GEOLOGY AND METALLOGENY OF NORTHWESTERN BRITISH COLUMBIA

SMITHERS EXPLORATION GROUP – G.A.C., CORDILLERAN SECTION

WORKSHOP

OCTOBER 16 - 19, 1988

PROMOTING SUCCESS

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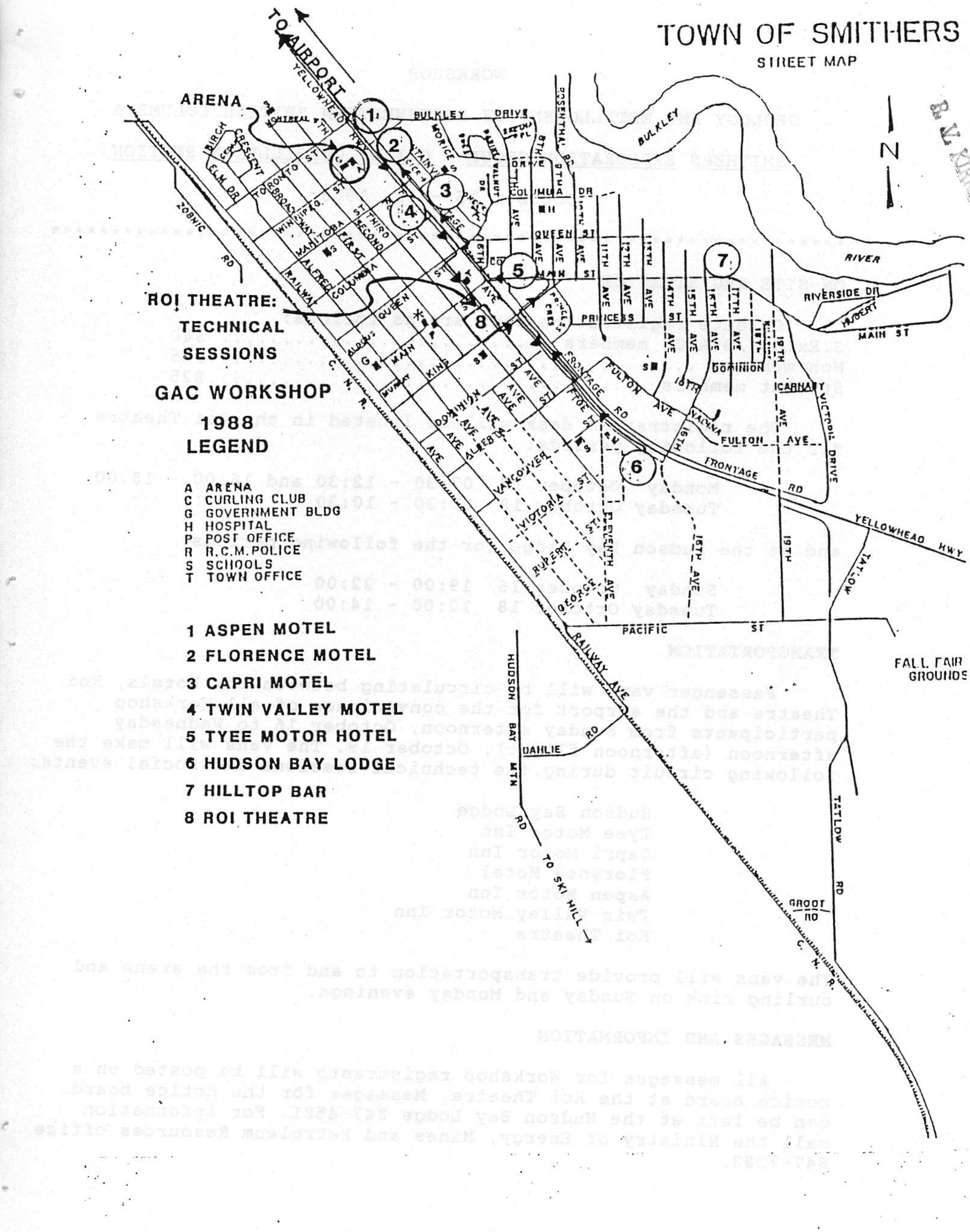

TOWN OF SMITHERS
STREET MAP
B. V. KIRKHAM
N
ARENA
TO AIRPORT
ROI THEATRE:
TECHNICAL
SESSIONS
GAC WORKSHOP
1988
LEGEND
A ARENA
C CURLING CLUB
G GOVERNMENT BLDG
H HOSPITAL
P POST OFFICE
R R.C.M. POLICE
S SCHOOLS
T TOWN OFFICE
1 ASPEN MOTEL
2 FLORENCE MOTEL
3 CAPRI MOTEL
4 TWIN VALLEY MOTEL
5 TYEE MOTOR HOTEL
6 HUDSON BAY LODGE
7 HILLTOP BAR
8 ROI THEATRE
BULKLEY DRIVE
BULKLEY RIVER
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FULTON AVE
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TO SKI HILL
DAHLIE RD
TATLOW RD
GROOT RD
FALL FAIR
GROUNDS
VICTORIA DRIVE
ZOBNIC RD

WORKSHOP

GEOLOGY AND METALLOGENY OF NORTHWESTERN BRITISH COLUMBIA

SMITHERS EXPLORATION GROUP - G.A.C., CORDILLERAN SECTION

October 15 - 21, 1988

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ON-SITE REGISTRATION

On site registration fees are as follows:

S.Ex.Gp./G.A.C. members $40
Non-members $55
Student members $25

The registration desk will be located in the Roi Theatre for the following periods:

Monday	October 17	07:30 - 12:30 and 16:00 - 18:00
Tuesday	October 18	07:30 - 10:30

and at the Hudson Bay Lodge for the following periods:

Sunday	October 16	19:00 - 22:00
Tuesday	October 18	12:00 - 14:00

TRANSPORTATION

Passenger vans will be circulating between the hotels, Roi Theatre and the airport for the convenience of all Workshop participants from Sunday afternoon, October 16 to Wednesday afternoon (afternoon flight), October 19. The vans will make the following circuit during the technical sessions and social events:

Hudson Bay Lodge
Tyes Motor Inn
Capri Motor Inn
Florence Motel
Aspen Motor Inn
Twin Valley Motor Inn
Roi Theatre

The vans will provide transportation to and from the arena and curling rink on Sunday and Monday evenings.

MESSAGES AND INFORMATION

All messages for Workshop registrants will be posted on a notice board at the Roi Theatre. Messages for the notice board can be left at the Hudson Bay Lodge 847-4581. For information call the Ministry of Energy, Mines and Petroleum Resources office 847-7383.

RESTAURANTS

There are a number of restaurants in Smithers which are close to the Roi Theatre. Check your registration package for details and location map.

SOCIAL EVENTS

Following the Sunday evening registration all are welcome at a **Pick-up Hockey Game** at the arena from 10:00 -11:30 p.m. If you brought your runners, don't forget the **Fun Run** on Monday at 12:30 p.m. leaving from the Hudson Bay Lodge.

The BIG EVENT is the **Curling Funspiel** on Monday evening from 7:30 to 11:30 p.m. All registrants have been assigned to a team, check your registration package for your curling time. This event is sanctioned by the North American Couch Potatoe Society as being for the non-athlete with chairs close by for those who need that option.

Free Beer and Sandwiches courtesy of J.T. Thomas Diamond Drilling Ltd. will be served during the Tuesday noon poster session at the Hudson Bay Lodge. Hospitality suites on Sunday and Tuesday evenings at the Hudson Bay Lodge are ideal opportunities to bend an ear at the same time that you bend your elbow.

COORDINATING COMMITTEE

Co-Chairman	Dave Lefebure
Co-Chairman	Bob Anderson
Registration	Ellen Woolverton
Field Trips	Hans Smit
	Lorne Warren
Audio-visual	Mary Lou Malott
Vans, Treasurer	Cory Tremblay
Secretary	Janet Harris
	Elaine Konschuh
	Sue Ciampichini
Sponsors	Joyce Warren
Speakers	Al Campbell
Session Coordinator	Colin Harivel
	Will Tompson
	Wayne Bulmer
	Ron MacArthur
Funspiel	Colin Harivel
	Larry Hewitt
Posters	Anne Havard
Fun Run	Bruce Hobson
Catering	Linda Palmer

SCHEDULE

SATURDAY, SUNDAY OCTOBER 15, 16

FIELD TRIP A: PRINCE RUPERT TO SMITHERS TRANSECT

SUNDAY EVENING, OCTOBER 16

REGISTRATION — HUDSON BAY LODGE

19:00 - 22:00 No-host bar, registration and poster set-up will be in banquet room on main floor.

HOCKEY SCRIMMAGE — ARENA, HERITAGE PARK

21.30 - 23:00 No charge to play in pick-up hockey game. Dig out your skates and hockey stick and come join the fun.

HOSPITALITY SUITES — HUDSON BAY LODGE

21:00 - 23:30 Hudson Bay Lodge

MONDAY MORNING, OCTOBER 17

SPEAKERS BREAKFAST MEETING — HUDSON BAY LODGE

07:00 - 07:45 Speakers and session coordinators for first day will meet for breakfast in the dining room.

REGISTRATION — ROI THEATRE

07:30 - 12:30 Registration in lobby, be sure to pick up registration package with program.

FIRST TECHNICAL SESSION - NORTHERN CORDILLERAN OVERVIEW — ROI THEATRE

08:30 - 08:45 Introductory Remarks

08:45 - 10:50 Overview speakers

10:50 - 11:10 Coffee Break

MONDAY MORNING cont., OCTOBER 17

SECOND TECHNICAL SESSION ROI THEATRE
- NORTHERN B.C. & YUKON: THE PALEOZOIC THROUGH MESOZOIC

11:10 - 12:10 Talks

MONDAY AFTERNOON, OCTOBER 17

POSTER SESSION AND FUN RUN HUDSON BAY LODGE

12:10 - 14:30 Lunch Break

12:30 - 13:30 Fun Run

12:30 - 14:00 Poster Session

SECOND TECHNICAL SESSION cont. ROI THEATRE

14:30 - 16:10 Talks

16:10 - 16:30 Coffee Break

16:30 - 17:30 Talks

REGISTRATION ROI THEATRE

16:00 - 18:00 Registration in lobby, be sure to pick up registration package with program.

MONDAY EVENING, OCTOBER 17

CURLING FUNSPIEL CURLING RINK

19:30 - 23:30 A curling bonspiel designed for everybody with the emphasis on fun. Wear clean shoes, running shoes are recommended. If you don't want to curl, come cheer on the rest of us! **Sponsored by JEMPLAND CONSTRUCTION LTD. and FALCON DRILLING**

TUESDAY MORNING - OCTOBER 18, 1988

SPEAKERS BREAKFAST MEETING — HUDSON BAY LODGE

07:00 - 07:45 Speakers and session coordinators for second day will meet for breakfast in the dining room.

REGISTRATION — ROI THEATRE

07:30 - 10:30 Registration in lobby, be sure to pick up program.

SECOND TECHNICAL SESSION cont. — ROI THEATRE

09:00 - 10:10 Talks

10:10 - 10:30 Coffee Break

THIRD TECHNICAL SESSION — ROI THEATRE
NORTHERN CORDILLERAN MESOZOIC/CENOZOIC STRATIGRAPHY, STRUCTURE & METALLOGENY

10:30 - 12:30 Talks

TUESDAY AFTERNOON, OCTOBER 18, 1988

REGISTRATION — HUDSON BAY LODGE

12:00 - 14:00 Registration in lobby, be sure to pick up registration package with program.

POSTER SESSION and BEER and SANDWICH LUNCHEON — HUDSON BAY LODGE

12:30 - 13:45 Poster session in banquet room.

12:30 - 13:30 Free beer and sandwich luncheon in banquet room generously provided by **J.T. THOMAS DIAMOND DRILLING LTD.**

THIRD TECHNICAL SESSION cont. — ROI THEATRE

14:00 - 15:40 Talks

15:40 - 16:00 Coffee Break

16:00 - 17:10 Talks

TUESDAY EVENING, OCTOBER 18 — HUDSON BAY LODGE

19:00 - 22:00 Poster Sessions in banquet room.

21:00 - 23:00 Hospitality suites

WEDNESDAY MORNING OCTOBER 19

SPEAKERS BREAKFAST MEETING HUDSON BAY LODGE

07:00 - 07:45 Speakers and session coordinators for third day will meet for breakfast in the dining room.

THIRD TECHNICAL SESSION cont. ROI THEATRE

08:30 - 10:10 Talks

10:10 - 10:30 Coffee Break

10:30 - 11:30 Plenary Session

11:30 - 11:45 Closing Remarks

WEDNESDAY AFTERNOON, OCTOBER 19

FIELD TRIPS B and C HUDSON BAY LODGE

13:15 Meet in the parking lot behind Hudson Bay Lodge with gear for trip.

WEDNESDAY, THURSDAY OCTOBER 19,20

FIELD TRIP B: MINERAL DEPOSITS OF THE SMITHERS AREA

WEDNESDAY, THURSDAY, FRIDAY OCTOBER 19,20,21

FIELD TRIP C: PRECIOUS METAL DEPOSITS OF THE STEWART CAMP

TECHNICAL SESSION 1 - NORTHERN CORDILLERAN OVERVIEW

MONDAY

1 08:45 GEOLOGICAL FRAMEWORK OF NORTHWESTERN BRITISH COLUMBIA
HUBERT GABRIELSE
2 09:25 NEW EDITION OF TECTONIC ASSEMBLAGE MAP OF THE CANADIAN CORDILLERA AND ADJACENT USA - JOHN O. WHEELER AND P. MCFEELY
3 10:05 METALLOGENY OF NORTHWESTERN BRITISH COLUMBIA - W.J. MCMILLAN

TECHNICAL SESSION 2 - NORTHERN B.C. & YUKON: THE PALEOZOIC THROUGH MESOZOIC

4 11:10 RECENT EXPLORATION DEVELOPMENTS IN THE YUKON - GRANT ABBOTT
5 11:40 LATE TRIASSIC VOLCANICS AND MASSIVE SULPHIDE DEPOSITS, ALEXANDER TERRANE, NORTHWEST B.C. - D.G. MACINTYRE
6 14:30 STRATIGRAPHY, STRUCTURAL GEOLOGY, & GEOCHRONOLOGY OF IRVINE LAKE & GRAVEL CK. MAP AREA RANCHERIA DISTRICT, SOUTHERN YUKON - DONALD C. MURPHY
7 15:00 LATE PALEOZOIC MARGINAL BASIN AND ISLAND ARC ENVIRONMENTS IN THE SYLVESTER ALLOCHTHON - J. NELSON AND J. BRADFORD
8 15:30 ERICKSON GOLD CAMP, CASSIAR - ALEX BORONOWSKI
9 16:30 A CLOSER LOOK AT THE LLEWELLYN FAULT - TECTONIC IMPLICATIONS & ECONOMIC MINERAL POTENTIAL - M.G. MIHALYNUK, L.D. CURRIE AND J.N. ROUSE
10 17:00 LODE GOLD DEPOSITS OF THE ATLIN AREA - D.V. LEFEBURE, M. BLOODGOOD AND C. REES

TECHNICAL SESSION 3 - N. CORDILLERAN MESOZOIC STRATIGRAPHY, STRUCTURE METALLOGENY

TUESDAY

11 09:00 GEOLOGIC SETTING OF THE STIKINE TERRANE - TOM RICHARDS
12 09:30 GEOLOGY AND MINERALIZATION OF THE STIKINE ASSEMBLAGE, MESS CREEK AREA, NORTHWESTERN BRITISH COLUMBIA - PETER HOLBEK
13 10:30 A PALEOZOIC AND MESOZOIC STRATIGRAPHIC AND PLUTONIC FRAMEWORK FOR THE ISKUT MAP AREA(104B), NORTHWESTERN B.C. - R.G. ANDERSON
14 11:00 STRATIGRAPHY AND MINERAL DEPOSITS IN THE UNUK-SULPHURETS AREA, NORTHWESTERN BRITISH COLUMBIA - JIM BRITTON
15 11:30 GEOLOGICAL SETTING OF THE VOLCANIC-HOSTED SILBAK PREMIER MINE AREA, NORTHWESTERN BRITISH COLUMBIA(104A/4 AND 104B/1) - DEREK BROWN
16 14:00 STRATIGRAPHY AND STRUCTURAL STYLE OF THE BOWSER & SUSTUT BASINS, NORTH-CENTRAL BRITISH COLUMBIA - C.A. EVENCHICK
17 14:30 A PRELIMINARY APPRAISAL OF THE AU-AG METALLOGENY OF THE TOODOGGONE DISTRICT, NORTH-CENTRAL BRITISH COLUMBIA - JAMES R. CLARK
18 15:00 LEAD ISOTOPE DISCRIMINATION OF JURASSIC FROM LATER DEPOSITS, IN SMITHERS, STEWART AND TOODOGGONE AREAS - J.E. GABITES AND C.I. GODWIN
19 16:00 PRELIMINARY GEOLOGY OF THE GERMANSEN LANDING AREA - FILIPPO FERRI AND DAVID M. MELVILLE
20 16:30 MID TO LATE CRETACEOUS VOLCANISM IN WEST CENTRAL BRITISH COLUMBIA AND ASSOCIATED MINERAL DEPOSITS - D.G. MACINTYRE

WEDNESDAY

21 08:30 STRATIGRAPHY AND PETROLOGY OF THE OOTSA LAKE GROUP IN THE WHITESAIL RANGE" - JOHN DROBE
22 09:00 PRECIOUS METAL EPITHERMAL MINERALIZATION IN THE OOTSA LAKE GROUP, WOLF PROPERTY, CENTRAL B.C. -KATHRYN P.E. ANDREW
23 09:30 AN OVERVIEW OF THE COAST PLUTONIC COMPLEX BETWEEN 53° AND 55° N - PETER VAN DER HEYDEN

10:30 PLENARY SESSION

POSTER DISPLAY

BANQUET ROOM - HUDSON BAY LODGE

REGIONAL MAPPING - B. C. GEOLOGICAL SURVEY BRANCH.

1. GEOLOGY OF THE SKUD RIVER AND SKUD GLACIER AREA
   DEREK BROWN & MIKE GUNNING

2. GEOLOGY AND MINERAL DEPOSITS OF SPHALER CREEK/FLOOD GLACIER MAP SHEETS - JIM LOGAN & VICTOR KOYANAGI

3. TELKWA FM. STRATIGRAPHY, ZYMOETZ RIVER, TERRACE
   MITCH MIHALYNUK

4. PRELIMINARY GEOLOGY OF THE TUTSCHI LAKE AREA
   MITCH MIHALYNUK & JONATHAN ROUSE

5. ISKUT - SULPHURETS PROJECT - JIM BRITTON

6. GEOLOGY OF THE MANSON CREEK MAP SHEET
   FILIPPO FERRI & DAVE MELVILLE

7. GEOLOGY AND LODE GOLD MINERALIZATION OF THE ATLIN MAP AREA - MARY ANNE BLOODGOOD, CHRIS REES, DAVE LEFEBURE

8. UPPER CRETACEOUS VOLCANICS IN THE BABINE RANGE/DOME MOUNTAIN - DON MACINTYRE & PAT DESJARDINS

9. GEOLOGY OF THE TOODOGGONE MAP AREA - ANDRE PANTELEYEV & TOM SCHROETER

EXPLORATION PROPERTIES

10. FIREWEED, CANADIAN UNITED MINERALS - BOB HOLLAND

11. SHASTA, ESSO MINERALS CANADA - PETER THIERSCH

12. YELLOWJACKET, HOMESTAKE MINERAL DEVELOPMENT CO.
    R. BOYD

13. A SYNOPSIS OF A LARGE-TONNAGE, HI-GRADE PORPHYRY COPPER-GOLD DEPOSIT ON THE KERR PROPERTY, UNUK RIVER AREA, STEWART B. C., WESTERN CANADIAN MINING CORP.
    BOB HEWTON

RESOURCE DATA AND ANALYSIS - B.C. GEOLOGICAL SURVEY BRANCH

14. MINFILE PC AND RECENT RELEASES FOR N.W.B.C.
    LARRY JONES, VICTORIA

DISTRICT GEOLOGY - B.C. GEOLOGICAL SURVEY BRANCH

15. EXPLORATION ACTIVITY IN NORTHWESTERN BRITISH COLUMBIA
    DAVE LEFEBURE AND MARY LOU MALOTT

A PALEOZOIC AND MESOZOIC STRATIGRAPHIC AND PLUTONIC FRAMEWORK FOR THE ISKUT MAP AREA (104 B), NORTHWESTERN B.C.

R. G. Anderson
Geological Survey of Canada
100 West Pender Street, Vancouver, B.C. V6B 1R8

Iskut River map area (56-57° N, 130-132°W; NTS 104B) encompasses an important geological transect through the west-central Cordillera. Stratigraphic, structural, plutonic and metamorphic transitions among Paleozoic Stikine Assemblage, Mesozoic Stikinian, Middle and Upper Jurassic Bowser Basin, and Mesozoic(?)-Tertiary Coast Belt rocks occur within the map area. Precious metal lode deposits in the Silbak-Premier-Big Missouri, Suphurets and Reg-Snip-Bronson Creek camps within the map area attract increasingly intense exploration interest in the area.

The overview emphasizes Paloezoic and Mesozoic stratigraphy and plutonic episodes within the Iskut River map area. Of particular interest to mineral explorationists are the Lower Jurassic volcanics and related granitoids because much of the precious metal vein deposits seem to be associated with these rocks.

Sr and Nd isotopic studies by Scott Samson at the University of Arizona on samples of Devonian to Upper Jurassic rocks from the map area (Samson et al., 1987, E.O.S. v. 69, no. 44 p. 1548) suggest a young, geochemically and isotopically primitive crust underlies this part of Stikinia.

PALEOZOIC STIKINE ASSEMBLAGE

Paleozoic Stikine Assemblage rocks are most extensively exposed in the discontinuous outcrops in and around the Iskut ice field in the northern part of the map aree. The assemblage is distinguished by biostratigraphically important coralline reef limestone members and intercalated mafic to felsic volcanics.

The Lower te Middle Devonian (Early Devonian-post-Pragian) unit near Forrest Kerr Creek, comprises at least four distinct coralline limestone members interlayered with mafic volcaniclastics, felsic crystal tuff, pebble conglomerate and siliceous shale. The unit contains the most penetratively deformed rocks in the area.

Mississippian (Visean-Namurian) rocks north of Newmont Lake include thick-bedded coralline reef limestone interbedded with distinctive chert and pillowed basalt, hyaloclastite and epiclastic rocks. The thick-bedded nature of the Mississippian limestone distinguishes it from Permian equivalents.

Permian (Leonardian) strata include important, thin bedded coralline limestone and volcanic arc-like mafic to felsic volcanic flows, tuffs and volcaniclastics. Around Newmont Lake, the plagioclase porphyritic intermediate to felsic volcanics resemble Jurassic Hazelton Group equivalent rocks in the region; the association with the limestone members is an important distinction. South of the Iskut River, Permian volcanic rocks are commonly green and of low greenschist-grade; contact metamorphism by nearby Jurassic to Tertiary plutons is likely an important factor in the metamorphic overprint.

Stikine assemblage strata may include Upper Triassic and upper Lower Jurassic (Toarcian) limestone members. If so, the assemblage's age range, Devonian to Early Jurassic would overlap with other Cordilleran Paleozoic-Mesozoic tectonostratigraphic assemblages of oceanic affinity (e.g., Cache Creek Group in southern B.C.) but differs from them in tectonic association. However, conodont colour alteration index values are generally greater than 5 for Permian and older strata and less than 5 for Triassic strate suggesting a widespread Permo-Triassic event. Stratigraphic relations on the flanks of the Stikine assemblage suggest important sub-Triassic and sub-Toarcian unconformities, as well.

MESOZOIC STIKINIAN STRATIGRAPHY

Upper Triassic and Lower and Middle Jurassic strata define the Stikinia terrane and are metallogenically the most faveurable for precious metal deposits. Bowser Lake Group rocks delimit the Bowser Basin and are considered an overlap assemblage. Their description is included in this section because there is evidence for the inception of a "proto-Bowser Basin" in the Toarcian and Bajocian.

Upper Triassic, Stuhini Group volcanic and sedimentary rocks show marked facies changes from northwest to southeast in the Iskut River map area.

To the northwest, distinctly bimodal, basalt and rhyolite flows and tuff overlie an important, well-dated, Upper Triassic limestone member. The limestone extends from Mount Choquette at least as far east as Mount Verrett and as far south as Iskut Mountain. The marker unit locally includes coarse limestone and chert breccia and conglomerate whose facies are interpreted as the Late Triassic slope break of the Stikine assemblage. Decimeter-scale growth faults are common in the volcanics and suggest that synvolcanic earthquake activity gave rise to chert-limestone turbidite flows. East-southeasterly-trending bimodal feeder dykes in Paleozoic Stikine assemblage limestone mark the cessation of longstanding carbonate sedimentation and breakup and drowning of the carbonate reef complex. Coarse grained clinopyroxene ±hornblende phenocrysts are characteristic of the mafic flows.

To the southeast, on McQuillan Ridge and east of Storie Creek, Upper Triassic rocks include predominant, mainly mafic, flows and volcaniclastics and minor, intercalated, *Minotis*-bearing shale. Clinopyroxene- (±hornblende-) phyric volcanics also characterize the Stuhini Group's eastern facies but felsic volcanics appear to be absent.

Lower Jurassic (Pliensbachian?-Toarcian) volcanics and minor sedimentary rocks dominate in the southeastern and central part of the Iskut River map area. The rocks appear to be the most prospective for precious metal lode deposits (e.g., Silbak Premier-Big Missouri and Sulphurets camps and Kay prospect).

Lower Jurassic volcanics are characterized by significant and abrupt facies changes and although generally unfossiliferous, are commonly correlated with the Telkwa Formation of the Hazelton Group. From a regional mapping perspective, the recognizable Upper Triassic Stuhini Group and upper Lower Jurassic (Toarcian) member of the Spatsizi Group serve as useful bounding marker strata. A regionally extensive Pleinsbachian(?) volcanic stratigraphy includes: lowermost mafic and intermediate volcanic flows and volcaniclastics interlayered with shale or argillite (Grove's Unuk River Formation); medial maroon and green epiclastic volcaniclastics and tuff (Grove's Betty Creek Formation); and an uppermost, aerially extensive and distinctive, felsic welded tuff and tuff breccia (locally known as the Monitor Lake rhyolite; Grove's Salmon River Formation, in part and Alldrick's Mount Dilworth "formation"). The felsic volcanics represent the terminal eruptive event in Early Jurassic volcanism.

Upper Lower and lower Middle Jurassic strata (Toarcian and Bajocian) are perhaps the most useful bio- and lithostratigraphic units of the Jurassic strata. Similar Toarcian rocks can be recognized as far north as the Stikine Arch north of the Stikine River. The Toarcian and Bajocian rocks are coeval with and in part lithological correlatives with formations within the formally defined Spatsizi Group.

Buff, sandy limestone contains <u>Weyla</u> bivalves and belemnites whose temporal overlap is restricted to the Toarcian. The regionally recognized sub-Toarcian unconformity is best demonstrated east of Storie Creek where Toarcian strata unconformably overly <u>Minotis</u>-bearing Upper Triassic Stuhini Group. From Mount Dilworth north to Storie Creek, there is an increase in shale at the expense of limestone in Toarcian rocks.

Bajocian rocks conformably overlie Toarcian limestone and comprise a sedimentologically unique alternation of white tuff and black, radiolarian-bearing siliceous shale. An identical, well-dated unit, formally defined as the Spatsizi Group's Quock Formation in the Spatsizi map area to the northeast was informally described as the "pajama beds" to depict the distinctive dark and light strata. In the Iskut map area, bed thickness and tuff:shale ratio decrease in Bajocian rocks from Monitor Lake north to the Mitchell Glacier near the present southern limit of Middle and Upper Jurassic Bowser Lake Group. Detailed stratigraphy of the Bajocian unit has the potential to predict the location of submarine hydrothermal exhalative vents.

Facies changes in the Toarcian and Bajocian rocks suggest a shale-out to the north in both units. The changes may anticipate the Bowser Basin's inception by 10-15 million years.

Middle and Upper Jurassic (Bathonian to Oxfordian-Kimmeridgian) Bowser Lake Group rocks occur mainly in northeastern Iskut River map area and consist of monotonous, medium-bedded green to brown, plagioclase-rich greywacke which predominates over Buchia-bearing, thin-bedded shale. Paucity of marker beds in the Bowser Lake Group frustrate detailed mapping and regional correlation of distinctive northerly- and easterly-trending cross fold axes.

PLUTONISM AND EASTERN LIMIT OF THE COAST BELT

Plutonic rocks occur throughout the Iskut map area but dominate in the southwest. In the past, mappers have included all granite plutons as part of the Coast Plutonic Complex (CPC).

More mapping, and especially, isotopic dating remain to be done to define the plutonic episodes and their plutonic styles. Presently, at least four episodes are recognized: Late Triassic, Early Jurassic (Texas Creek plutonic suite), Eocene (Hyder plutonic suite), and Oligocene-Miocene. Paleozoic and mid-Cretaceous plutonism seem likely but are unsupported by intrusive relations or isotopic age data.

Late Triassic and Early Jurassic plutons are coeval and cospatial with Stuhini Group and Hazelton Group-equivalent volcanic rocks and their plutonic styles reveal a direct link to the volcanics via distinctive porphyritic dykes. Eocene plutons apparently lack dykes and volcanic equivalents. The Coast Plutonic Complex' eastern boundary, from Stewart northwest to Elbow Mountain and the Stikine River, is defined by the eastern limit of Tertiary (Eocene) plutonism. From Elbow Mountain north to the map area's boundary, the Stikine River marks the boundary between mid-greenschist-grade metamorphic rocks and Tertiary plutons to the west and low greenschist-grade rocks and Late Triassic-Early Jurassic plutonic suites and volcanic equivalents to the east.

Late Triassic plutons vary in composition from clinopyroxene diorite or gabbro through biotite-hornblende qnartz monzodiorite to alkali-feldspar megacrystic hornblende-biotite quartz monzonite. Ultramafite (hornblendite, hornblende clinopyroxenite) inclusions are rare but important because the indicate the coeval and cospatial relationship between felsic granitoids and Late Triassic Alaskan-type ultramafite suite (Polaris suite) characteristic of northern Stikinia and Quesnellia. The most characteristic attribute of the Late Triassic plutonic suite is the abundance of east-northeasterly-trending clinopyroxene-bearing basalt dykes (bimodal rhyolite-basalt in the west) which crosscut the felsic plutons and were feeders to the cospatial Upper Triassic Stuhini Group volcanics.

Early Jurassic plutons (189-195 Ma; Texas Creek plutonic suite) are widespread, distinctive and metallogenically important. Two plutonic styles appear important: calc-alkaline (biotite-) hornblende granodiorite and quartz monzodiorite plutons crosscut by aikali-feldspar-phyric andesite dykes (e.g., Texas Creek pluton and "Premier porphyry" dykes near Silbak Premier mine); and biotite syenite plutons (e.g., dated Early Jurassic Galore Creek syenite and undated plutons near Mitchell Glacier and the Snip deposit). The typical green weathering appearance of the calc-alkaline suite indicates the suite's widespread alteration to chlorite and epidote. Discrete, east-trending mylonite zones in the Texas Creek pluton are distinctive. The importance of Early Jurassic alkaline plutonism (e.g., as alkali-feldspar porphyry dykes or syenite plutons) in the localization of precious metal lodes has been recognized for some time.

Tertiary plutons (50-55 Ma; Hyder plutonic suite; and unnamed 20 Ma alkaline magmatism) are more siliceous, biotite-rich, and less altered than Mesozoic plutons. Monzogranite, quartz monzonite and granodiorite predominate but minor monzodiorite and microdiorite (e.g. Portland dyke swarm) occur. The plutons lack dykes and preserved volcanic equivalents. Tertiary plutons crosscut all regional structural fabric, are considered posttectonic but locally, where they comprise bimodal diorite-granite (e.g., Portland dyke swarm), may indicate extensional tectonics.

There is good evidence for Oligocene-Miocene (18-25 Ma) ultrapotassic magmatism; it is mainly represented by scattered biotite minette lamprophyre dykes.

EPITHERMAL PRECIOUS METAL MINERALIZATION IN THE OOTSA LAKE GROUP, WOLF PROSPECT, CENTRAL BRITISH COLUMBIA

Kathryn P.E. Andrew
British Columbia Geological Survey Branch
756 Fort St., Victoria, B.C. V8V 1X4

Epithermal precious metal mineralization in Eocene Ootsa Lake Group rhyolite is documented at the Wolf prospect, central British Columbia. Despite potential for significant epithermal mineralization, detailed geologic mapping and exploration of the Ootsa Lake Group on the Nechako plateau has been hindered by extensive overburden and costly limited access. Logging activity in reoent years has enabled construction of new roads which have opened up the area considerably.

The Ootsa Lake Group unconformably overlies Lower and Middle Jurassic rocks of the Hazelton Group. In the Wolf area it comprises calc-alkaline rhyolite tuffs and flows intruded by felsic stocks and dykes (Fig. 1). These intrusive and extrusive rocks are cogenetic, representing a single magma series, and their observed chemical diversity could be the result of feldspar differentiation. They are dated by whole rock K-Ar as mid-Eocene (47.6 to 49.9 $\pm$ 1.7 Ma). A caldera collapse setting is suggested for these explosively erupted tuffs, flows and subvolcanic porphyries. Poorly consolidated epiclastic rocks with a mid-Miocene (13.5 to 17 Ma) palynomorph assemblage occur beneath Ootsa Lake Group rhyolite at Wolf. It is suggested that the older Ootsa Lake Group has been thrust over the mid-Miocene assemblage.

At the Wolf prospect, precious metal minerals occur in bladed quartz-carbonate veins and heterolithic breccias within rhyolite of the Ootsa Lake Group. Metallic minerals include electrum, native silver and silver sulphosalts occuring as inclusions in and adjacent to pyrite. The veins and breccias comprise five silicic zones bordered by argillic and sericitic altered rhyolite.

Fluid inclnsions define growth zones in precious-metal bearing quartz-carbonate veins and precious-metal poor late drusy quartz veins. These primary fluid inclusions are typically two-phase and liquid-rich with low salinities and low CO_2 oontents. Heating studies of quartz-carbonate veins indicate two distinct fluid inclusion homogenization temperatures, 270°C and 170°C. Fluid inclusions from the drusy quartz veins homogenize at 250°C.

Oxygen isotope compositions of vein quartz, rhyolite and alkali feldspar phenocrysts are depleted in ^{18}O by 4 to 9 ‰. These ^{18}O depletions are caused by a high degree of isotopic exchange between rhyolite and large volumes of low ^{18}O content fluids et elevated temperatnres. Oxygen and hydrogen isotope evidence indicates that hydrothermal solutions at Wolf were meteoric in origin with virtually no contribution from magmatic sources.

Post mid-Eocene block faulting and earlier structures relating to collapse of the Wolf caldera provided conduits for circulating hydrothermal fluids and controlled the deposition of veins. Fluid inclusion homogenization temperatures show that fluids depositing the quartz-carbonate veins and associated mineralization were boiling and existed under two pressure regimes; hydrostatic and near lithostatic. Both conditions confirm epithermal depths of emplacement of about 100 m below paleosurface (Fig. 2). The fluids then evolved to a non-boiling, lower salinity, extremely ^{18}O depleted variety which precipitated late barren drusy quartz veins. Geological setting, vein and breccia textures, alteration, metal distribution and depositional fluid composition at Wolf resemble a low sulphur, hot spring or silicified stockwork deposit.

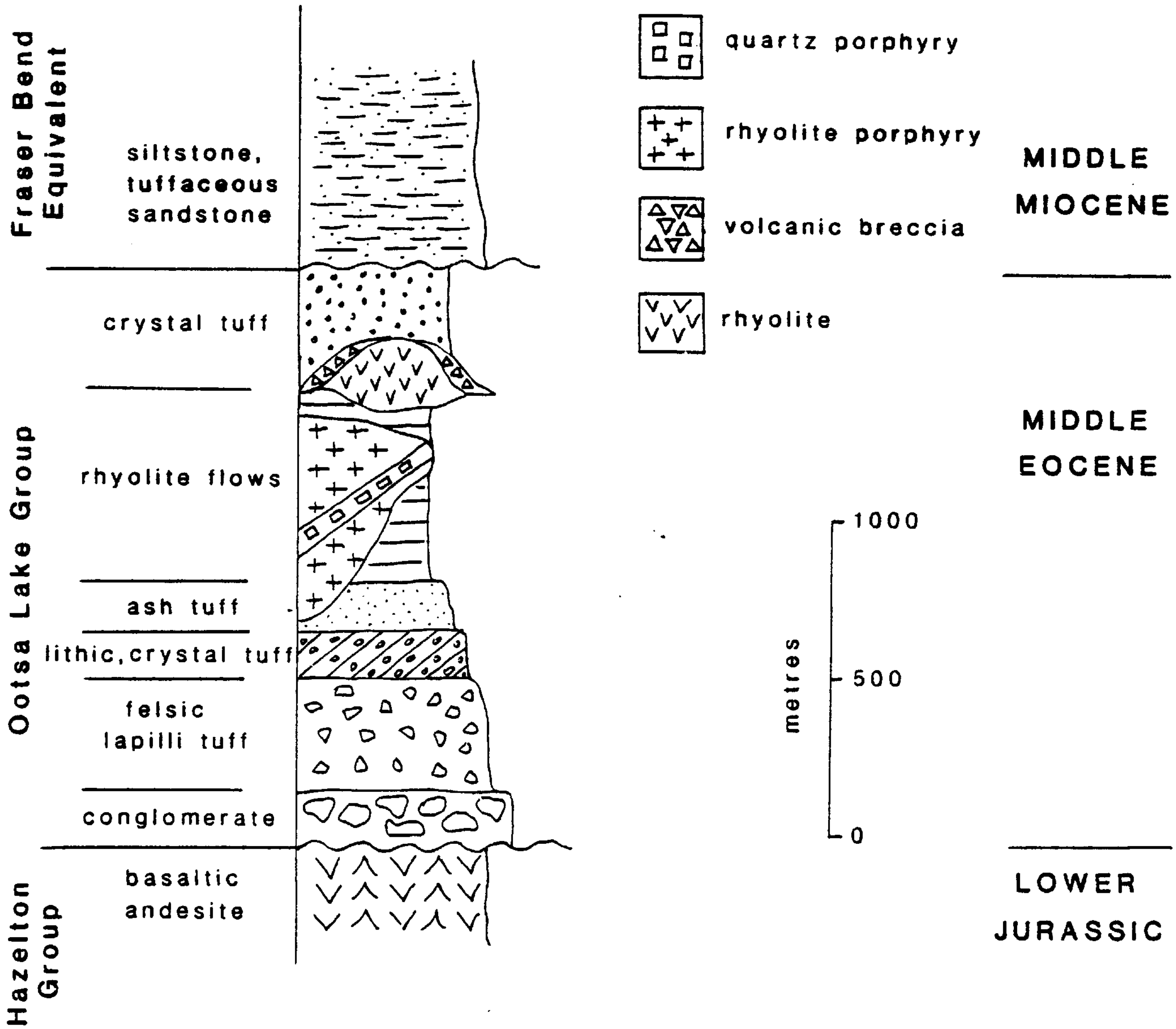


Figure 1. Composite volcanic succession, rhyolite member of the Ootsa Lake Group, Wolf prospect, central B.C.

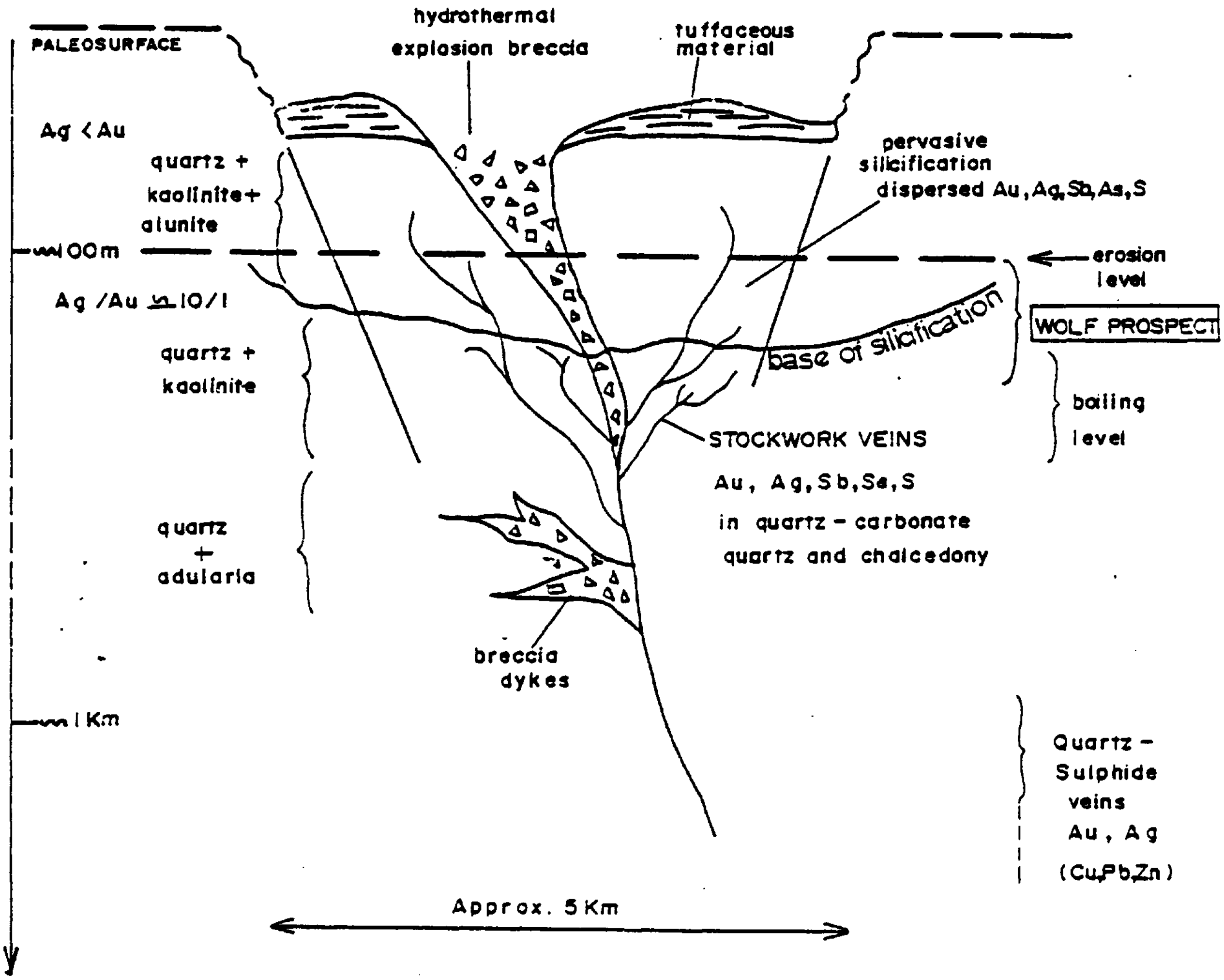


Figure 2. Schematic cross-section of low sulphur, hot-spring type silicified stockwork model for the Wolf prospect, central B.C.

ERICKSON GOLD CAMP
CASSIAR, B.C., N.T.S. 104 P/4 & 5
Alex Boronowski
TOTAL Energold Corporation
1500 - 700 West Pender Street, Vancouver, B.C., V6C 1G8

Location

The Erickson Gold Camp is transected by the Stewart-Cassiar Highway approximately 100 kilometres south of the B.C.-Yukon border (figure 1). The Camp is situated adjacent to the world-class Cassiar asbestos mine, both are located within the Sylvester allochthon.

General Geology

The Sylvester allochthon consists of metavolcanics, metasediments, and ultramafics. The assemblage contains fossils which range in age from Late Devonian to Late Triassic.(Gordy,Harms) The emplacement of the mildly deformed, fault bounded assemblage of oceanic crust occurred between Late Triassic and mid-Cretaceous time.(Nelson & Bradford) The Cassiar Batholith and satellite stocks were intruded along the western margin of the allochthon from middle to late Cretaceous time. Potassium-argon dating of sericite, obtained from quartz stringers associated with auriferous quartz veins hosted within metavolcanics of the Sylvester Group, indicate an early Cretaceous age.(Sketchley)

Erickson Gold Mine - Production

To date, Erickson Gold Mining Corporation's production has totalled 540,000 tons grading 0.455 opt.Au. and 0.33 opt.Ag. Of this total 422,000 tons have been mined from quartz veins within steeply dipping shear structures in the Main Mine and Cusac Mine. The remaining 118,000 tons grading 0.306 opt.Au. have been produced from the Vollaug Vein.

During 1987, 95,179 tons were milled at a daily average of 261 tons. The average mill feed grade was 0.42 opt.Au. and 0.20 opt.Ag. with a recovery rate of 92.80% for gold and 90.50% for silver. Operating cost/ton was $117.39. The mill produces a high-grade gravity concentration and a flotation concentrate. Mining techniques employed during 1987 included shrinkage stoping, modified room and pillar, and some selective open-pitting.

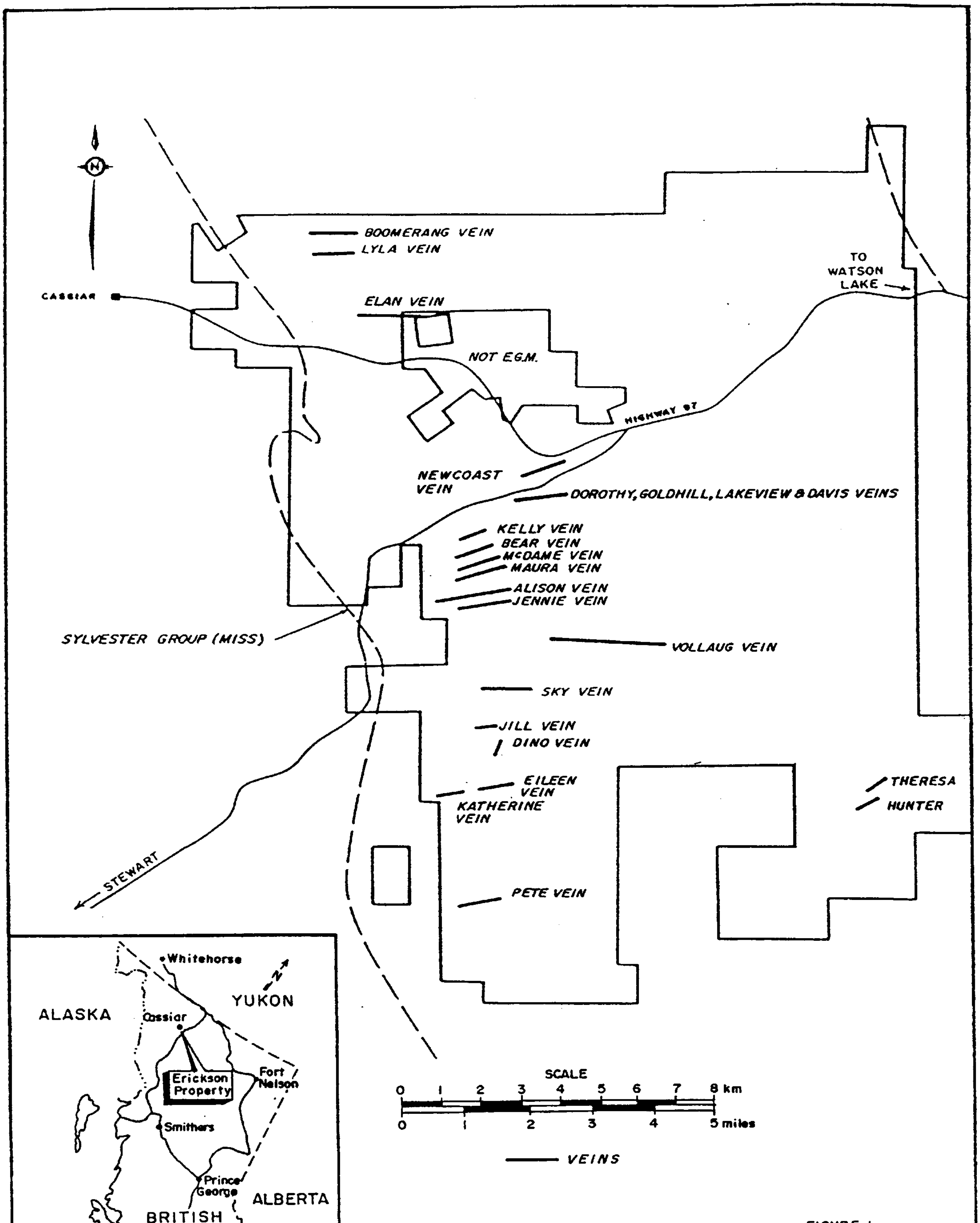


FIGURE 1

ERICKSON GOLD CAMP

PROPERTIES OWNED AND OPERATED BY ERICKSON GOLD MINING CORP.

SEPT. 12, 1988

Erickson Gold Mine - Geology

The auriferous quartz veins at Erickson are hosted in dilatent zones within sheared metabasalts. Gold was probably transported as gold bisulfide $Au(HS)^{2}$, within hot (350° Celsius), moderately saline water containing dissolved carbon dioxide. Precipitation of gold may have been triggered by: decrease in sulphur and/or decrease in oxygen and/or increase in Fe (Dussell).

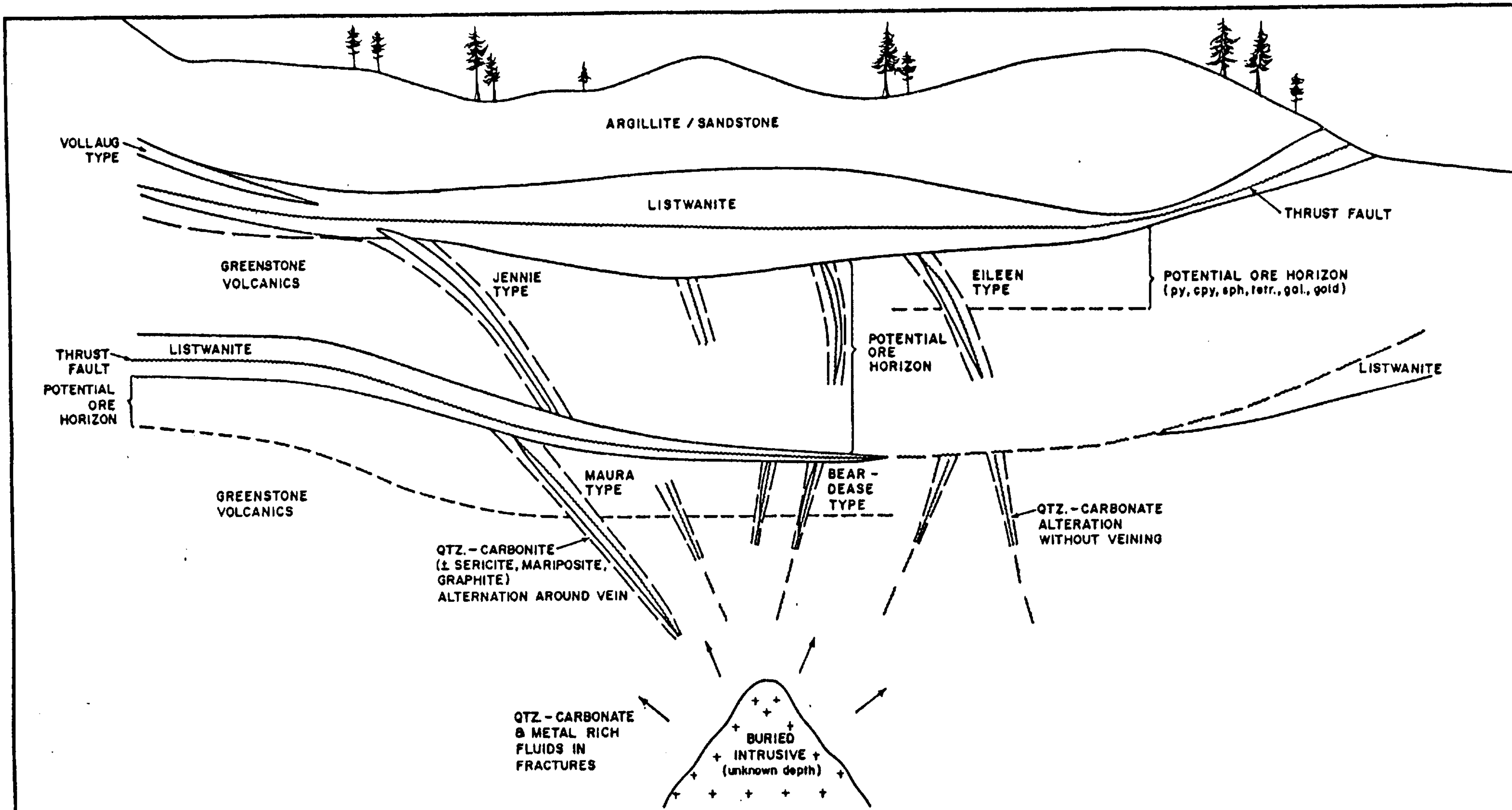
Steeply and shallowly dipping auriferous quartz veins have been mined in the Camp (figure 2). The steeply dipping veins are hosted within sheared basalts and the shallowly dipping veins occurring along the thrust plane between ultramafics and argillite. Thsse structures and crosscutting structures probably represent major crustal breaks which have served as conduits for the auriferous solutions and dilatent zones for trapping gold.

Listwanite, a metasomatic rock derived by the hydrothermal alteration of serpentinites and possibly komatiitic basalts, are spatially associated with every known economic auriferous quartz vein system except the Taurus deposit. Three classifications of listwanites have been identified within the Camp:

1. Serpentine-Carbonate
2. Talc-Carbonate
3. Quartz-Mariposite-Carbonate

Possibly the listwanite signifies proximity to a deep crustal break, a possible source of gold, and an environment where acidic gold-bearing hydrothermal solutions would be neutralized and enhance precipitation of gold.

Carbonatization, silicification, and iron enrichment are the most pervasive alteration features adjacent to auriferous quartz veins. Carbonate alteration ranges from weak to intense dolomitization as the quartz vein is approached. The alteration zone normally extends less than 15 metres outward from the vein. The bleached white volcanics of the intense carbonate alteration contain an iron enrichment halo consisting of euhedral pyrite crystals. The pyritohedrons range in size from millimetres to several centimetres and can represent up to 10% of the rock. Generally carbonatization occupies a much broader area than the zone of silicification and is most intense within and adjacent to the quartz vein. At least three periods of quartz injection have been noted. Each injection has refractured the previous phase giving the rock a crackle breccia texture. Late clear, grey quartz veinlets within brecciated white quartz is a favorable characterietic of auriferous quartz veins. Carbon alteration is present as amorphous carbon within the basaltic rock and stylolitic laminations within the quartz veins. Stylolitic laminations are most common in shallowly dipping veins such as the Vollaug Vein which has an argillite hangingwall. In summary, intense alteration of basalts within shear zones provides a favorable host for the deposition of gold.



Note: Ore veining on East to Northeast trending faults in close proximity to major Northwest trending structures.

TOTAL ERICKSON RESOURCES LTD.

Erickson Gold Mine

CARTOON MODEL OF GEOLOGY AND MINERALIZATION

SEPTEMBER 12, 1988

FIGURE 2

<u>Shallowly Dipping Veins</u> (Figures 3 & 4)

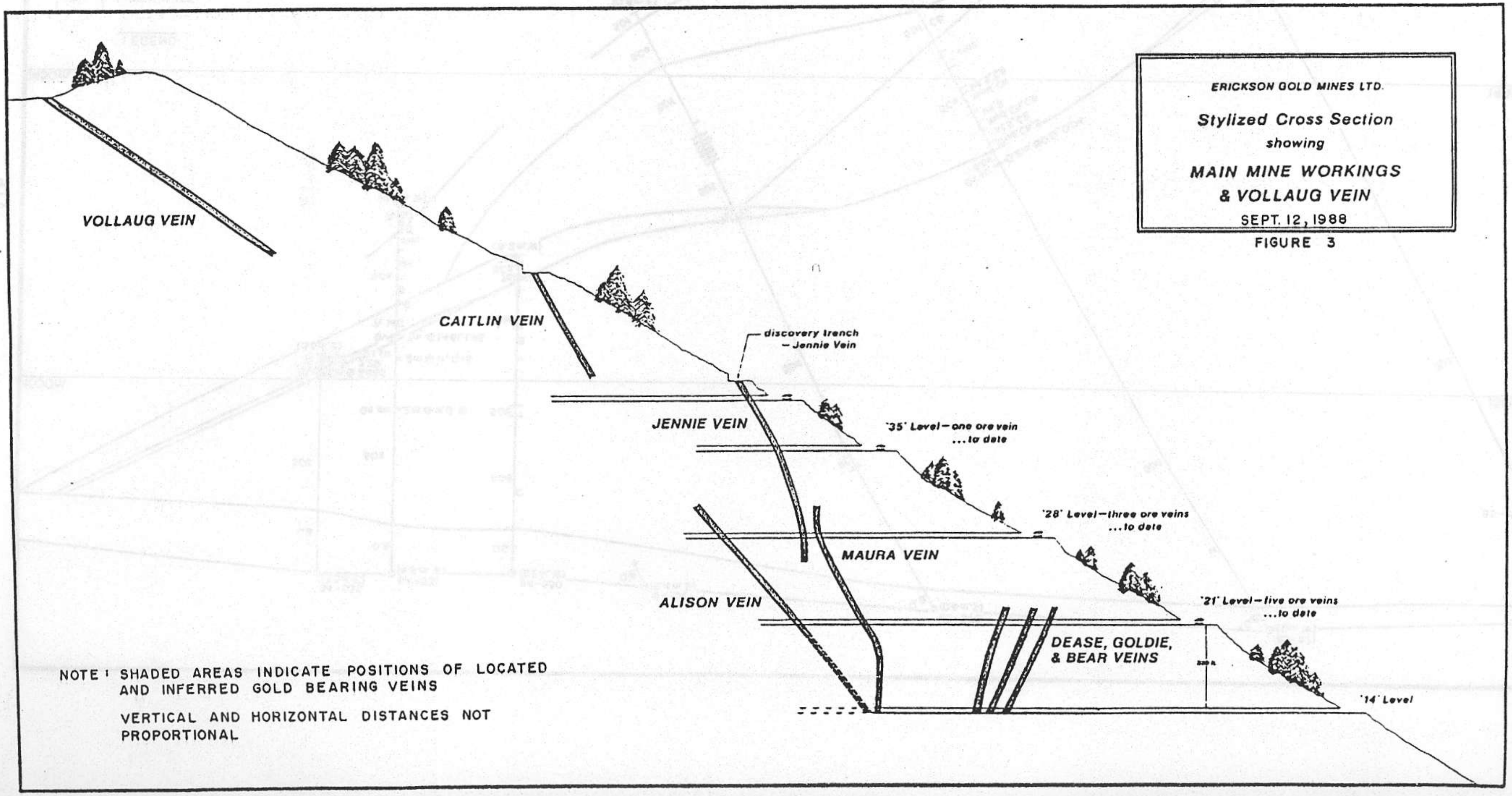
The Vollaug and Jennie's Revenge are the only shallowly dipping quartz veins that have been mined profitably.

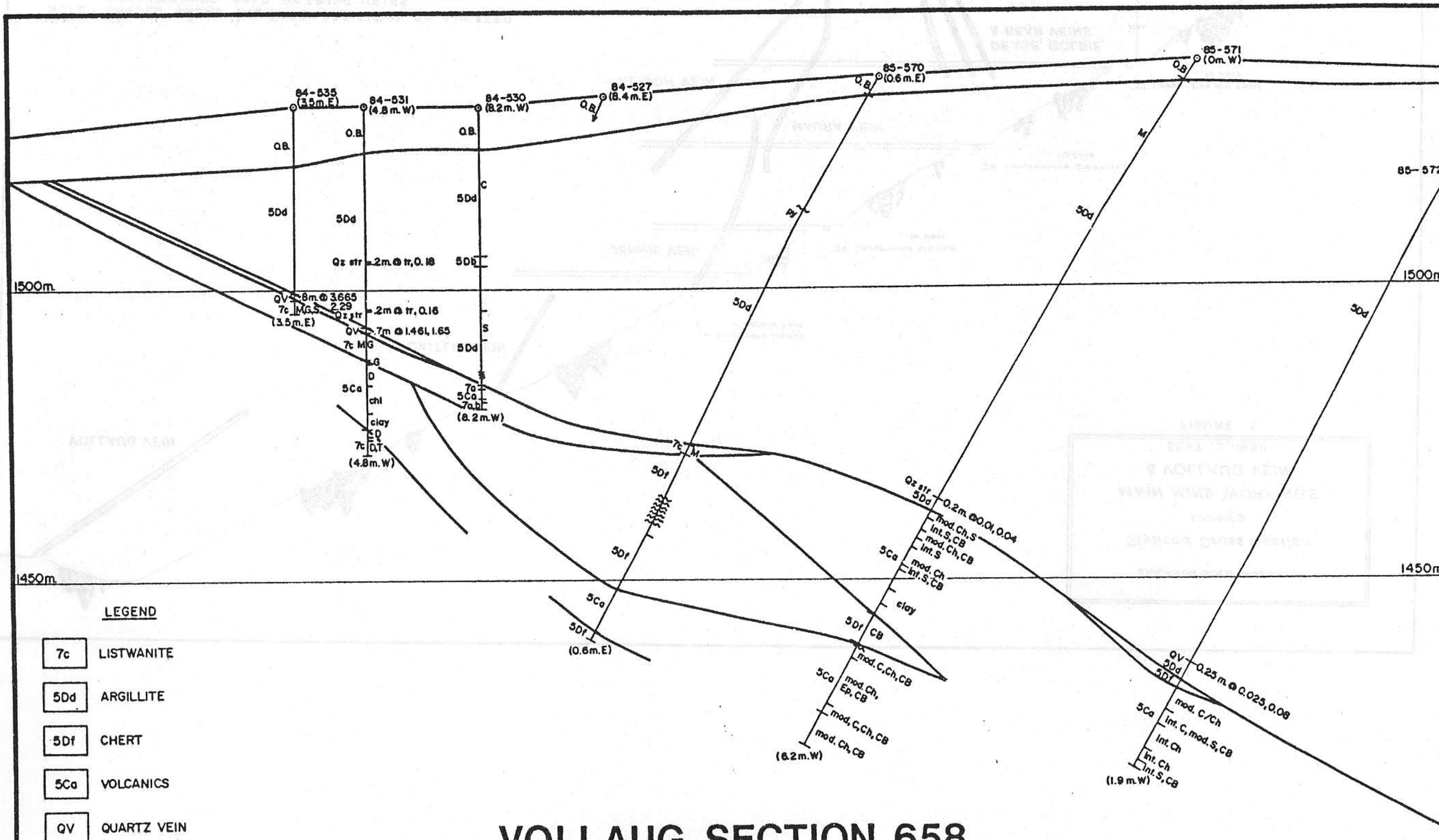
The Vollaug Vein is exposed across an east-west strike length of 2.7 kilometres. The east-west striking vein dips approximately 30° towards the north. The western extent of the Vollaug Vein terminates at the Erickson Creek Fault Zone, which may represent a major crustal break and alteration zone trending 170°. The eastern extent has not been traced beyond Finlayson Creek, another N-S trending structure. The thickness of the vein varies due to deformation within the vein, but thicknesses of up to 3 metres have been intersected.

The Vollaug Vein normally occurs at the contact between hangingwall graphitic argillites and footwall metasomatized serpentinites (listwanite). The listwanites are underlain by metabasaltic flows and interbedded cherts. The Vollaug Vein lies within a shear zone indicating a sinistral strike-slip sense of motion. The vein strikes 080° to 110° and dips between 25° to 40° to the north.

The Vollaug Vein is composed of parallel black graphitic ribbons within milky white quartz. The milky white quartz contains minor siderite. A later stage clear grey quartz occurs as crosscutting veinlets and breccias. Sketchley identified the following minerals within the black graphitic ribbons: clay or white mica and quartz with lesser siderite, graphite, iron and titanium oxides, and free gold. Mineralization generally represents less than 1% of the vein and consists of tetrahedrite, pyrite, sphalerite, galena, chalcopyrite, and free gold in order of abundance. Gold occurs scattered throughout the milky white quartz but is concentrated adjacent to and within the black graphitic ribbons. The hangingwall portion of the vein often contains the higher gold values.

Ore shoots often trend 290° and plunge shallowly to the WNW which is coincident to an axis representing the intersections of the vein and the P shear planes (105-115° and dipping 70-80° South). Lamprophyre and diabase dykes within the area trend 290°.


ERICKSON GOLD MINES LTD.
Stylized Cross Section
showing
MAIN MINE WORKINGS
& VOLLAUG VEIN
SEPT. 12, 1988
FIGURE 3
VOLLAUG VEIN
CAITLIN VEIN
discovery trench
– Jennie Vein
JENNIE VEIN
'35' Level – one ore vein ...to date
'28' Level – three ore veins ...to date
MAURA VEIN
ALISON VEIN
'21' Level – five ore veins ...to date
DEASE, GOLDIE, & BEAR VEINS
'14' Level
NOTE : SHADED AREAS INDICATE POSITIONS OF LOCATED AND INFERRED GOLD BEARING VEINS
VERTICAL AND HORIZONTAL DISTANCES NOT PROPORTIONAL



VOLLAUG SECTION 658

(Looking West 90°)

SEPTEMBER 12, 1988

FIGURE 4

Steeply dipping Veins (Figures 3 & 5)

At the Erickson Gold Mine production has been predominantly from the Jennie, Maura, and Alison veins.

Although all basically similar, the different veins seem to have significant differences in texture, mineralogy and possibly paragenesis.

At least three periods of quartz injection have been noted within an economic quartz vein. Each injection brecciated the previous quartz deposition. Veins are often cross fractured (tension gash direction) and contain dusting of pyrite along these fractures. Stylolitic-type textures parallel to the margins of the vein are common. These textures are composed of graphite and probably represent a solution line between quartz injections. Often inclusions of country rock occur within the vein. The strike, dip, and thickness of a vein cen vary.

Jennie Vein

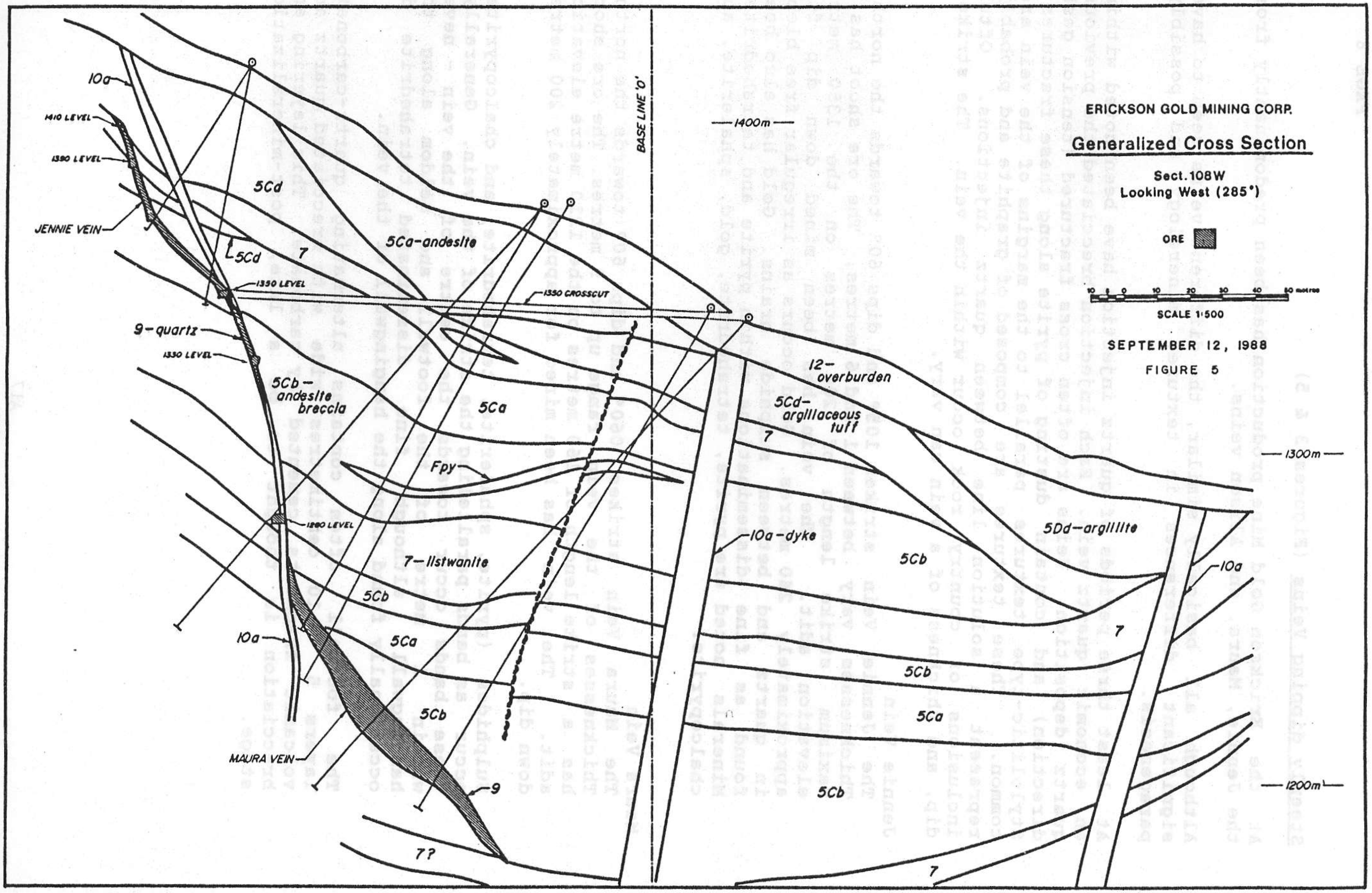
The Jennie Vein strikes 105° and dips 60° towards the north. Thicknesses vary between 1 and 6 metres. The ore shoot has a maximum strike length of 200 metres on the 1350 metre elevation adit. The vein has been mined down dip for approximately 240 metrss. Gold occurs as irregular free blebs in quartz and between sulphide grains. Gold has also been found as fine disseminations within pyrite and tetrahedrite. Minerals noted are pyrite, tetrahedrite, gold, sphalerite, and chalcopyrite.

Maura Vein

The Maura Vein strikes 060° and dips 60° towards the north. Thicknesses of the vein range up to 9 metres. The ore shoot has a strike length of 160 metres on the 1210 metre elevation adit. The vein has been mined for approximately 200 metres down dip.

Sulphides (pyrite, sphalerite, tetrahedrite, and chalcopyrite) occur as bands paralleling the strike of the vein. Generally, these bands occur towards the centre of the vein - never within 1 metre of the footwall and seldom along the hangingwall, although fine disseminated tetrahedrite is occasionally found along the hangingwall of the vein.

The footwall often contains alternating quartz-carbonate layers 5 - 10 centimetres wide with brecciated quartz and volcanic fragments cemented by carbonate. This layering and brecciation is thought to be a late, post-mineralization stage.


ERICKSON GOLD MINING CORP.
Generalized Cross Section
Sect.108W
Looking West (285°)
ORE
SCALE 1:500
SEPTEMBER 12, 1988
FIGURE 5
BASE LINE 'O'
1400m
1300m
1200m
10a
1410 LEVEL
1390 LEVEL
JENNIE VEIN
5Cd
7
5Ca-andesite
1350 LEVEL
1350 CROSSCUT
9-quartz
1330 LEVEL
5Cb-andesite breccia
5Ca
12-overburden
5Cd-argillaceous tuff
Fpy
1280 LEVEL
7-listwanite
5Cb
10a-dyke
5Dd-argillite
MAURA VEIN
9
7?

Mineralization occurs as irregularly shaped coarse-grained clusters of pyrite approximately 10 centimetres wide, patches of fine-grained mixtures of pyrite-tetrahedrite-chalcopyrite, and individual disseminated grains of sphalerite, tetrahedrite, chalcopyrite and pyrite. Stronger zones of mineralization (5% sulphides), up to 2 metres wide and 10 - 15 metres long, are associated with zones of "stylolitic" graphite textures.

Clear grey quartz filled fractures occur perpendicular to the walls of the white quartz Maura Vein. Carbonate and quartz filled fractures parallel the walls of the Maura Vein but dip 70 - 80° towards the south.

Alison Vein

The thickness of the vein ranges between 1 - 3 metres. The vein has a strike length of 90 metres on the 1280 metre elevation adit and has been traced down dip over a 190 metre interval. Graphitic styolites are contained throughout the vein but the abundance decreases westward. Disseminated fine to medium grained chalcopyrite, sphalerite, tetrahedrite and pyrite occurs throughout the vein. But the greatest concentration of sulphides occurs within 50 centimetres of the vein's footwall or hangingwall. The footwall contains up to 1% pyrite of which the majority (75%) is coarse-grained disseminated pyrite. The hangingwall contains up to 0.3% sulphides of which 50% is pyrite.

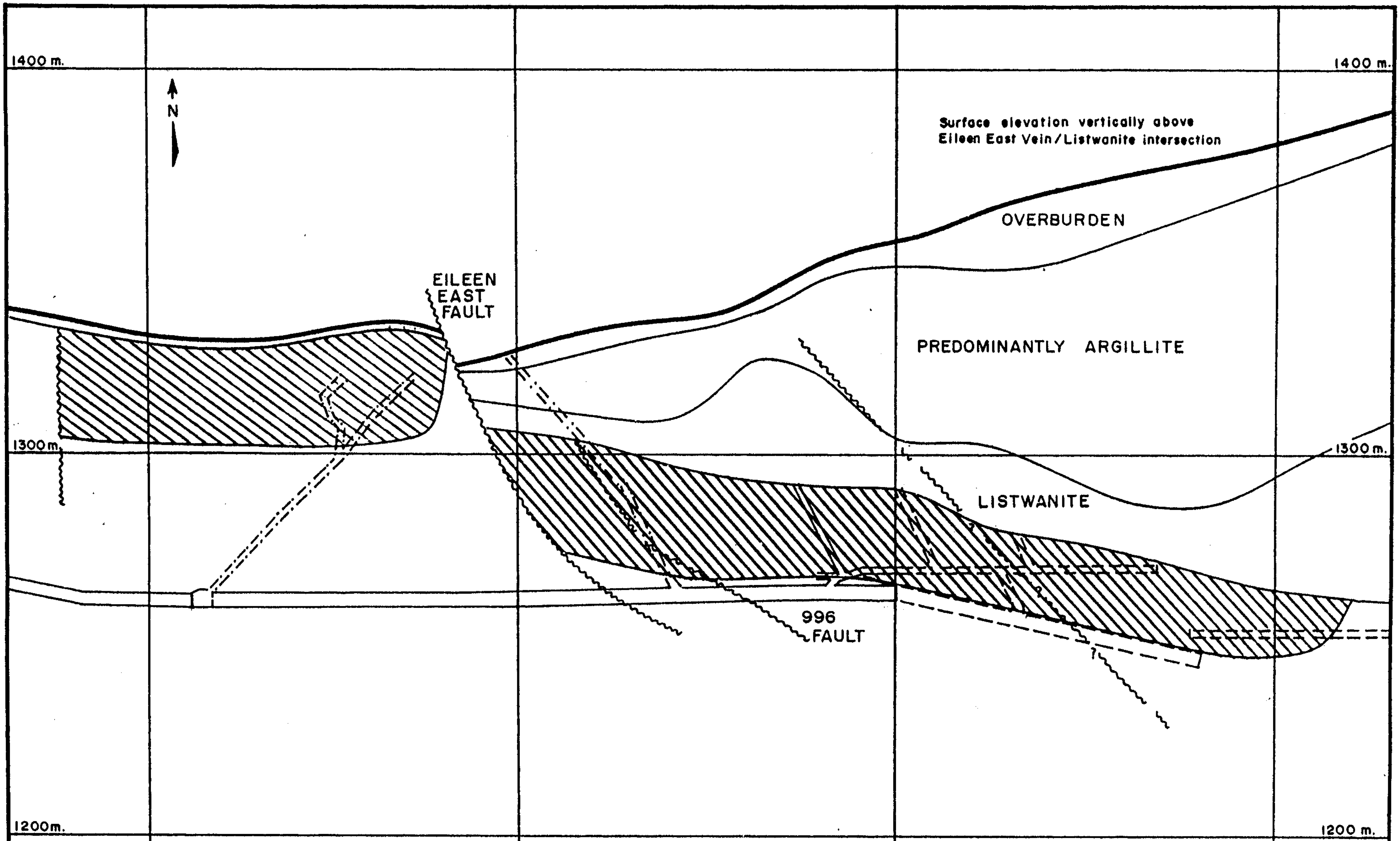
The vein contains cross cutting quartz-carbonate and clear grey quartz veins.

Eileen Vein (figure 6)

The Eileen Vein is located in the Cusac Mine approximately 8 kilometres south of the Main Mine area.

The Eileen vein averages 1.5 metres in thickness. The ore shoot has been mined over a strike length of 300 metres and down dip for approximately 30 metres from the listwanite contact. The shoot plunges to the east and follows the dip of the listwanite contact. The vein has an average strike of 060° - 070° and dips 60° to the north. The shear structure hosting the Eileen Vein demonstrates a sinistral sense of motion.

Mineralogy is similar to the Main Mine area but the average grade of gold (0.90 opt.Au.) is considerably higher. Pyrite occurs as coarse-grained and fine-grained knots throughout the vein but increases in amount towards the wallrock contact. Generally, gold values are higher towards the wallrock and listwanite contact. Sphalerite, tetrahedrite, and minor galena occur within the pyrite knots and normally indicate better gold grades.



CUSAC - EILEEN LONGITUDINAL SECTION
(looking North 330°)

SEPTEMBER 12,1988

FIGURE. 6

EILEEN VEIN ORE SHOOT

SECT. 1005 SECT. 1000 SECT. 995 SECT. 990

0 5 10 20 30 40 50m.
SCALE

Late stage dolomite veins

McDame Vein

The McDame Vein strikes 105° and dips steeply south. The layered dolomite-type vein achieves widths greater than 3 metres. The vein consists of quartz and carbonate, displays colloform and brecciated textures with a small amount of pyrite. Quartz occurs as quartz fragments in brecciated areas and in the form of silica flooding of the matrix. The structure has not demonstrated that this system becomes auriferous at depth. The late stage dolomite-type veins do not contain the alteration assemblage as found around quartz veins. According to B. Nesbitt these veins are isotopically distinct from to the auriferous quartz veins.

Exploration Techniques

During the last decade the exploration techniques have evolved as the search for new auriferous quartz veins has advanced from surface discoveries to hidden deposits.

Initially the exploration department relied upon geochemical soil sampling, trenching and gold-silver assays. Presently several pathfinder characteristics are utilized to grade the potential of a vein or area for hosting an economic deposit. These pathfinder tools were developed as a result of detailed geological mapping, geophysical orientation surveys, and the use of multi-element geochemical analysis.

Presently, the following characteristics are utilized for evaluating a target or target area:

- intensity and extent of alteration (carbonatization, silicification, and addition of carbon)
- spatial relationship to listwanite
- character and composition of the multi quartz injections forming the auriferous quartz veins
- presence of an iron enrichment within and surrounding the quartz vein
- mineralogy of the quartz vein
- arsenic geochemical soil and rock anomaly
- type of structural deformation and orientation of structures
- a geophysical VLF anomaly indicating favorably orieatated structures

The auriferous quartz veins are relatively small targets and therefore it is essential to utilize the above criteria for assessing the potential of an area for hosting an economic deposit.

Acknowledgment

This compilation is based upon a decade of data collecting and interpretations by the staff of Erickson Gold Mining Corporation, provincial and federal geologists, the universities, and independent theses.

STRATIGRAPHY AND MINERAL DEPOSITS IN THE UNUK - SULPHURETS MAP AREA, NORTHWESTERN B.C.

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INTRODUCTION

The Unuk and Sulphurets area is currently being mapped by the Geological Survey Branch as part of a multi-year study of the geology and mineral deposits of the Iskut - Sulphurets Gold Belt. The project is directed by D. J. Alldrick. Its goals are to revise published geology maps, now 20 to 60 years out of date, to document the numerous mineral discoveries made during that time, and to propose models of ore genesis.

GEOLOGIC SETTING

The Unuk-Sulphurets area is situated in the rugged Boundary Ranges of the Coast Mountains physiographic belt. It lies along the western margin of the Intermontane tectonic belt and, accord-ding to terrane concepts, is entirely within Stikinia. The area is underlain by Upper Triassic to Middle Jurassic volcanic and sedimentary rocks that have been folded, faulted and weakly metamorphosed, mainly during Cretaceous time. Strata are cut by at least three intrusive episodes that produced small synvolcanic plutons, satellitic stocks of the Coast Plutonic Complex, and various dykes, dyke swarms, and sills. Intrusive activity spans Jurassic to Tertiary time. Remnants of Pleistocene to Recent basaltic flows are preserved west of the Unuk-Harrymel drainage.

The geology is typical of an island arc complex. Formations have characteristics that persist for tens of kilometres but individual members show little lateral continuity due to rapid facies changes and the simultaneous operation of volcanic and sedimentary processes.

STRATIGRAPHY

Stratigraphic reconstruction of the area is impeded by the lack of good markers, particularly in volcanic successions, the paucity of fossils, few way-up structures, and thrust faults. Sufficient fossil, radiometric, and lithostratigraphic data exist to permit broad correlation with the main Mesozoic Groups: Takla, Hazelton, and Bowser Lake. More precise correlation with formations, members, or facies of these groups is not yet possible. Lithologic similarities alone are a shaky basis for correlation beyond the limits of mapping.

The rocks can be divided into 5 main lithostratigraphic units which form an apparently conformable, but discontinous, succession spanning Norian to Bajocian time. Formation names are informal.

The oldest unit (Lower Unuk R. formation) consists mainly of immature clastic sediments with volcaniclastic interbeds. The rare occurrence of Monotis indicates a Triassic (Norian) age.

This is succeeded by a thick sequence of mainly andesitic pyroclastics and flows (Upper Unuk R. formation) with thin sedimentary interbeds that include turbidites, wackes, and conglomerates. Sequences of pillowed andesites, limestones, and lenses of felsic pyroclastics are useful as local markers within this unit. The uppermost strata of this formation, particularly near Brucejack Lake, are marked by the appearance of coarse K-feldspar phenocrysts in plagioclase-hornblende phyric andesite ("Premier Porphyry"). Age is Hettangian to Pliensbachian.

Succeeding this is a heterogeneous sequence of varicoloured tuffs and flows, interbedded with hematitic sedimentary rocks, subordinate pillow lavas, and columnar-jointed dacites (Betty Cr. formation). Widespread hematite in this unit implies that much of it was deposited subaerially. Age is Pliensbachian to Toarcian.

This is overlain by a thin but widespread sequence of felsic pyroclastic rocks, including welded tuffs (Mt. Dilworth formation). This forms a useful regional marker that is locally distinguished by abundant pyrite and siliceous hydrothermal alteration. Age is Toarcian.

The uppermost unit (Salmon R. formation) is a thick sequence of mainly turbiditic siltstones and fine sandstones. The basal member is a coarse, pyritiferous, fossil-bearing wacke of Toarcian age. On Prout Plateau a distinctive chert-pebble conglomerate occurs within 200 metres of the basal contact. This unit appears to pass conformably upwards into Bowser Lake Group sediments (late Bajocian and younger Ashman Formation).

MINERAL DEPOSITS

Both precious (Au,Ag) and base (Cu,Pb,Zn,Fe,Ni) metal deposits occur in the map area. Two new gold mines are under development: the West Zone of Newhawk Gold Mines Ltd. and the Goldwedge deposit of Catear Resources Ltd. Underground exploration commenced in 1987 on the DOC property (Magna Ventures -Silver Princess joint venture). Limited mining has also occurred at the Globe and Cumberland gold prospects in the 1900s, the Kay silver-gold prospect off and on since the 1930s, and the E&L nickel-copper deposit in the 1960s.

Using a simple, nongenetic scheme mineral occurrences can be grouped into four main categories: veins, disseminations, intrusive contacts, and stratabound.

Veins

Several types occur including high-grade gold-silver veins which are the preferred exploration target at present. Vein types and examples are as follows.

1. Base metal quartz-carbonate veins with pyrite, galena and sphalerite occur locally outside the main areas of alteration around Brucejack Plateau.

2. Silver-rich base metal veins with pyrite, galena, sphalerite, tetrahedrite, and chalcopyrite occur mainly in the south-west of the map area. An example is the Knip prospect which yields assays of up to 3000 grams per metric ton (gpT) Ag but less than 1 gpT Au.

3. Precious and base metal veins consist of polymetallic quartz-(carbonate) stringers, stockworks, and tension gash fillings. The best exposed example is the Brucejack Lake West Zone which contains pyrite, ruby silver, tetrahedrite, electrum, argentite, chalcopyrite, galena, and sphalerite. Precious metal and base metal mineralization may belong to different mineralizing episodes. The Kerr A zone may be of this type.

4. Precious metal veins are essentially pyrite and electrum in quartz or quartz-calcite veins. Arsenopyrite may occur peripherally in the host rocks. An example is the Goldwedge deposit.

5. Fissure veins are massive bull quartz with little or no wall-rock alteration. In the Q17/Q22 veins on the DOC property gold is associated with specular hematite, galena, and pyrite especially along sheared vein margins.

6. Carbonate veins, some strongly pyritiferous, are widespread, late stage stringers. They are not known to carry precious metal values but sampling has been limited. Thickest examples occur near Atkins Glacier.

7. Barite veins with minor quartz, calcite, and sulphides occur locally near Brucejack Lake.

Disseminations

Large gossans up to 20 aquare km in area occur around Treaty, Mitchell, Freegold, Sulphurets, and Cone Glaciers, the Sulphurets Icefield, and the ridges between Tritescook, Fewright, and King Creeks. These consist essentially of pyrite disseminated in argillic and phyllic alteration zones that have been dynamically metamorphosed. At Treaty gossan native sulphur and alunite indicate acid-sulphate alteration characteristic of high levels in epithermal systems. Within some gossans prospecting has discovered copper, molybdenum, gold, and silver mineralization in silicified zones, quartz stockworks, and porphyry-style disseminations. Precious and base metal zones do not necessarily coincide. Examples include the Snowfield gold zone south of

Mitchell Glacier which has 7 MT of 2.57 gpT disseminated Au; the Mitchell, Kirkham, Sulphurets and Kerr B porphyry copper-molybdenum prospects near Brucejack Plateau; and the Eric and Cole copper prospects west of the Unuk R.

Intrusive Contacts

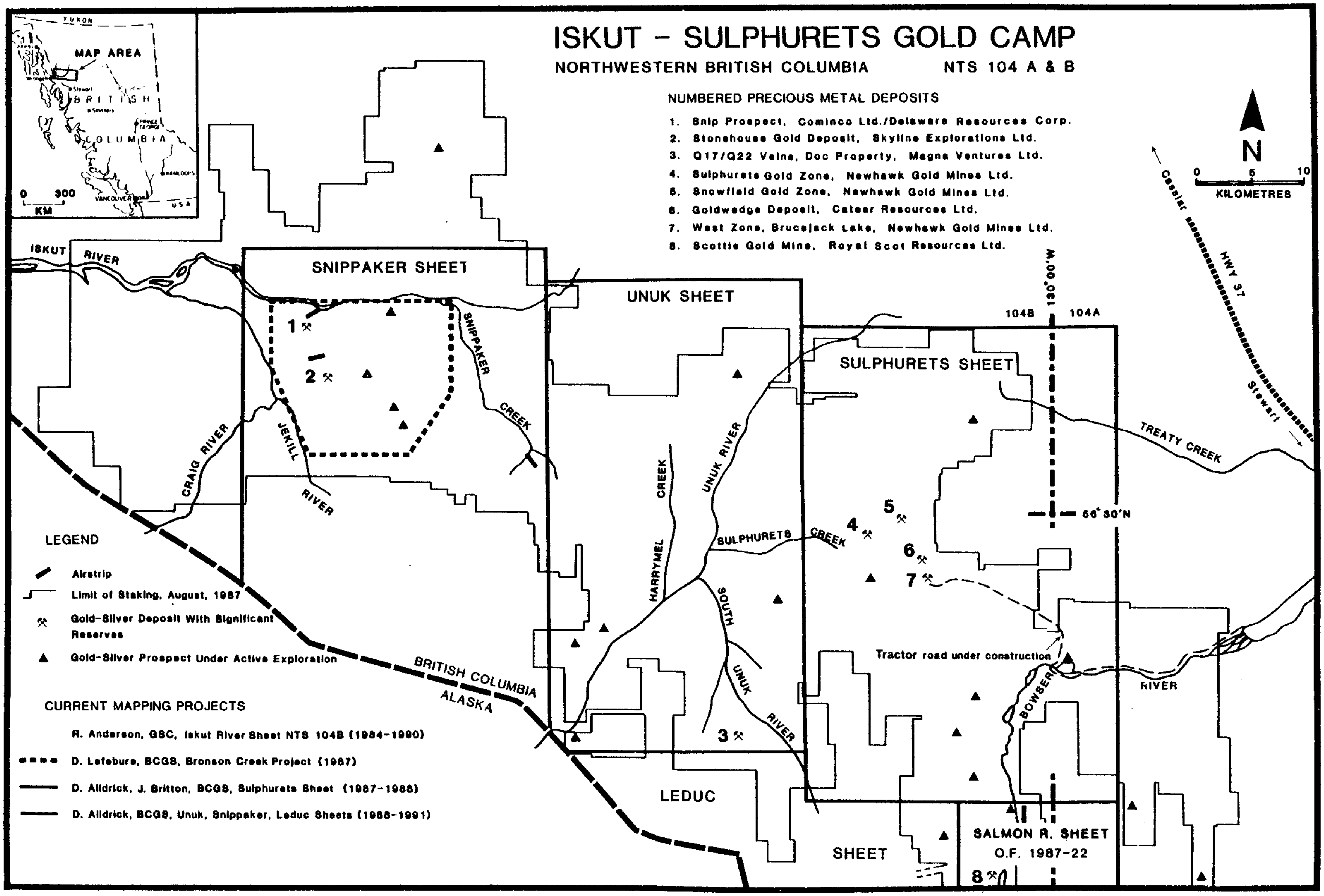
Sulphide and metal oxide bearing deposits with a close spatial or temporal association with an igneous intrusion are included in this category. Examples are: the Konkin zone, a possible gold skarn; the E&L nickel-copper deposit; the Max iron-copper skarn; and pyrrhotite-chalcopyrite mineralization around the margin of the Lee Brant stock.

The Konkin gold zone consists of electrum-magnetite-hematite-chalcopyrite-pyrite-quartz-calcite veinlets in chlorite-diopside-garnet-bearing rock adjacent to a dioritic stock. The discovery chip sample (Aug. 1987) assayed 960 gpT over 1.3 m.

The E&L deposit is massive and disseminated pyrrhotite-pentlandite-chalcopyrite-pyrite along the margin of a hornblende gabbro. Drill indicated reserves are 1.5 MT of 0.7% Ni, 0.6% Cu with untested PGE potential. The Max deposit is a skarn-type replacement in limestone with magnetite and chalcopyrite that has 10 MT of 45% Fe.

Stratabound

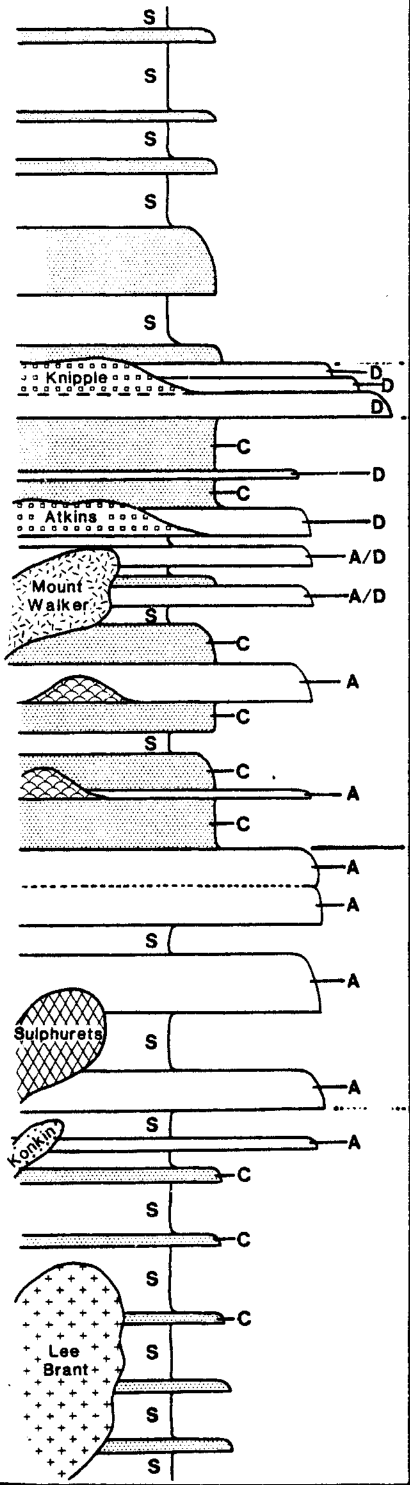
Stratabound mineralization consists of pyritic zones, lenses and seams contained within a particular stratum or restricted set of strata. Examples include: disseminated pyrite in Mt. Dilworth formation felsic pyroclastics between Treaty Glacier and Prout Plateau; pyritic seams in the lowest members of the Salmon R. formation; and disseminated to massive pyrite in dacite porphyry and its overlying sediments at the toe of Knipple Glacier. The Kay prospect on Prout Plateau may belong to this category. It consists of stockwork mineralization (galena-sphalerite-tetrahedrite-jamesonite-polybasite) and massive sulphide pods (sphalerite-galena-pyrite) in silicified, brecciated felsic pyroclastics.



Map courtesy of Teuton Resources Corporation, used & modified with permission.

Figure 1-18-1. Iskut-Sulphurets gold camp; precious metal deposits and current mapping projects.

SCHEMATIC STRATIGRAPHY



MAP UNIT, FORMATION, THICKNESS, and AGE	LITHOLOGIES * indicates diagnostic features	MINERAL OCCURRENCES
UNIT 4 SALMON RIVER FORMATION >1000 m Toarcian to Bajocian	*Black siltstones with lesser thick-bedded sandstones and minor limestone lenses. *Basal fossiliferous and pyritic wacke.	
UNIT 3: MOUNT DILWORTH FORMATION 75 m to 150 m Toarcian	*Felsic pyroclastics and flows. Tuff breccias, lapilli tuffs, ash tuffs, and dust tuffs. Local *welded ash flows and *agglomeratic tuff breccias. *Chalcedonic veins.	KNIP
UNIT 2 BETTY CREEK FORMATION 700 m to 1200 m Pliensbachian to Toarcian	Interbedded volcanic tuffs, flows, and *hematitic sedimentary rocks. *Purple to maroon conglomerates, wackes, siltstones and mudstones. Basaltic to dacitic tuffs and flows. *Pillow lavas, crystal and lithic tuffs. *Columnar jointed units. Minor black fossiliferous siltstone sequences.	TREATY ISLAND GOLD WEDGE SHORE, RED RIVER
UNIT 1B UPPER UNUK RIVER FORMATION 1000 m to 1500 m Hettangian to Pliensbachian	Volcanic strata with lesser black siltstone members. *Two feldspar porphyry ±hornblende (Premier Porphyry), *hornblende porphyry, and *bedded airfall crystal tuff. Minor fossil occurrences.	GOSSAN HILL WEST IRON CAP SNOWFIELD SPINE, ELECTRUM, 367 4-J's
UNIT 1A LOWER UNUK RIVER FORMATION >1000 m Norian to Hettangian	Mixed sedimentary strata with minor tuff units. *Black siltstones, heterolithic pebble to cobble conglomerates and wackes. *Hornblende feldspar crystal tuffs. Minor fossil occurrences.	KERR KONKIN

Figure 1-18-2. Schematic stratigraphy, Sulphurets map area. A = andesitic volcanics; D = dacitic volcanics; S = siltstones; C = conglomerates; stipple = sandstones.

Figure 1-18-3. Geology and mineral deposits, Sulphurets map area.

GEOLOGICAL SETTING OF THE VOLCANIC-HOSTED SILBAK PREMIER MINE, NORTHWESTERN BRITISH COLUMBIA (104A/4 and 104B/1)

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ABSTRACT

Detailed mapping of a 7.5 km^2 area at 1:2,500 around Silbak Premier and a 1:10,000 compilation map over 60 km^2 have established Hazelton Group stratigraphy and structure. Hazelton Group stratigraphy begins with at least 1,000 metres of Late Triassic-Early Jurassic (210 $^{+24}_{-14}$ Ma; U-Pb zircon) green andesite flows, breccias and tuffs, however the base of the section is not exposed. Less than 1750 metres of green and maroon andesitic to dacitic volcaniclastic rocks overlie the andesite unit. North of Silbak Premier, at Slate Mountain, the volcaniclastic unit is overlain by up to 200 metres of a black tuff unit containing characteristic fresh biotite and white plagioclase fragments. The top of the Hazelton Group is a regional marker horizon, the Monitor rhyolite breccia and tuff (197 ± 14 Ma; zircon U-Pb). Hazelton volcanics are overlain by three different units. At Slate Mountain, Bowser Lake Group Bathonian/Callovian argillite and siltstone (at least 1500 metres thick) lie above Hazelton rocks. Farther north on Mount Dilworth, Monitor rhyolite is succeeded by black tuff or a Toarcian buff carbonate. East of Monitor Lake, less than 75 metres of Bajocian Spatsizi Group silicic shale and tuff overlies Hazelton volcanic rocks.

Three intrusive episodes are discerned through isotopic dating: Early Jurassic (190 ± 2 Ma; U-Pb zircon) Texas Creek plutonic suite dacitic porphyries; Eocene Hyder suite leucocratic dykes; and Oligocene-Miocene (25.2 ± 2.3 Ma; K-Ar biotite and 18 ± 6 Ma; Rb-Sr) biotite lamprophyre dykes. The Jurassic suite includes K-feldspar megacrystic "Premier porphyry" sills and dykes that are in part spatially and possibly genetically associated with mineralization.

Structural features include disharmonic tight folds, ductile shear zones, and brittle faults. At least four phases of pre-Eocene deformation are defined by: (1) moderate west-plunging recumbent folds, (2) north-plunging inclined folds, (3) north-plunging upright folds, and (4) moderate west-plunging pencil lineations.

The map area is divisible into three structural domains: the North, East and Silbak domains. The **North domain** is characterized by a marked structural discordance between warped Hazelton volcanic rocks and disharmonically folded Bowser Lake Group argillite and siltstone. Three phases of folding are: first phase tight to isoclinal disharmonic, recumbent folds; second phase open folds with shallow northwest-dipping axial planar cleavage; and third phase upright, shallow north-plunging synclinorium. Structural continuity is difficult to establish due to lack of marker horizons and inferred detachments. The **East domain** is characterized by phase 3 gently north-northwest-plunging folds and locally east-verging asymmetric chevron folds in the Spatsizi Group. In contrast to North domain, Monitor rhyolite and/or Spatsizi Group are structurally conformable with Bowser Lake Group rocks. The **Silbak domain** is characterized by phase four pencil lineations and quartz veins. Stope geometry illustrates that mineralization occurs along two trends: northeast zone and northwest zone of unknown phase.

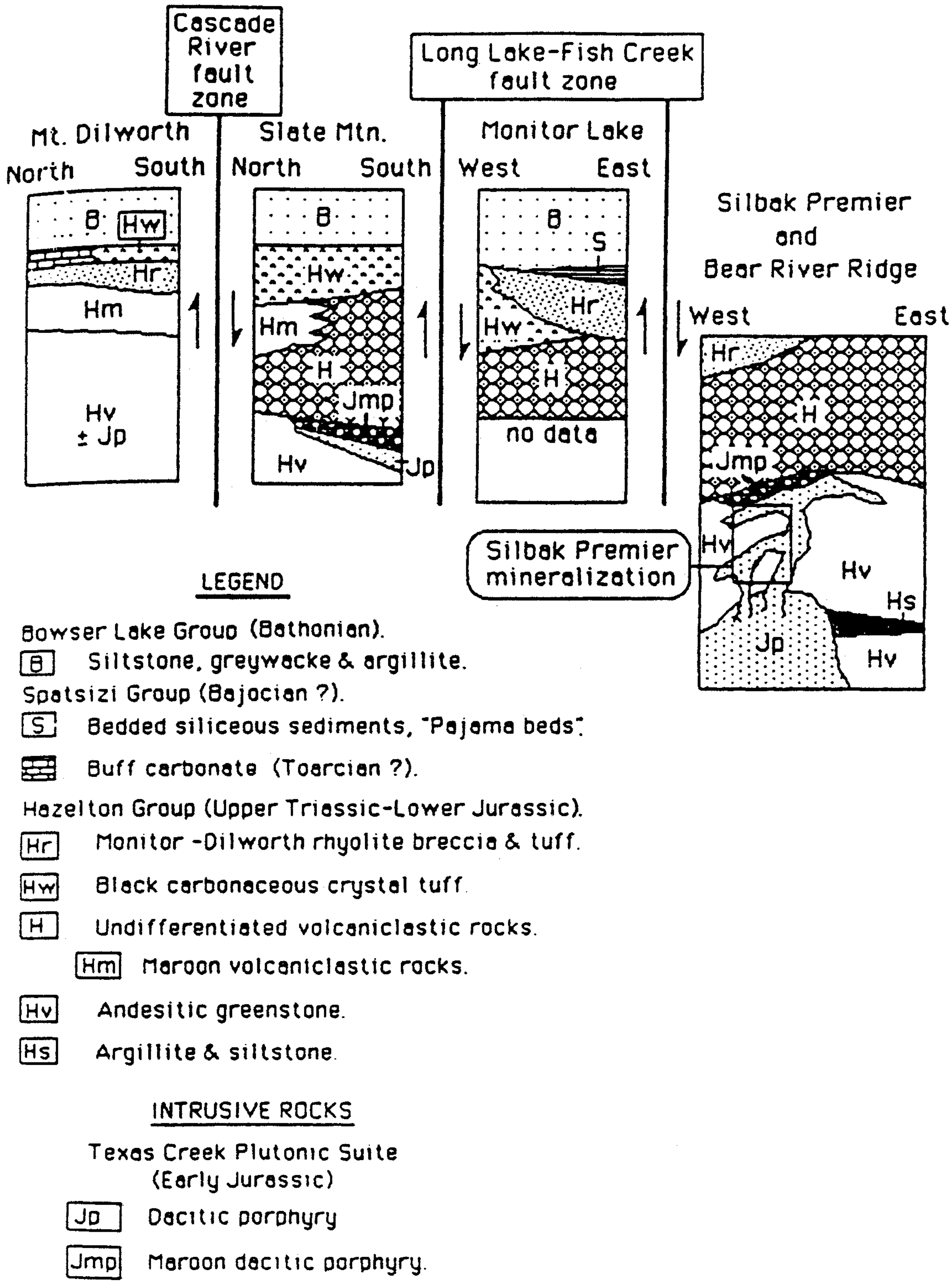
Steeply dipping, east-striking ductile fabrics occur in the Texas Creek batholith at the Riverside mine, Alaska, and in maroon volcaniclastics along Bear River Ridge. Mylonitic fabrics at Riverside mine suggest a dextral sense of shear. A biotite lineation in the mylonitic foliation yields a totally reset Eocene K-Ar date.

The width of Eocene Hyder dyke swarms indicate that there has been at least one kilometre of northeast brittle crustal extension. About 1,400 metres of dextral transcurrent movement along the Long Lake-Fish Creek fault is post-Eocene dyke emplacement. Oligocene-Miocene lamprophyre dykes fill fractures produced during east-west extension.

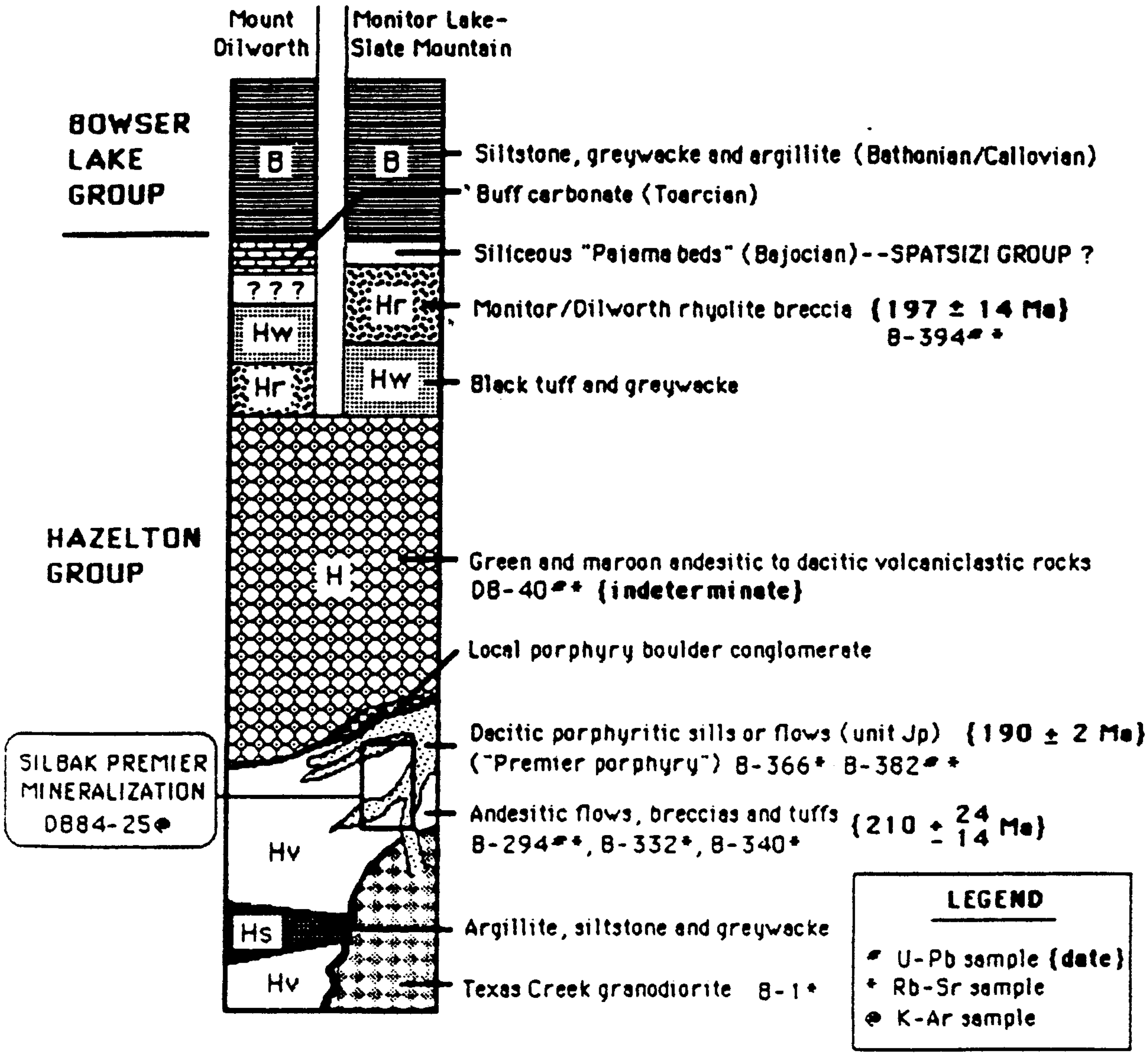
Regional syntectonic greenschist grade metamorphism produced a carbonate-chlorite-sericite-pyrite mineral assemblage, probably in Middle Cretaceous time, bracketed by isotopic dating results.

Hazelton Group volcanic rocks and coeval Texas Creek porphyritic rocks are subalkaline high-K to very high-K andesites and dacites. Tectonic discrimination diagrams indicate a calcalkaline, volcanic arc setting, with similar geochemical patterns to those for Andean volcanic rocks.

Mineralization is hosted in Hazelton Group andesites and coeval Texas Creek porphyritic dacite sills and dykes. Mineralization and porphyry emplacement appear to have been controlled by northeast- and northwest-striking structures. Ore is predominantly discordant but locally concordant with moderately northwest-dipping andesite flows and breccias. No mineralization occurs in or above overlying maroon volcaniclastic rocks. Sericite alteration gives a Paleocene K-Ar date (63 $\pm$ 5 Ma); this is interpreted to be partially reset. The spatial link with Texas Creek K-feldspar porphyry and the discordant nature of the ore suggests mineralization is Early Jurassic age. These characteristics also favour an epigenetic model for the Silbak Premier deposit.



Idealized stratigraphic columns, Stewart, northwestern British Columbia: (a) Mount Dilworth and (b) Slate Mountain sections are drawn north-south, (c) Monitor Lake and (d) Silbak Premier/Bear River Ridge sections are east-west. Faults have oblique slip displacement. Sections are not to scale.



Schematic stratigraphic location of geochronometry samples near Silbak Premier, Stewart, northwestern British Columbia.

A PRELIMINARY APPRAISAL OF THE AU-AG METALLOGENY OF THE TOODOGGONE DISTRICT, NORTH-CENTRAL BRITISH COLUMBIA

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For the past decade, the Toodoggone district has been one of the most active areas of mineral exploration in the Canadian Cordillera. The district contains one former Au-Ag producer (Baker), a major new Au-Ag mine in development (Lawyers), several deposits undergoing final feasibility studies, and numerous other precious metal occurrences in various stages of exploration. In spite of the high level of exploration activity, a metallogenic and lithotectonic framework has yet to be fully established.

The deposits range from deep-seated precious/base mctal-bearing porphyries, stockworks and veins, through epithermal Au-Ag veins and breccias, to near-surface replacement type gold mineralization. These contrasting styles and levels of emplacement appear to have developed during a restricted early Jurassic episode and represent an unusual metallogenic environment. In addition to classic gold-silver deposits, the Toodoggone area contains several deposits of barite-hosted Au mineralization, and is one of the few epithermal districts which juxtaposes adularia-sericite and acid-sulfate styles of alteration. The structures and volcanic rocks which host the deposits also reflect one of the most active and important periods in the tectonic evolution of the northern Cordillera.

A preliminary study of the setting of the district suggests that the "Toodoggone volcanics" are equivalent to the Hazelton Group. These subaerial, high-K andesites and dacites have undergone very low grade metamorphism, and are only locally affected by younger plutonism. On the basis of observed geological relationships and a reinterpretation of published geochronological data, it is proposed that deposition of the "Toodoggone volcanics" occurred in two main stages, and that the mineralizing event was restricted to the lower (stage I, ~190 Ma) cycle of volcanism and/or the interval between stages I and II (Clark and Williams-Jones, 1987). The timing of Toodoggone stage I volcanism is reasonably well constrained by seven K-Ar age determinations spanning 204-189 Ma (Carter, 1972; Gabrielse et al., 1980; Panteleyev, 1983; Diakow, 1985). Stage II is more poorly constrained by two K-Ar determinations of 182-179 Ma (Gabrielse et al., 1980), but the onset of stage II volcanism is unlikely to have occurred prior to 186 Ma. The errors associated with the ages allow a non-depositional interval of up to ten million years between stages I and II. Stage I and older rocks are characterized by widespread alteration and contain virtually all the epithermal mineralization; stage II rocks are largely unaltered and contain few, if any, Au-Ag prospects. Toodoggone volcanism thus spans typical Hazelton ages, with stage I overlapping the Telkwa and Nilkitkwa, and stage II the Smithers (i.e., Yuen Member) formations.

The structures which host the mineral deposits include normal, thrust and sinistral strike-slip faults. These reflect, in part, the large-scale tectonic regimes associated with Lower Jurassic plate movements and terrane amalgamation.

Gold-silver deposits representative of the various classes of mineralization include the Porphyry Pearl, Baker, Shasta, Lawyers AGB and Cliff Creek, BV and Verrenass-Bonanza deposits. Porphyry Pearl is a porphyry type Au-Ag-Cu-Pb-Zn deposit, consisting of quartz, quartz-magnetite-pyrite and anhydrite stockworks hosted by potassic and phyllic altered granodiorite. Au-Ag-Cu mineralization at the Baker mine appears to be fairly deep-seated in origin. The main quartz vein is characterized by a high Ag:Au ratio, and sericite-chlorite-pyrite alteration of the host Takla Group andesite. The main Shasta Ag-Au zones consist of quartz and carbonate stockworks and breccias in potassic and silicic altered "Toodoggone volcanic" andesites/dacites (stage I). Mineralization is characterized by high Ag:Au ratios and minor base metal contents, suggesting a somewhat deep emplacement level. The Lawyers AGB and Cliff Creek zones represent the intermediate level class, and are economically the most important Au-Ag deposits known in the district. Moreover, the Cliff Creek zone covers the transition between intermediate and deep levels of emplacement. The distinguishing features of the AGB chalcedony-amethyst veins and breccias include relatively high Ag:Au ratios, and associated Kfeldspar-sericite alteration of the host "Toodoggone volcanic" andesites (stage I). By contrast, the alteration in the Cliff Creek deposit contains potassic, phyllic and argillic assemblages near-surface, and chlorite-dominant assemblages at depth. Mineralization at the BV deposit consists of gold in barite-quartz veins, hosted by silicified and sericitized "Toodoggone volcanic" andesite (stage I). The high grade Verrenass-Bonanza area deposits are characterized by a sequence of progressively more acidic alteration events which created the porosity necessary for the open-space deposition of barite-gold (Clark and Williams-Jones, 1986) in "Toodoggone volcanic" andesite/dacite (stage I).

The practical implications of this preliminary evaluation of Toodoggone Au-Ag metallogeny are: (1) surface exploration for epithermal Au-Ag mineralization should focus on stage I volcanics and underlying rocks in the Toodoggone area; (2) Toodoggone-equivalent subaerial Hazelton volcanics adjacent to the district should receive greater exploration attention; and (3) the range in Toodoggone mineralization styles and structural settings negate the value of any one exploration model.

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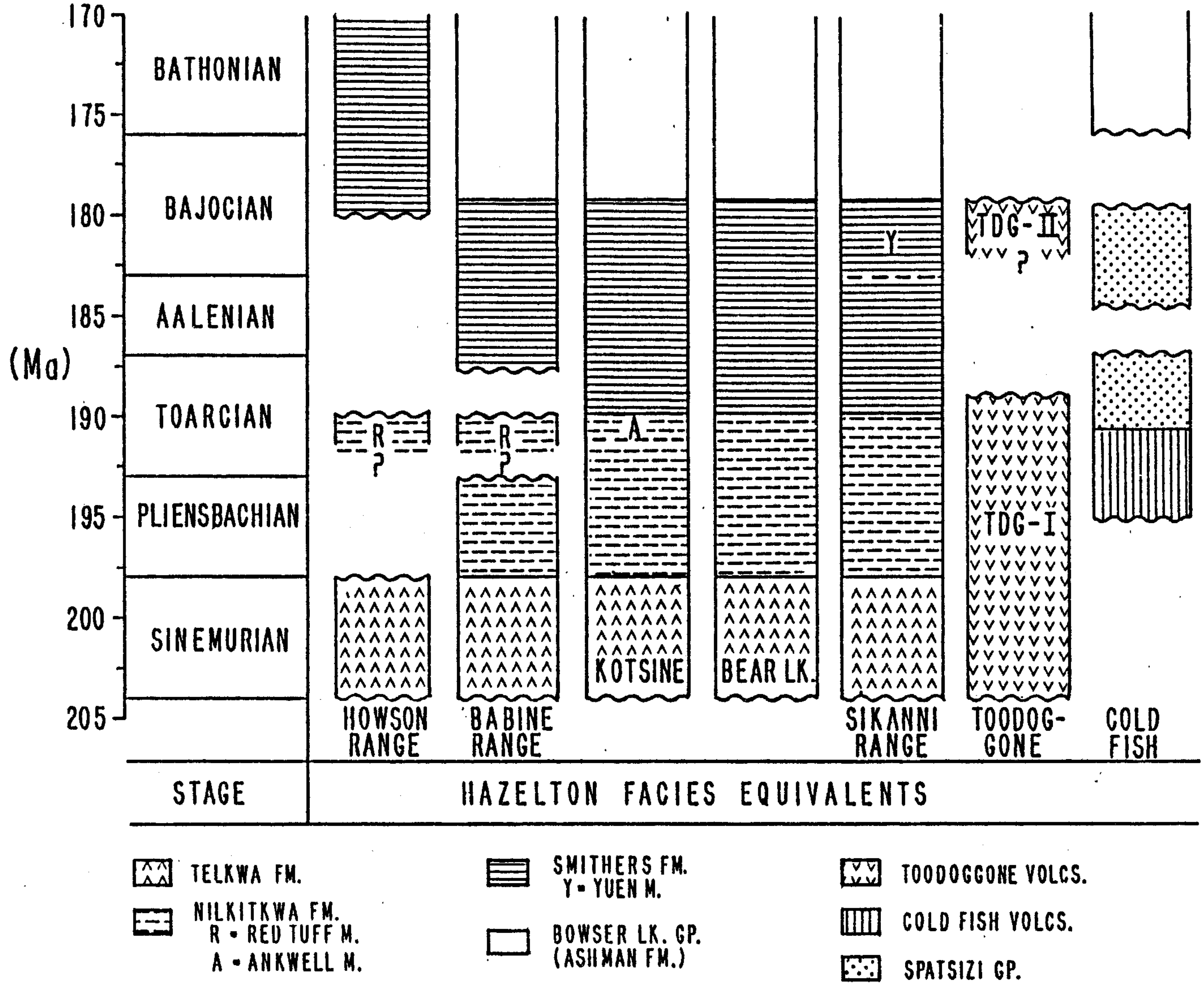
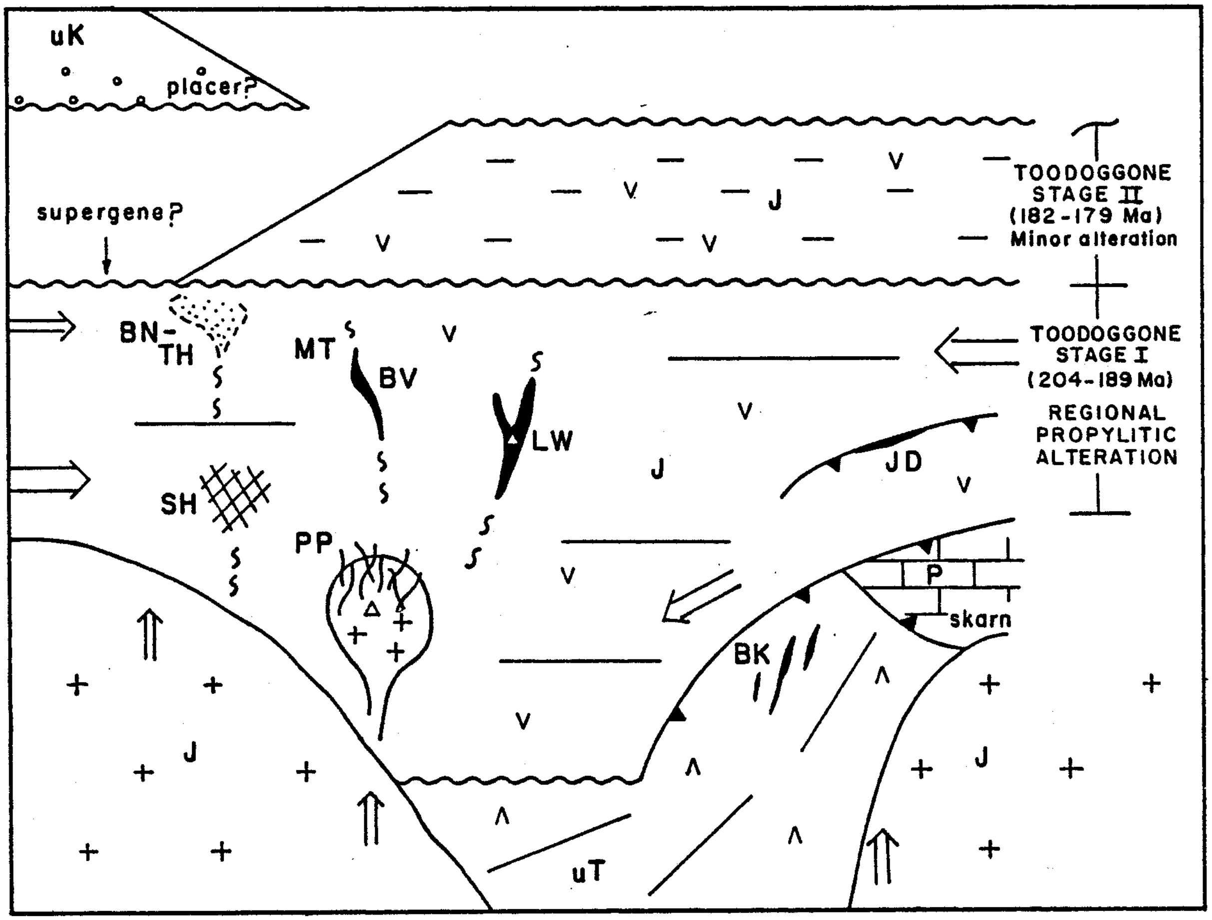


Chronostratigraphic sections through Hazelton facies equivalents around the eastern side of the Bowser-Sustut basins (south to north). All sections rest unconformably or in fault contact with Talka-Stuhini assemblages. Note the apparent restricted correlation of Toodoggone stage II volcanism with the tuffaceous sediments of the Yuen Member. Howson through Sikanni facies after Tipper and Richards (1976), Cold Fish facies after Thomson et al. (1986). Geologic time scale of Kent and Gradstein (1985).



Schematic diagram summarizing the metallogenic, stratigraphic and structural features of the Toodoggone district. The Lower to Middle Jurassic (J) "Toodoggone volcanics" are underlain and are in thrust contact with Upper Triassic (uT) Takla Group andesites and Permian (P) Asitka Group limestones, and are overlain by Upper Cretaceous (uK) Sustut Group conglomerates. Au-Ag deposits are generally confined to Toodoggone stage I and older rocks. PP=Porphyry Pearl; BK=Baker; SH=Shasta; JD=JD-West/Gumbo; LW=Lawyers; MT=Mets "A"; BN=Bonanza; TH=Thesis III.

STRATIGRAPHY AND PETROLOGY OF THE OOTSA LAKE GROUP IN THE WHITESAIL RANGE

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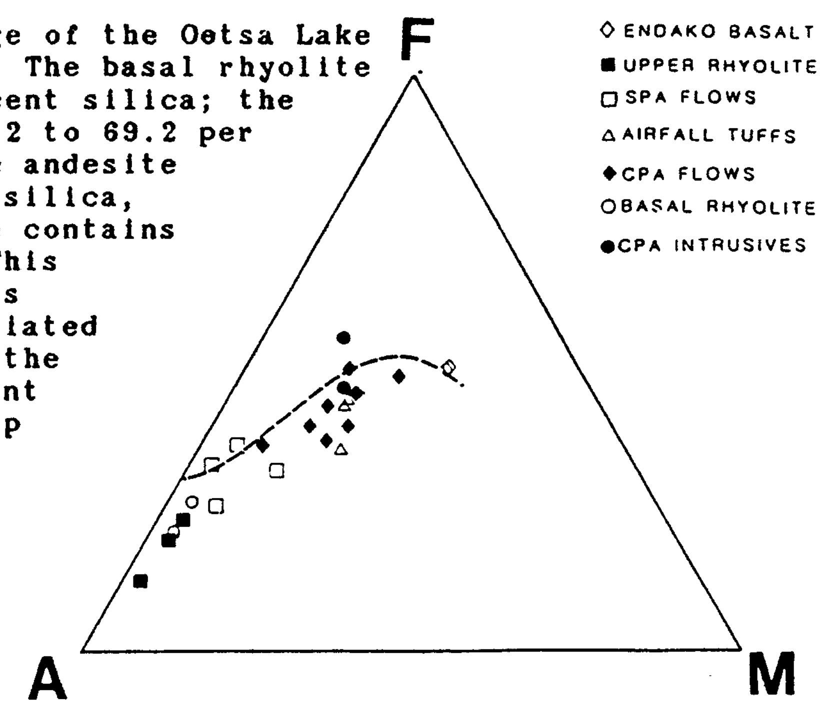
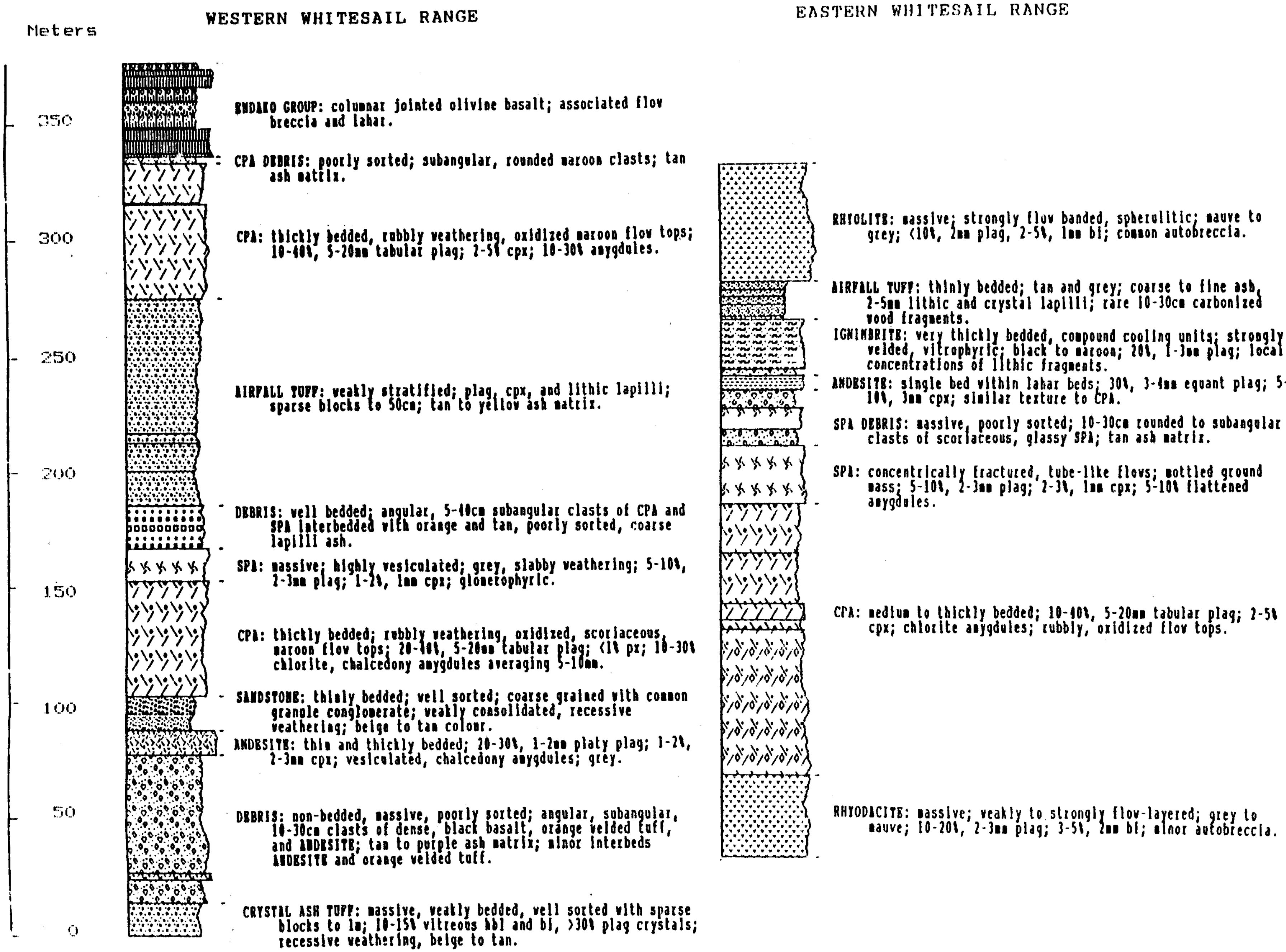
Ootsa Lake Group volcanic rocks are confined to the interior plateau of central British Columbia, near the western boundary of the Intermontane Belt. At the margin of the plateau, in the Whitesail Range, uplifted blocks reveal a type section of andesitic to rhyolitic lava flows, and airfall and ashflow tuffs. These overlie Middle Jurassic Smithers Formation sediments, and in turn are disconformably overlain by basaltic flows of the Endako Group. Four potassium-argon age dates, spanning the stratigraphy, give an age range of 50.0 to 49.8 +/- 1.7 Ma for the Ootsa Lake volcanics in this area. On an AFM diagram, the Ootsa Lake Group rocks plot as calc-alkaline; in contrast, the less differentiated Endako basalts plot as tholeiites.

Basal units of the Ootsa Lake Group are varied and discontinuous. Rhyodacite, lahar, and strongly welded ashflows each disconformably overlie the Smithers Formation. Above these are coarse, crowded, plagioclase phyric andesite (CPA) flows, slabby, sparsely plagioclase phyric andesite (SPA) flows, and lahar. A period of erosion produced local angular, poorly sorted, stratified debris deposits containing clasts of the two andesite types, and preceded the eruption of a thick, crystal-lapilli airfall tuff. This tuff, which contains coarse plagioclase and pyroxene crystals, is probably related to overlying CPA flows that are identical to CPA flows underlying the tuff.

Rhyolite flows overlying the airfall tuffs in the eastern Whitesail Range correlate with extensive rhyolite flows overlying CPA flows at Whitesail Reach. They are strongly flow-layered and commonly autobrecciated. This is the highest stratigraphic unit seen in the Whitesail Range; at Whitesail Reach, vitrophyric andesite flows overlie the rhyolites, and in turn are overlain by conglomerate containing clasts of underlying andesite and rhyolite. In the Whitesail Range, olivine basalt of the Endako Group fills channels cut into the airfall tuff through overlying CPA flows.

The compositional range of the Ootsa Lake Group is relatively narrow. The basal rhyolite contains 66.9 to 68.8 per cent silica; the upper rhyolite contains 67.2 to 69.2 per cent silica. The most mafic andesite contains about 53 per cênt silica, though the average andesite contains about 55 per cent silica. This narrow silica range suggests eruption of a pre-differentiated source magma, separated in the crust from a primitive parent magma that remained too deep to be erupted.





Meters
WESTERN WHITESAIL RANGE
EASTERN WHITESAIL RANGE
350
300
250
200
150
100
50
0
ENDAKO GROUP: columnar jointed olivine basalt; associated flow breccia and lahar.
CPA DEBRIS: poorly sorted; subangular, rounded maroon clasts; tan ash matrix.
CPA: thickly bedded, rubbly weathering, oxidized maroon flow tops; 10-40%, 5-20mm tabular plag; 2-5% cpx; 10-30% amygdules.
AIRFALL TUFF: weakly stratified; plag, cpx, and lithic lapilli; sparse blocks to 50cm; tan to yellow ash matrix.
DEBRIS: well bedded; angular, 5-40cm subangular clasts of CPA and SPA interbedded with orange and tan, poorly sorted, coarse lapilli ash.
SPA: massive; highly vesiculated; grey, slabby weathering; 5-10%, 2-3mm plag; 1-2%, 1mm cpx; glomerophyric.
CPA: thickly bedded; rubbly weathering, oxidized, scoriaceous, maroon flow tops; 20-40%, 5-20mm tabular plag; <1% px; 10-30% chlorite, chalcedony amygdules averaging 5-10mm.
SANDSTONE: thinly bedded; well sorted; coarse grained with common granule conglomerate; weakly consolidated, recessive weathering; beige to tan colour.
ANDESITE: thin and thickly bedded; 20-30%, 1-2mm platy plag; 1-2%, 2-3mm cpx; vesiculated, chalcedony amygdules; grey.
DEBRIS: non-bedded, massive, poorly sorted; angular, subangular, 10-30cm clasts of dense, black basalt, orange welded tuff, and ANDESITE; tan to purple ash matrix; minor interbeds ANDESITE and orange welded tuff.
CRYSTAL ASH TUFF: massive, weakly bedded, well sorted with sparse blocks to 1m; 10-15% vitreous hbl and bi, >30% plag crystals; recessive weathering, beige to tan.
RHYOLITE: massive; strongly flow banded, spherulitic; mauve to grey; <10%, 2mm plag, 2-5%, 1mm bi; common autobreccia.
AIRFALL TUFF: thinly bedded; tan and grey; coarse to fine ash, 2-5mm lithic and crystal lapilli; rare 10-30cm carbonized wood fragments.
IGNIMBRITE: very thickly bedded, compound cooling units; strongly welded, vitrophyric; black to maroon; 20%, 1-3mm plag; local concentrations of lithic fragments.
ANDESITE: single bed within lahar beds; 30%, 3-4mm equant plag; 5-10%, 3mm cpx; similar texture to CPA.
SPA DEBRIS: massive, poorly sorted; 10-30cm rounded to subangular clasts of scoriaceous, glassy SPA; tan ash matrix.
SPA: concentrically fractured, tube-like flows; mottled ground mass; 5-10%, 2-3mm plag; 2-3%, 1mm cpx; 5-10% flattened amygdules.
CPA: medium to thickly bedded; 10-40%, 5-20mm tabular plag; 2-5% cpx; chlorite amygdules; rubbly, oxidized flow tops.
RHYODACITE: massive; weakly to strongly flow-layered; grey to mauve; 10-20%, 2-3mm plag; 3-5%, 2mm bi; minor autobreccia.

STRATIGRAPHY AND STRUCTURAL STYLE OF THE BOWSER AND SUSTUT BASINS, NORTH-CENTRAL BRITISH COLUMBIA

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A large part of north-central British Columbia is underlain by the Mesozoic sedimentary fill of the Bowser and Sustut basins. The strata of the basins now comprise an impressive fold belt that is the result of considerable northeasterly contraction. The basins are important not only for their anthracite coal deposits (Klappan and Groundhog), but because their sedimentation and deformation provide a record of the convergence of the two Superterranes during Jurassic and Cretaceous time.

Strata of the Bowser Basin, called the Bowser Lake Group, are Middle Jurassic to Cretaceous in age and were deposited on Early Jurassic volcanic rocks (Cold Fish volcanics) and sedimentary rocks (Spatsizi Group). Although a general trend from marine to fluvial and alluvial environments has been recognized by several workers, details of the regional depositional history of the basin are poorly known. The Ashman Formation at the base of the Bowser Lake Group is perhaps the only regionally mappable unit. In the overlying, undivided Bowser Lake Group, the liklihood of a complex vertical and lateral repetition of shallow marine, deltaic, and fluvial facies, combined with intense contractional deformation and dip-slip displacement on faults prohibit immediate recognition of a regional stratigraphy. In some areas of relatively simple open folding a local stratigraphy can be mapped, but its regional significance remains uncertain without a comprehensive sedimentological, biostratigraphic, and structural interpretation for the basin.

Strata of the Sustut Basin are mid- to late Cretaceous in age and were deposited on a structurally complex basement of Bowser Lake Group, Spatsizi Group, and Cold Fish volcanics. The Sustut Group consists of more than 2000 m of fluvial sediments. The basal unit, the Tango Creek Formation was deposited by rivers that flowed southwesterly from the Omineca Belt, carrying the first metamorphic detritus across the northern Intermontane Belt. The overlying Brothers Peak Formation was deposited by rivers flowing from the rising Omineca Belt in the east, and from the developing fold belt in the west.

The dominant structures affecting the Bowser Basin and southwest Sustut Basin are northwest-trending folds which plunge gently except where they interfere with local, northeast-trending folds, and plunge up to 35 degrees. Fold geometry varies from open to tight, upright to gently inclined northeast-verging, with angular to rounded hinges. Cross-sections where folds are well-exposed show that the beds have been shortened by folding to at least half of their original length. The large amount of northeasterly contraction accommodated by the folds must be matched by detachments, but major thrust faults are difficult to recognize in the Bowser Lake Group in the absence of distinctive stratigraphy or widespread marker units. Thrust faults with unequivocably large displacement can be identified near the boundary of the two basins, where the four major map units outcrop, and three separate thrust faults have enough stratigraphic throw to repeat map units. The greatest stratigraphic throw is demonstrated where the Early Jurassic Cold Fish volcanics lie structurally on the mid-Cretaceous Sustut Group.

The structural and stratigraphic relationships at the boundary of the two basins also provide information on the timing of deformation. The basal Sustut Group stratigraphically overlies a thrust fault that has been offset by normal faults, indicating pre-Sustut (ie. pre- mid-Cretaceous) contractional deformation and normal faulting. The same unconformity and complex underlying geology is carried by a thrust fault which has volcanics in the hanging wall and Tango Creek Formation in the footwall, indicating post- mid-Cretaceous contractional deformation. In addition to providing constraints on the timing of deformation, the presence of Early Jurassic volcanics structurally on top of the Tango Creek Formation demonstrates that the early Mesozoic basement of the Bowser and Sustut basins is also involved in the contractional deformation. If the shortening at the northern common boundary of the Bowser and Sustut basins is representative of the rest of the Bowser Basin, then the basin, now only 200 km across structural trend, was at least 400 km across before folding, and the western boundary was at least as far west as the west side of the Coast Mountains.

PRELIMINARY GEOLOGY OF THE GERMANSEN LANDING AREA

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Rocks belonging to the Takla and Slide Mountain Groups underlie the area immediately around Germansen Landing, B.C.. The middle Paleozoic to lower Triassic Slide Mountain Group can be subdivided into three units. The basal unit is characterized by phyllite, argillite and lesser limestone with isolated bodies of serpentinized ultramafics and listwaenites. This unit is succeeded by the central unit of siltstones, cherts, argillites and ribbon cherts which are intruded by gabbroic sills and dykes. The upper unit is composed primarily of massive to pillowed basalts with lesser chert and argillite.

The upper Triassic Takla Group has been subdivided into five units. At the base is found dark grey to grey argillite, siltstone, cherty argillite, wacke, limestone and minor chert. This is succeeded by dark grey to grey-green polymictic volcanic sandstone and conglomerate of unit 2. This unit contains lesser siltstone and argillite. Maroon to dark grey-brown andesites and basalts which are interlayered with agglomerates and volcaniclastics comprise unit 3. Unit 4 is distinguished by dark grey-green magnetic augite porphyrys and basalts with associated pyroclastics and volcaniclastics. The upper unit is a dark grey volcanic sandstone and conglomerate with minor grey-green argillite and siltstone.

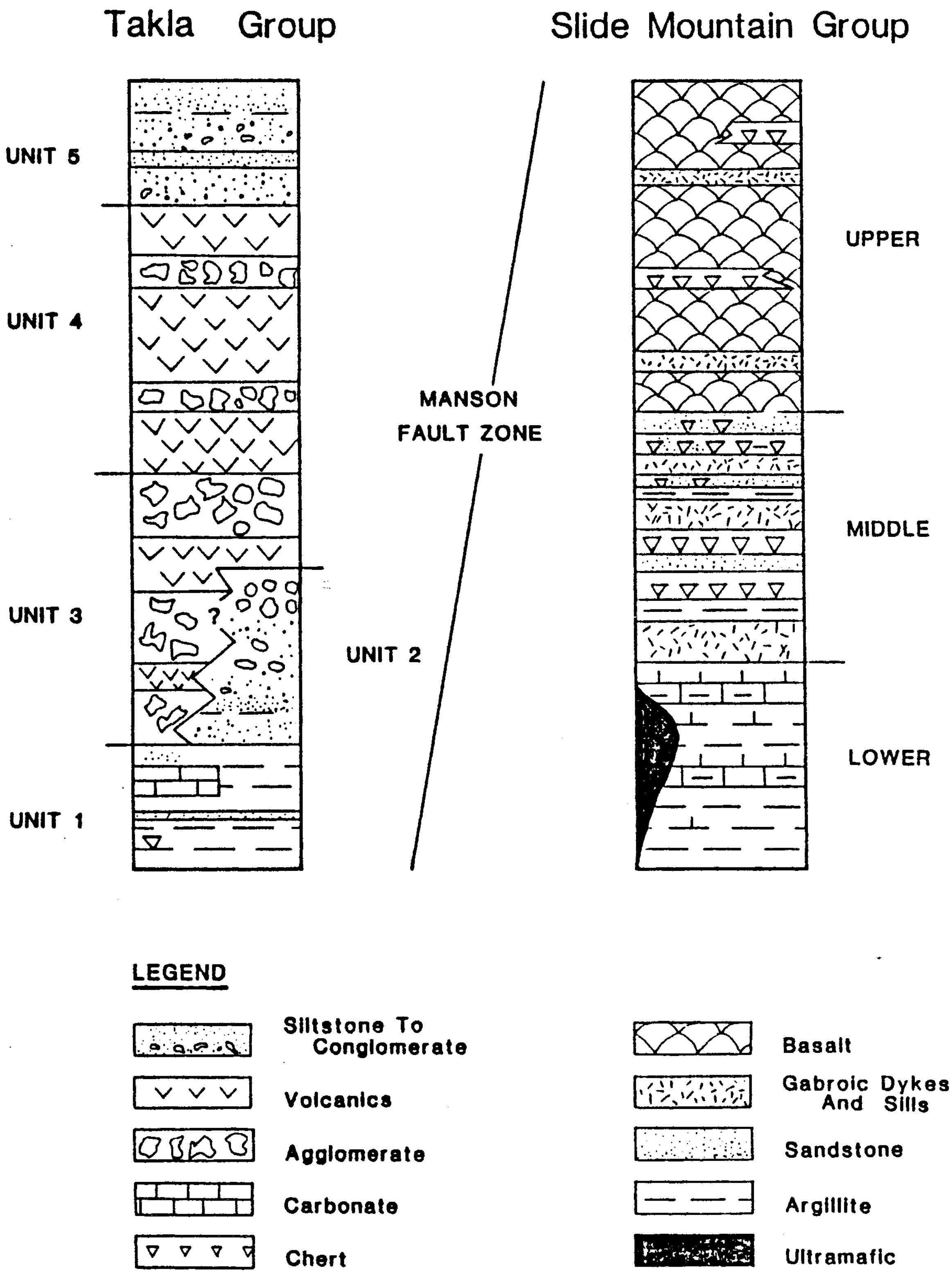
The Slide Mountain and Takla Groups are intruded by the Cretaceous Germansen Batholith. This body is made up of two phases; an early(?) foliated hornblende-biotite granite to granodiorte and a later two-mica granite.

The major structural element within the area is the northwest to southeast trending Manson fault zone. A strong stretching lineation indicates strike-slip motion of unknown sense. The trace of this fault approximately defines the boundary between the Slide Mountain and Takla Groups. The lower most phyllites and argillites of the Slide Mountain and Takla Groups contain a penetrative cleavage which parallels the Manson fault zone. Folds within the Takla Group west of the Manson fault zone generally are broad and strike east-west but swing into parallelism with the Manson fault zone as they are traced eastward into this fault zone.

The relationships between the Slide Mountain and Takla Groups is problematic. Exposure is poor and mapping is further complicated by the Manson fault zone. Where the contact between the two groups is exposed one recognizes evidence for a fault relationship of unknown sense. In these areas Takla Group rocks sit structurally higher than the Slide Mountain Group.

Most mineral showings in this area are spatially related to the Manson fault zone. These are sulphide-bearing quartz-carbonate veins which can be associated with a sericite-ankerite alteration of the surrounding rocks. This alteration is characterized by finely disseminated to porphyroblastic ankerite with an accompanying sericitization and silicification. These veins and alteration zones contain appreciable amounts of gold and silver.

GENERALIZED STRATIGRAPHIC SECTION



LEAD ISOTOPE DISCRIMINATION OF JURASSIC FROM LATER DEPOSITS, IN THE SMITHERS, STEWART, AND TOODOGGONE AREAS.

J.E. Gabites and C.I. Godwin
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Galena lead isotope data has been collected from mineral deposits hosted by Jurassic volcanic rocks and later intrusions, in the Smithers, Stewart, and Toodoggone areas of the Stikine Terrane.

Analyses from deposits in the Toodoggone area form a coherent cluster on a standard lead isotope plot, centred around 206Pb/204Pb = 18.79, 207Pb/204Pb = 15.59. These deposits are hosted mainly in the Early to Middle Jurassic Toodoggone Volcanics; all are clearly genetically closely related. Mineralization in this epigenetic gold camp is related to the volcanism rather than later events.

Analyses from deposits in the Stewart area fall into two clusters (see Alldrick, Gabites and Godwin 1987: Lead Isotope Data from the Stewart Mining Camp (104B/1) in "Geological Fieldwork 1986", Paper 1987-1, Mineral Resources Division, B.C. Ministry of Energy, Mines and Petroleum Resources). These represent cluster (1): mineralization genetically related to the Early to Middle Jurassic Hazelton Volcanics, with average 206Pb/204Pb = 18.82 and 207Pb/204Pb = 15.61, and cluster (2): vein mineralization related to Cretaceous to Tertiary intrusions of the Coast Plutonic Complex with an average of 206Pb/204Pb = 19.15 and 207Pb/204Pb = 15.62. These clusters are tight, so that discrimination of deposits by age can be made on the basis of a single lead isotope analysis. The similarity of lead from Jurassic deposits from the Hazelton and Toodoggone Volcanic rocks emphasizes their common tectono-genesis within the Stikine Terrane.

Deposits in the Smithers area are harder to classify. None of the analyses fall in cluster (2) (possibly because the Smithers area is further from the axis of the Coast Plutonic Complex than is the Stewart area); however they lie along a line between clusters (1) and (2). The Jurassic cluster (1) is the lower end member. Since several of the deposits analysed are clearly related to intrusions (e.g. Poplar and Rocher de Boule), the conclusion we draw is that there has been remobilisation of lead from the Hazelton Volcanion, and mixing of varying amounts of it with lead from the intrusive rocks.

GEOLOGICAL FRAMEWORK OF NORTHWESTERN BRITISH COLUMBIA

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The geological framework of northwestern British Columbia can be related to nine terranes and three morphogeological belts. On the east the Omineca Belt includes the displaced miogeoclinal Cassiar Terrane, the pericratonic Kootenay Terrane, the accreted, oceanic Slide Mountain and Dorsey terranes and a few small fragments of Quesnellia of volcanic island-arc affinity. The Intermontane Belt includes the accreted island-arc lithologies of Quesnellia and Stikinia and the oceanic Cache Creek Terrane. On the west the Coast Belt contains the dominantly metasedimentary Nisling Terrane separated from the volcanic and sedimentary Taku Terrane by plutonic and metamorphic rocks.

The Cassiar Terrane contains a well exposed sequenee of Late Proterozoic to Late Devonian miogeoclinal carbonate and clastic rocks overlain by a wedga of clastic Upper Devonian to Lower Mississippian strata which represent a rift assemblage, possibly of foredeep origin.

Rocks assigned to the pericratonic Kootenay Terrane may represent a western facies of Upper Proterozoic strata intruded by mid-Paleozoic plutons.

The Slide Mountain Terrane is characterized by an oceanic assemblage of chert, argillite, limestone, minor quartz sandstone, basalt, diorite and ultramafic rocks ranging in age from Late Devonian to Early Mississippian. The axial region in the southern part of the Sylvester Allochthon also includes a variety of quartz- and K feldspar-rich granitic plutons. The Dorsey Terrane hes similar rocks but lacks ultramafics.

Quesnellia is underlain by Upper Triassic to Lower Jurassic island-arc volcanic rocks and related granodiorite plutons. The volcanics are overlain locally by Upper Triassic limestone and, more generally, by Lower Jurassic sediments. Quesnellia may have been generated on a Slide Mountain basement.

The Cache Creek Terrane has essentially the same lithologies as the Slide Mountain ranging in age from mid-Mississippian to Late Triassic. The youngest rocks include greywacke interbedded with radiolarian chert. Faunas in Cache Creek rocks are of Tethyan aspect in contrast to the southern North American fauna of Slide Mountain Sylvester strata.

Rocks assigned to Stikinia are from Early Devonian to Middle Jurassic in age and consist of assemblages of Upper Paleozoic and Mesozoic island-arc volcanic rocks and related plutons, platformal upper Paleozoic carbonates and a variety of volcanic arc-related sediments inclnding the Stikinia-derived Lower Jurassic Takwahoni Formation.

Metamorphic rocks in the Nisling Terrane are mainly metasedimentary and may range in age from Late Proterozoic through early Paleozoic.

The Taku Terrane has lithologies not unlike those in Stikinia although commonly they are more metamorphosed.

Collision of the amalgamated terranes of the Intermontane Belt with ancestral North America in Middle Jurassic time, and their subsequent accretion, led to the distinctive structural styles characterizing the Intermontane and Omineca belts. Both east- and west-verging structures occur in the Omineca Belt with the latter dominant west of the Kechika Fault as far north as the Dease River. They are cut by mid-Cretaceous (ca. 105-110 Ma) granites. Emplacement of the mid-Cretaceous Cassiar Plutonic Suite may have coincided with or shortly followed the formation of broad anticlinoria and synclinoria.

The nested stack of gently to moderately dipping thrust sheets in the Sylvester Allochthon evolved in part during pre-Late Permian deformation and plutonism and in part during emplacement of the allochthon onto the Cassiar Terrane, possibly in Middle Jurassic time. Permian subduction, island-arc(?) volcanism, granite plutonism and contractional deformation may have been precursors to Mesozoic tectonism. The Sylvester Allochthon was obducted at least 100 km eastward from a possible suture zone.

The thin sliver of Quesnellia strata in the Dease Lake area appear to have been thrust northeastward over rocks of the Cassiar Terrane in late Early or Middle Jurassic time. Strata assigned to the Cassiar Terrane show an inverse metamorphic gradient beneath the main thrust fault.

Vergence in the southern part of the Cache Creek Terrane is dominantly towards the southwest and culminates in the King Salmon Fault along which the terrane has been thrust over Stikinia. The collision between Stikinia and the Cache Creek Terrane is closely constrained. Structures are cut by granitic plutons ad old as 170 Ma and the basal units of a clastic wedge derived from Cache Creek rocks and deposited on Stikinia are dated as mid-Bajocian in the north and mid-Bathonian in the Bowser Basin to the south. Meagre evidence in a few places suggests that at least some of the Lower Jurassic greywacke (Inklin Formation) which overlies Cache Creek strata was derived from the northeast, possibly from Quesnellia.

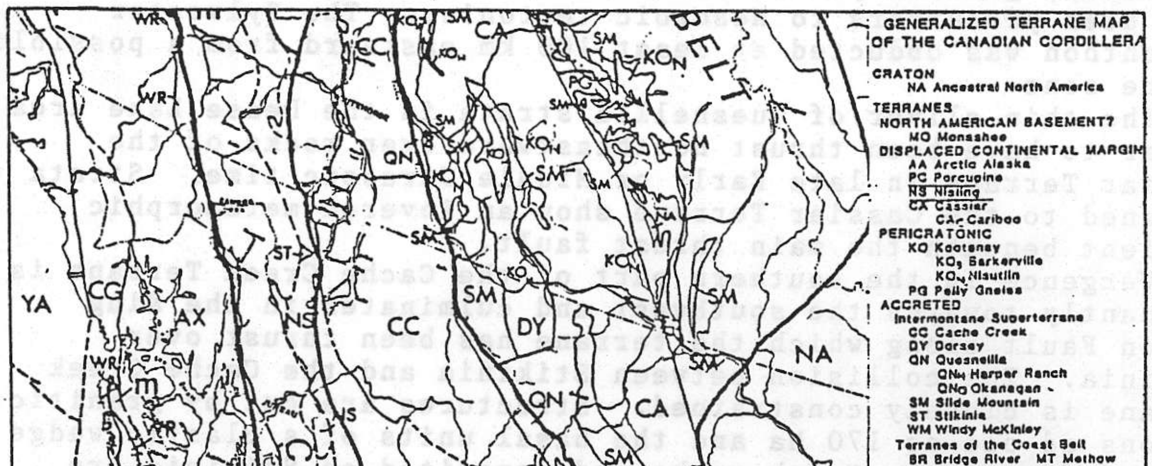
South verging thrust faults are well documented along the northern margin of Stikinia in the Dease Lake region. Southwest and west verging thrust faults involve Triassic and Jurassic rocks along the northeast and eastern margins of Stikinia whereas the western margin is characterized by northerly trending tight folds particularly well seen in late Paleozoic carbonates.

The overlap rocks on Stikinia, dominated by the Bowser Lake and Sustut groups, have been deformed into mainly northwest trending, northeast verging folds and thrust faults presumably in response to Late Cretaceous compression related to upward and eastward movement of the Coast Belt.

Dextral strike-slip faults bound contrasting structural and stratigraphic domains in the northeastern part of the region. They were active particularly during mid-Cretaceous and Eocene times. Northeast-trending block faults and east-trending sinistral faults, typified by the Pitman lineament are becoming more widely recognized.

Granitic intrusion in the Omineca Belt characterized by distinctive plutonic suites seems to have been concentrated in three distinct episodes: Ca. 105, 70 and 50 Ma; in Quesnellia - ca. 200, 150, 105 and 50 Ma; in the Cache Creek Terrane - ca. 165 and 70 Ma; in Stikinia - ca. 215-225, 190-200, 165-180 and 50-70 Ma; and in the northern Coast Belt - ca. 70-50 Ma.

Alkalic volcanism presumably related to the interaction of the Pacific and North American plates began in the Stikine area at about 15 Ma and continued almost to the present.



An overview of the Coast Plutonic Complex between 53° and 55° N.

Peter van der Heyden, Univ. of British Columbia

ABSTRACT

The Coast Plutonic Complex (CPC) is a composite magmatic arc and structural/metamorphic belt which records a long history of subduction related processes within the western margin of North America. The CPC has long been viewed as a Cretaceous batholith, but new radiometric dates (mainly U-Pb) from the CPC between 53° and 54° N reveal the presence of early Late Jurassic plutonic, metamorphic and structural domains, which appear to have partially escaped the widespread Cretaceous and Tertiary thermal and tectonic overprint so evident elsewhere in this belt. These Jurassic features have important implications for the tectonic evolution of the western Canadian Cordillera.

A west facing early Late Jurassic magmatic arc is inferred to have been built largely on the Insular superterrane (Alexander + Wrangellia), which extends into the western flank of the CPC. Plutonism, metamorphism and crustal thickening (inverted metamorphic gradients in a major ductile shear zone) of the same age occured in what is interpreted to be the thermally softened back-arc, in the eastern flank of the CPC, which is coincident with the western extension of the Intermontane superterrane (Stikinia + Cache Creek + Quesnellia). The boundary between the superterranes in Late Jurassic time consisted of intra-arc rift/wrench fault basins.

The Late Jurassic arc and intra-arc basins obliquely overprint a Early and Middle Jurassic magmatic arc (the Hazelton-Bonanza arc), and is in turn overprinted and disrupted by Cretaceous and Tertiary magmatic, metamorphic and tectonic features (the main component of the CPC). The Cretaceous arc shows a prounounced eastward migration of the magmatic front with time. A major mid-Cretaceous magmatic pulse was associated with widespread crustal shortening and a change from island arc to continental (Andean) setting. Eocene magmatism in the CPC was probably accompanied by crustal extension in the Central Gneiss Complex; extension may have continued into middle and late Tertiary time, resulting in a network of block faults and eruption of olivine basalts in the Intermontane Belt and Insular Belt.

Successive overprints and migrating magmatic belts reflect episodic magmatism and changes in relative plate motions and velocities between the North American continent and Pacific oceanic lithosphere, within a setting of oblique, east-dipping subduction. This scenario for the evolution of the CPC differs from the terrane collision model of Monger et al. (1982), in that the entire Jurassic through Tertiary history is interpreted as a result of long-lived subduction beneath a single 'megaterrane'. There are no sutures in the CPC, and the CPC is not the result of a collision between discrete superterranes.

GEOLOGY AND MINERALIZATION OF THE STIKINE ASSEMBLAGE MESS CREEK AREA, NORTHWESTERN, B.C.

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The Stikine Assemblage in the Mess Creek area consists of Mississippian aged, variably altered, deformed, metamorphosed and mineralized schists, phyllites and greenstones. Original lithologies were mafic pyroclastics and epiclastics, felsic volcanic breccias and tuffs, graphitic sediments, and gabbroic sills. Regional dynamothermal metamorphism to lower greenschist facies occurred between Late Permian and Middle Triassic time. Four phases of deformation are recognised including two early phases of northwesterly trending isoclinal, recumbent folding followed by easterly trending kink bank and chevron style folding, and northerly trending parallel-style folding. The first phase of folding was synchronous with metamorphism and produced a penetrative axial planar foliation. Second phase folds significantly outlasted thermal effects and produced a locally pronounced crenulation cleavage. Third and fourth phase folding also affected overlying Late Triassic sediments and could be related to terrane collision in Early Jurassic time.

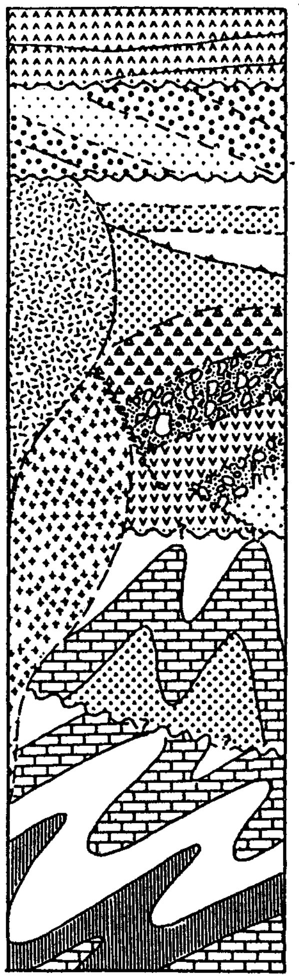
Three stages of plutonism occurred within the Mess Creek area. Potassium-argon and rubidium-strontium dates from plutons of the Hickman batholith indicate Early to Middle Triassic ages for quartz diorites and a Middle Jurassic age for quartz monzonites. Alkalic, generally syenitic plutons, commonly associated with porphyry Cu-Au deposits yield Early Jurassic ages.

Gold and silver mineralization is hosted by structurally controlled quartz and quartz-carbonate veins and associated alteration. Two ages of alteration have been identified. Widespread and commonly conformable silicification and potassium metasomatism, characterized by a quartz-muscovite-carbonate assemblage, is pre-kinematic and attributed to volcanogenic hydrothermal systems. Foliation-parallel quartz veins associated with this alteration are ubiquitous but generally barren of precious metals. Later alteration, which consists of intense carbonatization, silicification and sericitization, is fracture controlled and commonly hosts gold and silver bearing veins that cut all deformation fabrics. Gangue and alteration mineralogy includes ankerite, siderite, quartz, albite, muscovite, fuchsite, chlorite, manganiferous dolomite, barite and lanthanide group phosphates. Ore mineralogy includes pyrite, sphalerite, tetrahedrite, arsenopyrite, chalcopyrite, galena, silver and bismuth tellurides, electrum and gold. Sulphide concentrations within veins range from massive to sparsely disseminated.

Hydrothermal fluids related to vein mineralization and alteration are characterized as having high CO_2:H_2O and K^+:Na^+

and low pH. Precipitation of quartz, carbonates and sulphides was caused by a pH increase due to hydrolysis reactions with wall rocks.

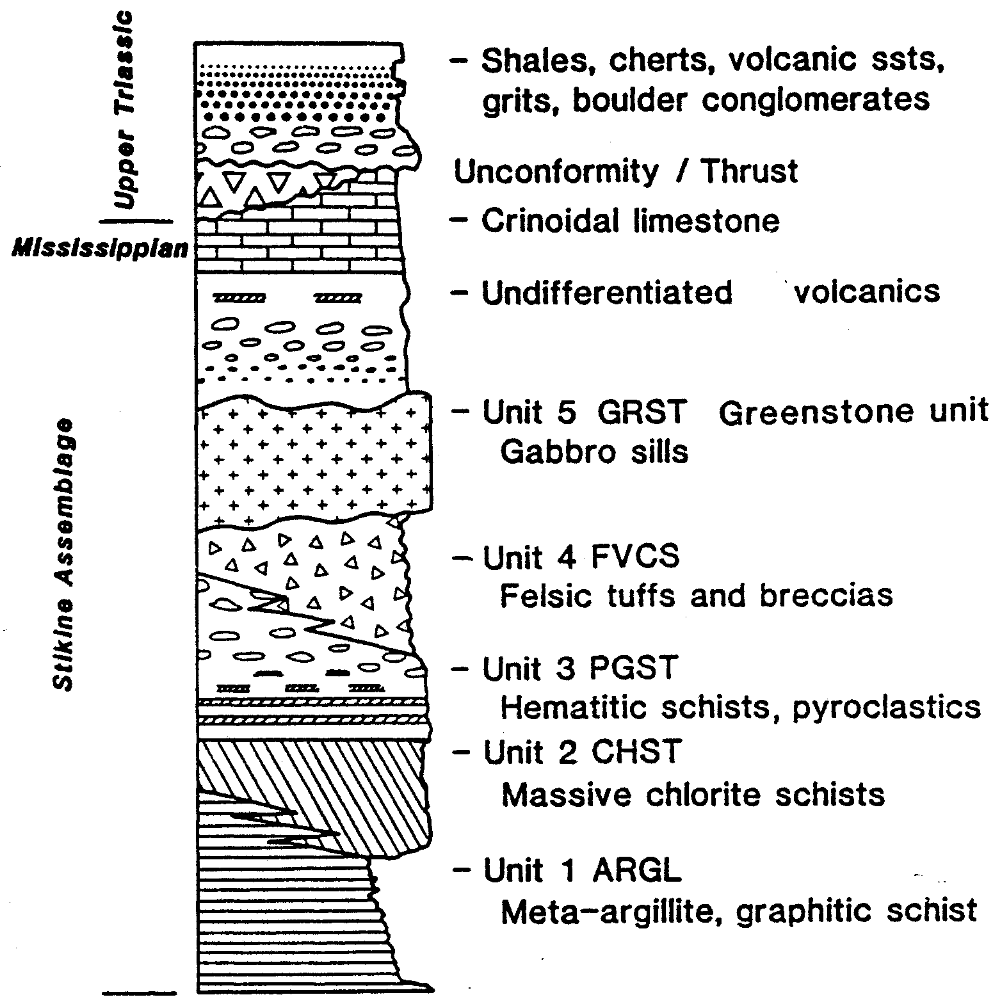
Potassium-argon and rubidium-strontium dating of alteration and mineralization yields Early Jurassic ages, which coincide with regional alkalic plutonism and possible time of tectonic accrection of allochthonous terranes.



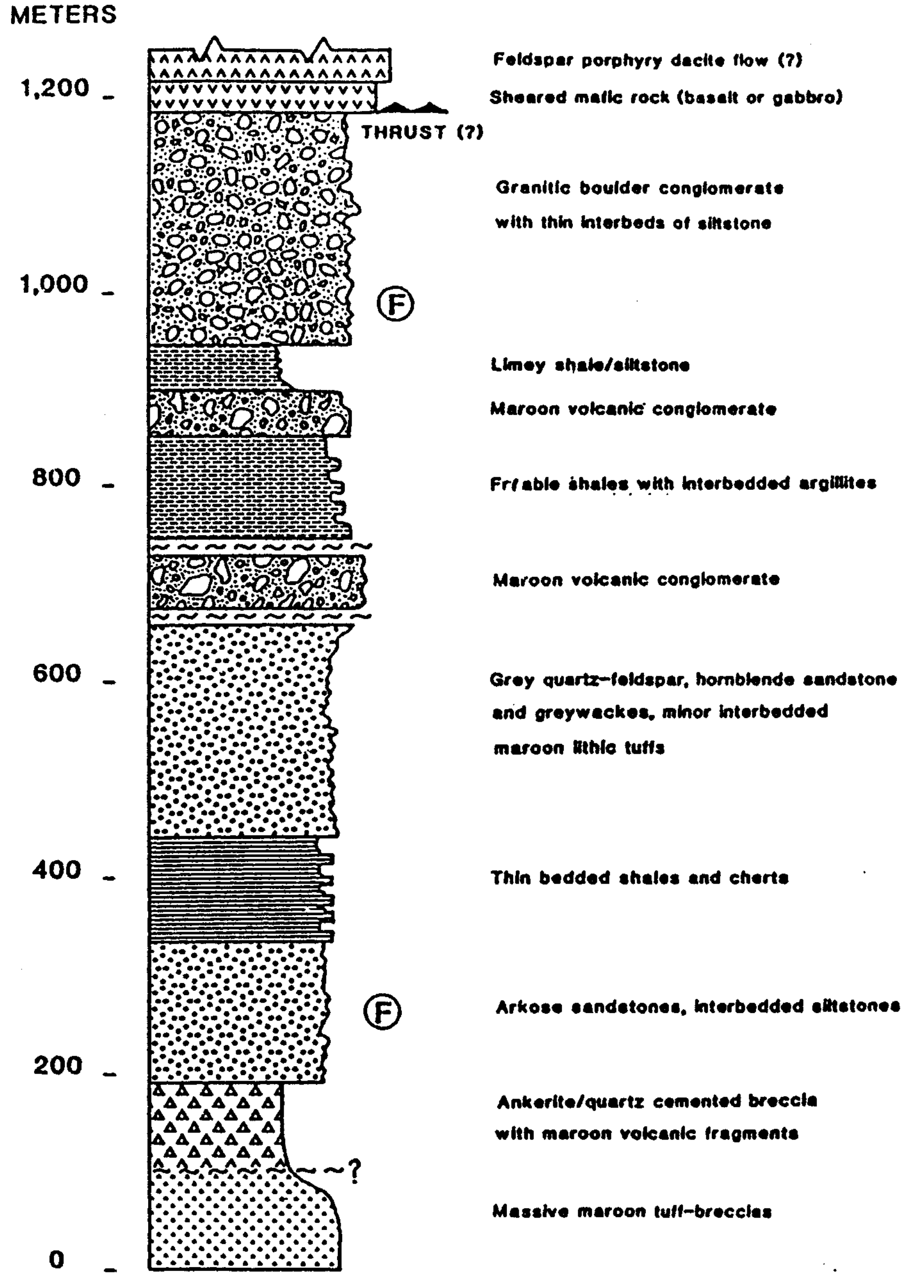
PERIOD/ EPOCH		INTRUSIVE ROCKS	AGE[1]	GROUP OR NAME	LITHOLOGY
QUATERNARY TERTIARY				EDZIZA VOLCANICS	Basalt flows and related pyroclastic rocks: minor rhyolite
				UNCONFORMITY	
CRETACEOUS				SUSTUT	Conglomerate, quartzose sandstone, arkose
				UNCONFORMITY	
JURASSIC		YEHINIKO PLUTON	176±6 Ma	HAZELTON (?)	Maroon to green lithic tuffs, crystal ash tuffs, volcanic conglomerates, minor greywacke
				FAULT CONTACT	
TRIASSIC	LATE	HICKMAN PLUTON NIGHTOUT PLUTON	230±16 Ma	STUHINI	Augite andesite flows, pyroclastic rocks, maroon volcanic conglomerate, ash tuffs volcanic sandstones/wackes
				UNCONFORMITY/FAULT	
TRIASSIC	MID				Siltstone, greywacke, chert, shale, volcanic conglomerate, granite boulder conglomerate
				UNCONFORMITY/FAULT	
PALEOZOIC	PERMIAN				Limestone, chloritic ash tuffs, minor chert
				UNCONFORMITY ?	
PALEOZOIC	MISSISSIPPIAN / DEVONIAN			STIKINE ASSEMBLAGE	Limestone, chlorite phyllites, greenstone, quartz sericite schist, lithic tuffs, argillite

1 See Table 2.1.

Table of formations for the Mess Creek area, northwestern B.C.



Schematic stratigraphic column of Stikine Assemblage rocks, Mess Creek area, northwestern B.C.



Stratigraphic section of unnamed Upper Triassic sediments at the western headwaters of Mess Creek, northwestern B.C.

LODE GOLD DEPOSITS OF THE ATLIN AREA

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The Atlin terrane is located in the northern part of the Intermontane Belt of the Canadian Cordillera. The terrane is typically in fault contact to the east with metamorphic rocks of the Omineca Belt and a narrow strip of Lower Mesozoic volcanic and sedimentary rocks. In contact to the west are Lower Jurassic sedimentary and Upper Triassic to older variably metamorphosed strata to the west belonging to the Nisling and Stikinia terranes.

Cache Creek Group cherts, pelites, carbonates and mafic volcanics of Pennsylvanian to Permian age make up the Atlin terrane. Ultramafic Atlin intrusions, typically peridotite, intrude the Cache Creek Group although many of the contacts are faulted. Early and Late Cretaceous granitic intrusions crosscut the Cache Creek Group and Atlin intrusions.

Since 1898 more than 590,000 ounces (19 135 618 grams) of gold have been recovered from placer deposits in the immediate Atlin area since 1898. The placer gold is derived from gold-bearing quartz-carbonate veins hosted by the Cache Creek Group and Atlin intrusions. First pass exploration for lode gold was completed at the turn of the century by prospectors and placer miners who discovered numerous mineral occurrences, including the Yellowjacket, Pictou, Beavis, Anaconda, Lakeview, Surprise and Golden View. The only ore recovered was from the Imperial Mine which produced a total of 245 tonnes of ore grading 13.7 grams gold per tonne. In the last decade the search for lode gold veins has started again with major exploration programs initiated by several companies.

Lode gold occurs in quartz-carbonate veins, veinlets and stockworks which vary from centimetres to several metres in width. Sparse sulphides are usually present, including pyrite disseminations in the veins and wall rock. Small amounts of sphalerite, galena, chalcopyrite, millerite, gersdorffite (NiAsS), hessite (Ag_2Te), tetradymite (Bi_2Te_2S) and bismuthinite (Bi_2S_3) can be found in the mineralized quartz veins as well.

Intense carbonate, quartz and green mica, frequently called listwanite, forms an alteration envelope for many of the veins. The protolith is typically an ultramafic rock in contact with volcanics or cherts. The alteration starts with the development of serpentinite followed by progessively more carbonate-rich alteration assemblages which can ultimately produce a listwanite.

Current exploration guides for lode gold in the Atlin area are:

1) proximity to known placer gold,
2) along major fault systems,
3) near ultramafic contacts.

Limited surface exposures have enhanced the importance of soil and rock geochemistry as well as magnetic surveys.

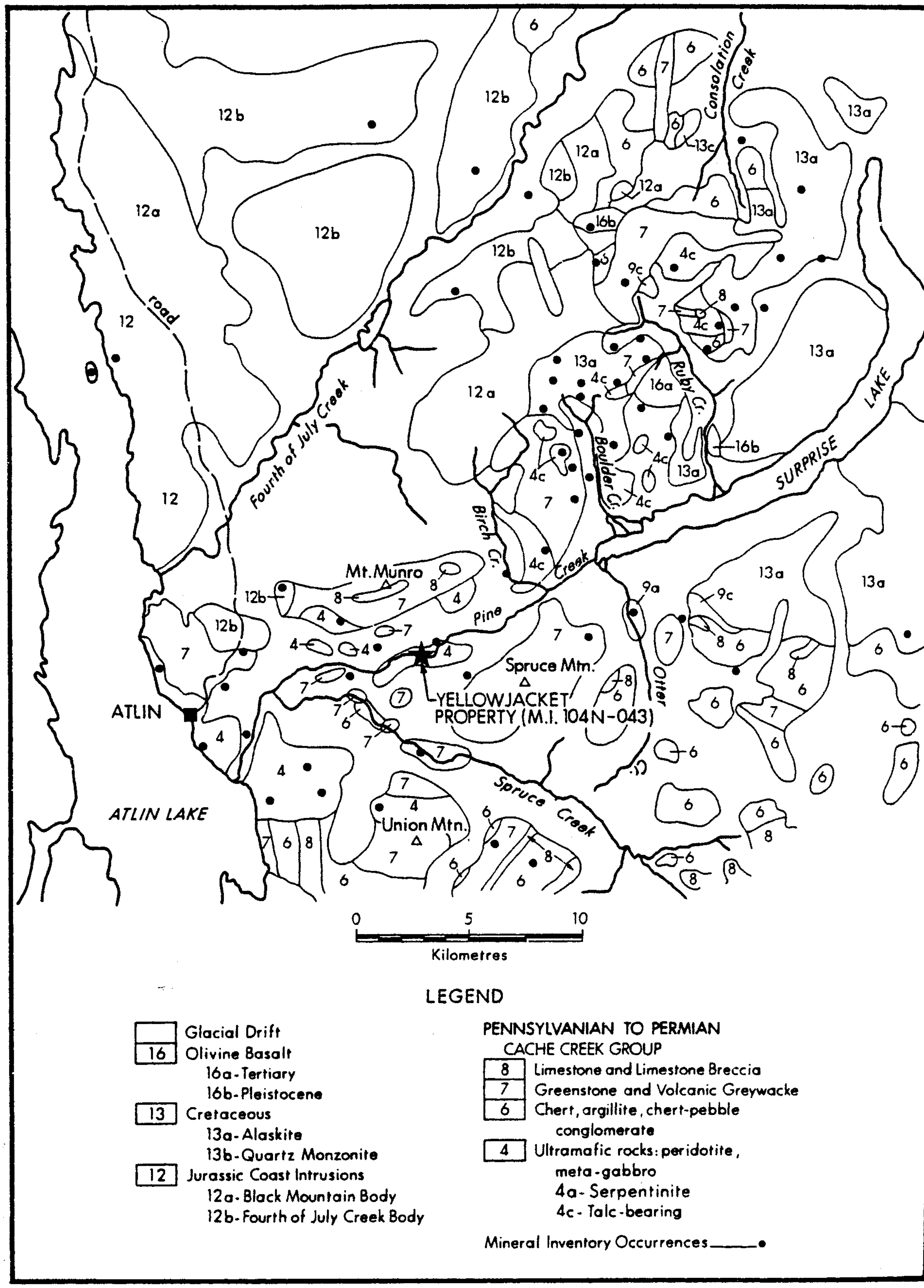


Figure 1. Geology and mineral occurrences of the Atlin area (modified from Aitken, 1959).

LATE TRIASSIC VOLCANICS AND MASSIVE SULPHIDE DEPOSITS, ALEXANDER TERRANE, NORTHWEST B.C.

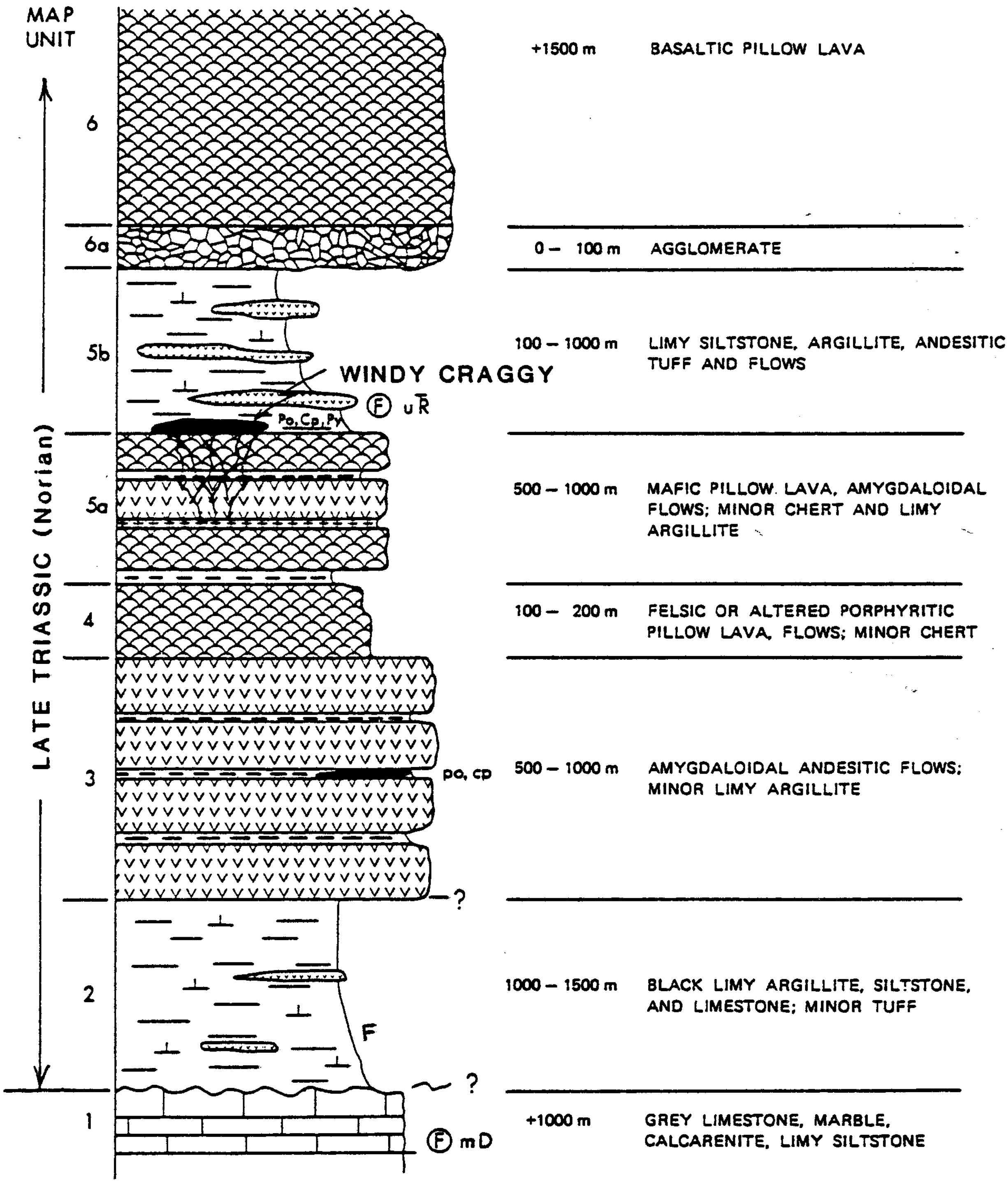
D.G. MacIntyre, Ministry of Energy, Mines and Petroleum Resources, Geological Survey Branch, Victoria, B.C.

Late Triassic volcanic and sedimentary rocks are preserved in rectilinear, fault-bounded areas within the Alexander Terrane of Northwest B.C. These rocks unconformably overlie Paleozoic platformal carbonates and basinal clastics that have been deposited on a Precambrian crystalline basement. Paleomagnetic data, Tethyan fossil assemblages and stratigraphic similarities with the North American miogeocline suggest that these rocks represent a northwardly displaced slice of ancestral North America.

The Late Triassic stratigraphic succession in the St. Elias Mountains of Northwest B.C. and Southeast Alaska is divisible into a lower sedimentary and an upper volcanic unit. The lower unit is predominantly calcareous turbidites with pelagic limestone and chert interbeds. These rocks were deposited in a Late Carnian to Early Norian basin. Overlying and partly interbedded with these sediments is a unit of predominantly basaltic pillow lava and tuff. Dioritic sills and dykes that are compositionally identical to non-pillowed flows are common in the Late Triassic section particularly in the vicinity of massive sulphide deposits. Calcareous siltstones interbedded with the basaltic lavas have yielded Norian age conodonts. Massive sulphide deposits such as Windy Craggy, Mt. Henry Clay and Glacier Creek occur in the lower part of the upper volcanic unit. Extensive chlorite alteration occurs in the footwall of these deposits. Quartz-sericite alteration may also be present, particularly where felsic volcanics occur in the section.

Chemical analyses of Late Triassic basalt collected from several areas in the Alexander Terrane indicate that these rocks are transitional from subalkaline to alkaline in composition. They appear to be of an island arc or back arc basin affinity. They can be distinguished from their slightly older, predominantly tholeiitic counterparts of the Wrangellia and Taku Terranes by higher alkali concentrations, lower TiO_2, and higher concentrations of light rare earths. These features may reflect a progressive change from tholeiitic to more alkali enriched compositions as a magmatic front advanced eastward from Carnian to Norian time. Some contamination by partial melting of the continental crust may have influenced original magma compositions within the Alexander Terrane.

The stratigraphic position and chemical composition of the Late Triassic sedimentary and volcanic rocks of the Alexander Terrane suggests these rocks were deposited in a Norian marginal or back arc basin, in a tectonic setting similar to the modern day Guaymas basin of the Gulf of California. The formation of massive sulphide deposits probably occurred in rift troughs centered on spreading centers within the basin. Heat released by emplacement of sills into the sedimentary-volcanic pile drove the large hydrothermal cells that resulted in extensive alteration and veining of the basaltic flows. Sulphide mounds comprised largely of pyrrhotite and partly replaced by pyrite and chalcopyrite developed near fluid discharge points on the seafloor. Closure of the Norian basin in Jurassic or later time resulted in tight folding and faulting of the sediments, flows and massive sulphide mounds within the trough.



Preliminary stratigraphic column for the Alsek-Tatshenshini map-area.

MID TO LATE CRETACEOUS VOLCANISM IN WEST CENTRAL BRITISH COLUMBIA AND ASSOCIATED MINERAL DEPOSITS

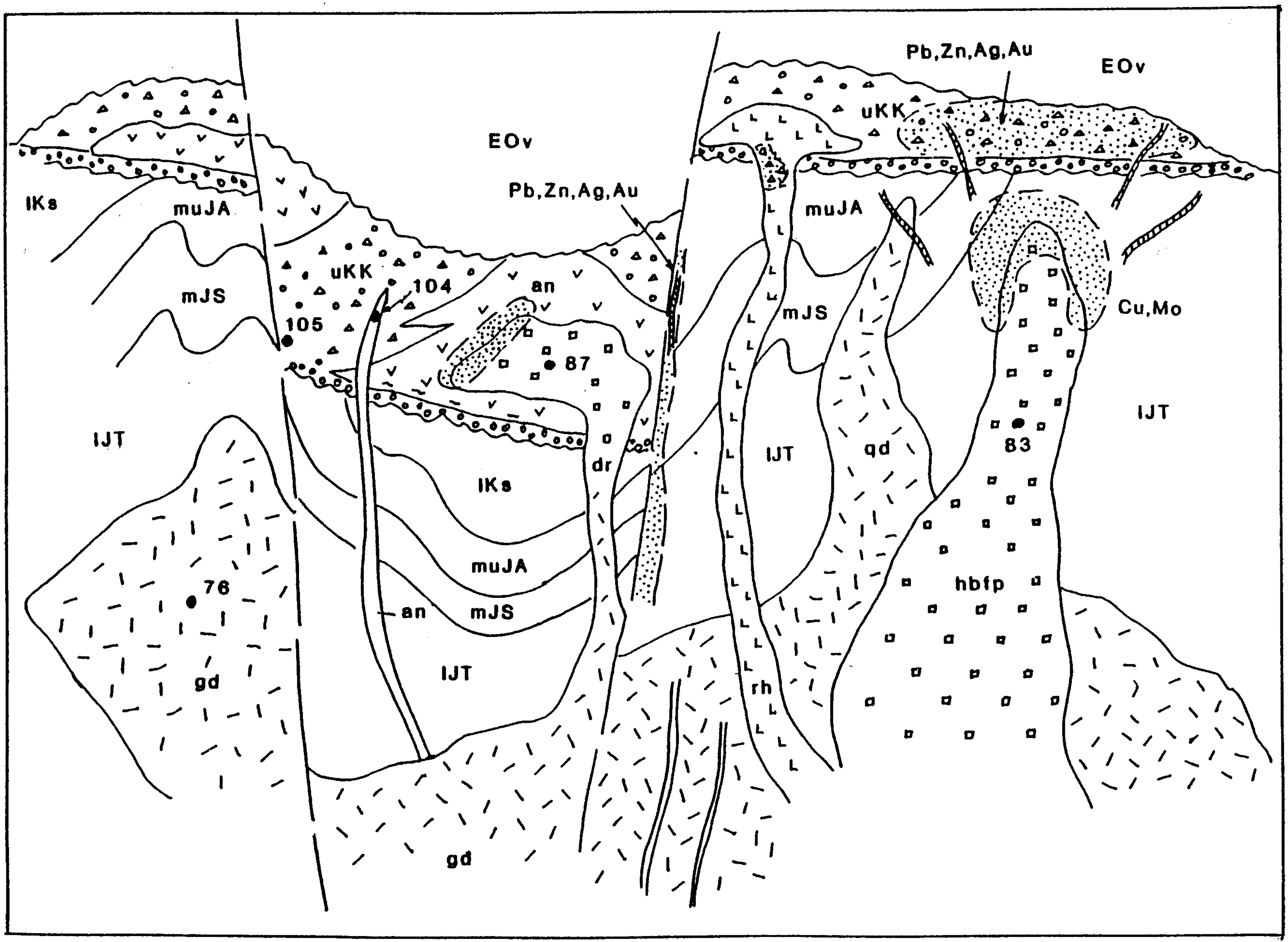
MacIntyre, D.G., Ministry of Energy, Mines and Petroleum Resources, Geological Survey Branch, Victoria, B.C.

In West Central British Columbia, porphyritic andesites and related volcaniclastic and pyroclastic rocks of the Mid to Late Cretaceous Kasalka Group are preserved in areas of crustal subsidence that may be of a volcano-tectonic origin. In the type area, south of Tahtsa Lake, the Kasalka Group lies with angular discordance on the Early Cretaceous sedimentary rocks of the Skeena Group and is unconformably overlain by Eocene sedimentary and volcanic rocks of the Ootsa Lake Group. Limited potassium argon age dating suggests the Kasalka Group volcanics range in age from 105 to 87 Ma. These ages are similar to those of the Mount Nansen and South Fork volcanics in the Yukon and the Kingsvale and Spences Bridge volcanics in southern B.C.

In the Tahtsa Lake and Mt Cronin areas the Kasalka Group includes a lower division comprised of siliceous ash flows, air fall tuffs, lahars and related epiclastics with minor augite phyric flows and an upper division predominated by augite-hornblende-feldspar phyric flows and flow breccias, lahar and air fall tuff. Rocks of the lower division were deposited during episodes of explosive volcanism possibly related to early caldera formation while the upper division rocks are probably the remains of large statovolcanoes. Angular unconformities and intraformational conglomerates within the succession suggest tilting and active erosion of fault blocks accompanied the early stages of volcanism. Plugs and dykes of rhyolite and porphyritic andesite occur peripheral to and within the areas of subsidence and appear to be a diagnostic component of the Cretaceous volcanic centers. Granodioritic intrusions, some with porphyry copper type mineralization are also found peripheral to the area of subsidence and may represent the exposed tops of large granitic bodies that underlie the volcanic centers.

Nearly complete sections of the Kasalka group have been preserved in downthrown fault blocks. These rocks are therefore favourable hosts for mineral occurrences that form at shallow depths, for example gold and silver bearing mesothermal and epithermal veins. Some epithermal vein systems have been recognized although the amount of exploration conducted for these targets has been fairly limited. Extensive zones of clay, sericite and silica alteration with disseminated pyrite and minor galena and sphalerite are also common, particularly where high level porphyritic intrusions cut or underlie the volcanic pile. These zones often have elevated silver and gold values. Permeable horizons within the volcanic succession and high angle fault zones acted as aquifers for the hydrothermal

IDEALIZED SECTION - CRETACEOUS VOLCANIC CENTER



LEGEND: **lJT** - Telkwa Fm.; **mJS** - Smithers Fm.; **muJA** - Ashman Fm.; **lKs** - Skeena Gp.; **uKK** - Kasalka Gp.; **EOv** - Ootsa Lk. Gp.; **gd** - granodiorite; **qd** - quartz diorite; **dr** - diorite; **an** - andesite; **hbfp** - hb-bt-feld porph.; **rh** - rhyolite

breccia, tuffs   conglomerate   flows   porphyry

rhyolite   granitic int   vein   age date

fluids. Porphyry copper and molybdenum deposits formed at depth adjacent to and within porphyritic stocks and dykes. The vein systems within the volcanics are probably peripheral to these deposits.

METALLOGENY OF AND TECTONICS OF NORTHERN BRITISH COLUMBIA
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Understanding metallogeny in British Columbia is not just a 'when' and 'why', it is also a 'where' question. The relatively new 'terrane' and 'suspect terrane' concept implies that older mineral deposits in allochthonous terranes in British Columbia formed hundreds or thousands of kilometres from their present locations. It also follows that analyses of metallogenic patterns in allochthonous areas must be done within terrane boundaries and that contrasts between terranes are to be expected.

The two Superterranes that comprise the Canadian Cordillera formed by collision and amalgamation of smaller terranes as they travelled northward. Most of the allochthonous terranes consist of island arc assemblages in which volcanogenic massive sulphides and older arc-related deposits can be pre-amalgamation; other deposits formed during the magma-generating, consuming margin, amalgamation event. Younger deposits formed as a result of plutonism and related hydrothermal systems caused by collision and welding of the superterranes with North America. Post-docking volcanism and plutonism, generally related to extension tectonism, have related, mainly subvolcanic, epizonal, mineral deposits. The challenge is to make sense of the resulting fragmented, partly preserved, multiply overlaid pattern.

Several directly applicable tools that can be used to unravel this geological puzzle are mapping, mineral deposit studies and regional geochemical surveys. Other tools are paleontology, paleomagnetism, regional geological and tectonic synthesis and basin analysis.

The starting point in analysing this metallogenic 'Rubic's cube' is regional synthesis. To make real progress, you must first identify and outline the allochthonous terranes then document major transcurrent and thrust fault movements within them. Generalizations are possible with our present level of information; detailed analyses are not.

Mineral deposits in northern British Columbia occur in passive continental margin settings, in oceanic settings associated with probable ophiolitic suites, in convergent or consuming margin settings in island arc rocks, along the welded superterrane borders, and in post-docking intrusive and volcanic suites.

In northern British Columbia, from east to west the main metallogenic components are:

-ancestral North America with shale hosted lead-zinc-silver and carbonate platform base metal deposits

-the Cassiar terrane with craton-derived miogeoclinal, passive margin sediments hosting stratiform base metal-barite deposits, and also granite-related molybdenum, tungsten and tin skarns, and silver-rich veins or mantos;

-thrust-stacked, oceanic marginal basin volcanics, sediments, and basic intrusive and ultrabasic rocks of the Slide Mountain terrane with gold, asbestos, jade and possibly chromite deposits.

-island arc volcanics and sediments of the Quesnel terrane with skarn, porphyry and meso- to epithermal gold deposits;

-oceanic volcanics and sediments, and ultramafic rocks of the Tethyan Cache Creek terrane with potential for asbestos, jade and gold deposits;

-island arc rocks of the Stikine terrane with precious metal, porphyry copper and/or molybdenum deposits and skarns;

-schist and paragneiss, basic to felsic volcanics and sediments of the Alexander terrane with potential for skarns, and volcanogenic gold and cobalt-bearing cupriferous pyrite and polymetallic massive sulphide deposits.

Superimposed on the terranes are post-accretion granite, volcanic and fault-related precious metal, copper, molybdenum, tungsten, tin and uranium deposits. There is also potential for paleoplacer and placer gold.

A CLOSER LOOK AT THE LLEWELLYN FAULT - TECTONIC IMPLICATIONS AND ECONOMIC MINERAL POTENTIAL

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Geologic mapping at 1:50,000 scale between Skagway, Alaska and Atlin, B. C. (Figure 1) has more clearly defined the trace of a major structural feature known as the Llewellyn Fault for sone 65 km along its exposed length.

This fault marks the western extent of known Nisling Terrane rocks which, in the areas studied, are a polydeformed, subamphibolite facies metamorphic suite of unknown, but probable Paleozoic to Proterozoic age. Metamorphic grade increases to the north and south where upper and lower amphibolite grade rocks are reported. In the map area they are unconformably overlain by lithologies ranging in age from Upper Triassic to probable Mid - to Upper Jurassic. This diachroneity indicates that the Nisling Terrane was in places exposed at various times throughout the Mesozoic; likely in response to episodic motion along the Llewellyn Fault. The Mesozoic stratigraphic succession straddles the fault and is much thicker east of the fault than to the west; although the east and west strata are clearly related (See Figure 2 & 3).

At the latitude of mapping, the Llewellyn Fault represents a potential terrane boundary and may, in part, have controlled deposition within the Whitehorse Trough through its role as a basin-bounding fault. Ubiquitous turbidites and slump deposits within the Lower Jurassic Inklin Formation may be recorders of a tectonically active basin margin.

A stream sediment survey in the Tutshi Lake area has clearly shown the Llewellyn belt to be anomalous in As and Au; while sparse lithogeochemical sampling has revealed some anomalous Au values from sheared rocks along the fault (Figure 4). As a long-lived structural element, the Llewellyn Fault, and rocks adjacent to it, offer high potential for economic mineral deposits related to a meteoric/magmatic hydrothermal system of enormous scale.

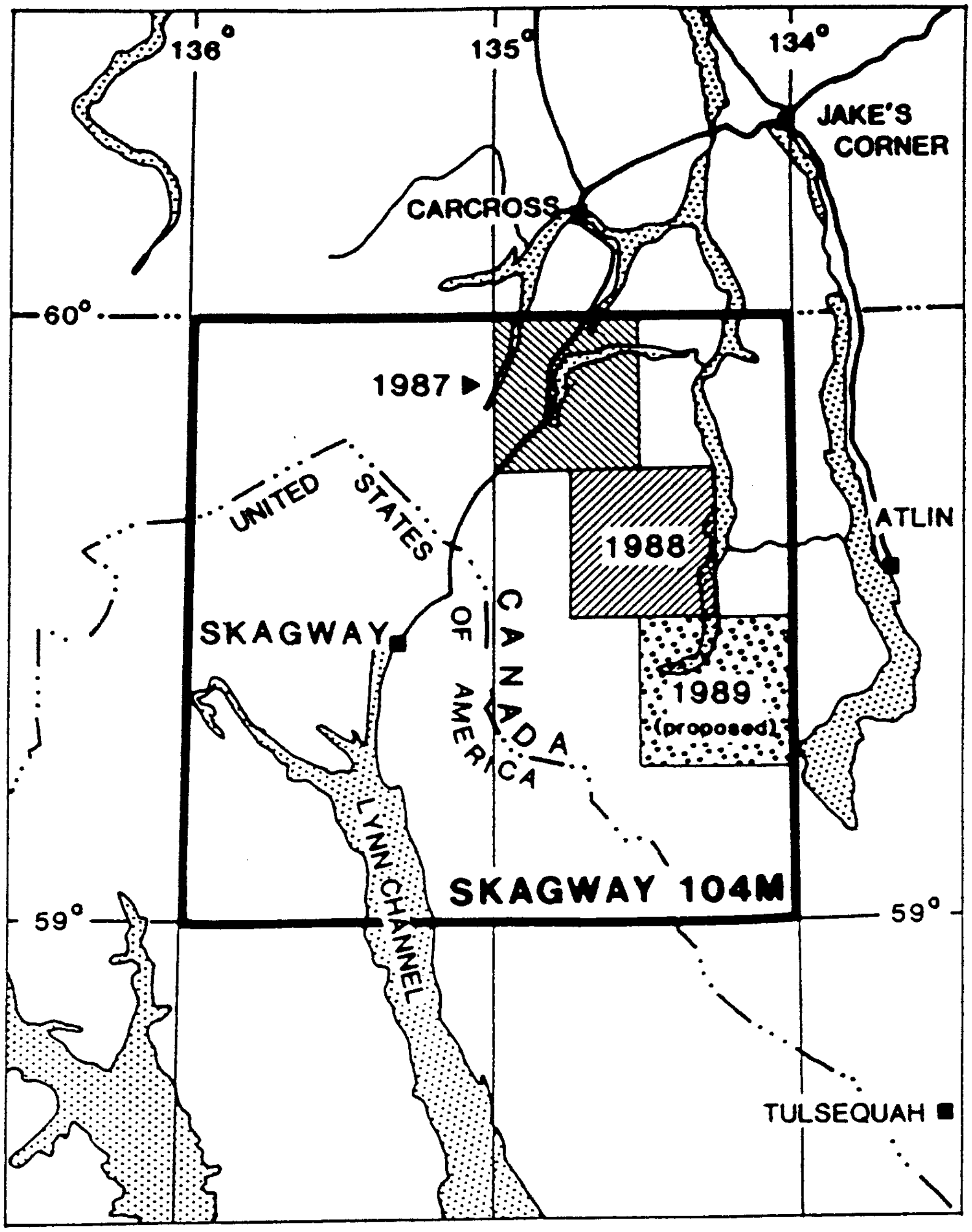


FIGURE 1 TAGISH PROJECT LOCATION

FIGURE 2 CORRELATIONS WITHIN DOMAINS AND ACROSS LLEWELLYN FAULT

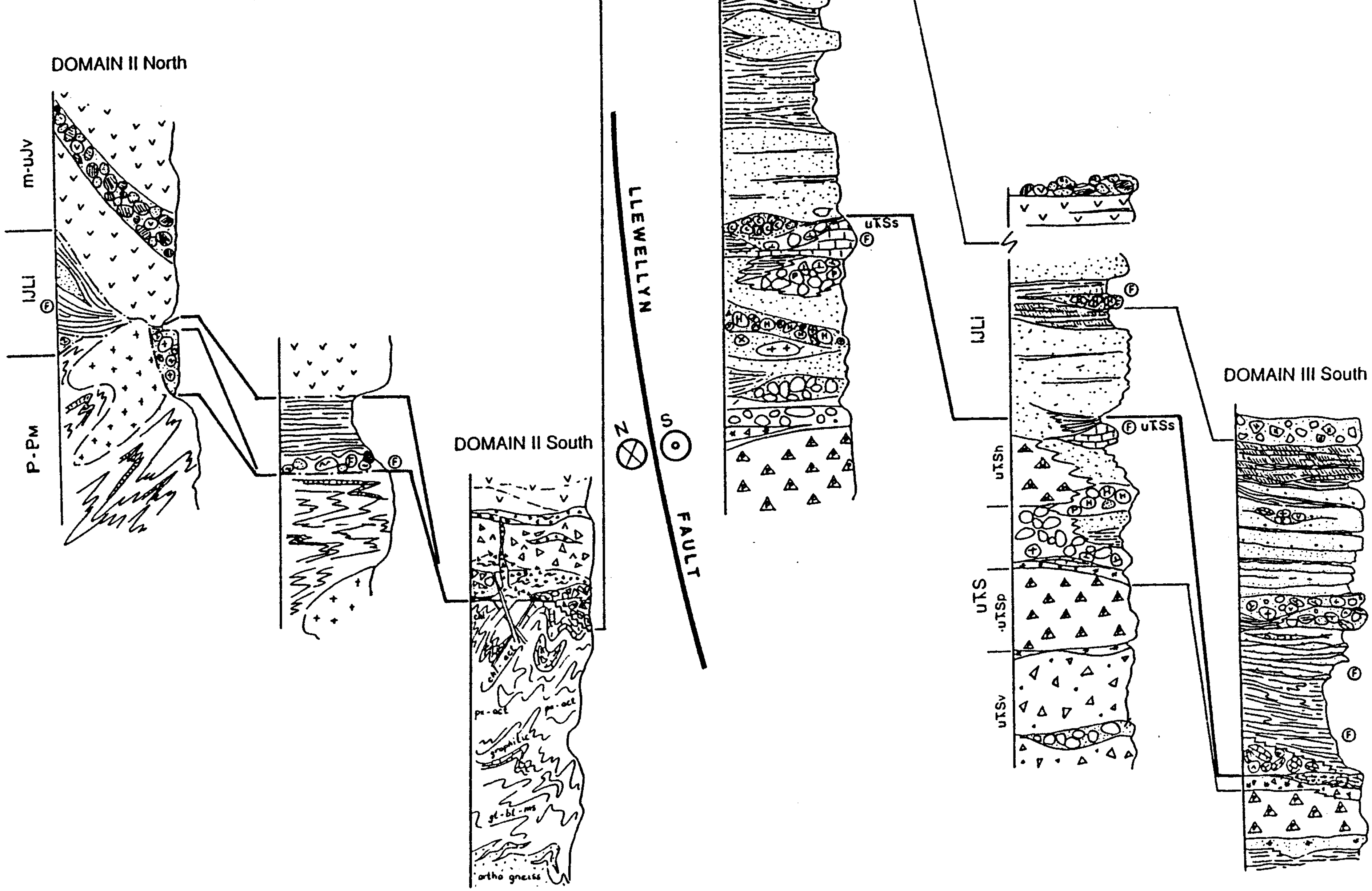


FIGURE 2 LEGEND

SYMBOLS USED IN STRATIIGRAPHIC COLUMNS

SOURCE CLAST
(in approximate order of youngest to oldest)

SOURCE	CLAST	
Unknown		Unaltered granite/granodiorite
		Intermediate to felsic volcanic tuffs and flows
		Rhyolite flows and breccias
		Silisiclastics and siliceous argillites
		Greywacke, siltstone, sandstone
		Argillite, argillaceous siltstone
Unknown		Conglomerate
		Chert (sedimentary or volcanogenic?)
		Limestone
		Hornblende porphyry tuffs
		Crystal and lithic ash tuffs
		Dominantly pyroxene-porphyry tuffs and breccias
		Polymictic lapilli tuffs and flows
Unknown		Altered granodiorite, syenite
		Marble
		Metamorphics – dominantly schists
		Fossil locality
		Facies change

LITHOLOGIES CORRELATED

MIDDLE TO UPPER JURASSIC (?)

muJv	*Variegated pyroclastic lapilli tuffs; bladed feldspar porphyry flows*
muJc	*Clast-supported conglomerate derived primarily from Inklin Formation siltstones and argillites*

LOWER JURASSIC

LABERGE GROUP, INKLIN FORMATION (where undivided denoted as lJLI)

lJLIg	*Siltstones, arenaceous wackes (greywackes); may contain macrofossils*
lJLIa	*Argillites (may be silty)*
lJLIc	*Conglomerates; rarely contain macrofossils*

UPPER TRIASSIC

STUHINI GROUP (where undivided denoted as uTs)

uTsv	*Variegated feldspar-phyric tuffs and lesser flows*
uTsp	*Green pyroxene-feldspar porphyry tuffs and breccias characteristic of this group*
uTsc	*Conglomerates and associated sediments*
uTsh	*Hornblende-phyric lapilli ash tuffs and tuffites (may include conglomerates)*
uTss	*Norian carbonates commonly displaying strong internal deformation enclosed within conglomerates and argillites*

PALEOZOIC TO PROTEROZOIC (?)

BOUNDARY RANGES METAMORPHICS

PPM	*A polydeformed metamorphic terrane of uncertain origin; variably metamorphosed to upper greenschist grade within the map area, and reported up to amphibolite grade to the south.*

FIGURE 3

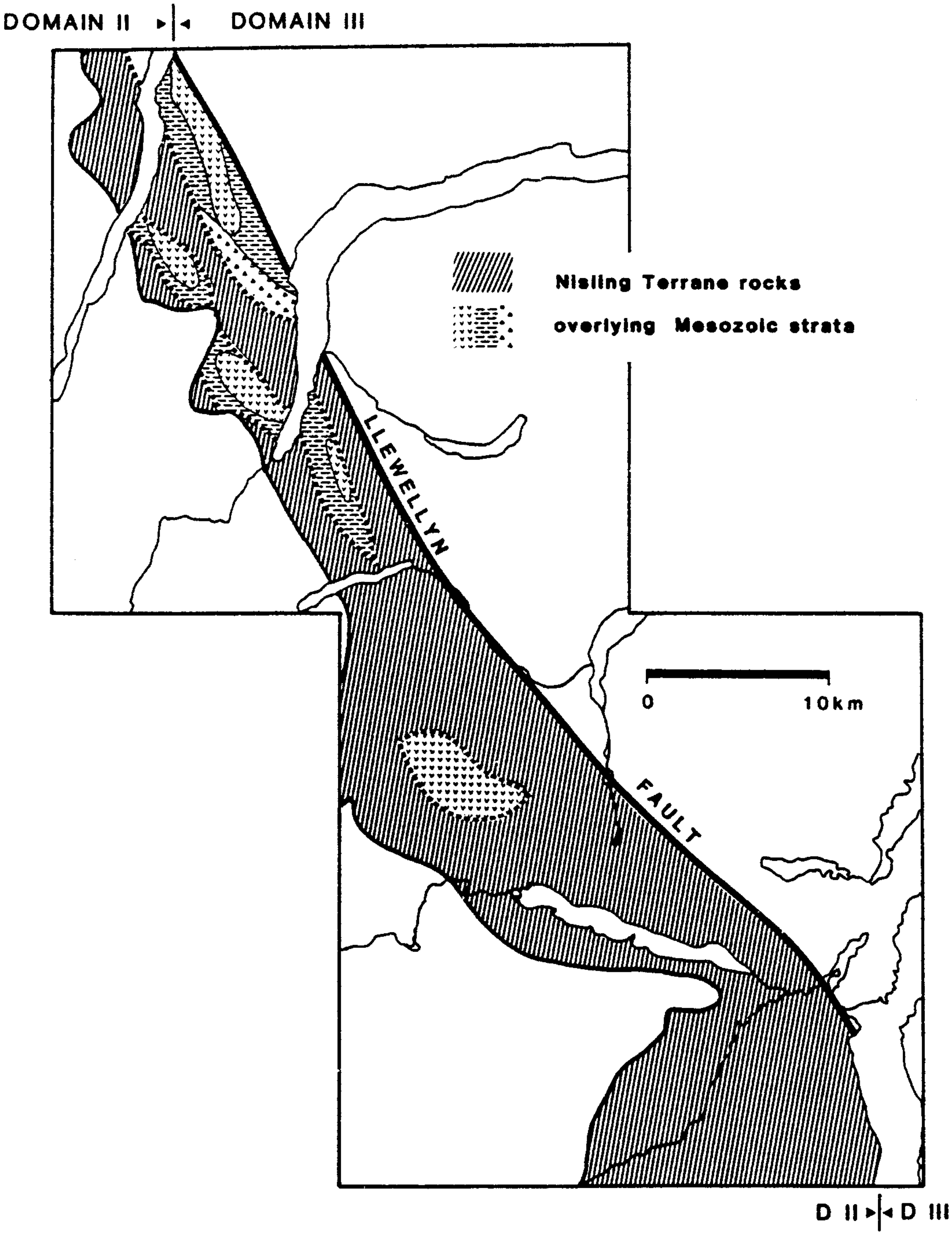
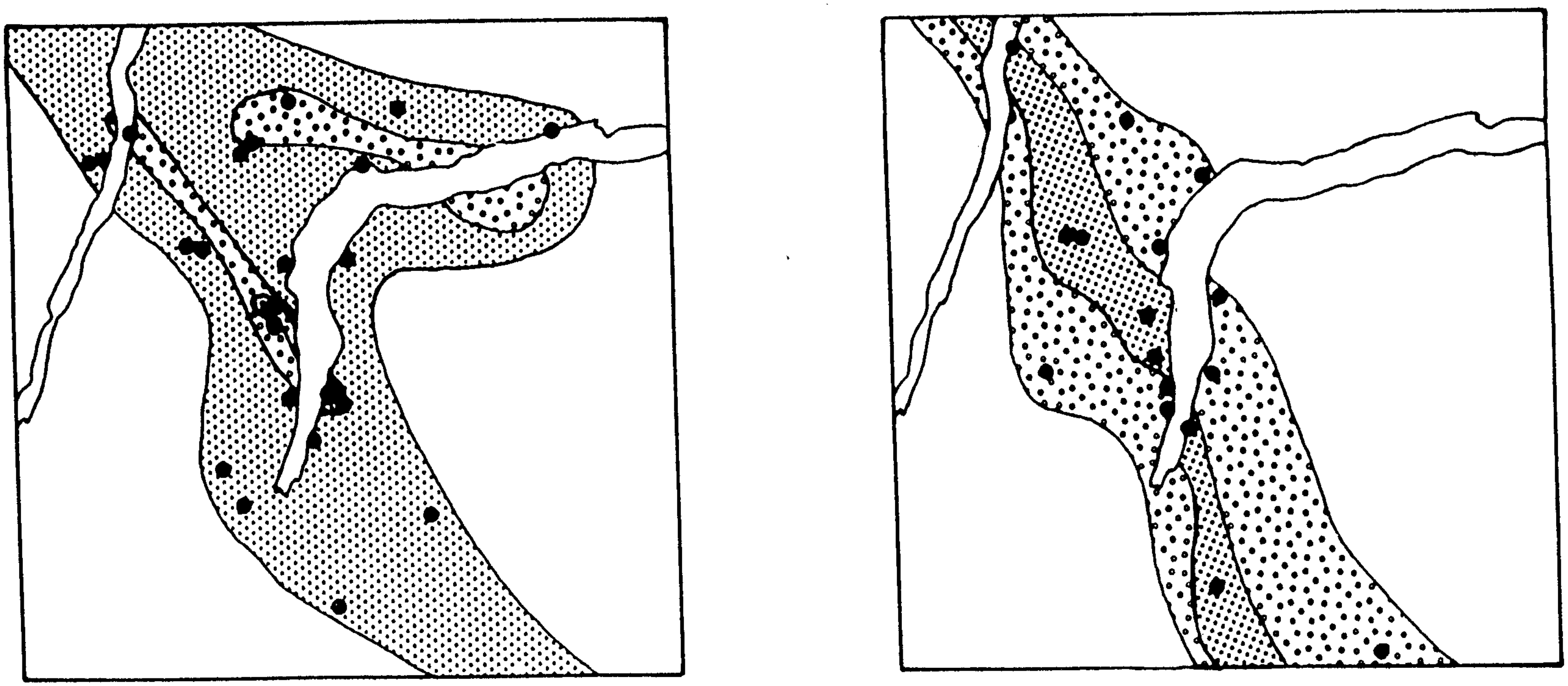

DOMAIN II
DOMAIN III
Nisling Terrane rocks
overlying Mesozoic strata
LLEWELLYN
FAULT
0
10km
D II
D III

FIGURE 4 Au and As DATA from 1987 STREAM SEDIMENT SURVEY



- ☐ Au < 19 ppb
- Au > 19 < 80 ppb
- Au > 80 < 800 ppb
- Au > 800 ppb

- ☐ As < 117 ppb
- As > 117 < 240 ppb
- As > 240 ppb

• Selected Sample Locations

STRATIGRAPHY, STRUCTURAL GEOLOGY, AND GEOCHRONOLOGY OF IRVINE LAKE AND GRAVEL CREEK MAP-AREAS, RANCHERIA DISTRICT, SOUTHERN YUKON

Donald C. Murphy

The University of British Columbia

Irvine Lake and Gravel Creek map-areas lie within the northern Omineca Belt, west of the Tintina-NRMT fault. The eastern part of the area (all of Gravel Creek and the eastern two-thirds of Irvine Lake map-areas) is underlain by deformed Proterozoic to Silurian meta-sediments and meta-plutonic rocks (preliminary middle Paleozoic U/Pb zircon age) of Cassiar terrane (Monger 1984), a fragment of the North American miogeocline which has been displaced northward on the Tintina-NRMT fault. To the west, in thrust contact (Zak fault) with Cassiar terrane, are deformed basaltic meta-volcanics, serpentinized ultramafic rocks, meta-gabbro, cherty meta-sediments, and unfoliated diorite of Slide Mountain terrane (Monger, 1984). Unfoliated to weakly foliated granitoids of the Cassiar suite (Marker Lake, Cabin Creek, and Gravel Creek stocks and Cassiar batholith; dating in progress) occur throughout the area intruding both Cassiar and Slide Mountain terranes.

The rocks of Cassiar terrane are deformed by two regional phases of deformation and cut by steep N-S and NE-SW trending faults. The earliest phase of deformation consists of E-verging folds (mappable at 1:50,000 scale only in the vicinity of the Zak fault) and associated axial surface foliation; the spatial relationship of these structures with the Zak fault suggests, but does not prove, a genetic relationship. Early structures are deformed by open to tight, locally overturned map-scale W-verging folds. Both phases of regional deformation occurred before the growth of peak metamorphic minerals (up to sillimanite zone) and the emplacement of the Cassiar plutonic suite. Steep faults occur primarily in the eastern part of the area and may be due to displacement on the Tintina/NRMT fault.

The northern end of the Cassiar batholith extends into the southwestern corner of Irvine Lake map-area. Its northeastern contact with rocks of Slide Mountain terrane is a sub-vertical, northwest-southeast trending mylonite zone several tens of metres wide. Various mesoscopic structures including S-C fabrics and shear bands prove dextral displacement parallel to a variably plunging, but commonly sub-horizontal stretching lineation. The mylonite zone lies along a pronounced topographic lineament which extends from trace of the Cassiar fault south of the Alaska Highway northwestwardly into the Irvine Lake map-area. Although not conclusive, the topographic expression of this feature suggests that the Cassiar fault extends northwestwardly into

Irvine Lake map-area rather than veering off to the west as previously mapped.

Late Paleozoic Marginal Basin and Island Arc Environments in the Sylvester Allochthon; and Structural Framework of Mineralization in the Cassiar-Erickson Camp

J. Nelson and J. Bradford
British Columbia Geological Survey Branch, Victoria

The Sylvester allochthon is located in the Cassiar Mountains near the B.C. - Yukon border. It is a telescoped stack of Late Devonian to Triassic rocks, lying in thrust contact above autochthonous strata of the Cassiar platform. From the Yukon border to the Dease River, the allochthon consists of three lithologic/structural divisions. The lowest division comprises thrust-interleaved sedimentary suites of Mississippian to Permian age. Division II contains basaltic suites of MORB affinity with interbedded sediments. Mississippian sediments in both Divisions I and II exhibit ties to the Earn Group, a North American stratigraphic unit. The association of MORB basalts with sediments, which may constitute up to 95% of section, suggests slow spreading and high sedimentation rates, features more indicative of marginal basins than true mid-ocean ridges.

Two separate ultramafic-gabbroic thrust sheets in Division II, the Cassiar and Zus Mt. sheets, indicate that spreading produced at least local new oceanic crust. The structurally highest unit in much of Division II is a Triassic siliciclastic-carbonate sequence, the Table Mt. sediments. The Table Mt. sediments may have unconformably overlain the Late Paleozoic basalts and ultramafites of Division II; however the contact has been thoroughly obscured by shearing.

Division III is of arc affinity. Elements in it include Pennsylvanian to Permian basaltic andesites, andesites, dacites and rhyolites; shallow-water limestones; and intermediate intrusive bodies. The presence of pure quartz sandstones and metamorphic detritus in Division III hint at subadjacent continental basement, possibly a rifted sliver of North America. Early Division II/ Division III proximity is suggested by granitic clasts and quartz sandstones in one Permian volcaniclastic suite in Division II.

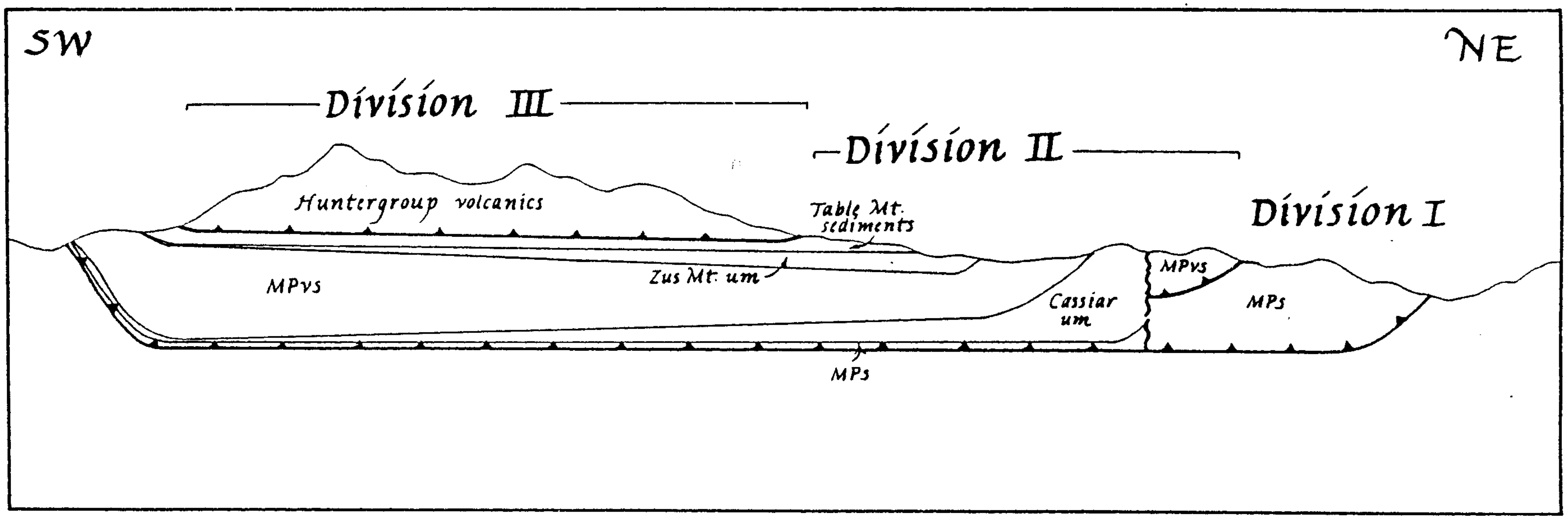
A general model for the development of the Sylvester allochthon involves the creation of marginal basins along the North American continental margin by Devono-Mississippian rifting. Basalt volcanism and continued slow spreading in these basins up to mid-Permian time was accompanied by intermediate to felsic igneous activity founded on slivers of continental crust located further outboard, above probable east-dipping subduction zones.

Jurassic (and earlier?) tectonism collapsed these elements into the present structural order. The major remaining question is the amount of lateral, coastwise transport that occurred prior to and during emplacement of the allochthon onto the North American miogeocline.

Economic mineralization in the Sylvester allochthon centers on gold and asbestos producers in the Cassiar-

Erickson camp. Mesothermal gold-quartz veins of the Erickson-Taurus system cut upper basalts of Division II and follow the base of the Table Mt. sediments, which in part is marked by a thin selvage of serpentinite/talc schist/listwanite. This ultramafic remnant is structurally equivalent to the Zus Mt. ultramafic sheet. The Cassiar and McDame asbestos ore bodies are located within the lower (Cassiar) ultramafic sheet. Both Erickson and Cassiar mineralization have been dated as Early Cretaceous and pre-Cassiar batholith.

A NNW-trending high angle fault defines the western limit of the Erickson-Taurus vein system. A N-S fault, the Marble Creek fault, extends from the western rim of the Cassiar pit, south into Marble Creek, where tabular massive sulfide replacement bodies (Magno and D showings) abut against it. Thus these northerly high angle faults apparently controlled a variety of mineralization types.



SYLVESTER ALLOCHTHON : Schematic cross-section in Cassiar-Erickson camp

GEOLOGIC SETTING OF THE STIKINE TERRANE

Tom Richards, Tom Richards Prospecting Ltd.

The Western Canadian Cordillera is a collage of crustal terranes, comprising mainly volcanic arc and oceanic assemblages, successively accreted to the continental margin, commencing during Jurassic times. Each terrane possessed its own geologic evolution until accreted. The Stikine Terrane (Stikinia) (Figure 1) represents the largest single block of this collage, covering an area of in excess of 120,000 km2. Its eastern boundary is defined by a set of northerly to northwesterly trending faults (Fraser River-Takla-Ingenika-Kutcho-Nahlin System), its western boundary by the Yalakom fault system and an extrapolated extension northward along the east margin of the Coast Plutonic Complex. These are fundamental boundaries, and likely represent the original configuration of the Terrane, particularly along its eastern boundary. The arcuate trace of the eastern margin of the Stikine Terrane parallels the trend of the Triassic and Jurassic island arcs that may be postulated to have originated from a westerly dipping subduction zone that lay to the east, along the Teslin-Pinchi suture. The understanding of the tectonic configurations that ultimatly caused present geologic framework of the Western Canadian Cordillera is, and will continue to be, one which will give challenge to those who work with the rocks. Subduction zones have been postulated for both sides of Stikinia.

Stikinia is bordered along its eastern boundary by the Oceanic Cache Creek Terrane to the north and south, and the island arc Quesnel Terrane, to the east. The Stikine Terrane contacts the Cadwallader and Bridge River Terranes to the south, and metamorphic and granitoid rocks of the Coast Belt along most of its western boundary. These rocks of the Coast Plutonic Belt may be part of, and form basement to Stikinia. Seismic refraction studies across the central portion of the Terrane indicate that crustal thicknesses south of the Skeena Arch are in the order of thirty-seven kilometers, and to the north, in the Bowser Basin, twenty-nine kilometers. This probably infers the presence of a more granitic-like crust underlying the southern half of the Stikine Terrane than to the north.

The Stikine Terrane consists of Upper Paleozoic to Upper Tertiary rocks, that can be grouped into four tectono-stratigraphic elements; a volcanic island arc assemblage of Late Paleozoic to Middle Jurassic age, a molasse assemblage of Middle Jurassic to early Late Cretaceous age, a transtensional continental volcanic arc assemblage of late Late Cretaceaous to Eocene age, and a final, post orogenic episode of uplift, erosion and plateau basalt volcanism that defines the present geomophology of the terrane, from late Eocene to Present.

The Upper Paleozoic to Middle Jurassic arc-volcanic period represents the interval when the Stikine Terrane evolved as a discrete entity, separated from the influence of adjacent terranes. Upper Mississippian to Permian volcaniclastics, pelite, carbonate basalt and rhyolite of the Stikine Assemblage (Asitka Group) comprise the oldest stratigraphic assemblage of the Terrane. These strata are exposed near the margins, particularly in the northwest corner of the Terrane.

Strata of the Upper Triassic (Karnian to Norian) comprise an assemblage of mainly subaqueous basalt, andesite (commonly with augite phenocrysts), intermediate volcanics, limestone and volcaniclastic sedimentary rocks. They are known as the Stuhini Group in the north, the Takla in the east. These rocks accumulated in a series of thick volcanic piles across the northern and eastern margins of the Terrane. The east-southeast axis of accumulation of these volcanics define the axis of the Stikine Arch. Triassic volcanism along the Stikine Arch possibly evolved in response to a south westerly dipping subduction zone located north of the Stikine Arch. Triassic volcanism along the eastern margin of the terrane appear to have developed in association with rift-like structures. The Triassic volcanics change facies westward into shales, siltstones and greywackes within the ancestral Bowser Basin.

The final episode of arc-volcanism is represented by the Lower to Middle Jurassic (Sinemurian to Bajocian) calc-alkaline volcanics and sediments of the Hazelton Group. These form an arcuate zone along the north east margin of Stikinia, and underlie much of its southern half, where the arcuate trend is no longer apparent. The Hazelton Group is comprised of basalt to rhyolite volcanics and sedimentary rocks deposited in both subaereal and subaqueous environments. Pyroclastic rocks greatly predominate over flows, and a typical lithotype is a reddish to maroon, poorly to unsorted, well bedded, lithic - crystal - vitric lapilli tuff, with lithic clasts of dacite-andesite feldspar porphyry and crystals of feldspar. Four stratigraphic units define the Hazelton Group. Basal unit to the Hazelton Group is a polymictic conglomerate of Sinemurian age or older, containing clasts of limestone, cherts, augite porphyry, granitic rocks and volcanics correlative with the underlying Stikine Assemblage and Takla-Stuhini Groups. The most widespread unit is represented by thick accumulations of non-marine reddish coloured, andesite to rhyolite pyroclastics and flows of Sinemurian to Bajocian age, and known as the Telkwa formation, Toodoggone Volcanics, Coldfish Lake volcanics, Babine shelf facies, Sikanni facies, Bear Lake facies, and the submarine Kotsine facies.

Each of these assemblages is separated by major northwest trending faults. A marine volcaniclastic-tuff assemblage of Pliensbachian to Bajocian age is known as the Nilkitkwa Formation. These interfinger with the Telkwa-Toodoggone equivalents, and change facies westward into the a back-arc ancestral Bowser Basin. The upper formation of the Hazelton Group is an assemblage of shallow marine, very fossiliferous, highly tuffaceous, sedimentary rocks of the Smithers Formation.

Island arc volcanism waned by Middle Bajociam times (Upper Bajocian-Bathonian), with the destruction of the subduction zone. The tightening of the area between the Stikine Terrane and the Craton resulted in the uplift of the marginal arc terranes and adjacent oceanic Cache Creek Terrane, shedding detritus into the Bowser Basin, beginning the molasse stage of the evolution of Stikinia.

The molasse stage comprises two major units, the Bowser Lake and the Skeena Groups. The Bowser Lake Group comprises a suite of mainly marine clastics deposited in delta systems, prodeltic channels and basinal turbidites of late Middle Jurassic to late Late Jurassic (Lower Cretaceous?) age. The Skeena (Sustut) comprises a suite of nonmarine and marine paralic clastics. They are of mid Lower Cretaceous (Hauterivian) early Upper Cretaceous (Cenomanian) age, deposited off an uplifted terrane to the east, the Omineca Crystalline Belt.

Deposition of the Bowser Lake Group was centripital along the north, east and south part of the Bowser Basin, and appears to be longitudinal-southward, in the western part of the basin. Clastic deposition in the north, off the Stikine Arch was characterized by a flood of cherts as thick, conglomeratic channel fills indicating both emergence of the Cache Creek Atlin Terrane and major subsidence along the northern boundary of the Basin. In contrast, off the southern margin of the Bowser Basin, detritus was entirely volcanic and granitic debris derived off the Skeena Arch from the Stikine, Takla, and Hazelton strata and coeval intrusives. Deposition was controlled by northwardly prograding deltaic assemblages of much lower energy deposition than was apparent to the north. Conglomerates are significant only in the basal Bowser Lake beds along the Skeena Arch.

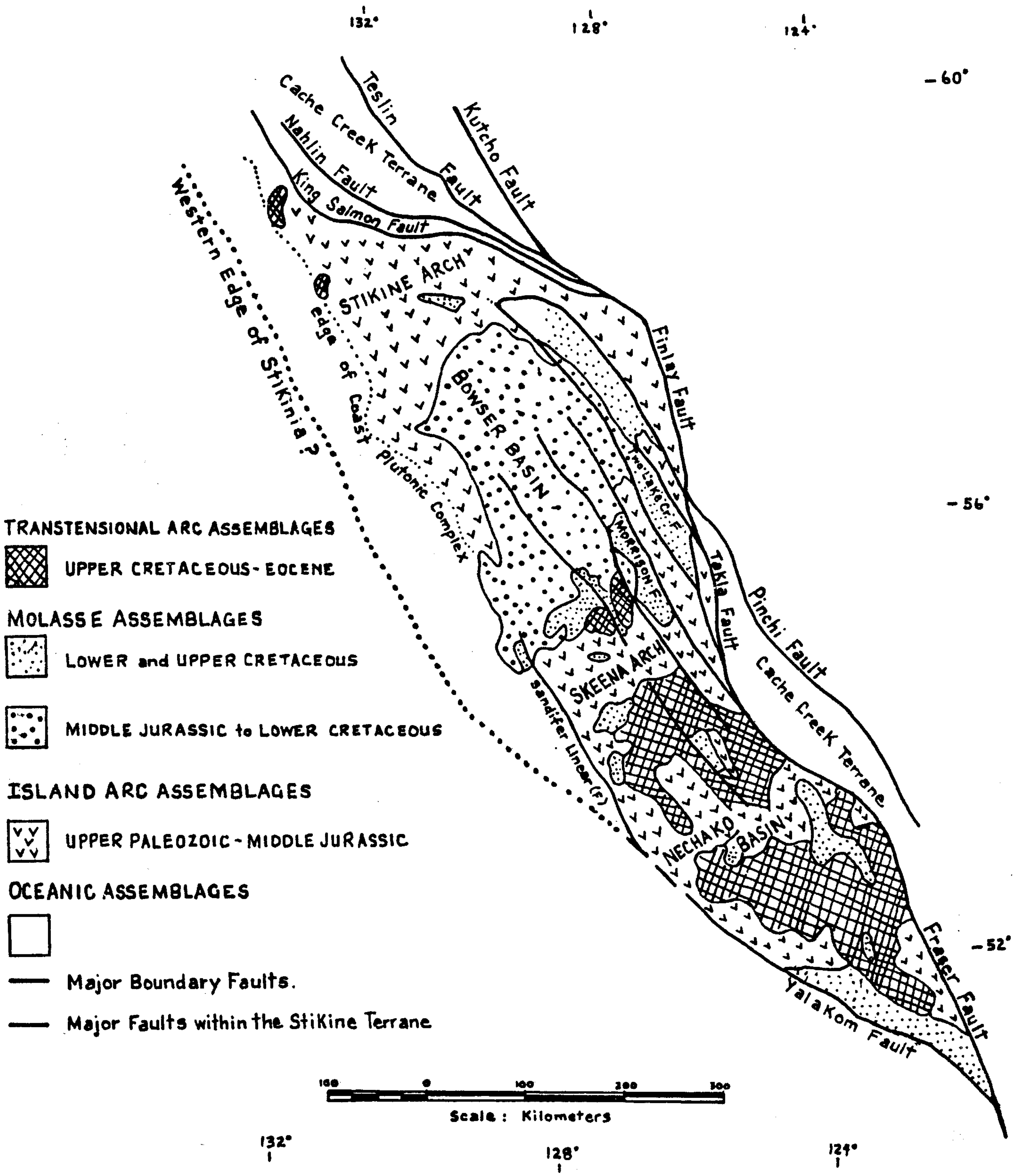
By mid Early Cretaceous time, the Stikine Terrane became effectively part of the Craton. Regional uplift of the Terranes to the east resulted in a regional change in sediment transport direction, and detrital provenance. The Skeena Group (Sustut, Jackass Mountain and Pasayten Groups) sediment transport direction was to the southwest, across the southern two-thirds of Stikinia, and likely continued across the present trace of the Coast Crystalline Complex. Clasts of the Skeena comprise cherts and volcanics, reworked from underlying strata, as well as significant quantities of muscovite, quartz and quartzite. This metamorphic detritus signaled the emergence of the Omineca crystalline terrane to the east. The net effect of deposition of the Skeena assemblages resulted in a peneplanation of much of the Stikine Terrane. Lower Cretaceous volcanics of the Gambier Group are exposed along the southwest margin of Stikinia, and trend southwards, across the southern Coast Mountain, inferring linkage of the Stikine Terrane with those Terranes to the west at least by Early Cretaceous times.

The transition from the molasse assemblages of the Bowser-Skeena assemblages to a transtensional, continental arc assemblage was coincident with the beginning of emergence of the Coast Plutonic Complex, and possibly in response to the impingement of the craton onto the Wrangel-Alexander Terranes. These volcanic assemblages include the mid Cretaceous to late Late Cretaceous Kasalka and Kingsvale Groups, and Paleocene to Eocene Ootsa Lake Group and Eocene-Oligocine Endako Group. The subduction zone that spawned these volcanics likely lay to the west. The transition from paralic Skeena sediments to continental arc volcanics is marked by a dramatic restrictions in the sedimentary basin, eruption of alkali augite basalt across the Skeena Arch, eastward directed thrust faults along the east flank of the Coast Plutonic Complex, and deposition of a coarse clastic red bed assemblage fed from the west, and underlying much of the Upper Cretaceous-Paleocene volcanic assemblages.

The transtensional continental arc assemblage comprises a suite of mainly calc-alkaline volcanics deposited in discrete, down-drop volcanic basins. The oldest suite is characterized by the (mid to Upper Cretaceous), Kasalka Group, deposited across the Skeena Arch in a series of caldera-like structures. These are basalt to rhyolite, mainly intermediate in composition. These volcanics were deposited unconformably relationship on the underlying Skeena. The younger Ootsa Lake Group (dominantly Eocene) is much more widespread, extending across most of the south half of Stikinia, and intermittently across the eastern and northern part, where they are correlative with the Sloko Group. The terminating phase of volcanism is marked by basaltic volcanism of the Endako Group, deposited in basins along the southeastern part of the Terrane. Drainage patterns shifted dramtically from a southwestern to an easterly and southwesterly longitudinal trend.

The Oligocene to Present internal is a post orogenic episode marked by regional uplift, developement of a basin and range morphology, rapid uplift of the Coast Plutonic Complex, and stream capture from major rivers rapidly down-cutting through the uplifting Coast Belt. Basin and range morphology is best developed across the Skeena Arch. In the southern part of the Terrane, the interval is marked by eruption of the Chilcotin plateau lavas, and the east-west trending Anahim shield volcanoes. That the process is still in progress is evidenced by the easterly younging ages of the Anahim volcanics, indicating the westward migration of the Craton across a still active hot spot.

Figure 1. Major Tectonic and Stratigraphic Elements of the StiKine Terrane; British Columbia Cordillera;



STRATIGRAPHIC AND TECTONIC ELEMENTS
STIKINE TERRANE; BRITISH COLUMBIA

Post Orogenic	CENOZOIC	Late Tertiary	PLIE / PLIO	Anahim Volcanics Chilcotin Lavas		BASALT		Development of Basin and Range Morphology, Regional Cordilleran Uplift
			MIO		Poplar Butte Volcanics	BASALTIC		
				ENDAKO GROUP	Buck Creek Volcanics	BASALTIC, ANDESITE		
Transtensional Volcanic Assemblages		Early Tertiary		OOTSA LAKE GROUP	Goosly Lake Volcanics Babine Volcanics	RHYOLITIC TO BASALTIC	KASTBERG INTRUSIONS QUANCHUS INTRUSIONS BABINE INTRUSIONS NANIKA INTRUSIONS	Epoch of Development of Down-Drop Volcanic Basins.
				KASALKA GROUP	Brian Boru Formation Tip Top Hill Formation Suskwa River	CALC-ALKALINE ANDESITIC TO RHYOLITIC	BULKLEY INTRUSIONS	Begin Uplift of Coast Crystalline Belt - welding of Wrangellia and Alexandria to Craton.
Molasse Assemblages	MESOZOIC	Cretaceous	U	Red Bed Assemblage, Rocky Ridge Volcanics		CONGLOMERATE, SANDSTONE, ALKALIC BASALT		
			L	SKEENA-SUSTUT GROUP		CHERT PEBBLE SANDSTONE. BLACK SHALE, SANDSTONE, CONGLOMERATE		Begin Uplift of Omineca Crystalline Belt - welding of Stikinia to Craton.
		Jurassic	U	BOWSER LAKE GROUP	Deltaic Assemblages Trout Creek Assemblages Ashman Formation	CONGLOMERATE, SILTST. GREYWACKE, SILST. SHALE		
			M L	HAZELTON GROUP	Smithers Formation Nilkitwa Formation Toodoggone, Telkwa Formations	CALC-ALKALINE, MARINE & NON MARINE VOLCANICS & SEDIMENTS. POLYMICTIC CONGLOMERATE	OMINECA INTRUSIONS TOPLEY INTRUSIONS	Development of Bowser Basin;
Island ARC Assemblages		Triassic	U	TAKLA-STUHINNI GROUP	SAVAGE, DEWAR & MOOSEVALE FORMATIONS	ALKALINE MAFIC VOLCANICS; SEDIMENTS & LIMESTONE		Stikinia an independent Arc Terrane, Separated from Craton.
			L					
	PALEOZ.	Permian		STIKINE ASSEMBLAGE		LIMESTONE, CHERT, RHYOLITE, ANDESITE, BASALT,		
		Penn.						
		Miss.						

NEW EDITION OF THE TECTONIC ASSEMBLAGE MAP OF THE CANADIAN CORDILLERA AND ADJACENT USA

John O. Wheeler and P. McFeely, Geological Survey of Canada, 100 West Pender Street, Vancouver, B.C., V6B 1R8

The 1:2,000,000 scale map displays tectonic assemblages, bounded by unconformities or faults, deposited in specific tectonic settings during particular intervals of time. It shows plutonic rocks, mainly as suites defined by age, composition and other attributes, grouped, for the most part, into the magmatic episodes identified by R.L. Armstrong (GSA Abstracts, 1985, p. 338). The map also displays numerous faults, major metamorphic boundaries, important carbonate-shale transitions, melanges, volcanic rocks broadly subdivided according to composition, volcanic centres and diatremes.

New additions to the map include: age of adjacent Pacific Ocean floor; formations in the Mackenzie Delta and adjacent Beaufort Sea beneath the Pliocene and younger cover; subdivisions of the Alexander Terrane; the Paleozoic and Mesozoic clastic wedges and accretionary prisms; Upper Proterozoic and Middle Cambrian rift assemblages; and Proterozoic to Triassic pericratonic terranes between the North American passive margin and the Mesozoic volcanic allochthonous terranes. Perhaps the most common changes from the previous edition are new and revised ages of plutonic rocks, especially in the Coast Plutonic Complex.

The legend shows the assemblages and suites by age, name, tectonic setting, lithologic and other attributes, and their positions in time and space in relation to the Cordilleran terranes and the five morphogeological belts. It also highlights important overlap assemblages, the position and direction of dispersal of clastic wedges, and the composition and stratigraphy of the terranes.

AUTHOR INDEX

LIST OF SPEAKERS

TECHNICAL SESSION 1 - NORTHERN CORDILLERAN OVERVIEW

MONDAY

1 08:45 GEOLOGICAL FRAMEWORK OF NORTHWESTERN BRITISH COLUMBIA HUBERT GABRIELSE
2 09:25 NEW EDITION OF TECTONIC ASSEMBLAGE MAP OF THE CANADIAN CORDILLERA AND ADJACENT USA - JOHN O. WHEELER AND P. MCFEELY
3 10:05 METALLOGENY OF NORTHWESTERN BRITISH COLUMBIA - W.J. MCMILLAN

TECHNICAL SESSION 2 - NORTHERN B.C. & YUKON: THE PALEOZOIC THROUGH MESOZOIC

4 11:10 RECENT EXPLORATION DEVELOPMENTS IN THE YUKON - GRANT ABBOTT
5 11:40 LATE TRIASSIC VOLCANICS AND MASSIVE SULPHIDE DEPOSITS, ALEXANDER TERRANE, NORTHWEST B.C. - D.G. MACINTYRE
6 14:30 STRATIGRAPHY, STRUCTURAL GEOLOGY, & GEOCHRONOLOGY OF IRVINE LAKE & GRAVEL CK. MAP AREA RANCHERIA DISTRICT, SOUTHERN YUKON - DONALD C. MURPHY
7 15:00 LATE PALEOZOIC MARGINAL BASIN AND ISLAND ARC ENVIRONMENTS IN THE SYLVESTER ALLOCHTHON - J. NELSON AND J. BRADFORD
8 15:30 ERICKSON GOLD CAMP, CASSIAR - ALEX BORONOWSKI
9 16:30 A CLOSER LOOK AT THE LLEWELLYN FAULT - TECTONIC IMPLICATIONS & ECONOMIC MINERAL POTENTIAL - M.G. MIHALYNUK, L.D. CURRIE AND J.N. ROUSE
10 17:00 LODE GOLD DEPOSITS OF THE ATLIN AREA - D.V. LEFEBURE, M. BLOODGOOD AND C. REES

TECHNICAL SESSION 3 - N. CORDILLERAN MESOZOIC STRATIGRAPHY, STRUCTURE METALLOGENY

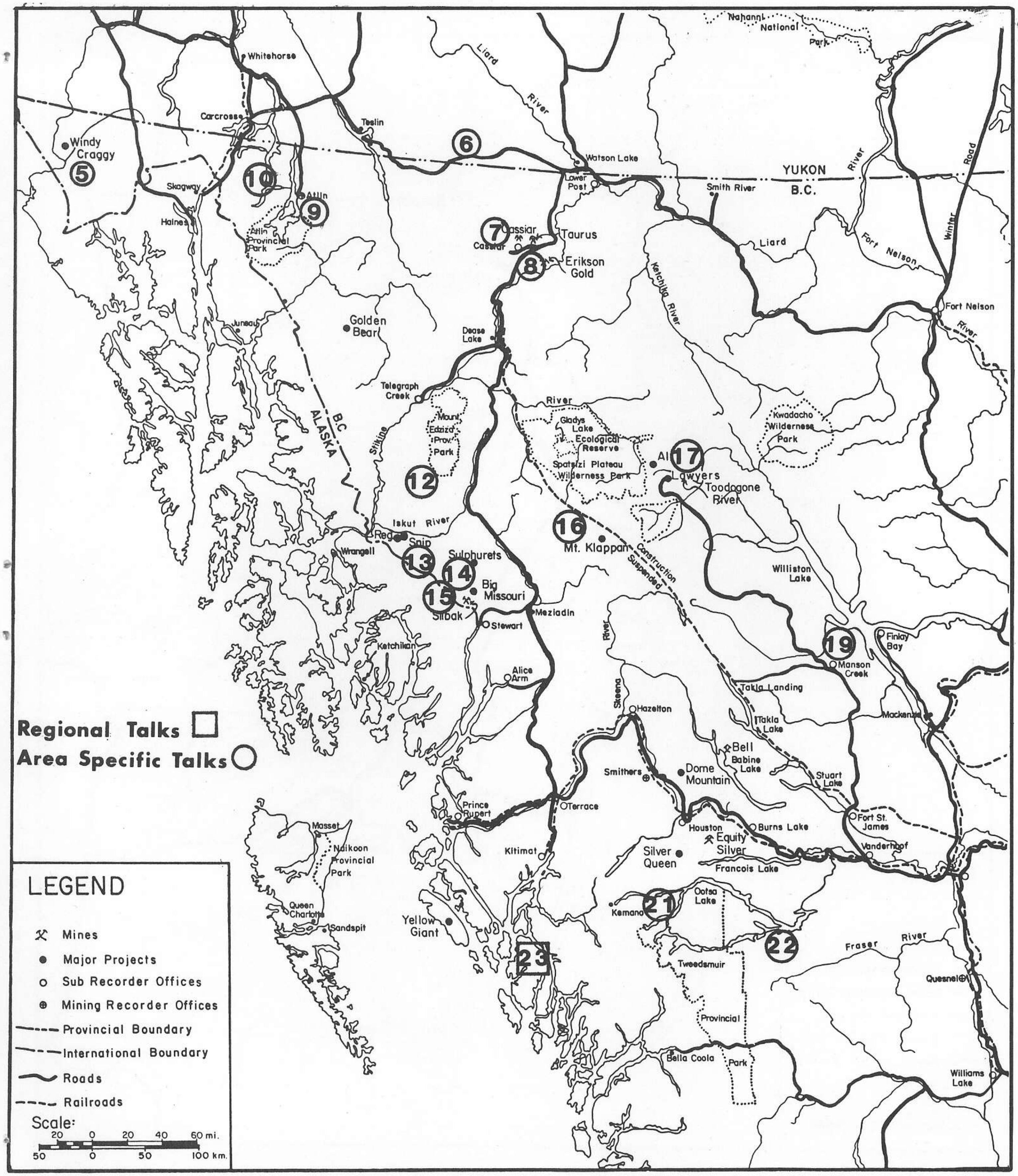
TUESDAY

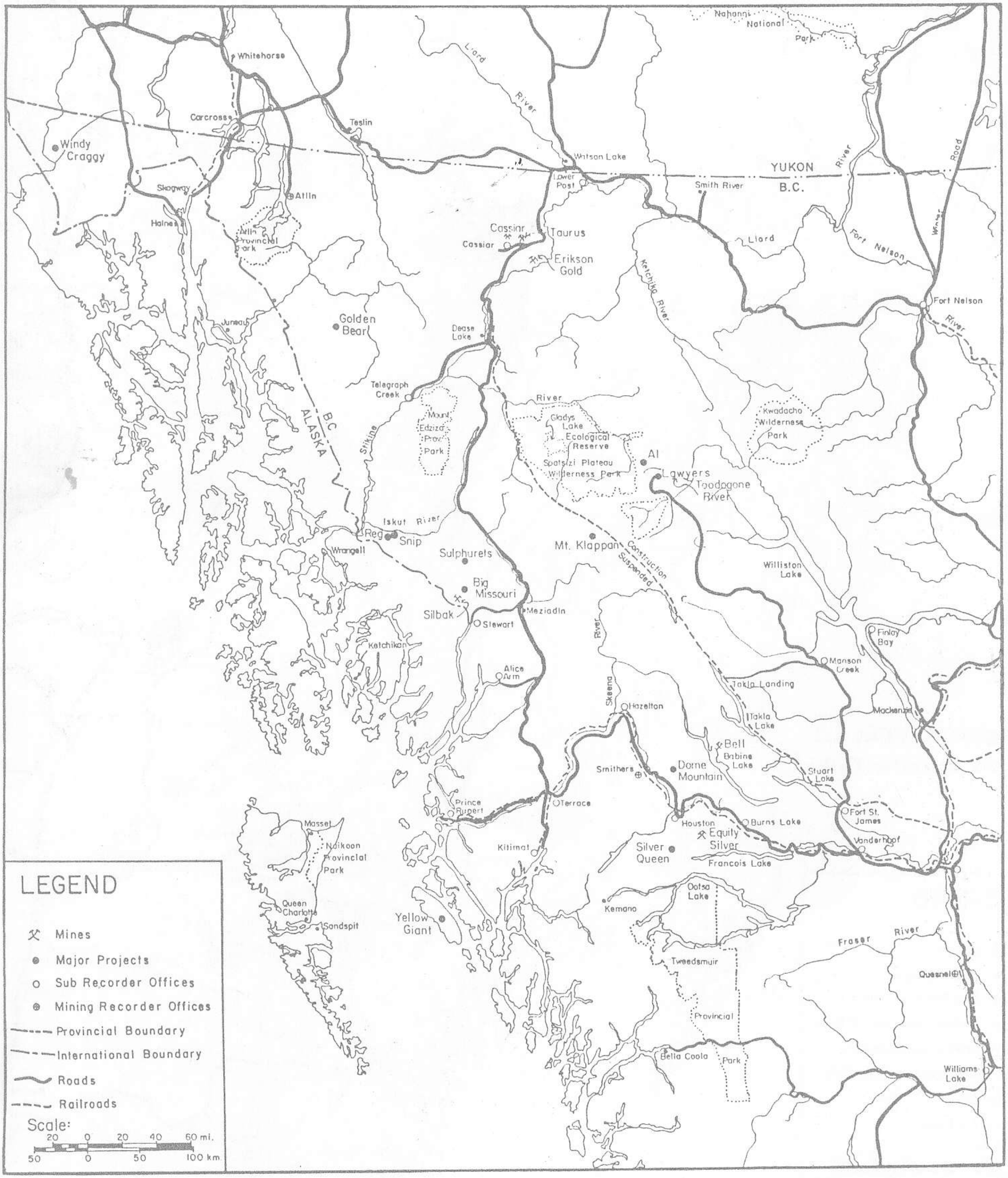
11 09:00 GEOLOGIC SETTING OF THE STIKINE TERRANE - TOM RICHARDS
12 09:30 GEOLOGY AND MINERALIZATION OF THE STIKINE ASSEMBLAGE, MESS CREEK AREA, NORTHWESTERN BRITISH COLUMBIA - PETER HOLBEK
13 10:30 A PALEOZOIC AND MESOZOIC STRATIGRAPHIC AND PLUTONIC FRAMEWORK FOR THE ISKUT MAP AREA(104B), NORTHWESTERN B.C. - R.G. ANDERSON
14 11:00 STRATIGRAPHY AND MINERAL DEPOSITS IN THE UNUK-SULPHURETS AREA, NORTHWESTERN BRITISH COLUMBIA - JIM BRITTON
15 11:30 GEOLOGICAL SETTING OF THE VOLCANIC-HOSTED SILBAK PREMIER MINE AREA, NORTHWESTERN BRITISH COLUMBIA(104A/4 AND 104B/1) - DEREK BROWN
16 14:00 STRATIGRAPHY AND STRUCTURAL STYLE OF THE BOWSER & SUSTUT BASINS, NORTH-CENTRAL BRITISH COLUMBIA - C.A. EVENCHICK
17 14:30 A PRELIMINARY APPRAISAL OF THE AU-AG METALLOGENY OF THE TOODOGGONE DISTRICT, NORTH-CENTRAL BRITISH COLUMBIA - JAMES R. CLARK
18 15:00 LEAD ISOTOPE DISCRIMINATION OF JURASSIC FROM LATER DEPOSITS, IN SMITHERS, STEWART AND TOODOGGONE AREAS - J.E. GABITES AND C.I. GODWIN
19 16:00 PRELIMINARY GEOLOGY OF THE GERMANSEN LANDING AREA - FILIPPO FERRI AND DAVID M. MELVILLE
20 16:30 MID TO LATE CRETACEOUS VOLCANISM IN WEST CENTRAL BRITISH COLUMBIA AND ASSOCIATED MINERAL DEPOSITS - D.G. MACINTYRE

WEDNESDAY

21 08:30 STRATIGRAPHY AND PETROLOGY OF THE OOTSA LAKE GROUP IN THE WHITESAIL RANGE" - JOHN DROBE
22 09:00 PRECIOUS METAL EPITHERMAL MINERALIZATION IN THE OOTSA LAKE GROUP, WOLF PROPERTY, CENTRAL B.C. -KATHRYN P.E. ANDREW
23 09:30 AN OVERVIEW OF THE COAST PLUTONIC COMPLEX BETWEEN 53° AND 55° N - PETER VAN DER HEYDEN

10:30 PLENARY SESSION


Whitehorse
Liard River
Nahanni National Park
Carcross
Teslin
Windy Craggy
5
6
10
Watson Lake
YUKON
B.C.
Skagway
Atlin
9
Lower Post
Smith River
Haines
Atlin Provincial Park
7
Cassiar
Taurus
8
Erikson Gold
Liard
Fort Nelson
Winter Road
Kechika River
Juneau
Golden Bear
Dease Lake
Fort Nelson
River
Telegraph Creek
Mount Edziza Prov. Park
River
Gladys Lake Ecological Reserve
Spatsizi Plateau Wilderness Park
Kwadacho Wilderness Park
B.C.
ALASKA
Stikine
12
Al
17
Lawyers
Toodogone River
Iskut River
16
Red
Snip
Mt. Klappan
Construction Suspended
Wrangell
13
Sulphurets
14
Williston Lake
15
Big Missouri
Silbak
Meziadin
Stewart
Ketchikan
River
19
Finlay Bay
Manson Creek
Alice Arm
Takla Landing
Skeena
Hazelton
Takla Lake
Mackenzie
Regional Talks
Area Specific Talks
Bell
Babine Lake
Smithers
Dome Mountain
Stuart Lake
Prince Rupert
Terrace
Fort St. James
Masset
Houston
Burns Lake
Equity Silver
Naikoon Provincial Park
Kitimat
Silver Queen
Vanderhoof
Francois Lake
LEGEND
Mines
Major Projects
Sub Recorder Offices
Mining Recorder Offices
Provincial Boundary
International Boundary
Roads
Railroads
Scale:
20 0 20 40 60 mi.
50 0 50 100 km.
Queen Charlotte
Sandspit
Yellow Giant
Kemano
21
Ootsa Lake
22
23
Fraser River
Tweedsmuir
Provincial
Park
Quesnel
Bella Coola
Williams Lake



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