dolostone lithofacies are assemblages of internal sediment, then remnants of the undissolved precursor should be present as cavities filled with internal debris. In short, "internal sediments" must be internal to something and that evidence is not apparent in most Josephine or varied dolostone breccias.

Although most shale seams in the upper portions of the Metaline Formation appear to be free of macrofossils, some have yielded specimens of fragile graptolites. It is highly unlikely that delicate chitinous graptolites could have survived the rigors of dissolution, disaggregation and re-sedimentation of the process of chemical dissolution and collapse and remained intact.

Qualitative multi-element analyses of core drilled in the early 1990s between Josephine rocks and uppermost Yellowhead rocks indicated a gradual increase in the content of phosphorous upward in that portion of the stratigraphic section. Earlier petrographic analyses of these rocks (Castor and others, 1980 and Dansart, 1982) had shown phosphates to be present in Josephine and gray massive lime mudstone lithofacies as disseminated grains and phosphatic fossil debris. If Josephine and varied dolostone rocks were largely insoluble residues and internal sediments derived from those sediments, one would expect to find phosphates and other insoluble components concentrated in the insoluble residue fraction remaining from their dissolution, either in the shale seams or as discrete phosphatic seams or hardgrounds. Instead, the relatively insoluble phosphates remain disseminated throughout Josephine, varied dolostone and gray massive lime mudstone lithofacies.

Dings and Whitebread (1965, Table 2, p. 16 and Table 3, p.21) presented chemical analyses of gray massive limestone and bedded dolostone that indicate very low levels of insolubles (average 0.15vol% and 0.71vol%, resp.). If the shale seams in the Josephine and varied dolostone lithofacies represent a portion of the insoluble residue resulting from dissolution, they represent dissolution of a tremendous thickness of those relatively pure carbonates. Evidence of this should be readily apparent in the foundering, sag or collapse of the unsupported rocks above the "internal sediments" and in a greatly thinned stratigraphic section where dissolution is purported to have been most pervasive, but there is no indication of this.

The rubble or breakdown breccias of karst deposits commonly comprise a variety of predominantly clast-supported breccias with angular fragments of local origin in matrix that ranges from internal sediment (fine-grained insoluble residue and/or disaggregated carbonate grains) to chemical precipitates (fine- to coarse-grained colliform, cockade or drusy sulfides, carbonates and silicates). These are in marked contrast to the matrix-supported character of breccias of the Josephine lithofacies.

Zieg and others (2000) implied (p. 9) that all or most of the brecciation apparent in Josephine and varied dolostone lithofacies resulted from dissolution-collapse, "…without a great deal of open space development…" Certainly, the sharp angularity of many breccia clasts indicates some form of post-lithification fragmentation. But without the creation of a great deal of open space and the removal of support of the overlying rock mass, there is little or no reason for the roofs and walls of dissolution cavities to collapse and generate the observed angular fragments.

A similar situation occurs with regard to irregular shale seams in both the Josephine and varied dolostone where greenish gray to black shale seams are interlayered with other lithologies, including "clastic" dolostone. The shale seams have been interpreted as insoluble residue interbedded with disaggregated and fragmented dolostone and shale by Zieg and others (2000). However, the rocks immediately overlying the seams show no evidence of dissolution or of the foundering, sag or collapse that would result if the shale seams were the insoluble products of extensive carbonate dissolution.
In meteoric karst situations, evidence of the sag or foundering of cavity roofs is commonly apparent as dilatant veins extending upward from the cavity-fill or by crackle brecciation grading upward into a network of fractures. Large cavities may have a dome-shaped roof that grades upward into crackle breccia with only minor clast dislocation and some exhibit a network of tangential fractures in the manner of a pressure arch. None of these are apparent above breccias in the Josephine or varied dolostone lithofacies. Where the tops of breccia bodies can be discerned, there is also no evidence of sag or collapse of either overlying Metaline or Ledbetter rocks into once-open space, nor of the dome- or chimney-like breccias present in many karst caves.

The conclusions of Zieg and others (2000) and Suda and Zieg (2001) that Josephine and varied dolostone lithofacies were formed almost entirely through dissolution and collapse, infers that the roof above the cavities in which they were formed was somehow supported and did not substantially collapse when that support was removed by dissolution. However they present no evidence of roof support such as pillars or cavity walls. If the vast amount of material that makes up the Josephine and varied dolostone lithofacies were an internal sediment comprising insoluble residue and collapse breccia, it must have developed within cavities in which roofs were somehow supported. This would have been in much the same manner as modern karst cavities or room-and-pillar mines where 20-30% of the volume is left as that provide support for the cavities created by mining. Even in these, which are open for only geologically short periods of time, collapse is fairly common.

If all of the precursors of the Metaline and varied dolostone breccias were removed by dissolution, vast expanses of the Metaline and the overlying Ledbetter would have been left unsupported to eventually founder, sag and collapse leaving the telltale signs of roof collapse recognized in karst and paleokarst deposits, but which are not apparent in unbrecciated Metaline rocks. Similarly, the walls of such caverns should be sharp, well-defined and readily distinguishable from the internal sediments they host, but this is not apparent in Josephine or varied dolostone breccias.

The paucity of vugs or of evidence of internal sedimentation in the matrix of most breccias in the Josephine lithofacies contradicts a paleokarst origin. If an original rubble of self supporting karst fragments were in-filled with dark lime or dolomitic mud to produce the breccias now visible, numerous open spaces would have been trapped among the fragments to later become open, partially filled, or filled vugs. These, however, are not apparent in the breccias of the Josephine lithofacies, although they are common in the later breccias that crosscut them and include them as fragments.

Morton (1981, Fig. 38) noted an upward progression in the Metaline Formation from even and parallel bedding in the light gray bedded dolostone to the hummocky, disconformable, irregular bedding in the Josephine and varied dolostone lithofacies. The gradual progression is accompanied by an increase in the number and irregularity of discrete shale beds, lenses, seams, partings and wisps that commonly define bedding planes. Shale seams pinch out laterally, grade into beds of argillaceous dolostone or bifurcate into one or more shale seams separated by and interbedded with dolostone. Although it is tempting to interpret the shale seams as insoluble residues and that the irregularities in bedding are the result of differential chemical dissolution, several factors argue against this. There is no indication that supposed internal sediments are confined within cavity walls, nor of the collapse of unsupported roofs above supposed internal sediments. Instead, the supposed internal sediment (shale and argillaceous dolostone) and disaggregated dolostone (clastic dolostone/shale) pinch and swell and grade into other lithologies with apparent disregard for the confines of the cavities that must have contained them. Nor are the lithologic relations at the contact any different than those within the Josephine unit or the varied dolostone unit. Shale seams commonly bifurcate laterally into one or more seams that are interbedded with dolostone or limestone and eventually pinch out in the same lithologies with which they are interbedded. If the seams were internal sediment, they would end abruptly against the walls or roofs of the cavities they fill. They cannot be interbedded with the same rocks they are purported to be internal to.

Age and formational relationships

The oldest rocks of concern to this investigation are those of the Middle Cambrian Maitlen Phyllite, which grade upward into the base of the Metaline Formation. Paleontological data (Park and Cannon, 1943, Yates, 1970 and 1976, Repetski, 1978, Carter, 1989a and –b, Repetski and others, 1989 and Schuster and others, 1989) indicate that throughout the extent of the Metaline Formation in NE Washington and SE British Columbia, the Metaline ranges from as old as Middle and/or Late (?) Cambrian to as young as the *Paraglossograptus tentaculatus* zone of the early Middle Ordovician. Similar data (Park, 1937a & -b, Greenman and others, 1977 and Carter, 1989 a & -b) indicate that the Ledbetter ranges from at least as old as the *Oncograptus*, *Tetragraptus approximatus* or *Tetragraptus fruticosus* zones of the Lower Ordovician to Silurian. The overlap in ages between the top of the Metaline and bottom of the Ledbetter indicate that those portions of the formations are coeval. This indicates that, although the contact can be a useful stratigraphic reference locally, it should always be kept in mind that it is not a time-stratigraphic feature and that local observations and measurements do not necessarily apply regionally.

Depths of Depositional Environments

Much of the interpretation of shallow-water deposition (shallow subtidal, peritidal and supratidal) in the Metaline Formation is based on textural interpretations, some of which are several steps removed from the direct observation of the textures of modern depositional environments. As such, the textures may be more reflective of diagenesis than of the depositional environment. Interpretations of the light gray bedded dolostone lithofacies as having been deposited in peritidal and supratidal environments (including those of Morton, 1974, Fischer, 1981, Bending, 1983, Zieg and others, 2000 and Zieg and Otto, 2001) are particularly suspicious in light of modern paleontologic and paleogeographic data. Schuster and others (1989, p15) noted of samples from the bedded dolostone and massive lime mudstone lithofacies that, "Species of both North American Midcontinent (warm, shallow) and North Atlantic (cool, deep) faunal realms are present in the presumed-indigenous assemblage, suggesting a depositional site near or at the continental margin zone of overlap of the two faunal realms." They also noted that near the top of the Metaline, "…the indigenous fauna is entirely of North Atlantic species…". These findings are consistent with those of Repetski (1994) and Berry and Finney (2003, Fig. 1), who illustrated that graptolite species from the *P. tentaculatus* zone catalogued by Carter (1989a and b) from the Ledbetter and Metaline formations reflect depositional environments on the slope and rise of the Laurentian continental margin, not the shallow inner or outer shelf environments or the deeper ocean floor. Bush (2001, pD-11) suggested that, "…below-wave base, poorly oxygenated subtidal and basinal environments in concert with localized slope deposits dominated the shelf edge in northeastern Washington throughout much of Metaline deposition." On the basis of conodont and graptolite data, Repetski and others (1989) suggested that the intertonguing transition from Metaline to Ledbetter sedimentation occurred, "…in an upper slope or shelf-margin depositional setting."

In contrast, oncolites, which are commonly accepted as evidence of algal accretion in shallow marine environments above wave base, are also abundant in the light gray bedded dolostone lithofacies. Their presence, together with that of both shallow and deep water conodonts, suggests that the shallow water components may have been routinely washed from shallow environments to deeper ones by tides or storms.

Most aspects of the Ledbetter suggest its depositional environment was relatively deep and anoxic: dark color and high carbon content; fine grain-size; ubiquitous pyrite; lack of bioturbation; and its general lack of benthic organisms while pelagic forms (graptolites) abound. Morton (1992) interpreted breccias, intraformational folds, truncated bedding and internally disrupted beds in the basal 20 meters of the Ledbetter, as well as beds of lime turbidites that become increasingly fine grained upward in the section, as evidence of allochthonous mass-gravity sedimentation down slope from shallower carbonate depositional environments. He also considered displacive calcite-quartz-pyrite pseudomorphs after gypsum or anhydrite, as evidence of hypersalinity.

Paleogeography

The Metaline and Ledbetter formations fit into the pattern recognized by stratigraphers and sedimentologists of deposition of Middle Cambrian miogeoclinal sediments along the passive margin of present-day North America following an episode of rifting (Stewart, 1972 and 1976, Lis and Price, 1976, Sears and Price, 1978, Armin and Mayer, 1983, Bond and Kominz, 1984 and Devlin and others, 1985). From the Middle Cambrian to the Middle Ordovician, a shallow carbonate platform (or ramp) of low relief hundreds of kilometers wide surrounded most of the North American craton. Palmer (1960) recognized three concentric sedimentation belts in lower Paleozoic shelf rocks around the continent: 1) an inner detrital belt of fine terrigenous clastics immediately adjacent to the emergent craton; 2) a middle carbonate belt dominated by shallow water dolomite and limestone; and 3) an outer detrital belt of marine mudstone and argillaceous carbonates. Palmer's depositional belts were subsequently recognized in the scattered exposures of Cambrian-Ordovician sediments in the northwestern U.S. by Yates (1970), Harbour (1978 and 1980), Bush and Fischer (1979 and 1981), Fischer (1980, 1982 and 1984), Martin and others (1980), Cleveland (1982), Bush and others (1985) and Bush and Hayden (1987), who suggested that from the Middle Cambrian through the Lower Ordovician, a broad shallow-water carbonate platform covered present-day western Montana, northern Idaho and northeastern Washington. Its outer edge was thought to have been occupied by a narrow belt of oncolitic, algal shoals that protected shallow waters on the platform from open ocean conditions to the west, with algal shoals extending as far seaward as the present-day Columbia River. From the shoals landward, to the east, the vicinity of the Idaho-Montana border, was thought to have been covered by a progradational mosaic of tidal flats and shallow lagoons, while north-central Idaho and northwestern Montana were occupied by peritidal carbonate environments. Seaward of the algal shoals, the transition to basinal conditions was interpreted as a carbonate ramp inclined seaward at less than one degree.

Cleveland (1982), however, noted that low-gradient carbonate platform hypothesis did not accommodate the occurrence of such slope-related deposits as the intraformational breccia unit (the Fish Creek breccia lithofacies) of the Metaline Formation, landward of the proposed platform edge. Bush and Hayden (1987) also pointed out that the interpretation of a low-angle carbonate ramp in northeastern Washington was markedly different from that of equivalent rocks in southeastern British Columbia and southwestern Alberta. In that area, Aitken (1966, 1971, 1978 and 1981), Aitken and Norwood (1967) and McIlreath (1977) demonstrated that from Middle Cambrian through Middle Ordovician, the margin of the carbonate platform ended abruptly in a steep, and at times nearly vertical, "stationary accretionary rim" (the Kicking Horse Rim).

Like the Metaline Formation, the Kicking Horse rocks are thought to have been the westernmost Cambrian-Ordovician platform carbonate deposits. But unlike the Kicking Horse rocks, Cambrian-Ordovician carbonates north of the Metaline district are not recognized - instead their age equivalents are the Lardeau Group of basinal mudrocks. If Metaline and Kicking Horse rocks represent the edge of the Laurentian continental margin, there is an apparent and abrupt deflection between them of more than 180 miles. It is unclear if this is truly a paleogeographic feature, a subsequent structural artifact or a combination of the two. The continental margin passes through the region with a general present-day N-S orientation, but it is marked by a major E-W deflection in northeastern Washington that connects westernmost carbonate ramp deposits in Stevens County with age equivalent carbonate slope deposits in southeastern British Columbia. The slope-deposited Fish Creek Breccia of the Metaline Formation may have developed along this E-W feature, while the basin in which most Metaline sediments were deposited evolved south and east of it. Development of the continental margin in this region may have been influenced by basin-margin penecontemporaneous faulting and it is likely that the Metaline Formation was deposited on a separate and more rapidly subsiding tectonic block than coeval platform carbonates to the east.

Anomalous Regional Thickness of Cambrian Rocks

The thickness of the Metaline Formation was estimated by McConnell and Anderson (1968) to be 5000 to 6500-feet in the Metaline district, and by Yates (1976) to be 5400-feet in northern Stevens County. In contrast, the westernmost occurrences of Metaline equivalent rocks in southern Stevens County are only 1000 to 1500-feet thick. Similarly, in the Metaline district and vicinity, the combined thickness of Cambrian units, including the lower two-thirds(?) of the Metaline, may be more than 20,000-feet (McConnell and Anderson, 1968, p. 1464), a major anomaly in the regional isopach pattern. To the east, the thickest portion of the Cambrian section in northern Idaho is about 3000-feet (Peterson, 1986), similar to that in western Stevens County. Burmester and Miller (1983) and Miller (1983) noted differences in the lithology and thickness of the Later Proterozoic Monk and Three Sisters formations and in the Lower Cambrian Gypsy Quartzite, which may reflect penecontemporaneous movement in the vicinity of the Flume Creek fault. In Stevens County, the Leadpoint fault delineates formational changes in the Lower Cambrian Maitlen Phyllite and sharply limits the extent of the Metaline Formation. The regional isopach pattern suggests that Metaline sediments in northern Stevens and Pend Oreille counties may have evolved on a tectonic block separate from and with a much higher rate of subsidence than equivalent carbonates of the intracratonic basin to the east. Within this block, penecontemporaneous faulting may have been a continuing influence on Metaline deposition.

Cratonic Sequences, Sea Level and Stratigraphic Succession

The age ranges of Metaline and Ledbetter formations suggest that they are the respective local equivalents of uppermost Sauk and lowermost Tippecanoe Cratonic sequences (Sloss, 1963, Vail and Mitchum (1979) and Shanmugam and others (1985) along the western margin of Laurentian craton. However, most studies have identified neither a depositional nor a biostratigraphic hiatus between them. Instead, they indicate that they are partially coeval across a diachronous contact and that they are locally interdigitate and interbedded. As a result, the Middle Ordovician fall of eustatic sea level of 100m (Vail and Mitchum, 1979 and Shanmugam and others, 1985) thought to have been responsible for the mid-continent unconformity does not appear to have been sufficient to have exposed the sediments of either the Metaline or Ledbetter formations.

Tectonostratigraphic Affiliation

Metaline and Ledbetter formations were included by Hedley (1955) as among the southernmost units of the Kootenay Arc, a narrow tectonostratigraphic assemblage of highly folded and faulted rocks within the eastern Cordilleran fold and thrust belt of southeastern British Columbia and northeastern Washington. The arc includes Late Proterozoic through Jurassic sedimentary and volcanic rocks, situated between the Middle to Later Proterozoic deposits of the Purcell Anticlinorum to the east and the metamorphic and volcanic rocks of the Shuswap Complex to the west.

The arc juxtaposes eugeoclinal deposits such as the Lardeau and Covada groups, which contain immature clastics and volcanic rocks, with deposits reflecting more quiescent miogeoclinal environments such as the Metaline and Ledbetter formations. Some suggest that the eugeoclinal rocks represent terrain accreted to the miogeoclinal margin of North America (Laurentia) in the late Jurassic to Paleocene (Monger and Price, 1979, Coney and others, 1980 and Price, 1981).

The geographic position of the Metaline and Ledbetter formations is far to the west of equivalent miogeoclinal carbonates in southern British Columbia, northern Idaho and northwestern Montana. In part, as a result of this peculiar position, some authors have suggested that all or part of the Kootenay Arc, including Metaline and Ledbetter formations, belong to the 400-km wide belt of eugeoclinal terrain accreted to the miogeoclinal margin of the North American craton in the Late Jurassic to Paleocene (Monger and Price, 1979, Coney and others, 1980, and Price, 1980). However, this interpretation overlooks the absence in Metaline or Ledbetter rocks of mafic volcanics or immature clastics that would indicate eugeoclinal deposition. Neither does it account for the position of the Metaline Formation in the regional distribution pattern of Cambrian-Ordovician miogeoclinal carbonate deposits documented by Bush and Fischer (1979 and 1981) and Martin and others (1980). Yates (1976) also concluded that the Metaline Formation belongs to the westernmost assemblage of miogeoclinal deposits of North America.

Mineralization in the Metaline Formation

Various forms of Zn-Pb mineralization are known to occur in the upper half of the Metaline Formation in the Metaline mining district and elsewhere and are described in detail by Morton (1992). The two major types, Josephine and Yellowhead have yielded almost all of the ore within the district and in Stevens County. Both are known to be generally stratiform. Morton (1992) concluded that both Josephine and Yellowhead probably belonged on a continuum between Mississippi Valley Type (MVT) deposits and Irish type Zn-Pb deposits. Rhodes (2001) emphatically disagreed and considered them to be solely MVTs in the mold of Pine Point.

Josephine mineralization. – Josephine mineralization principally comprises discordant breccias with matrix of vuggy, coarse-grained calcite-quartz-jasperoid with erratically scattered coarse-grained sphalerite and galena that supports fragments of Josephine, gray massive limestone, and varied dolostone lithofacies. Lesser amounts of mineralization occur scattered in patches and stringers. Locally, some occurs along faults, some of which continue upward across the Ledbetter/Metaline contact. Sphalerite color is generally reddish brown, but is known to range in isolated occurrences from yellow and amber to pale gray

Yellowhead mineralization. – All of the Yellowhead production in the district to date has come from 2 spatially separate orebodies, the East Side Yellowhead deposit in the Pend Oreille mine and the West Side Yellowhead deposit about one half mile to the west. The Pend Oreille deposits occurs as the uppermost of at least 2 known mineralized zones of ore grade/thickness, while the stratigraphic position of the West Side deposit is unknown, but very likely not an uppermost zone. Drilling on Washington Rock to the south of the mine has shown that ore grade/thicknesses of Yellowhead mineralization occur in at least five vertically coincident zones in the upper 2500' of the formation and that they are separated from each other by 600' to 820' of barren dolostone of the light gray bedded dolostone lithofacies. In the Pend Oreille mine, the top of the uppermost Yellowhead zone varies from 800' to 1300' below the Ledbetter/Metaline contact and another zone has been identified locally at a depth of about 1600' below the contact. All of the known orebodies, including the 2 productive deposits occur along pronounced NNE linear ore trends that are subparallel to, but locally cut by, major normal faults. The ore trends are also subparallel to significant facies changes within the Metaline Formation.

The lateral boundaries of orebodies as well as the hanging- and footwall boundaries, as seen in closely space development drilling (50' centers), mining, and underground mapping are very irregular and commonly discordant. In addition, although there appears to be good continuity of the ore zones between adjacent drill holes, geologically discrete, individually assayed subintervals seldom exhibit even crude lateral continuity (see Morton, 1992, Figure 7). The boundary irregularities and the internal discontinuity of ore subzones appear to contribute to inaccuracies in some methods of ore reserve calculation and may contribute to the over-estimation of ore reserve tonnages and grade relative to the apparent dilution and deletion that accompany actual mining.

Yellowhead orebodies occur within much more extensive envelopes of barren pyrite mineralization and although the envelops have much more lateral (and stratigraphic) extent, they do not appear to be laterally extensive enough to warrant the term "horizon." As a result, a hole can be drilled through an ore intercept at a measured interval below the Ledbetter/Metaline contact in one area and another hole can be drilled through the same interval a mile or so distant (but off the ore trend), and be completely free of pyrite.

Ledhead mineralization. – In the 1990s, surface drilling north of the Pend Oreille mine and development drifting in the northern portions of the mine encountered peculiar intercepts that did not appear to be either Josephine or Yellowhead mineralization, but an erratically localized combination of the two. The occurrences were located in varied dolostone and Josephine rocks and in the lowermost portions of the Ledbetter. They consisted of massive barren pyrite with the appearance of a bedded pyrite sand cemented by silica, mixture of pyrite and yellow, brownish red to amber sphalerite in very fine-grained bedding layers in disrupted black argillite and dark gray to black massive to bedded dolostone.

Other forms of Metaline mineralization. – Several other forms of Zn-Pb mineralization are known to occur in other parts of the district and in Stevens County (Gladstone Mt., Electric Point), but most of these appear to be largely fracture filling involving high-Ag galena and not directly related to Josephine or Yellowhead mineralization.

Possible genetic relationships. - To date, a clear genetic relationship between the 2 principal types of Zn-Pb mineralization has not been established. However, it seems unlikely that they are geographically coincident, of similar sulfide mineralogy (low-Ag galena) and were formed at temperatures in the same range and are unrelated. Both also appear to have some vague relationship to early structure (Josephine mineralization along faults that do not offset the Ledbetter/Metaline; distribution of Yellowhead mineralization in multiple, vertically coincident zones sub-parallel to post-ore faults and to Metaline stratigraphic features). Although almost all of 3 types of mineralization are clearly epigenetic, minor amounts of Josephine and Ledhead mineralization appear to have a syngenetic component (extremely fine-grained layered sphalerite beds[?] in otherwise unmineralized black argillite). From an exploration standpoint, the possibility that all 3 forms of Zn-Pb mineralization may belong to the same mineralizing system shouldn't be discarded out of hand.

Several aspects of Yellowhead mineralization suggest a somewhat obscure component of structural control of mineralization, while the vast lateral extent of some Yellowhead zones suggest a strong component of stratigraphic and/or hydrostatic control.

Folding

The major folds in the Metaline district are the Boundary Anticline and the few associated lesser structures such as the Grandview anticline/syncline - broad NE-oriented structures. Another type is the tight asymmetrical anticlines just above local thrusts like the Riverside anticline directly above Lee Thrust and the upright and overturned folds in the Ledbetter that lie above the base of the Slate Creek Thrust zone exposed along the west bank of the Pend Oreille River at the Pend Oreille mine. A third class of folds are exposed in only one place that I am aware of. The peninsula that separates the embayment of Lime Creek from the main body of the Boundary Dam Reservoir comprises a block of light gray bedded dolostone that is intensely deformed into complex ductile folds unlike any others in the district. This structure is so out of place amidst the gently-dipping rocks surrounding it that it is likely to have been down-dropped into its current position by normal faults from a possible previous position within the overlying Slate Creek thrust zone.

Normal Faulting

Several major SSW-NNE normal faults are known to pass through the Metaline district with several hundred to more that a thousand feet of displacement. These include such structures as the Chickahominy, YA-Riverside, Slate Creek and Lead Hill faults (and possibly the Flume Creek fault). These appear to be associated with and are commonly offset by secondary faults with displacements a few feet to several hundred feet. Both major and secondary faults are intruded locally by basalt dikes.

Thrust faulting

The Slate Creek thrust zone (Morton, 1992, Figure 5) was devised to account for the occurrence of highly contorted Ledbetter rocks of Lower Ordovician age (Carter, 1989a and Park, 1937) lying topographically above gently dipping Middle Ordovician Ledbetter rocks (Carter, 1989a) and to explain the drill indicated easterly dip of the "Slate Creek" fault east of the Pend Oreille mine. It was envisioned as a zone on the order of a thousand feet thick largely comprising highly contorted Ledbetter black argillites and lesser amounts of jumbled blocks of other formations between upper and lower thrust planes. The zone separates gently-dipping rocks below from intensely folded older rocks above. As far as I know, neither the upper nor lower plane has been positively identified on the surface or in drill core, but it is the only solution of which I am aware that addresses the observed juxtaposition of contorted older rocks lying above gently-dipping younger strata. Several other thrust faults have been mapped in the Metaline district and Stevens County and others have been recognized underground or interpreted from less direct evidence. Most of these appear to involve movement in or along black argillites. In the Pend Oreille mine at least one such fault, unrelated to black argillite slippage, was recognized as a 2' thick zone of recrystallized dolostone gouge roughly parallel to bedding just below the uppermost Yellowhead zone. The amount or direction of movement along local thrust faults has not yet been determined and they appear to be offset by major and secondary normal faults.

Igneous rocks

Very few igneous rocks are recognized in the Metaline district or immediately adjacent areas. Vesicular basalt (lamprophyre) dikes are recognized as intrusions along normal faults, some basalt flows occur in the center of the district and a unique intrusion of spherolitic rhyolite occurs on Boundary Mountain SW of the Libby claims.

GEOLOGY OF LIBBY CLAIM BLOCKS 1 & 2

The accompanying map and sections suggest that the Libby claims cover rocks of the steeply-dipping Maitlen, Metaline and Ledbetter formations on the SE limb of the gently-plunging Boundary anticline. The appear to be cut by the major Lead Hill and Slate Creek faults and numerous secondary faults. The following is based on the geology observed in the field, interpreted from the resultant map and sections A-A', B-B', C-C' from the drill logs and sections accompanying Olfert (1994) and Christopher (1991) and by comparison with similar rocks in the Metaline mining district and other areas in which the Metaline and Ledbetter formations are exposed.

Stratigraphy

<u>*Maitlen Phyllite*</u>. – The few exposures of dark gray limey phyllite along the new road that runs north along the Southwest Fork of Lead Creek appear to belong to the Maitlen Phyllite. The hillside west of the road is also underlain by the Maitlen, which

was observed only as float. The Maitlen was also intersected in drill hole DDH LB93-7 where the contact with the overlying bedded lime mudstone lithofacies of the Metaline appears to be sharp and unfaulted.

Metaline Formation. – DDH LB93-7 intersected more than 120' of interbedded black argillite, dark limestone and dolostone of the bedded lime mudstone lithofacies at the bottom of the Metaline before crossing the gradational transition into the Maitlen. Where the contact with the Maitlen crosses Highway 3 and bears north, it is interrupted by numerous small faults, but also appears to be a gradational contact. The bottom of the Metaline Formation exposed at that point doesn't include much if any of what would normally be labeled the bedded lime mudstone lithofacies and almost the entire section above there comprises an altered and brecciated version of the light gray bedded dolostone lithofacies, although so much of it is obscured by glacial sediment and colluvium, it is difficult to say with certainty. Surface exposures suggest that much of this part of the section is highly altered, brecciated and cut by intense silicification in the form of jasperoid and quartz in veins and patches.

Even with the amount of glacial and soil cover, what would appear to be the entire thickness of the Metaline Formation is exposed here and it is considerably different than that in the central portions of the Metaline district (in the vicinity of the Pend Oreille mine) only a dozen miles to the southwest. It is even substantially different from the exposures on Lead Hill or Boundary Mountain to the immediate southwest.

Crude measurement of the thickness of the Metaline Formation made on the sections shows considerable variation: Section A-A' – 5400'; Section B-B' – 4800'; Section C-C' – 4200'. The thickness estimated at Section A-A' is in the range estimated by McConnell and Anderson (1968) - 5000' to 6500' - and is identical to that estimated in northern Stevens County by Yates (1976). The apparent northward thinning of the section on the Libby claims could be the result of faulting (for instance – how much of the top of the section to the north may be cut out by the Lead Hill fault?) or it may be due to an actual decrease in the stratigraphic thickness to the north. The current lack of understanding doesn't allow for an informed decision between either option.

In general the Metaline section exposed on the Libby claims appears to be significantly different than the rocks exposed in the Pend Oreille mine: there are far fewer discrete occurrences of shale or argillite, the gray massive lime mudstone lithofacies is absent, apparently having wedged out completely on Lead Hill, and there is no indication of the presence of the variety of lithologies that make up the varied dolostone lithofacies. While much of the Metaline section exposed on the Libby claims appears to comprise breccia, there doesn't appear to have been much rotation of the larger fragments (some measuring tens of meters on a side), although local bedding attitudes can vary wildly. On Lead Hill, the dark variably siliceous dolostones and dolostone breccias of the Josephine lithofacies are concentrated near the top of the Formation and have the appearance of a stratigraphic lithofacies. At the relatively flat ridge top where Lead Hill crosses the border, that situation breaks down into chaos and although I have explained it on the map with a number of faults, the "stratigraphy" there is still pretty much a mystery.

Ledbetter Formation. – Little time was spent on the Ledbetter, but from float and the few exposures, it appears to be pretty much the same as to the south; largely black argillite with at least one lens of light to dark gray, fine-grained, supermature quartzite.

There are also some exposures of fine-grained, dark gray, massive siliceous dolostone that is indistinguishable from some of the Josephine exposures west of (stratigraphically below) the contact. Due to the lack of exposure, it is unclear if these originated as dolostone lenses in the Ledbetter, or if they are pieces of the Josephine that were jumbled in with the Ledbetter within the Slate Creek thrust zone and then down-dropped into their current position along the Lead Hill fault. The latter was proposed for a similar dolostone/argillite juxtaposition on the Bluebird claims farther to the south.

Mineralization

Zn-Pb mineralization exposed at the Yellow Zinc prospect and the Ed showing do not appear to be associated with pyrite and are, therefore, not likely to be Yellowhead. They appear to be partially fault/fracture related. Conceivably, they may represent some form or remobilization of Yellowhead sulfides at depth, but that is just conjecture. Little in the way of oxides or metal carbonates was noted in soil or outcrop, but this was such cursory examination that they could easily have gone unnoticed.

In the 1980s I relogged Vanguard's SC holes and noted Yellowhead mineralization in what I recall was SC-9 of approximately 10' of 2% Zn accompanying abundant pyrite. Together with the intercepts in LH93-1 and LH93-2, and the oxides on the surface of Lead Hill at multiple stratigraphic positions they suggest the likelihood that Yellowhead mineralization in at least one Yellowhead zone continues northward through the Libby claim blocks.

Folding

The relatively competent rocks of the Metaline Formation are steeply-dipping in accordance with their position on the SE flank of the Boundary Anticline, but are otherwise free of folds. The much less competent Ledbetter Formation appears to be highly contorted within the postulated Slate Creek thrust zone. It's low resistance to compression may be a principal reason for the location of the thrust zone in the first place. The Maitlen Phyllite is tightly folded on a small, local scale (greatly exaggerated in the accompanying sections), but otherwise appears to conform to the broad open folding of the Boundary Anticline.

Normal Faulting

The section through DDH93-4 suggests that although the contact may be faulted, both the Metaline and Ledbetter in that area dip steeply eastward, so the major normal fault that brings the steeply eastward dipping argillite in contact with the steeply westward dipping argillite (the Lead Hill fault?) may lie farther to the east.

The Mystery Mountain fault of Dings and Whitebread (1965, pl. 1) likely crosses the border and follows the southwestern fork of Lead Creek, but is entirely obscured there below glacio-fluvial sediment. No trace of it could be found on the north side of Highway where exposure is excellent.

It is also likely that glacio-fluvial sediment obscures a major WNW-ESE fault along the South Salmo River shown on Fyles and Hewlett's (1959) map that probably extends into the Libby area causing the apparent offset of both stratigraphy and the NNE Lead Hill fault.

Thrust faulting

The Slate Creek thrust zone (Morton, 1992, Figure 5) is shown on the sections to account for the occurrence of the contorted Ledbetter black argillites between intensely folded Maitlen and much less contorted Metaline rocks.

CONCLUSIONS

Nothing was noted in the surface exposures or soils on the Libby claim blocks which would indicate that Yellowhead mineralization which may underlie the claims actually reaches the surface. However, there is abundant evidence to suggest that Yellowhead in one of the multiple zones known to extend into the Lead Hill area immediately to the south. Yellowhead mineralization and ore occur in at least 5 separate, vertically coincident zones in the upper 2500' of the Metaline Formation in and around the Pend Oreille mine. Ore in at least 2 zones is known to occur along pronounced SSW-NNE linear trends that crudely parallel major post-ore normal faults that extend into the Libby area. Yellowhead mineralization has been encountered in drilling north of the Pend Oreille mine, in the East Riverside area, in the Bluebird area and in Lead Hill immediately south of the Libby claims. The galena-bearing pyrite nodules recovered by Mills (1974) north of the Salmo River also indicate the presence of Yellowhead mineralization passing through the claims. The numerous surface exposures of Fe-oxides and drill intercepts in multiple zones in the Lead Hill area indicate a good probability that one or more of these zones underlie the Libby claims.

The surface mapping suggests that there are major faults running through the area which may be accompanied by significant movement on secondary cross faults. This suggests further that as much geology as possible should be squeezed out of all the available outcrops before proceeding with any drilling.

Mapping for this project did not encounter surface evidence of Yellowhead mineralization on the Libby claims, but that is not surprising, considering the amount of glacial and colluvial cover and the depth of weathering indicated by previous drilling. Nor could this study cover all of the Libby ground in the available time.

The amount of silica present in the vicinity of the Yellow Zinc and North Ridge prospects is even higher than one would normally expect around Josephine mineralization, although it does appear to decrease somewhat to the north and across Highway 3. It's abundance in almost all of the section below the Josephine lithofacies is something of an anomaly.

On the SE end of North Ridge, the presence of Josephine exposures in close proximity to extensive quartzite beds surrounded by black argillite float is very similar to the situation observed on Blue Bird Ridge to the south of Lead Hill. There, Dings and Whitebread (1965) interpreted the odd juxtaposition as a lens of dark gray siliceous dolostone in Ledbetter black argillite. My own mapping of the Bluebird area, in conjunction with a re-evaluation of the more than 20 core holes drilled in the 1950s by

American Zinc, suggested that the dolostones belong to the Josephine lithofacies that had been caught up in the Slate Creek thrust zone, thrust over the Ledbetter/Metaline contact and then down-dropped by the Slate Creek normal fault. I interpret an almost identical situation here. Admittedly, it is not an elegant solution, but it does help explain a rather messy set of observations.

It seems likely, given the somewhat chaotic distribution of lithofacies near the border, that the Lead Hill fault continues on into BC and that it is accompanied by number of related cross faults in that area

The steep dip of Metaline rocks on the Libby claims could serve as an advantage in the development of Yellowhead deposits because surface exploration drilling could be conducted from stratigraphic positions either above or below suspected mineralized zones. In addition, should orebodies be discovered, the steep dip might allow the use of underhand mining methods that take advantage of the gravity flow of muck and employ low-headroom equipment, rather than the trackless room and pillar mining used to mine the gently-dipping orebodies in the Metaline district and that appear to be plagued by both excessive dilution and deletion.

RECOMMENDATIONS

All of the core available from the Libby claim blocks and Lead Hill should be relogged and photographed. Standard descriptive terms and those with the least genetic connotation should be used. Jargon should be completely eliminated. A library of descriptive terms accompanying photographs of the features they describe should be maintained so that all subsequent geologists and mining personnel can be “on the same page”. A drill log format that is suitable both for the type of rocks and ore anticipated, but that can also be readily entered into a computer program. Electronic data loggers might also be suitable and could eliminate transcription of hand written logs. A graphic summary log of each hole should also be produced.

The entire area should be remapped using the most modern equipment available (and affordable) and all outcrops should be recorded. The use of RTK GPS devices should be considered - they could eliminate the need for subsequent surveying. Much more attention should be paid to modifying topographic contours than was done in this study - this could help identify faults that might not be recognizable otherwise. The use of data-loggers (readily obtained from Sokkia, Garmin, DeLorme, Magellan, Trimble, etc.) should also be considered to avoid costly and time-consuming transcription by hand. Once the geologic data is in a digital format, it can be entered into one of many available 3-D programs that can produce maps, sections and 3-D models almost instantaneously.

The results of past geophysical and soil geochemistry programs suggest that these might not be the best exploration tools to apply to the Libby claims.

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AUTHOR'S QUALIFICATIONS

As author of this report, I certify that:

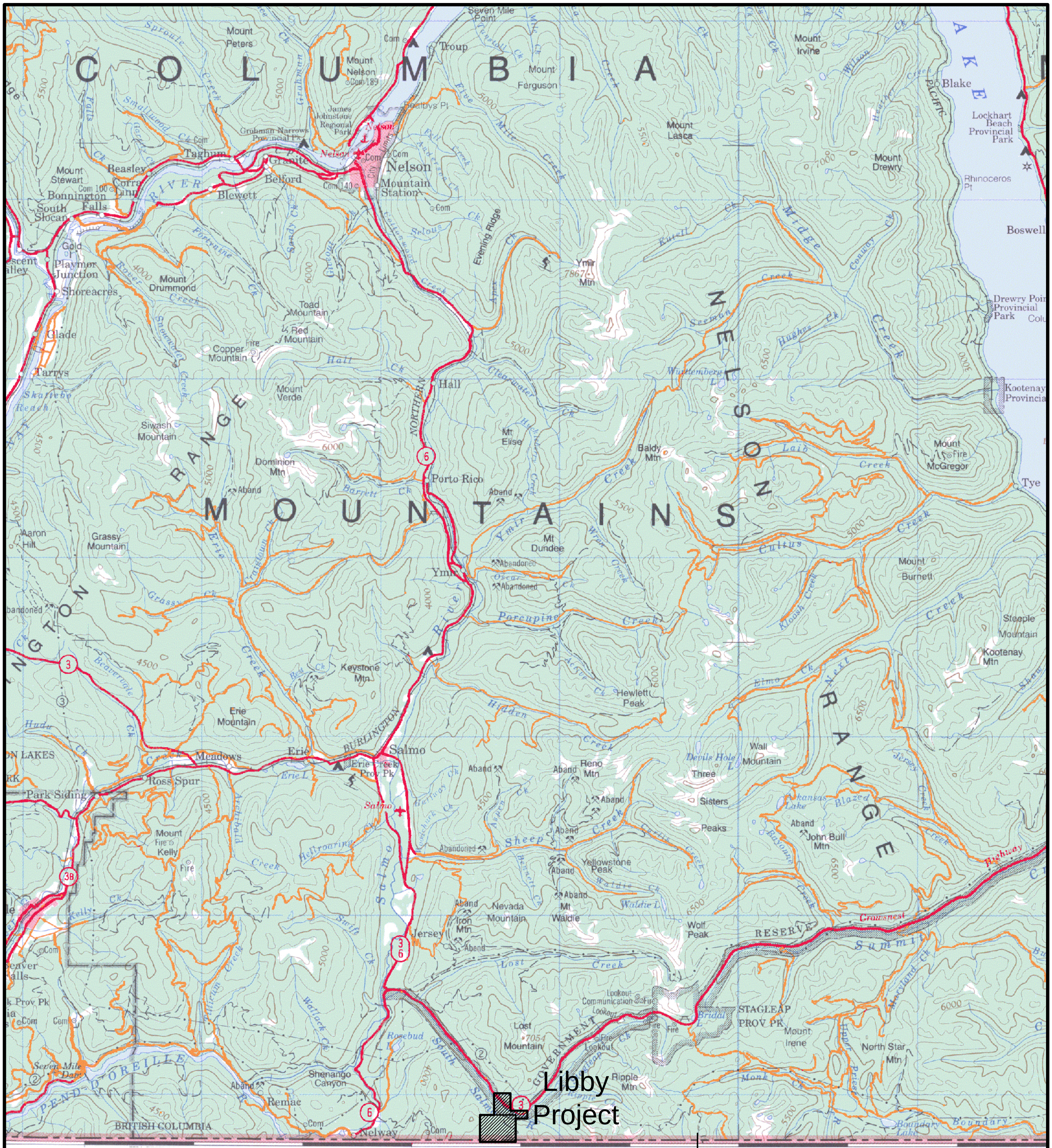
1. I received a BA in geology from California State University, Chico in 1970 and an MS in geology from Washington State University, Pullman in 1974.

2. I completed an MS thesis that was an in-depth investigation of the West Side Yellowhead deposit and similar deposits in the Metaline mining district, Pend Oreille County, NE Washington State that included surface and underground mapping and ore microscopy.

3. I have been employed as a geologist, geologic consultant and contract geologist with mining and minerals exploration companies from 1974 to the present, including GRC Exploration, Pintlar Corp., Resource Finance Inc., and Cominco American at the Pend Oreille mine. I have also been retained by Metaline Contact Mines and Guinet Management elsewhere in the Metaline mining district and I have also been employed as a geologist in other areas by Norandex, Homestake, Atlas Minerals and PT Freeport Indonesia. Since 1979, much of my work has involved geologic mapping in and around the Pend Oreille mine, both underground and on surface throughout the Metaline mining district and in equivalent rocks in Stevens County, including the surface geology of the Bluebird claim group and portions of Lead Hill. I have also logged thousands of feet of core drilled throughout the district.

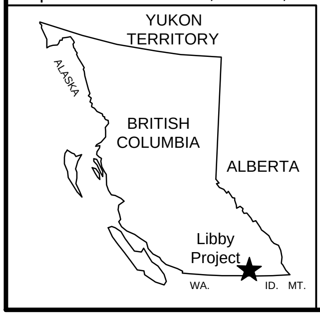
4. I have published peer-reviewed journal articles and given public presentations on the geology and Zn-Pb mineralization in the Metaline district (see "**REFERENCES CITED**" under "Morton").

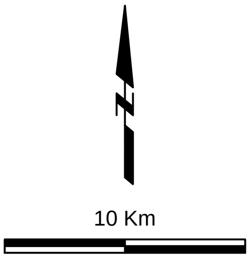
Jack A. Morton
Geologist
31 July 2012



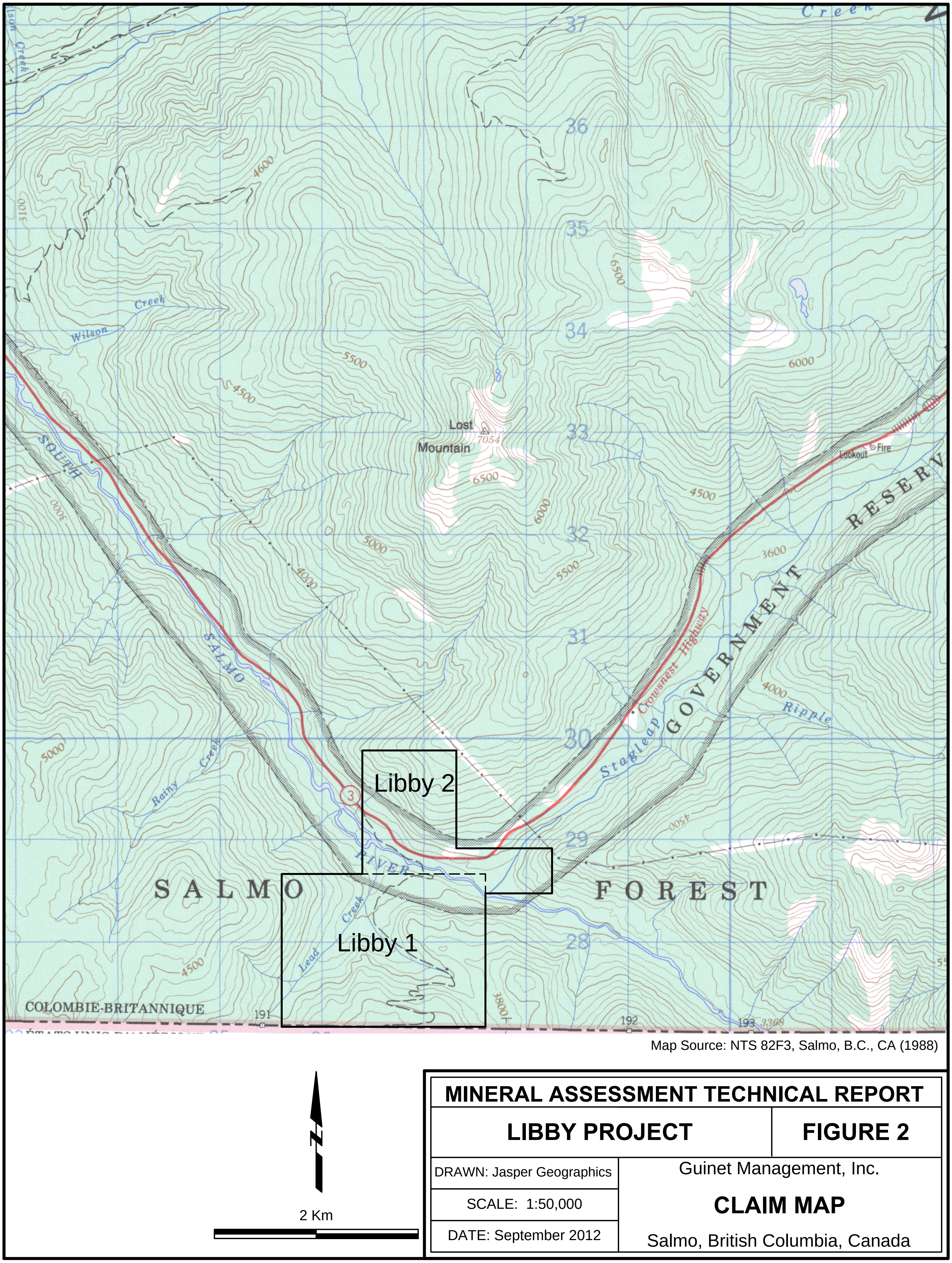
Map Source: NTS 82F, Nelson, B.C., CA (1995)

WASHINGTON | IDAHO

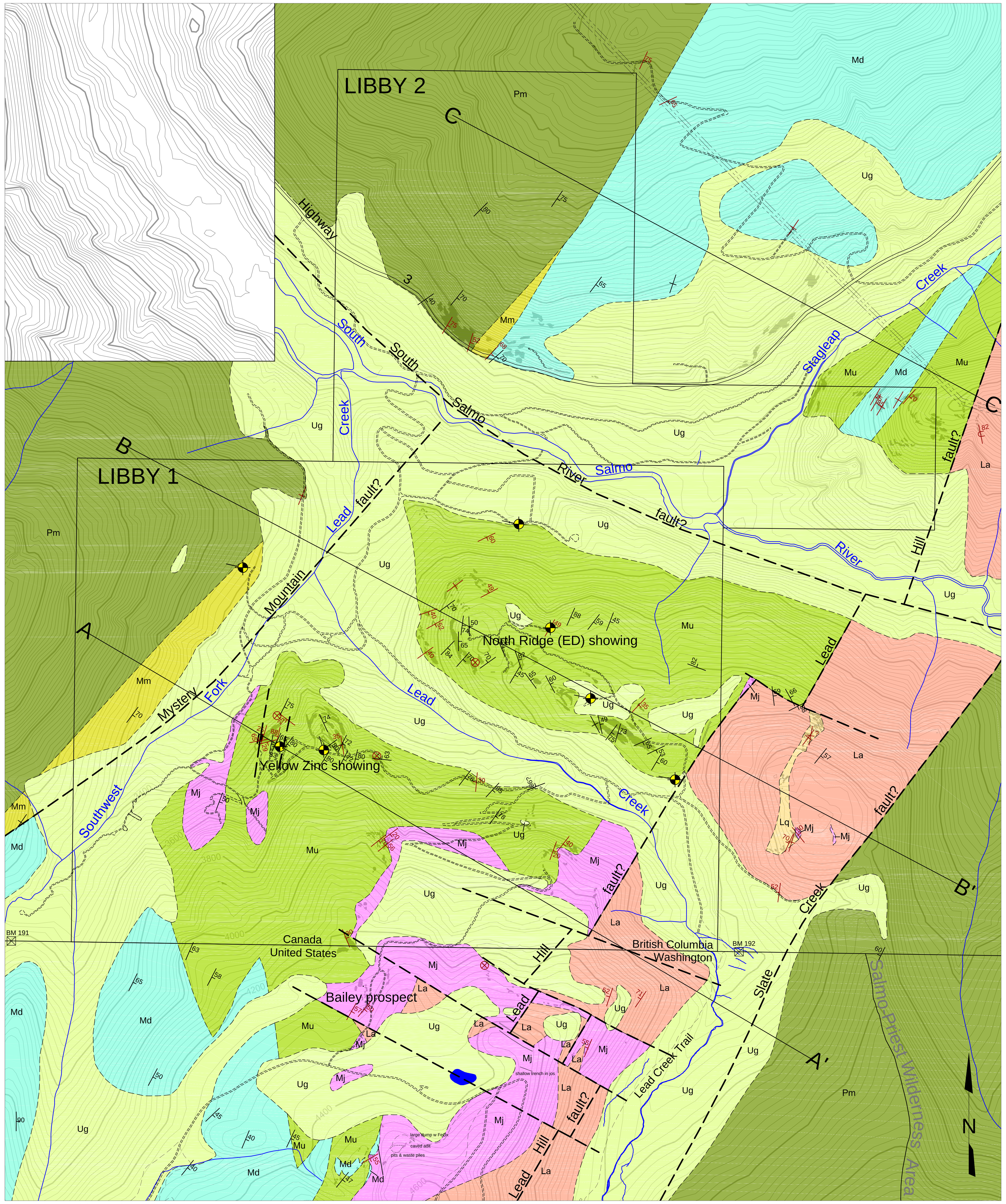




MINERAL ASSESSMENT TECHNICAL REPORT	
LIBBY PROJECT	**FIGURE 1**
DRAWN: Jasper Geographics	Guinet Management, Inc.
SCALE: as shown	**PROPERTY LOCATION**
DATE: September 2012	Salmo, British Columbia, Canada



MINERAL ASSESSMENT TECHNICAL REPORT	
LIBBY PROJECT	FIGURE 2
DRAWN: Jasper Geographics	Guinet Management, Inc.
SCALE: 1:50,000	**CLAIM MAP**
DATE: September 2012	Salmo, British Columbia, Canada



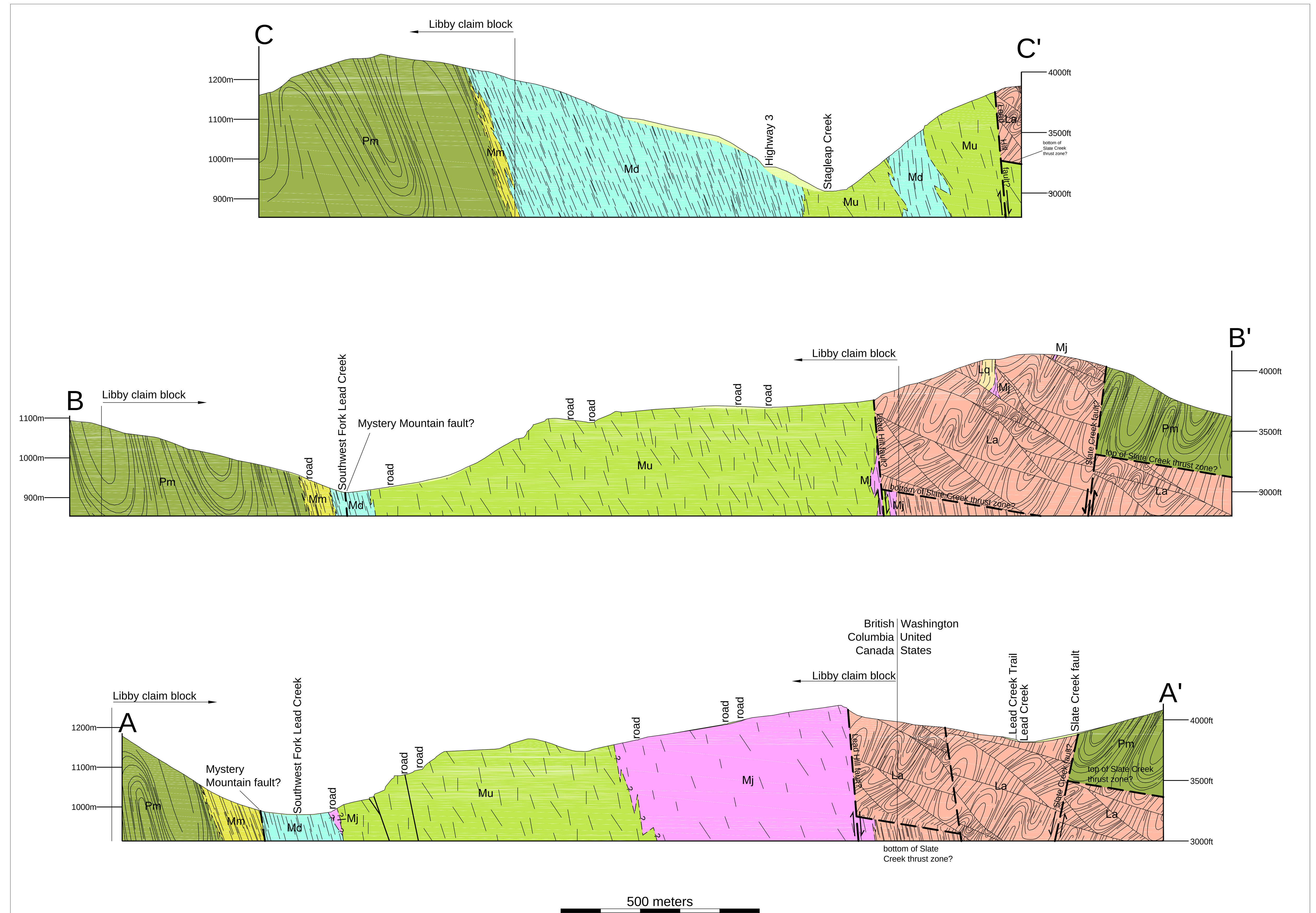
prepared for: Guinet Management Inc. by: Jack A. Morton date: 31 July 2012

500 meters

Geologic Map of Libby Claim Blocks 1 and 2

Salmo Pb-Zn Area
Nelson Mining Division
Southeastern British Columbia

NTS 82 F
Latitude 49 N
Longitude 117 W



prepared for: Guinet Management Inc. by: Jack A. Morton date: 31 July 2012

Geologic Cross Sections A-A', B-B' and C-C'

Salmo Pb-Zn Area
Nelson Mining Division
Southeastern British Columbia

EXPLANATION

Lithologies

Observed in outcrop (darker shade)
Inferred from float or previous maps (lighter shade)

Pleistocene to Recent
- Ug — Undifferentiated alluvial, glacial, glacio-fluvial and glacio-lacustrine unconsolidated sediment

Ledbetter (Active) Formation Lower Ordovician through Silurian
- La — Black argillite
- Lq — Light to dark gray, fine-grained, supermature quartzite

Metaline (Nelway) Formation - Middle Cambrian through early Middle Ordovician
- Mj — Josephine lithofacies - dark gray to black, variably siliceous fine-grained dolostone and dolstone breccia
- Mu — Dolostone of uncertain lithofacies affiliation (but likely light gray bedded dolostone lithofacies)- variably altered and/or brecciated, locally intensely silicified, light gray to black, massive to bedded dolostone
- Md — Light gray bedded dolostone lithofacies - light gray to black fine-grained, bedded to massive dolostone
- Mm — Bedded lime mudstone lithofacies - medium to dark gray and black thinly bedded to massive argillaceous lime mudstone, phyllitic lime mudstone and argillite

Maiden Phyllite Middle Cambrian
- Pm — Medium to dark gray and black phyllite and limey phyllite

MAP SYMBOLS

- Bedding Attitude from literature - inclined, overturned, horizontal, vertical
- Bedding Attitude observed - inclined, overturned, horizontal, vertical (Morton 2012)
- Contact, inferred (Morton, 2012)
- Fault, measured (Morton, 2012)
- Fault, inferred (Morton, 2012)
- BM 192 Border Monument
- Ramrod Drill Hole Collar, with inclination

MINERAL ASSESSMENT TECHNICAL REPORT	
LIBBY PROJECT	FIGURE 3
CMPLD: Jasper Geographics	Guinet Management, Inc.
SCALE: As Shown	GEOLOGIC MAP & CROSS SECTIONS
DATE: September 2012	Salmo, British Columbia, Canada

<u>Costs Incurred by</u>:
Jack A. Morton, Geologist,
2115 Friendly Grove Road NE
Olympia, WA 98506
phone: 360-705-0150
e-mail: jackamorton@comcast.net

For services rendered under Consulting Agreement with Guinet Management Inc., 2 February 2011

<u>Period: 1 – 30 June 2012</u>

<u>Monday, 4 June</u>

Research geology and mineral deposits of the Metaline (Nelway) Formation and Ledbetter (Active) Formation in southeastern BC and NE Washington in personal library and Internet……………………………………………………**1 day**

<u>Tuesday, 5 June</u>

Research geology and mineral deposits of the Metaline (Nelway) Formation and Ledbetter (Active) Formation in southeastern BC and NE Washington in personal library and Internet……………………………………………………**1 day**

<u>Wednesday, 6 June</u>

Research geology and mineral deposits of the Metaline (Nelway) Formation and Ledbetter (Active) Formation in southeastern BC and NE Washington in personal library and Internet……………………………………………………**1 day**

<u>Thursday, 7 June</u>

Research geology and mineral deposits of the Metaline (Nelway) Formation and Ledbetter (Active) Formation in southeastern BC and NE Washington in personal library and Internet……………………………………………………**1 day**

<u>Friday, 8 June</u>

Drive Nelway border crossing to Salmo, Salmo to Libby work site and return to Salmo. Drive Salmo to Castlegar and return for Guinet package pick-up. Establish contact with Sunshine Logging Co. at work site. Road recon. North and south of Hwy. 3. Partial rain.

Mileage…………………………………………………………**52 P (pavement) mi**
Mileage…………………………………………………………**5 OP (off-pavement) mi**
Payment, CBSA/ASFC, Work Permit #GR000000047T (RA)……………………**C$150.00**
Payment, Shop Easy Grocery Store, GPS batteries (RA)……………………………**C$7.83**
Payment, Shop Easy Grocery Store, groceries (RA)………………………………**C$84.69**
Payment, Greyhound for collect package from Guinet (RA)…………………………**C$29.38**
Payment, Sal-Crest Motel, 7 days (8-14 June, RA)……………………………………**C$588.00**

Saturday, 9 June

Drive to Libby work site and return, map Lead Hill ridge from east side at Lead Creek westward along Canada/US and down west side through YZ prospect. Look for Led/Met contact. Back to truck through logging operations in Block 2. Partial rain.

Mapping – 9 hours……………………………………………………………………**1 day**
Mileage……………………………………………………………………………**28 P mi**
Mileage……………………………………………………………………………**5 OP mi**

Sunday, 10 June

Drive to Libby work site and return, map Lead Hill ridge start of old road along W branch of Lead Creek to Canada/US and down through western portion of YZ prospect. Rain.

Mapping – 5 hours……………………………………………………………………**5 hrs**
Mileage……………………………………………………………………………**28 P mi**
Mileage……………………………………………………………………………**5 OP mi**

Monday, 11 June

Drive to work site and return. Heavy rain.

Mileage……………………………………………………………………………**28 P mi**
Mileage……………………………………………………………………………**2 OP mi**

Tuesday, 12 June

Drive to Libby work site and return. Map Lead Hill ridge from west side road up W. Branch Lead Creek southerly to Canada/US border and down parallel route. Partial rain.

Mapping – 10 hours…………………………………………………………………**1 day**
Mileage……………………………………………………………………………**28 P mi**

Mileage……………………………………………………………………………….4 OP mi
Payment, Shop Easy Grocery Store, groceries (RA)………………………………C$12.45

Wednesday, 13 June

Drive to Libby work site and return, map Lead Hill ridge from east side at Lead Creek westward along old road to Canada/US border and Bailey prospect and down alternate old road to YZ prospects. Partial rain.

Mapping – 9 hours……………………………………………………………………1 day
Mileage…………………………………………………………………………….28 P mi
Mileage……………………………………………………………………………….3 OP mi
Payment, Pend d'Oreille Steak, dinner (RA)………………………………………C$30.18
Payment, Shop Easy Grocery Store, groceries (RA)………………………………C$2.49

Thursday, 14 June

Drive to Libby work site and return, map Lead Hill ridge up center of ridge to Canada/US border and parallel route through interspersed outcrops. Partial rain.

Mapping – 7 hours……………………………………………………………………7 hrs
Mileage…………………………………………………………………………….28 P mi
Mileage……………………………………………………………………………….4 OP mi

Friday, 15 June

Drive to work site and return, map lower central Lead Hill ridge. Rain.

Mapping – 7 hours……………………………………………………………………7 hrs
Mileage…………………………………………………………………………….28 P mi
Mileage……………………………………………………………………………….5 OP mi
Payment, Shop Easy Grocery Store, groceries (RA)………………………………C$14.37

Saturday, 16 June

Drive to Libby work site and return, map North Ridge from E to W. Drive new log road through Block 3, map from drill site up ridge to W and back down and along new road. Rain.

Mapping - 10 hours……………………………………………………………………1 day
Mileage…………………………………………………………………………….28 P mi
Mileage……………………………………………………………………………….4 OP mi
Payment, The Salmo Pump, 2 sets GPS batteries……………………………………C$15.21

Sunday, 17 June

Drive to Libby work site and return, map North Ridge from log landing on SW to NW and along N side of ridge from E to W. Rain.

Mapping – 7 hours……………………………………………………………………**7 hrs**
Mileage……………………………………………………………..…..…………..**28 P mi**
Mileage……………………………………………………………...…..…………..**3 P mi**
Payment, Shop Easy Grocery Store, groceries (RA)……………………….....……**C$22.35**

Monday, 18 June

Drive to Libby work site and return. Map North Ridge from cliffs above log landing on NW to NE along N side of ridge. Recon route to Stagleap Creek and stream crossing. Map along and above Hwy 3. Partial rain.

Mapping – 9 hours…………………..……………………………………………**1 day**
Mileage……………………………………………………………..….…………..**30 P mi**
Mileage……………………………….…………………….....…..…………..**3 OP mi**

Tuesday, 19 June

Drive to Libby work site and return. Steady rain.

Mileage……………………………………………………………………………..**30 P mi**
Mileage…………………………………………………………..…………..**3 OP mi**

Wednesday, 20 June

Drive to Libby work site and return. Hike in to Stagleap Creek, cross stream and map to top of NE ridge with transmission towers and as far E as Lead Hill fault and descend back to stream and out to truck. Drive to top of NW ridge with transmission towers and map along road from top to bottom and along Hwy 3. Clear.

Mapping – 11 hours…………………………………………..……………………**1 day**
Mileage……………………………………………………………..……..………**30 P mi**
Mileage…………………………………………………………….….…………..**3 OP mi**
Payment, Sal-Crest Motel, 6 days (16-21 June, RA)…………….………….……..**C$530.88**

Thursday, 21 June

Drive return trip Salmo-Nelway border crossing.

Mileage………………………………………………………………….....……1**3 P mi**

Saturday, 23 June

Scan field maps and rubbersheet into AutoCAD base map drawing.…………..……**6 hrs**

Monday, 25 June

Digitize field sheet data into AutoCAD drawing……………………………...……**4 hrs**

Tuesday, 26 June

Digitize field sheet data in AutoCAD drawing……………………………...………**6 hrs**

Wednesday, 27 June

Digitize field sheet data in AutoCAD drawing……………………………...………**6 hrs**

Thursday, 28 June

Digitize field sheet data in AutoCAD drawing……………………………...………**6 hrs**

Friday, 29 June

Digitize field sheet data in AutoCAD drawing……………………………...………**6 hrs**

Saturday, 30 June

Digitize field sheet data in AutoCAD drawing……………………………...………**6 hrs**

Period: 1 – 30 June 2012

Sunday, 1 July

Construct Libby sections in AutoCAD…………..…………………………...………**6 hrs**

Monday, 2 July

Construct Libby sections and send both map and sections to Jasper Geographics…..**1 day**

Tuesday, 3 July

Write preliminary report on Libby geology………………………...………...………**1 day**

Wednesday, 4 July

Write and edit report on Libby geology…………………………………...………**1 day**

HOURLY/DAILY CHARGES

(70 hours @ US$52/hr)US$3640.…………………………...…**C$3731.00**
(13 days @ $400/day)US$5200…………………..…….….…..**C$5330.00**

SUBTOTAL………………….…………………………C$9061.00

OTHER CHARGES

Payment, CBSA,ASFC Work Permit……………………………**C$150.00**
Payments, Shop Easy Grocery Store……………………….…**C$144.18**
Payment, Greyhound…………………………………………..**C$29.38**
Payments, Sal-Crest Motel……………………………………..**C$1118.88**
Payment, Pend d'Oreille Steak……………………………..…..**C$30.18**
Payment, Salmo Pump……………………………….…………**C$15.21**
Mileage on-pavement - 407 miles @ US$0.45/mi (US$183.150
……………………………………………………………....**C$187.72**
Mileage off-pavement - 52 miles @ US$0.90/mi (US$46.80)
……………………………………………………….........**C$47.97**

SUBTOTAL OF OTHER CHARGES (US$)……......C$1732.52

TOTAL……...………..…..…………………………...……C$10784.52

Costs Incurred by:

Janet Elliot
Jasper Geographics
P.O. Box 417
Priest River, Idaho 83856
phone: 208 448-2205
e-mail: jmodene.elliott@gmail.com

Working on this project as staff for:

Klepfer Mining Services, LLC
13058 Sherwood Court
Hayden Lake, ID 83835
phone: 208-772-6993
e-mail: eric@klepfermining.com

Period: 1 – 30 September 2012

Janet Elliot CAD operation 16 ½ hours @ US$66/hr (US$1089)……………**C$1116.23**

TOTAL……………………………………….. C$1116.23

<u>Costs Incurred by</u>:
Vic Guinet, President and CEO
Guinet Management Inc.
46349 Hope River Road
Chilliwack, British Columbia V2P 3P4
Canada
phone: 604-928-5519
e-mail: vicguinet@yahoo.ca

<u>Period: 1 – 30 June 2011</u>

Vic Guinet

Travel Chilliwack to Libby work site and return 2 days @50%XC$200/day........…**C$200**

June 11

Prospecting new logging roads on Libby claims 1 day @CS200/day………………**C$200**

Expenses @C$100/day…………………………..………………………………**C$100**

Travel Libby work site to Chilliwack, 1 day @50%C$200/day……….……………**C$100**

<u>Period: 1 – 30 June 2012</u>

Vic Guinet

June 7 and 8

Communications with Canadian Border employees over Morton LMO v.
Work Permit 1 day C$200/day……………………………...……………………**C$200**

TOTAL……………………………………….. C$800.00

TOTAL COSTS INCURRED
ON LIBBY PROJECT 2011/2012......................……C$12700.75