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GEOLOGY, GEOCHEMISTRY AND MINERAL DEPOSITS OF THE AKIE RIVER AREA, NORTHEAST BRITISH COLUMBIA

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SUMMARY

Thick westward prograding clastic wedges were deposited along the margin of ancestral North America from Mid Proterozoic to Mid Paleozoic time. Periodic rifting and tectonic subsidence resulted in the formation of starved sub-basins along this otherwise passive continental margin. These sub-basins host important sedimentary exhalative barite-zinc-lead-silver deposits.

In northeast British Columbia, a thick succession of Paleozoic basinal facies clastic rocks is preserved within the northwest-trending, Kechika Trough. Within the trough, sedimentary exhalative barite and barite-sulphide deposits occur in starved basin sediments of Middle Ordovician, Early Silurian and Late Devonian age. The latter are the most economically significant and are hosted by carbonaceous cherty argillites and siliceous shales of the Middle to Late Devonian Gunsteel formation of the Lower Earn Group. The largest deposit is the Cirque, with reserves in excess of 35 million tonnes averaging 10 percent combined lead-zinc and 47 grams per tonne silver. Other potentially significant deposits include Driftpile Creek, Bear, Mt. Alcock, Fluke, Pie and Elf. Stratiform barite deposits are also common, particularly near the basin to shelf transition zone.

The Late Devonian barite-sulphide deposits are typically zoned with interlaminated barite-sphalerite-galena-pyrite occurring near suspected vent areas and grading outward into bedded barite. Beds of laminar-banded pyrite typically occur in hangingwall siliceous shales, particularly above the inferred vent zone. Epigenetic stringer sulphide zones are not recognized and footwall alteration is generally absent, implying that the deposits formed from ponded brines at relatively low temperature. Away from the main deposits the favourable stratigraphic interval is recognized by the presence of thin beds of nodular and laminated barite and thin laminae of pyrite in the shales. Thin tuff beds also occur locally in this stratigraphic interval and are evidence for a Late Devonian volcanic event.

A paleogeographic reconstruction of the Kechika Trough in Late Devonian to Mississippian time suggests barite-sulphide deposits formed in third order starved basins between uplifted, northwest-trending horst blocks that were capped by shallow water carbonate banks. The presence of intraformational breccias suggests fault movement accompanied barite-sulphide precipitation. This tectonic activity may have allowed the escape of heated, overpressured metalliferous brines from permeable reservoirs within the sedimentary pile. Sedimentary exhalative deposits formed where these brines were exhaled onto the seafloor and ponded in anoxic seafloor depressions.

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CHAPTER 1 INTRODUCTION

The main focus of this bulletin is the Akie River area of the Gataga mineral district in northeast British Columbia (Figure 1). Significant sedimentary exhalative barite-sulphide deposits were discovered in this area in the early 1980's. Host rocks are Paleozoic basinal facies clastic rocks of the Kechika Trough which is a southeast extension of the Selwyn Basin (Figure 1). These rocks were deposited along the rifted continental margin of ancestral North America, immediately outboard of an extensive carbonate platform (Figure 1).

The Geological Survey Branch of the B.C. Ministry of Energy Mines and Petroleum Resources mapped the Gataga district at 1 to 50,000 scale during the 1979, 1980, and 1981 field seasons (MacIntyre 1980; 1981; 1982, 1992). The location of the area covered by this work is shown in Figure 2. This bulletin summarizes the results of this mapping and subsequent related geochemical and petrographic studies which have now been completed.

The 1:100,000 scale geological compilation map accompanying this report (Figure 3A, in pocket) was prepared from original 1:50,000 scale field and open file maps. This map also shows geochemical, fossil, and mineral occurrence sample locations. The distribution of field station locations is shown in Figure 2. All data collected as part of this project is archived in digital format.

This bulletin summarizes the results of two university research projects completed as part of this project (Heather, 1982; Lowey, 1984). In addition, a co-operative silt, water and lake sampling program was done with Bruce Ballantyne of the Geological Survey of Canada in 1980 and 1981; a summary of result and a table of the data has also been included.

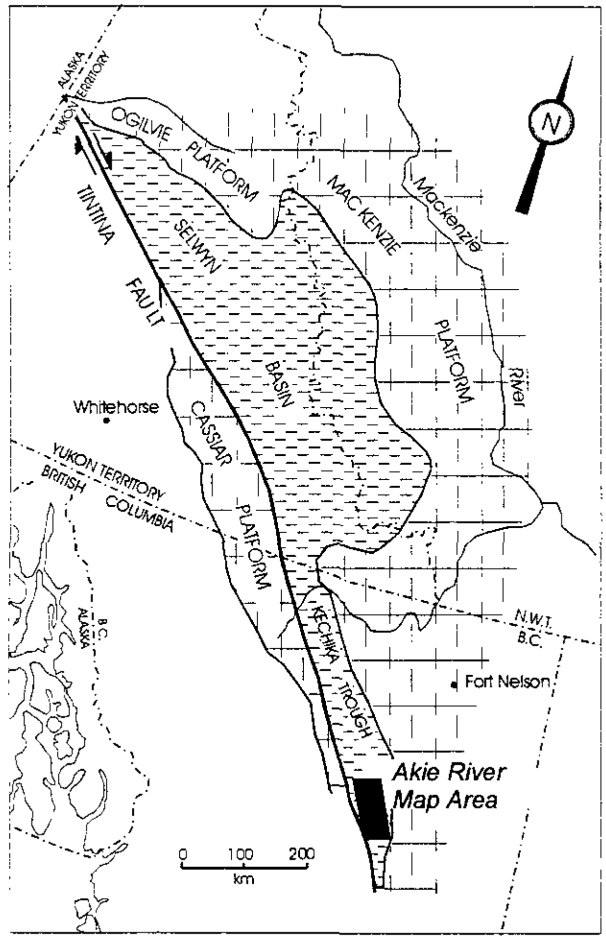

Figure 1. Location of the Akie River map area relative to major tectono-stratigraphic elements of the northern Cordillera.

LOCATION AND ACCESS

This project area within the Ware map sheet (94F) within the Muskwa ranges of the northern Rocky mountains, a northwest trending belt of folded and thrusted Paleozoic basinal facies sedimentary rocks that is approximately 100 kilometres long and 50 kilometres wide (Figure 3). This area is located approximately 70 kilometres northeast of Williston Lake, in the Rocky Mountains of northeast British Columbia.

Access is by fixed wing aircraft from the town of MacKenzie to the Finbow airstrip on the Findlay River, 20 kilometres south of Fort Ware. Float-equipped aircraft use Pretzel Lake, 10 kilometres northeast of the airstrip. The Gataga mineral district lies a further 40 kilometres to the east and is most easily accessed by helicopter. A rough access road was built in 1981 to the Cirque property and was upgraded in the early 1990's to aid underground development at the property. The road begins at the barge landing at the north end of Williston Lake and extends for some 55 kilometres along the east side of the Findlay river before heading eastward to the deposit. Recent logging activity in the area has provided additional road access to the southern part of the study area.

PHYSIOGRAPHY, CLIMATE AND VEGETATION

The study area is mountainous with a series of northwest trending ridges, locally rising to 2,200 metres elevation, transected by broad northeast trending drainage corridors. The northeast facing ridge slopes are generally steep and have excellent exposure; the southwest facing slopes dip moderately and are generally covered with talus, moss and grass.

The climate is cool with moderate rain and snow fall. Most valleys are free of snow by mid June.

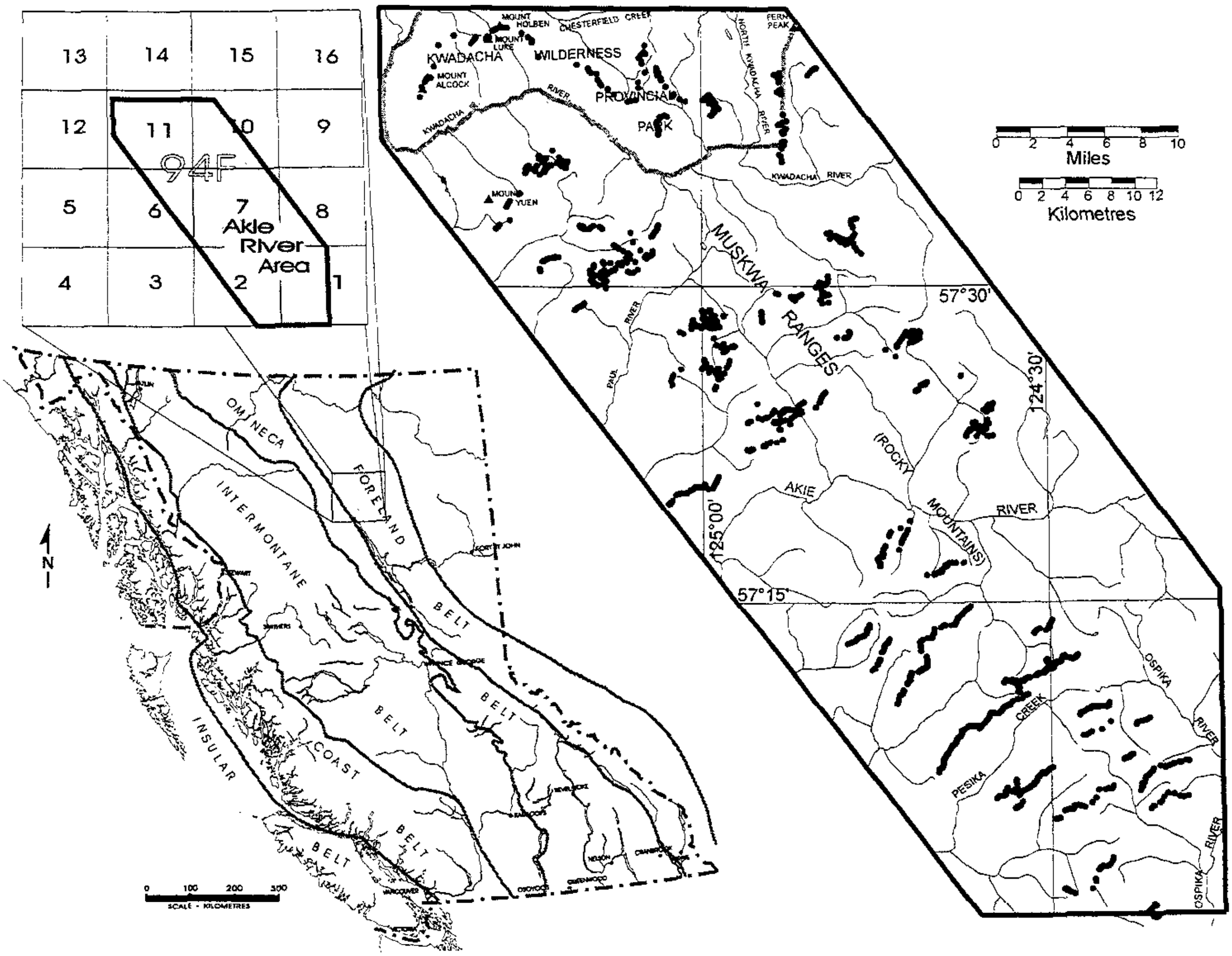

Figure 2. Location of the Akie River project area and tectonic belts of British Columbia. Inset shows location of field stations (circles) in the project area.

Although snow is not unusual at higher elevations even during the summer months, it does not begin to accumulate until late September. Temperatures in the summer months range from 5 to 30 degrees Celsius with an average near 18 degrees Celsius.

Vegetation in the area is restricted to valleys and lower slopes which are heavily timbered with spruce and other subordinate species. Extensive swamps occur in the broad valley bottoms that are associated with major drainage corridors. Landslide and avalanche scars are common on steeper slopes. Locally, vegetation has been killed by high concentrations of barite float in talus slopes. Iron oxide has been precipitated where springs drain iron rich black shales; springs draining carbonate rocks precipitate calcium carbonate. Locally a lime-green "zinc moss" occurs where springs drain zinc rich shales.

Above the tree line, the environment is sub-alpine, with mosses and lichens predominating. Alpine flowers are also abundant in the summer months. Animal species include abundant grizzly bear, cariboo, mountain goats and marmots.

PREVIOUS WORK

Previous mapping in the area was done by the Geological Survey of Canada. Gabrielse (1962,1977) mapped and carried out stratigraphic studies in the Ware

(94F), Tuchodi (94K), and Kechika (94L) map areas at 1 to 250,000 scale. Jackson *et al.* (1965) and Norford *et al.* (1967) also published stratigraphic studies of Ordovician and Silurian rocks in the Ware-Trutch map areas. Davies (1966) provided stratigraphic information in an unpublished Ph.D. thesis. Additional stratigraphic information is found in publications by Taylor and Stott (1973), Gabrielse (1975), and Thompson (1976), all of which describe stratigraphic units in adjoining map areas.

Taylor (1979), Taylor *et al.* (1979), and Cecile and Norford (1979) of the Geological Survey of Canada mapped at 1 to 250,000 scale and studied the stratigraphy of the Road River Group within the eastern half of the Ware map sheet. The Cyprus Anvil-Hudson's Bay Oil and Gas Joint Venture mapped the belt of Devonian rocks from Mount Alcock to south of the Pesika River as part of a regional and property based exploration program.

HISTORY OF EXPLORATION

Recognition of the potential for clastic-hosted stratiform sulphide and barite deposits of the Meggen and Rammelsberg type in Paleozoic basinal facies rocks of the North American miogeocline resulted in regional geological and geochemical exploration programs particularly within the Selwyn Basin of Yukon. This work resulted in discovery of the Howard's Pass deposit in 1972 and the Jason deposit in 1975. In the late 1970's the focus of exploration activity shifted southward toward the relatively unexplored Kechika Trough of the Northern Rocky Mountains.

Geophoto Consultants first explored the northern part of the Kechika Trough in 1970. In 1972, Canex Exploration (Placer Development Ltd.), while following up this earlier work, discovered bedded barite-sulphide occurrences in Devonian black clastics near Driftpile Creek. However, the most significant discovery known to date was not made until 1977 when a Cyprus Anvil/Hudson's Bay Oil and Gas Ltd. joint venture discovered the stratiform Cirque deposit in similar strata further to the south in the Paul River area. This deposit has drill indicated reserves in excess of 40 million tonnes containing 7.8 per cent zinc, 2.2 percent lead, and 48 grams per tonne silver. Extensive drilling at the Cirque and South Cirque deposits has provided much valuable information on the stratigraphic and structural settings of the stratiform barite-sulphide deposits.

When the Cirque deposit was acquired by Curragh Resources in 1985 it was subsequently renamed the Stronsay deposit. In 1989 Austriana de Zinc purchased 15% of the deposit from Curragh. The $10 million received from this sale was used to finance underground exploration, additional diamond drilling, metallurgical testing and environmental studies between 1989 and 1991. Total expenditure on the property to the end of 1991 was $55 million (1990 dollars). In 1994, Curragh Resources went into receivership. The Cirque property was subsequently acquired from the receiver by Teck Corporation (25%), Cominco Limited (25%) and Korea Zinc Company (50%). After completing a feasibility study in 1995, the new owners decided to defer a production decision until the zinc market improves.

Diamond drilling has also been done at the Pie, Fluke, and Elf prospects, all of which have bedded barite and massive sulphide hosted by Late Devonian black clastics. Middle Devonian and Mississippian age barite deposits have also been discovered in the area and these appear to be spatially associated with the Late Devonian occurrences suggesting a common structural control.

In 1980, Cominco Ltd. discovered the Aikie-Sika, ERN, CT stratiform barite-sulphide occurrences in Early Silurian clastic and carbonate strata that stratigraphically and lithologically resemble those hosting the Howard's pass deposit of Selwyn Basin. Also in 1982, ESSO located a stratiform massive pyrite body in probable Middle Ordovician black shales (Reb prospect). These discoveries further enhanced the overall potential of the district and prove the existence of more than one mineralizing event in the depositional history of the Kechika Trough.

The most recent discovery in the project area was made by Metall Mining Corporation in 1994 while exploring ground optioned from Ecstall Mining Corporation. This discovery, now known as the Akie deposit, was drill tested in 1994, 1995 and 1996.

ACKNOWLEDGEMENTS

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CHAPTER 2 GEOLOGY

REGIONAL SETTING

In northeast British Columbia, Paleozoic miogeoclinal basinal facies rocks of ancestral North American affinity were deposited in the Kechika Trough, a southeast extension of the Selwyn Basin (Figure 1). The Kechika Trough is bounded to the west and east by carbonates and shallow water clastic rocks of the Cassiar and MacDonald Platforms respectively (Taylor and MacKenzie, 1970). Rocks of the MacDonald Platform are host to Mississippi valley type Pb-Zn deposits (MacQueen and Thompson, 1978).

The Akie River project area is located within the Rocky Mountain fold and thrust belt of northeast British Columbia. Within this tectonic belt, northeast-directed contraction in Mesozoic time detached Paleozoic and older sedimentary strata from the cratonic basement and stacked these rocks as a series of southwest-dipping imbricated thrust plates (McClay *et al.*, 1989; Price, 1986).

The Kechika Trough is truncated by a major transcurrent fault that is coincident with the Northern Rocky Mountain Trench (Gabrielse, 1984). Reconstruction of the geology on either side of the trench suggests rocks west of the trench were displaced 450 or more kilometres northward (Tempelman-Kluit, 1977) by movement along dextral strike-slip faults in Mesozoic and Cenozoic time.

The Akie River area is underlain by a thick succession of basinal facies clastic and subordinate carbonate rocks of Late Cambrian to Late Triassic age (Figure 3, Table 1). These rocks crop out in narrow northwest-trending panels bounded by southwest-dipping thrust faults. The thrust panels are internally deformed into a series of tight, parallel, generally northeast-verging asymmetric, upright to overturned folds.

Although the map pattern reflects the effects of thrusting and folding, the geomorphology reflects the effects of differential erosion. The more resistant formations are usually well exposed, especially where they have been thrust up to form the backbones of prominent ranges. Recessive formations, on the other hand, are usually poorly exposed and typically underlie low hills and valley bottoms. This is particularly true of the Devonian shales that host the important stratiform barite-sulphide deposits of the district. Also, because of the relatively high stratigraphic position of these Devonian rocks, they usually occur only in the deeper synclinal troughs that lie below major thrust faults; elsewhere they are largely removed by erosion. Recognition of these factors is critical to successful exploration and resource assessment of the area.

LITHOSTRATIGRAPHIC UNITS

The lithostratigraphic units defined during this study are summarized in Table 1. The stratigraphic relationships of the map units defined in the Akie River area are shown in Figures 4 and 5. The unit thicknesses shown in Figure 5 are approximate because of the high level of structural imbrication, particularly within fine clastic sequences. Detailed stratigraphic columns are presented in Appendix A.

In the Akie River area, as is typical of turbiditic sequences near basin margins in general, facies changes are numerous and reflect the effects of changing water depth, paleoslope orientation and tectonic activity during the course of basin evolution. Figure 6 shows the inferred facies relationships that have been determined for the lithostratigraphic units defined in this study. The Paleozoic stratigraphic succession records the history of several marine transgressive cycles. Each cycle begins with shallow water carbonate and associated clastic sedimentation and ends with deposition of deep water black shale. These fining upward marine transgressive cycles are Late Cambrian to Early Ordovician, Mid-Late Ordovician, Early Silurian, Early Devonian and Late Devonian toEarly Mississippian in age.

PROTEROZOIC TO EARLY CAMBRIAN - WINDERMERE SUPERGROUP

Sedimentary rocks of Proterozoic age are exposed in major thrust plates and anticlinoriums east and north of the Gataga district (Figure 3). These rocks correlate with the Windermere Supergroup, a prograding clastic wedge that was deposited along the continental margin of ancestral North America in Late Proterozoic time. Coarse grit units within this sequence may have acted as important aquifers in the formation of both sediment and carbonate hosted zinc-lead-silver deposits (Lydon *et al.*, 1986).

EARLY TO LATE CAMBRIAN - GOG GROUP

In the northern half of the Gataga District, Early to Late Cambrian quartzite and massive limestone are exposed in a series of northwest-trending thrust plates (Fritz, 1979). These rocks are part of a chain of carbonate buildups that extends southward toward the Akie River area. These carbonate buildups were bounded by inner shelf and outer shelf clastic facies rocks to the east and west respectively. Fritz (1979) suggests these rocks are correlative with the Gog Group of the southern Rocky Mountains.

Table 1. Table of formations for the Akie River area.

Period or Epoch	Group	Formation	Map symbol	Lithology	Depositional Environment
Triassic			Ts	dolomitic siltstone minor limestone, dolostone	shallow water turbidite; regressive
				disconformable?	
Mississippian - Permian			MP	chert	starved basin
				conformable	
U. Devonian-Mississippian	Earn	Warneford	DMw	quartzose wacke, chert pebble conglomerate	proximal to distal turbidites; western source area
		Akie	DMA	brown weathering silty shale; minor siltstone	open marine, distal turbidite; transgressive
Middle-Upper Devonian		Gunsteel	DG	blue grey-weathering chert, cherty mudstone, argillite, shale; nodular and bedded barite +/- sulphide; minor pelagic limestone	starved basin, minor turbidite, local slump breccia
				conformable to unconformable	
Lower-Middle Devonian		Akie and Pesika reefs	DI/DC	medium to thick-bedded micritic and bioclastic limestone banks and reefs; minor shaly argillite, chert	shallow water, carbonate build-up regressive
				unconformable?	
Lower Devonian	Road River	Paul River	DRs	rusty-weathering black silty shale limy siltstone	distal turbidite slope and shelf facies; transgressive
				limestone debris flow, crinoidal siltstone, calcarenite, graptolitic black shale (Pragian)	slope to shelf turbidites, reef front breccia; transgressive
				quartzose conglomerate wacke, siltstone	shallow water, high energy
Silurian-Lower Devonian				black chert	starved basin
				unconformable	
Middle-Late Silurian	Road River		SR	brown to buff weathering dolomitic siltstone; platy, flaser-bedded minor quartz wacke, limestone olistostromes	shallow marine regressive
				unconformable	
Lower Silurian	Road River		SR	dolostone, dolomitic mudstone, black chert, argillite minor quartz wacke	shallow marine starved basin; transgressive
				unconformable	
Middle-Upper Ordovician	Road River		ORs	black graptolitic shale minor black chert siltstone	open marine distal turbidites; transgressive
			ORq	quartz wacke, pebble conglomerate, siltstone	proximal turbidite shallow water
		Ospika volcanics	ORv	orange-weathering ankeritic tuff, altered flows or sills	rift related volcanics
Lower-Middle Ordovician			ORc	platy, laminated buff to cream, limy siltstone, mudstone; limestone debris flow near base	shallow marine
Lower - Upper Ordovician		Skoki limestone	OSk	medium to thin-bedded dolostone, limestone; limy mudstone; crinoidal	shallow water shelf
				unconformable	
U. Cambrian - L. Ordovician	Kechika		ЄOK	nodular wavy banded phyllitic siltstone, limestone, shale, minor green tuff	shallow marine basin or inner shelf
				unconformable	
Cambrian	Gog		mЄc	med. to thick bedded limestone reef	shallow water reef
				quartz arenite and wacke	shallow water, near shore
				unconformable	
Hadrynian	Misinchinka		H	phyllite, schist	basin to shelf

Rocks of Early to Late Cambrian age do not crop out in the area covered by this study but are exposed in a chain of prominent limestone peaks immediately to the west. The Cambrian carbonate and quartzite units are believed to underlie the Akie River area and may comprised a relatively ridgid basement upon which Paleozoic strata have been detached and thickened by northeast directed thrusting.

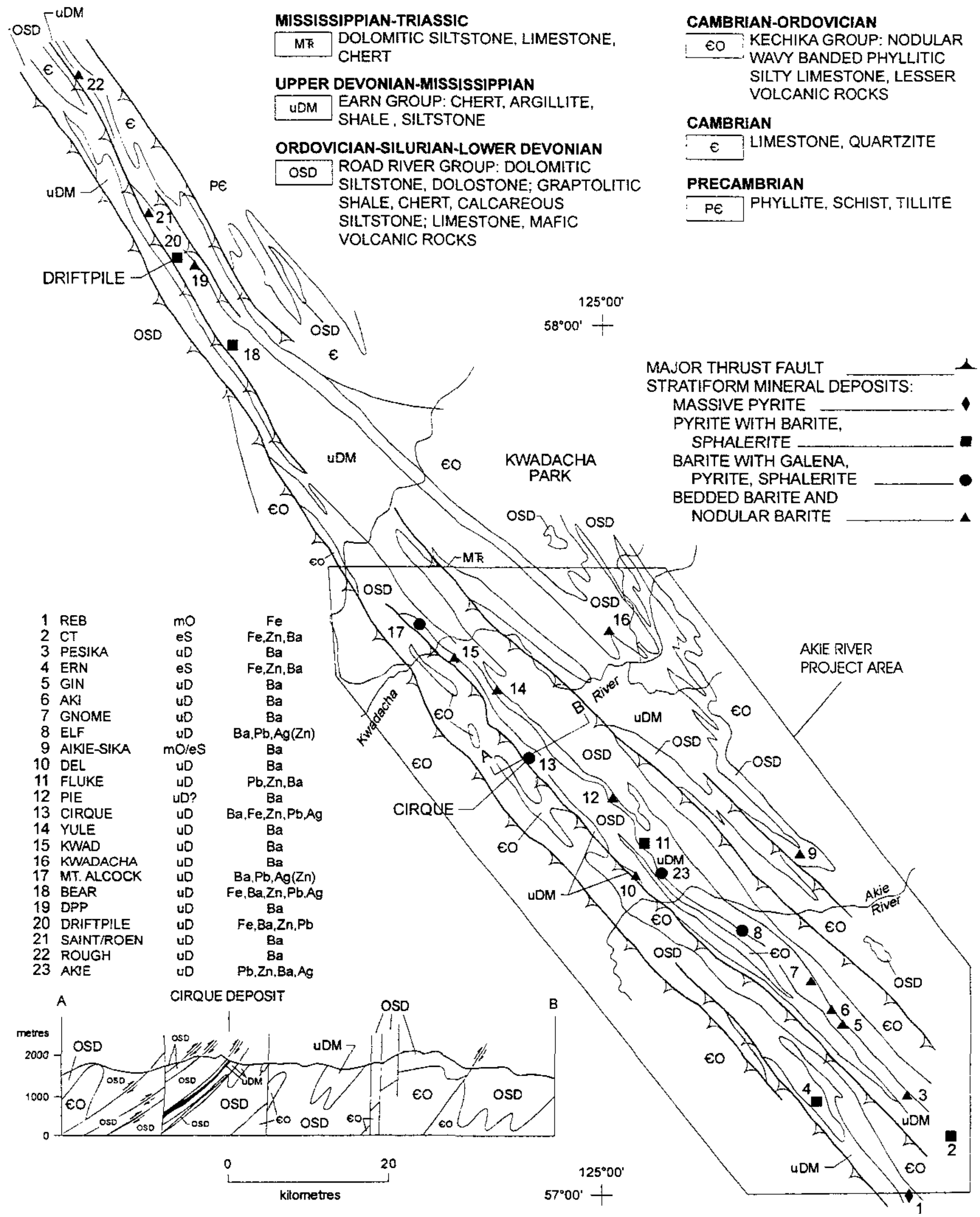


Figure 3. Generalized geology of the Gataga mineral district and location of the Akie River project area, northeast British Columbia.

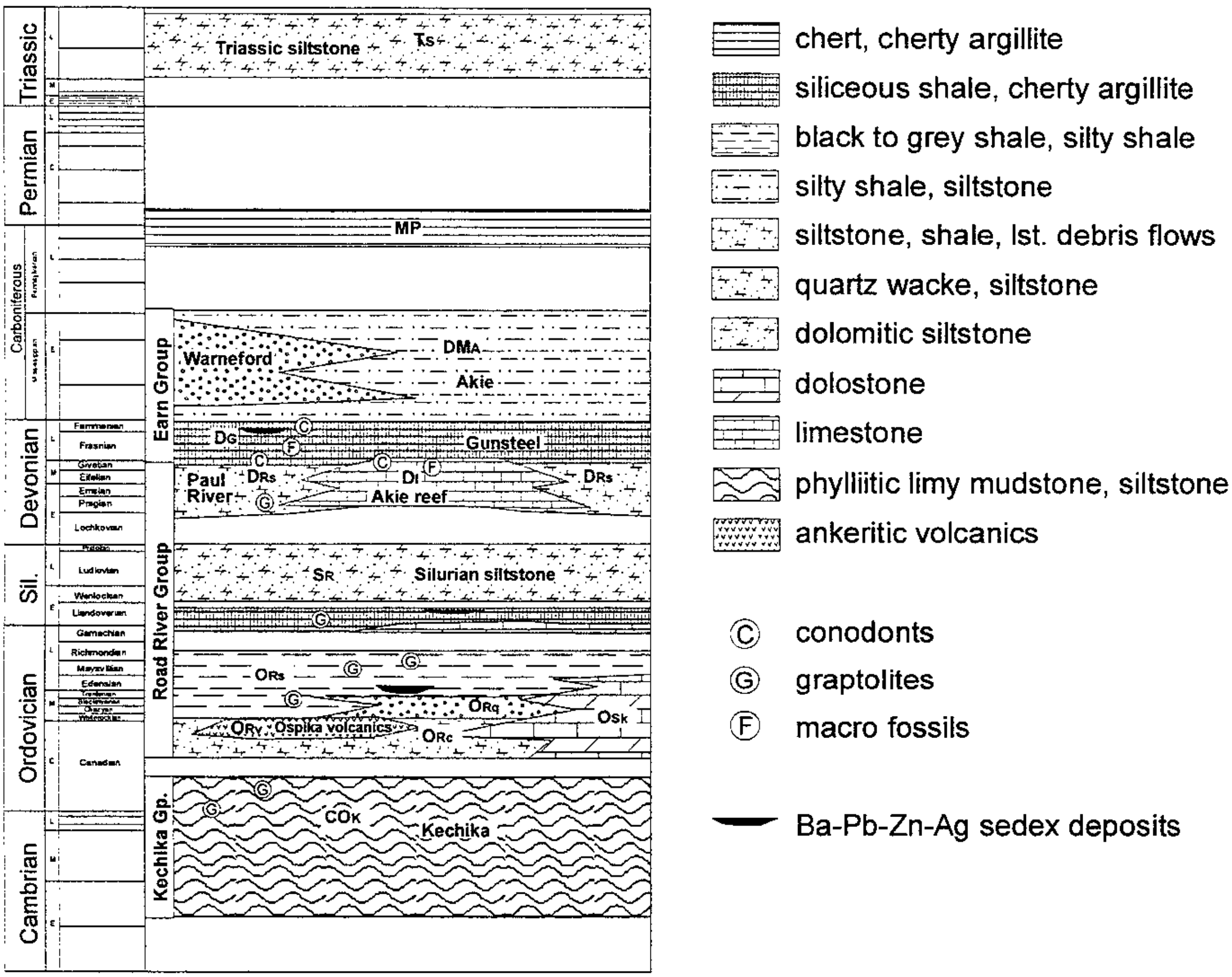


Figure 4. Generalized stratigraphy of the Akie river area of the Gataga mineral district, northeast B.C. See table 1 for detailed description of map unit symbols.

CAMBRIAN TO ORDOVICIAN - KECHIKA GROUP (€OK)

In the southern part of the Gataga district, the Cambrian limestone is overlain by up to 1,500 metres of cream to light grey-weathering, talcy, nodular phyllitic mudstone and wavy banded limestone of the Kechika 'Formation' (Cecile and Norford, 1979). The nodular structures in these rocks are the result of stretching and attenuation of sandy beds within a plastically deformed muddy matrix. Intense stretching and development of penetrative foliation within Kechika rocks relative to overlying and underlying successions may be the result of detachment and sliding of thrust plates along this unit. Much of this deformation is believed to be related to uplift of the Rocky Mountains in Tertiary time with northeast directed compression producing a series of stacked thrust plates. Kechika rocks, which range in age from latest Cambrian to late Early Ordovician, are well-exposed at the base of several large thrust plates. Lithologically similar rocks are absent or very thin in the northern part of the district, where, Ordovician shales directly overlie Cambrian limestone and quartzite (MacIntyre, 1983).

Several thin beds of greenish weathering tuff were noted in the sections of nodular phyllitic mudstone, particularly north of the Akie River. These tuff beds, which are rarely more than one metre in thickness, are evidence for volcanic activity during the late Cambrian to early Ordovician time period.

EARLY TO LATE ORDOVICIAN - SKOKI LIMESTONE (OSk)

The thickest sections of Ordovician limestone occur in the Pesika Creek area and northeast of the Kwadacha

River. Here, sections up to 500 metres thick of thin-bedded limestone occupy the same stratigraphic position as much thinner sections of limy siltstones and limestone debris flows elsewhere in the district. Both Jackson *et al.* (1965) and Davies (1966) concluded these limestones lie below the *Paraglossograptus etheridgei* graptolite zone, which is earliest Middle Ordovician. Lithologically similar rocks are very thin or absent in the northern part of the Gataga district where graptolitic shales and platy siltstones directly overlie Cambrian limestone.

ORDOVICIAN TO EARLY DEVONIAN - ROAD RIVER GROUP

In the southern part of the district, Kechika rocks are unconformably overlain by a succession of calcareous siltstone, shale, limestone, and volcanic rocks which have previously been assigned to the Road River Formation (Taylor *et al.*, 1979; Cecile and Norford, 1979). In this bulletin all rocks overlying the Cambrian to Ordovician Kechika Group and underlying the Middle to Late Devonian Earn Group (black clastics) are considered part of the Road River Group following the informal usage of Gordey *et al.* (1982). Road River rocks reflect the establishment of an abrupt, well defined basin-platform transition zone along the eastern margin of the Kechika Trough that persisted from Early Ordovician to Late Devonian time (Cecile and Norford, 1979). Clastic sediments were apparently deposited in the trough by turbidity currents moving down relatively steep westward-dipping paleoslopes.

EARLY - MIDDLE ORDOVICIAN - CALCAREOUS SILTSTONE (ORc)

The stratigraphy of the Road River Group in the Ware map-area has been described by Cecile and Norford (1979). In the Akie River area, the Ordovician part of the group includes a lower unit of cream, beige, and reddish brown-weathering, laminated calcareous siltstone and shale (ORc) with intercalated limestone turbidites and debris flows. Cecile and Norford (1979) suggested that the latter are derived from the platformal Skoki limestone (OSk) which crops out along the eastern and southern margins of the district.

MIDDLE TO LATE ORDOVICIAN - BLACK SHALE AND CHERT (ORs)

Thin-bedded calcareous siltstones of the lower Road River Group grade up section into a distinctive unit of black shale (ORs) that contains abundant Middle to Late Ordovician graptolite fauna. These fauna are part of the Caradoc and/or Ashgill series of the late Middle and early Late Ordovician (Appendix B). Graptolites proved to be a very useful tool for distinguishing Ordovician black shales from lithologically identical Devonian rocks. The Devonian graptolite faunas are sufficiently distinctive from the Silurian and Ordovician fauna to allow identification in the field.

Black chert horizons are locally interbedded with the shales particularly in the vicinity of the REB massive pyrite lense. The black shales onlap platformal carbonates to the south and east and are evidence of a major marine transgression that took place in Mid to Late Ordovician time. The base of the black shale unit is probably diachronous, younging eastward.

Gabrielse (1981) has suggested that the black shale unit has been removed by pre-Silurian erosion in the area southwest of the Gataga district because Kechika or basal Road River rocks there are directly overlain by Silurian siltstone. This data suggests that a shallow water shelf or platform was located along the west side of the Kechika Trough, and sediments in it were periodically exposed and eroded during marine regressions prior to early Silurian time.

MIDDLE ORDOVICIAN - QUARTZOSE WACKE AND SILTSTONE (ORq)

Along the eastern edge of the Kechika Trough, graded and cross-laminated beds of quartz wacke, arenite and pebble conglomerate occur locally within the black shale unit. These quartzose tubidites (ORq) which vary considerably in thickness and grain size, appear to have been deposited as submarine fans along the western margin of the MacDonald Platform. The quartz detritus may have been derived by erosion of Cambrian or older quartzites that were exposed east of the platform in Mid Ordovician time. Black shales interbedded and overlying the quartz wacke beds contain late Middle to Late Ordovician graptolite assemblages (Appendix B). The lowest quartz sandstone members are within the *Climacograptus bicornis* graptolite Zone, while upper members are within the *Orthograptus truncatus intermedius* and *Dicellograptus complanatus ornatus* Zones

MIDDLE ORDOVICIAN - OSPIKA VOLCANICS (ORv)

In the Akie River area, a northwest-trending belt of mid Ordovician volcanics extends from the Paul River to the Ospika River and beyond. The volcanics occur as discontinuous lenses and beds of green mafic flows or microdioritic sills and orange-weathering ankeritic crystal and lapilli tuffs (ORv). They are interbedded with both the late Early to early Middle Ordovician black shale facies and time equivalent platformal carbonates. Whole rock analyses, CIPW norms and sample locations are presented in Appendix C. The data is plotted using a variety of scatter and ternary plots in Figure 7. The Ordovician volcanic rocks are characterized by low SiO_2 and high CaO values. These abundances reflect the presence of pervasive ankerite alteration.

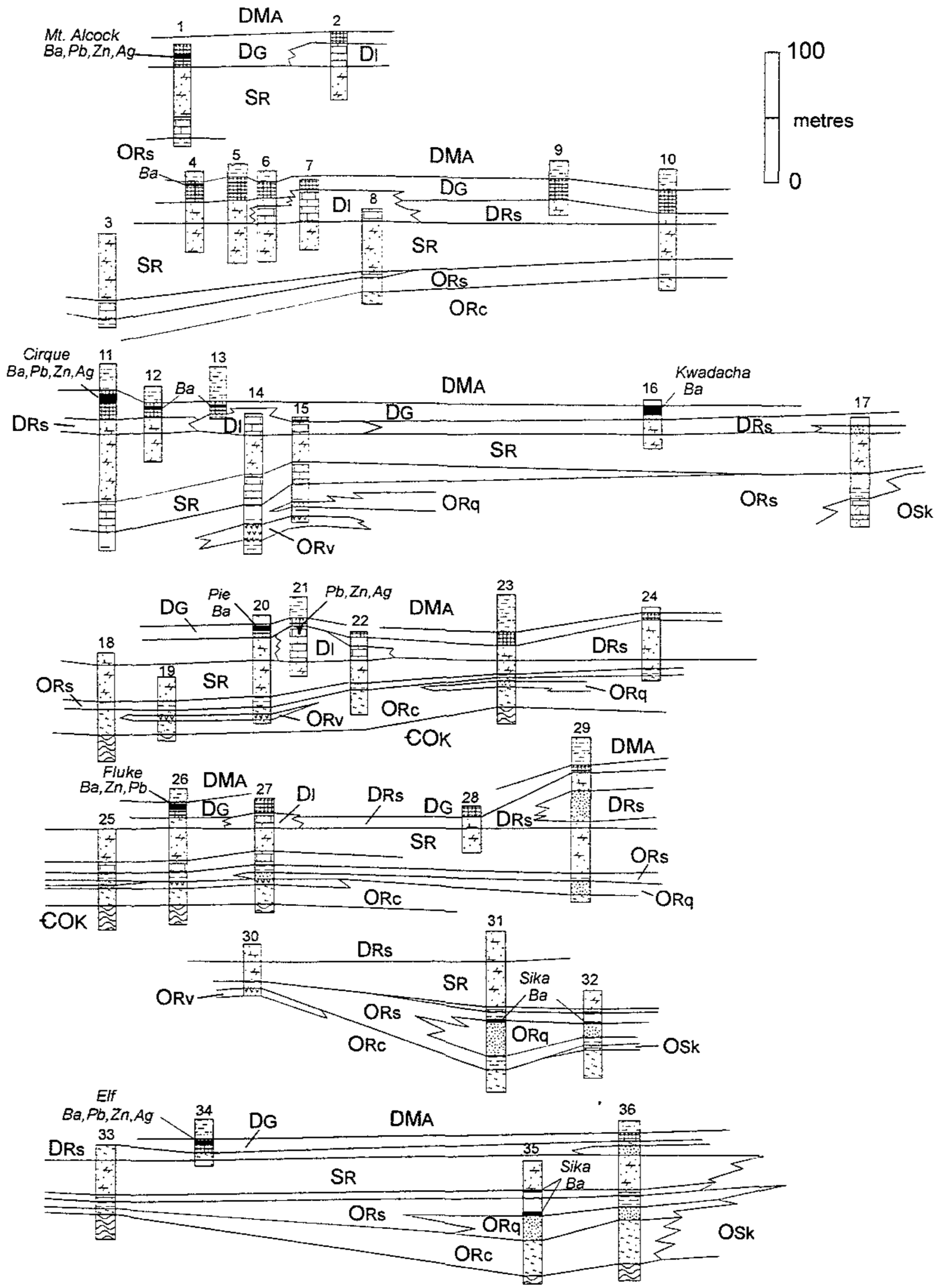


Figure 5. Stratigraphic columns in the Akie river area showing facies changes across the district. See Figure 4 for explanation of symbols and patterns. Location of columns and section lines is shown in Figure 6.

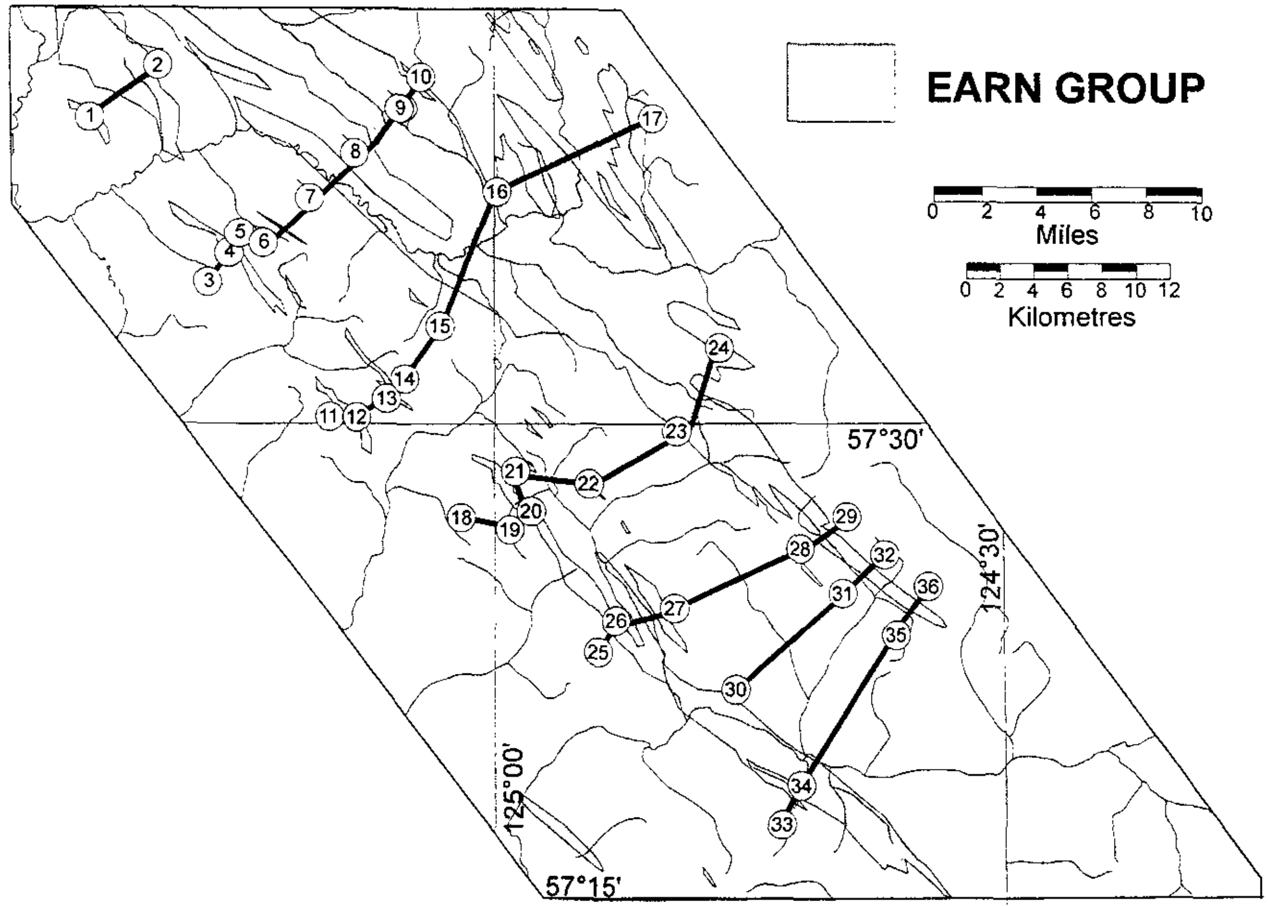


Figure 6. Location of the stratigraphic columns and section lines shown in Figure 5.

There is significant scatter on the AFM and alkali-silica plots and this is probably due to the effects of alteration on these elements. Where trace element data is available the rocks plot in the within-plate basalt field and are light rare earth enriched i.e. they do not have a MORB signature (Figure 7). This is consistent with their tectonic setting which suggests volcanism was related to rifting.

The areal extent of Middle Ordovician submarine volcanic rocks parallels the central axis of the Kechika Trough. The composition and linear distribution of these rocks suggests they were erupted along rifts bounding the sedimentary troughs.

EARLY - MID SILURIAN LIMESTONE, CHERT, QUARTZ WACKE AND DOLOMITIC SILTSTONE (SR)

Orodovician black shales are overlain by Early to Middle Silurian marine sedimentary rocks that are also included in the Road River Group. The basal part of the Silurian section, which ranges from 0 to 20 metres thick, consists mainly of thin-bedded to cross-laminated limestone and dolostone beds. Interbedded with these rocks and overlying black chert, laminated grey calcarenite and dark grey dolomitic shale are 1 to 2 metre thick limestone and dolostone debris flows. Orange-grey weathering quartz wacke and quartz arenite beds also occur within this unit and typically overlie or are interfingered with the basal limestone beds. These quartz-rich beds are only found along the eastern margin of the trough and appear to thicken eastward toward the MacDonald platform. By contrast, limestone and dolostone beds predominate within the trough.

The basal Silurian limestone unit is overlain by tan to orange-brown weathering dolomitic siltstone with varying proportions of orange-weathering limestone and dolostone interbeds. This unit varies from 100 to 500 metres in thickness. Immediately above the basal limestone member, the siltstone is thin-bedded, platy to shaly and recessive; it becomes thicker, more flaser-bedded, and resistant up section. The thick-bedded dolomitic siltstones are strongly bioturbated with numerous worm burrows and feeding trails exposed on bedding planes. Poorly preserved graptolites and sponge impressions are found in platy-weathering siltstone and shale members. Cecile and Norford (1979) documented

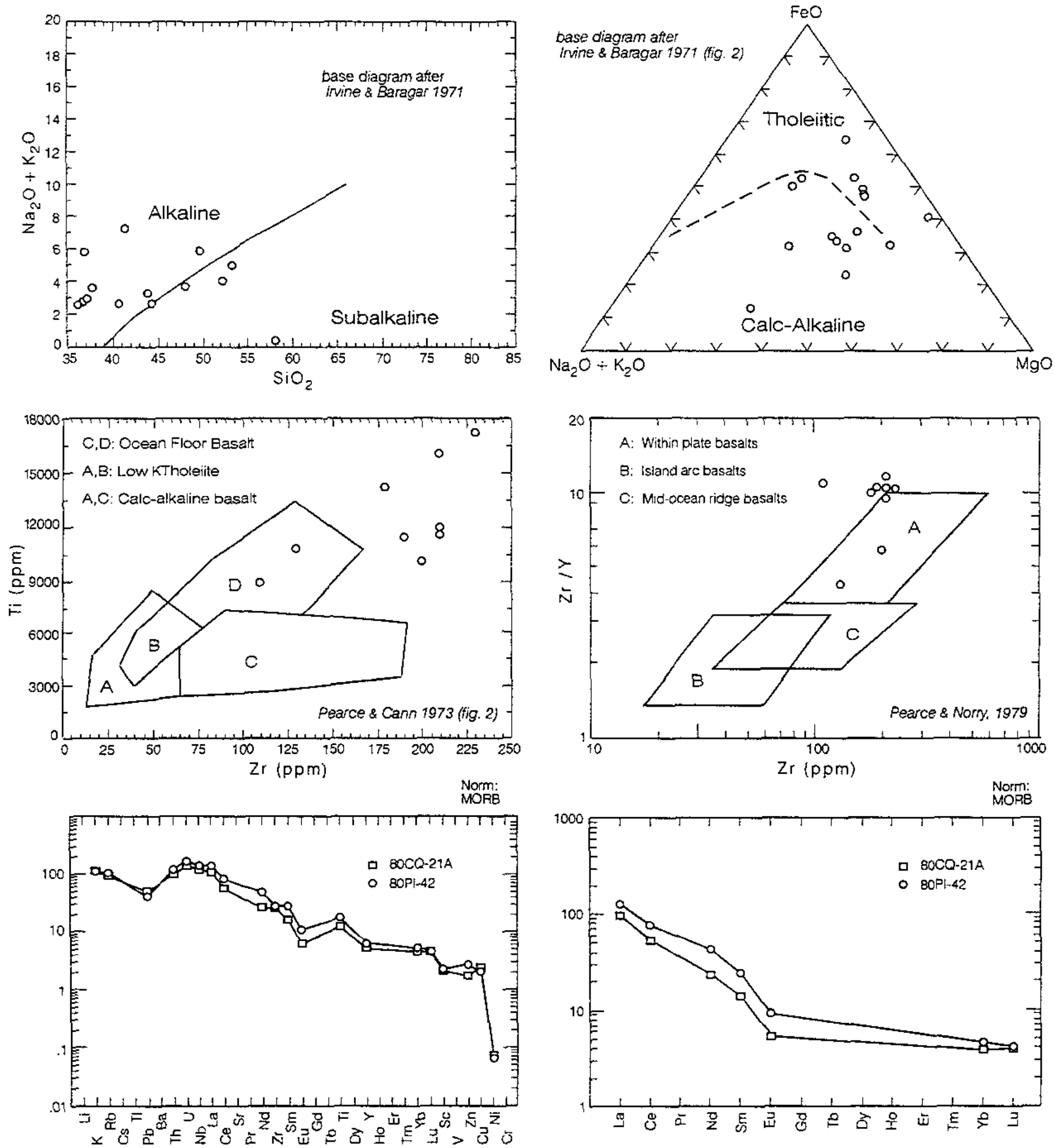


Figure 7. Major oxide and trace element discrimination diagrams for the Ordovician Ospika volcanics. See Appendix C for major oxide analytical data.

an unconformable relationship between the dolomitic siltstone and basal limestone units. The Silurian rocks are separated from underlying Ordovician graptolitic black shales by a sub-Middle Llandovery unconformity (Cecile and Norford, 1979). The basal limestone and overlying cherts and shales were deposited during a short-lived marine transgression that preceded a major regression and infilling of the Kechika Trough with dolomitic detritus derived from the MacDonald platform.

The Silurian siltstone unit is relatively uniform throughout the Kechika trough. In general, it is a dolomitic siltstone with such shallow water features as flaser bedding, worm burrows and feeding trails.

These features, plus the fact that the unit is bounded by major unconformities, even within the deepest parts of the trough, suggests that a major marine regression occurred in Middle Silurian time. this led to extensive erosion of the carbonate platform and partial infilling of the Kechika Trough with reworked dolomitic detritus.

In the Gataga district, Silurian siltstones are disconformably overlain by clastic and carbonate rocks of Devonian age (unit DRs). All of these rocks are included in the Road River Group.

LATE SILURIAN TO EARLY DEVONIAN CHERT, QUARTZ WACKE, SILTSTONE, SHALE AND LIMESTONE DEBRIS FLOWS (DRs)

In the Akie River district, the Silurian siltstone unit is overlain by marine turbidites that are in whole or in part Lower Devonian in age (unit DRs). This unit, informal known as the Paul River formation (Pigage, 1986), includes black chert, interbedded black shale and limestone debris flows, rusty weathering dark grey siltstone to silty shale and, in the eastern part of the district near the platform margin, quartz wacke. All of these rocks are mapped as part of the Road River Group.

The transition from Silurian siltstone to overlying, deeper water turbidites is often marked by a thin unit of platy weathering black chert, cream to tan weathering dolomitic mudstone or siltstone and limestone. Irwin (1990) reports the occurrence of Lochkovian (Early Devonian) conodonts in this unit. In turn, this member is overlain by interbedded dark grey calcareous siltstone and laminated black silty shale that contains Early Devonian graptolites. The cherty argillites and laminated mudstones appear to be restricted to the deeper water parts of the Devonian succession and may be distal equivalents of coarser grained Early Devonian slope facies rocks mapped as unit DRs.

Along the eastern basin to platform transition zone, a resistant unit of grey, thick bedded quartz sandstone and siltstone turbidites up to 200 metres thick, occurs near the base of the Devonian succession (Figure 5). This member, which is mapped as part of the DRs unit, is stratigraphically overlain by interbedded limestone debris flows and black shales. The latter contain Lower Devonian graptolites. The best exposures of quartzose turbidites occur in the North Kwadacha River area, particularly near the crest of Fern Peak. Elsewhere in the study area, particularly to the west, the unit is very thin or absent.

A distinctive unit of interbedded limestone debris flows and graptolitic black shales overlies the basal quartz sandstone-siltstone unit or sits directly on Silurian siltstone. Clasts within the debris flows are subangular to subrounded, 2 to 30 centimetres in diameter, and moderately to well-sorted and graded. Clast size decreases basinward and presumably downslope from the source area. Dr. Brian Norford of the Geological Survey of Canada identified the Pragian age (Early Devonian) graptolite *Monograptus yukonensis* in samples of shale collected from this part of the Devonian section (Appendix B). The limestone turbidites are restricted to two linear belts separated by the shallow water carbonate buildups of the northwest-trending Early to Middle Devonian Kwadacha, Akie and Pesika Reefs. The Early Devonian section is also present as far south as the Ospika river and along the basin to platform transition zone on the east side of the study area. These rocks apparently thin and fine up section and basinward and are interpreted to be slope facies turbidites.

In the Akie River area, a unit consisting of dark grey to brown weathering, recessive, silty shale and siltstone overlies Early Devonian limestone turbidites and shales. In part, these rocks onlap the Early to Middle Devonian carbonate buildups of the Akie and Kwadacha reefs. Bands and laminae of silt and sand characterize this unit. Some of the silty bands are calcareous and weather to an orange to brown colour. This unit appears to be thickest along the western margins of the Akie and Kwadacha reefs; it rapidly thins and fines basinward. This unit is very thin or absent in the thrust panel containing the Cirque deposit. Pigage (1986) and Jefferson *et al.*, (1982) included these rocks with the black shales of the Akie formation. In this study, these rocks are mapped as the Paul River formation (unit DRs) of the Road River Group; the Akie formation is restricted to silty shales of Late Devonian to Mississippian age.

Five to ten centimetre thick beds of orange to green weathering crystal tuff occur sporadically within the Early to Middle Devonian section. These tuff beds increase in thickness and number toward the southwest corner of the map area.

EARLY TO MIDDLE DEVONIAN - CARBONATE REEFS (DI)

Thick carbonate buildups of the Akie, Kwadacha and Pesika Reefs, which apparently range in age from late Early to late Middle Devonian (Gabrielse, 1975), disconformably overlie the Silurian siltstone unit. Early Devonian limestone turbidites and shales are absent below the thickest parts of the reefs, suggesting that these areas were topographic highs where the Early Devonian strata were either eroded away or never deposited. Beneath the reefs, the upper part of the Silurian section is often red to pink-weathering, suggesting possible exposure and oxidation prior to the main episode of marine transgression and carbonate deposition.

The Akie and Kwadacha Reefs are up to 200 metres thick along their western margins and apparently thin gradually to the north and east. The reefs are mainly

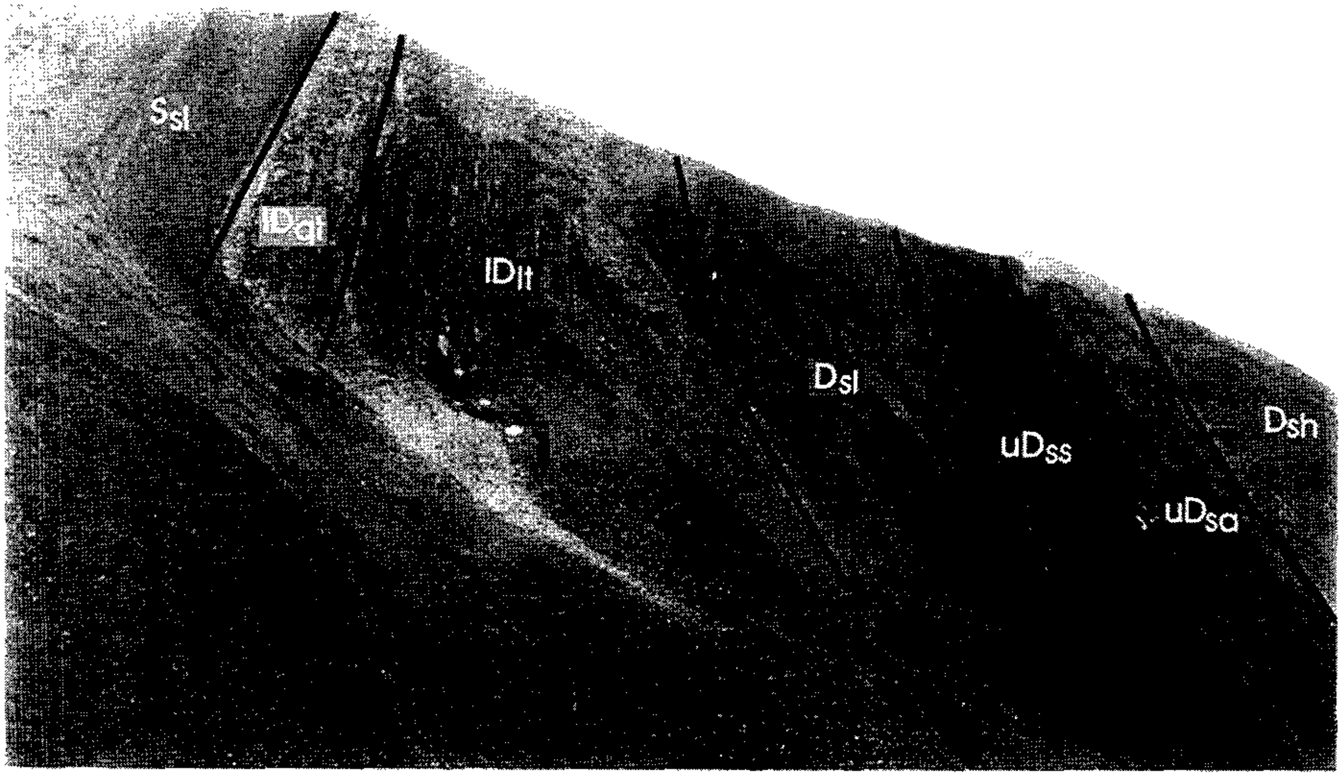


Plate1. View south toward a well-exposed, slightly overturned section of Silurian to Upper Devonian strata. Section is located close to the basin to platform transition (No. 24, Figure 6). Ssl=Silurian siltstone; lDqt=Lower Devonian quartz wacke turbidites; lDlt=Lower Devonian limestone debris flows and black graptolitic shale; Dsl=Lower-Middle Devonian siltstone; uDss=Middle-Upper Devonian black silty shale; uDsa=Upper Devonian Gunsteel Formation; Dsh=Upper Devonian-Mississippian Akie Formation

composed of medium to thick-bedded micritic and bioclastic limestone with occasional thin bedded shaly and argillaceous intervals. Locally, the reefs are very fossiliferous with crinoid, coral and stromatoporoid-rich zones. Beds rich in 'two hole' crinoid ossicles typically occur near the tops of the reefs. The presence of crinoid ossicles with twin axial canals indicates a probable late Early to early Middle Devonian age (Cecile, personal communication, 1981).

Although the age of the reefs in the Kechika Trough is generally accepted to range from late Early to late Middle Devonian (Gabrielse, 1975), a sample collected from near the top of the Pesika reef, just west of the ERN showing contained the early Frasnian conodont faunas *Ancryodella rotundiloba* (Bryant) and *Polygnathus* sp. (locality C-102892, Figure 8). This suggests that reef growth, in some areas, extended into the early Late Devonian.

In the Pesika Creek area, thick-bedded reef limestones overlie Early Devonian graptolitic shales and limestone debris flows of Early Devonian age. This stratigraphic relationship suggests that reef growth and carbonate buildup advanced basinward during Middle Devonian time.

Gabrielse (1981) described pebble conglomerates directly overlying Middle Devonian limestone of the Akie Reef near its eastern limit. These coarse clastic rocks were probably deposited along a shoreline bounding a northwest-trending landmass that was exposed during this time period. This unconformity does not appear to extend into adjacent troughs where clastic sedimentation appears to have been continuous for most of the Devonian.

MIDDLE DEVONIAN TO MISSISSIPPIAN - EARN GROUP

Blue grey weathering shale, siliceous carbonaceous shale, cherty argillite, porcellanite and coarse quartzose turbidites ranging from Middle Devonian to Mississippian in age overlie rocks of the Road River group. These rocks are similar in age and lithology to the Earn Group as defined by Campbell (1967) and as used by Gordey *et al.*,(1982) in Selwyn Basin. In this study, and in part following the usage of other workers in the area (Pigage, 1986), the Earn Group is subdivided into three informal formations - the Gunsteel, Akie, and Warneford.

The Earn Group was deposited during a major marine transgression that terminated reef growth and

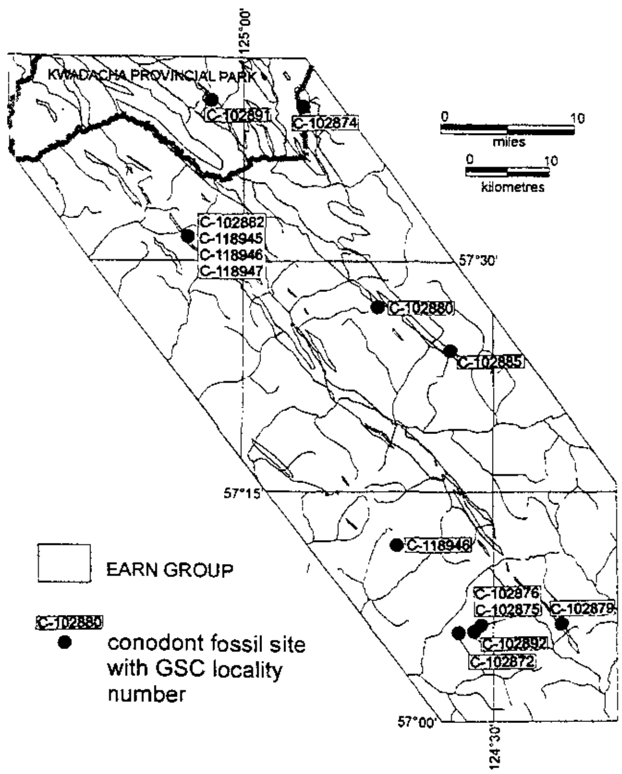


Figure 8. Conodont fossil localities in the Akie River area. See Appendix B for fossil descriptions.

resulted in progressive onlapping of fine clastic sediments onto the MacDonald platform. These relationships suggest that the base of the Earn Group is diachronous, younging progressively to the east.

MIDDLE TO LATE DEVONIAN - GUNSTEEL FORMATION (DG)

In the Akie River district, a distinctive unit of bluish grey-weathering, rhythmically bedded cherty argillite and siliceous carbonaceous shale, that is informally called the Gunsteel formation (DG), overlies Early to Middle Devonian siltstone and silty shale. The Gunsteel rocks also onlap and, in part, are interbedded with the Early to Middle Devonian carbonate buildups of the Akie, Kwadacha and Pesika Reefs. The Gunsteel formation is of similar lithology and age to rocks assigned to the lower Earn Group by Gordey *et al.* (1982) in the Selwyn Basin. These Earn Group rocks are of particular importance; they host major stratiform barite-sulphide deposits both in the Selwyn Basin and in the Kechika Trough.

The siliceous Gunsteel rocks vary from less than 20 metres thick near the margins of the shale basin, where they onlap reef limestones, to several hundred metres thick in adjacent troughs. They are resistant and typically blocky to slabby-weathering. The unit is comprised of medium to thin beds of banded black chert or porcellanite, cherty argillite, laminated siliceous silty shale, black siltstone, and black carbonaceous shale.

Thin beds of grey siltstone, dark grey fetid limestone and bioclastic limestone debris flows that contain clasts with two hole crinoid ossicles occur locally, particularly near the interbasin reefs. These debris flows are probably derived from crinoid-rich beds that occur near the tops of the reefs, suggesting that Gunsteel rocks are, in part, basinal correlatives of the reefs. Orchard of the Geological Survey of Canada has identified late Middle to earliest Late Devonian (late Givetian-early Frasnian) conodont fauna both in crinoidal limestone beds within the Gunsteel section and from crinoid rich beds within the reefs, further supporting this correlation (Figure 8; Appendix B).

Barite beds stratigraphically below the Cirque deposit contain the ammonoid *Ponticeras* (Jefferson *et al.*, 1983), an index fossil for the earliest Late Devonian (Frasnian). A limestone bed in the footwall sequence of the Kwadacha barite deposit contained a conodont fauna of similar age (C-102891, Figure 8). These data provide further evidence for a late Mid to early Late Devonian age range for Gunsteel rocks and their contained barite-sulphide deposits.

Soft sediment slump structures are common in Gunsteel rocks and intraformational breccias occur locally. These deposits suggest growth faults may have been active during deposition of the Gunsteel rocks.

Laminae of pyrite and nodular barite are typically present in black cherty mudstone beds near the top of the Gunsteel formation. These beds are present regionally and are at the the same stratigraphic position as barite-sulphide deposits in the district. They are a useful tool for delineating favourable stratigraphy for barite-sulphide deposits.

LATE DEVONIAN TO MISSISSIPPIAN - AKIE FORMATION (DMA)

Gunsteel rocks are conformably overlain by recessive, thick bedded, non-siliceous, rusty brown to tan weathering, medium grey aluminous shales of probable Late Devonian to Mississippian age. These rocks comprise the informal Akie formation as first defined by Jefferson *et al.*, (1983). The Akie formation correlates, in part, with the Besa River formation (Kidd, 1963;·Pelzer, 1966) of the MacDonald Platform. These formations were deposited during a major, eastward advancing, marine transgression that occurred in Late Devonian to Mississippian time.

The Akie formation shales are difficult to distinguish from older shale members in the district. However, in general they have a phyllitic sheen on cleavage surfaces and show faint colour banding, which is less common in other shale members. Orange weathering calcarenite beds, although rare, are also locally present. The basal part of the Akie formation is

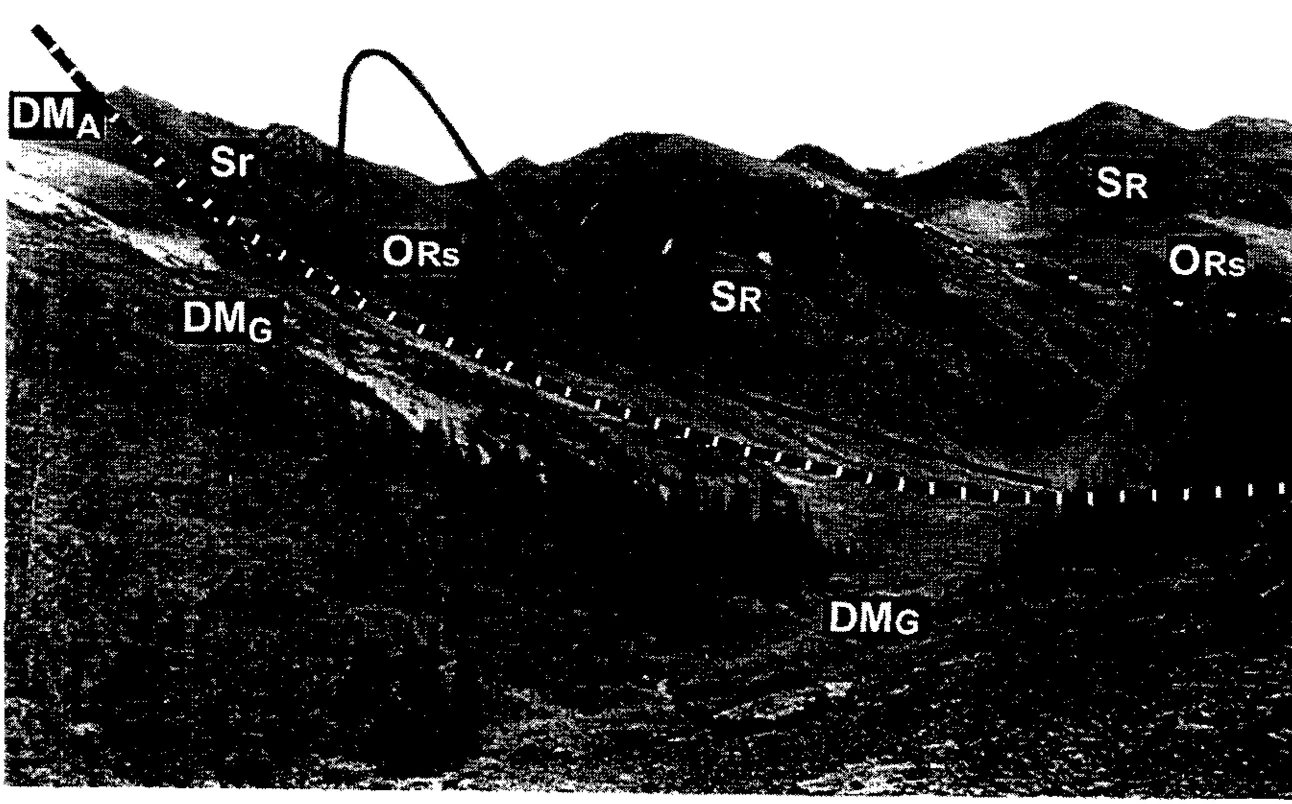


Plate 2. View southeast toward the Cirque deposit showing imbricated and folded thrust panels of Road River Group Ordovician shale (ORs) and Silurian siltstone (SR) structurally overlying the Akie (DMA) and Gusteel (DMG) formations of the Upper Devonian to Mississippian Earn Group. Thrust fault traces are shown as dashed lines; stratigraphic contacts as solid lines.

typically rusty weathering and may contain pyrite laminae and barite nodules.

The only conodont localities within the Akie formation are located east of the Cirque deposit (C-118946, C-118947, Figure 8, Appendix B). Here, a thick section of silty shale overlies cherty argillite of the Gunsteel formation. Two calcarenite beds from the lower part of the Akie formation section were sampled and these yielded *Palmatolepis* sp. *Polygnathus* sp. indet. and *Palmatolepis* sp. indet.. indicating a probable Late Devonian age (late Frasnian-early Fammenian).

LATE DEVONIAN TO MISSISSIPPIAN - WARNEFORD FORMATION (DMw)

Proximal to medial turbidites, characterized by grey-weathering resistant beds of chert pebble conglomerate, quartz wacke and siltstone, interfinger with Late Devonian to Mississippian black shales of the Akie formation in the Warneford River area, northwest of the study area. These quartzose turbidites are informally called the Warneford formation. This formation is thin or absent is the current study area. However, thin quartzose siltstone and wacke beds that occur in the Gunsteel section that hosts the Cirque deposit may be distal equivalents of the Warneford formation (Pigage, 1986).

In the Driftpile Creek area, which is north of the study area (Figure 3), the Warneford formation turbidites are part of a series of submarine fan deposits that thicken and coarsen westward (Carne,1978). This suggests that an actively eroding landmass existed along the western margin of the Kechika trough in Late Devonian to Mississippian time. Gordey (1981) suggested that an extensional or trans-tensional regime was responsible for source area elevation and basin development in the Selwyn Basin at this time and a similar conclusion appears valid for the Kechika Trough.

MISSISSIPPIAN TO TRIASSIC - CHERT AND SILTSTONE (MP, Ts)

The youngest rocks in the Gataga district are the dolomitic siltstones and limestones that occur in the core of a large, northwest-trending synclinorium located northeast of the Kwadacha River. Although these rocks are lithologically similar to the Silurian siltstone unit, they are easily distinguished by the presence of Triassic brachiopods (Gabrielse, 1977).

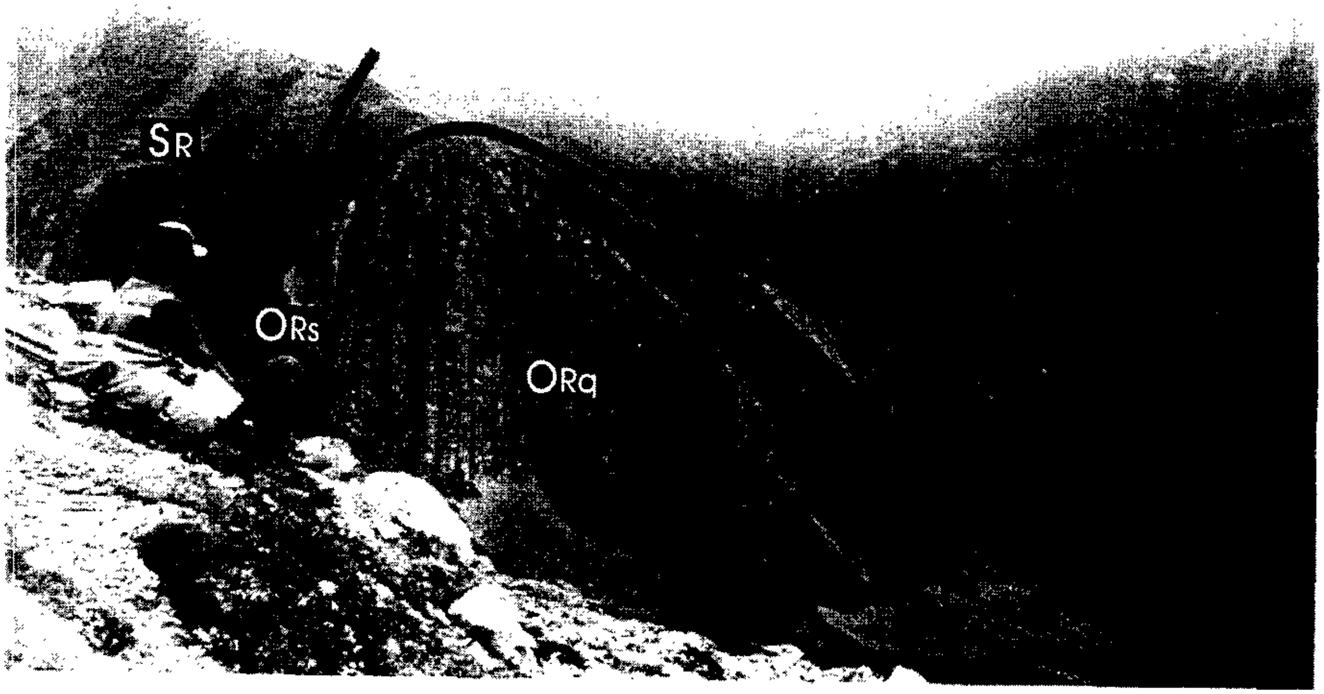


Plate 3. View northeast near the basin to platform transition showing an asymmetric, southwest verging anticline cored by interbedded, Middle Ordovician quartz wacke and black shale (ORq) of the Road River Group. Quartz wackes are overlain by Middle to Upper Ordovician black shale (ORs) and Silurian siltstone (SR). Bedded barite occurs at the ORs - ORq contact.

Two collections from this unit, both from exposures on Mount Holben, where sent to E.T. Tozer of the Geological Survey of Canada for identification. Sample 79AL24 contained the Carnian to Lower or Middle Norian brachiopod *Halobia* and sample 79AL28A contained the Late Norian brachiopod *Monotis* (Tr 4 1980 ETT, Appendix B).

The Late Triassic rocks are separated from underlying Devono-Mississippian strata by a 10 to 20-metre-thick layer of light coloured, chalcedonic chert (unit MP) that may correlate with either the Mississippian Prophet Formation or the Permian Fantasque Formation that occur in the MacDonald Platform, east of the study area.

STRUCTURE

The linear nature of the geology of the Akie River area reflects the "thin-skinned" tectonic style of the Rocky Mountain Fold and Thrust Belt. Northeast-directed compression resulted in detachment of the Paleozoic strata from a rigid crystalline basement and partial stacking of the detached plates along a series of imbricate thrust faults (Plate 2). The thrust plates, which are composed of relatively incompetent basinal facies rocks, have been internally folded during thrusting (Figure 3A, in pocket). In general, incompetent strata below overriding thrust plates have tight isoclinal folds with southwest-dipping axial planes whereas rocks in the overriding plate are asymmetrically folded and often have northeast-dipping axial planes. This style of folding may be related to the development of inversion structures similar to those described by McClay *et al.*, (1989) in the Driftpile Creek area.

The structural style changes from west to east across the map area. In the west, imbricate, southwest dipping reverse faults bound asymmetric overturned folds with southwest dipping to vertical axial planes. To the east, large scale upright folds occur within major synclinoriums that are bounded by outward dipping reverse faults that truncate folds within overriding anticlinoriums (Figure 3A, in pocket). Devonian strata are preserved within the synclinoriums. This structural style suggests that high angle growth faults bounding depositional troughs in Devono-Mississippian time were reactivated during Tertiary compression and became the locus of major thrust faults in the district. That major high angle thrust faults may be localized along much older crustal breaks is also suggested by close spatial association of Paleozoic mineralization, reef building, coarse clastic fans and volcanism to such faults.

Pigage (1986) attempted an estimate of the degree of crustal shortening in the vicinity of the Cirque deposit using Thompson's (1981) ratio of 0.6 between deformed and undeformed lengths in other parts of the Northern Rocky Mountains. Using this ratio Pigage concluded that the belt of Earn Group rocks hosting the Cirque deposit, which is now 4.5 kilometres in width, would have originally been some 7.5 kilometres wide.

Detailed studies of the structure of the Cirque deposit led to the recognition of two coaxial phases of deformation (Pigage, 1986). The earliest deformation, which is recognizable throughout the study area, includes northwest-trending, tight asymmetric folds that verge northeast and have gently dipping southwest limbs and steep to overturned northeast limbs. The steep limbs are often broken and offset by high angle reverse faults, resulting in the juxtaposition of Ordovician and Silurian strata against the Mid to Late Devonian Gunsteel shales. The high angle reverse faults may coalesce at depth into a major detachment surface possibly rooted in the highly attenuated Kechika formation. Shales typically have a pervasive slaty cleavage that is axial planar to the macroscopic folds; a closely-spaced fracture cleavage is found in the more competent strata.

The second phase of deformation folds the early slaty cleavage and develops a penetrative crenulation cleavage. This cleavage is axial planar to the late folds, which may have an amplitude of up to 30 metres (Pigage, 1986). The folds are open to upright, trend northwest and have northeast vergence.

High-angle listric normal and reverse faults are also common in the Akie River area and generally trend parallel or at slight angles to the major high angle thrust faults. These faults are probably related to brittle failure of thrust plates during detachment and thrusting. Displacements of up to several hundred metres have been documented at the Cirque deposit (Pigage, 1986).

North to northeast trending high angle faults offset earlier thrust and listric normal faults. Some of these faults have a strike-slip movement and may be synthetic shears related to an oblique compressional stress regime. This compressional event is believed to be Tertiary.

CHAPTER 3 GEOCHEMISTRY

A total of 443 samples were collected from map units hosting barite-sulphide deposits in the Akie River area. These samples were analyzed for SiO_2, Al_2O_3, Fe_2O_3, K_2O, Ba, Sr, Cu, Pb, Zn, Ag, Mo, Mn, Ni, Co, Hg and organic carbon by the British Columbia Geological Survey Branch analytical laboratory. Sample locations are shown in Figure 3A (in pocket) and Figure 9; analytical results grouped according to lithostratigraphic unit are given in Appendix D. Table 2 is a tabulation of the mean for each of these groups; means and standard deviations are also given in Appendix D.

The purpose of the lithogeochemical study was to try to characterize the geochemical signature of the favourable lithologies on both a regional and deposit specific basis. In particular, it was hoped that the Gunsteel host rocks might show some geochemical variation that could be used as a guide to mineral exploration.

In addition to the analytical work completed as part of the Akie River project, Lowey (1984) completed a Master of Science thesis on the lithogeochemistry and isotopic composition of the Late Devonian Gunsteel and Akie Formation rocks, and Heather (1982) completed a Bachelor of Science thesis on the stratigraphy and geochemistry of the Ordovician barite deposits and their host rocks.

GUNSTEEL FORMATION LITHOGEOCHEMISTRY

Sedimentary exhalative barite-sulphide deposits in the Akie River area occur within cherty argillites and siliceous shales of the Middle to Late Devonian Gunsteel formation of the Earn Group. Lowey (1984) collected 150 samples for chemical analysis from 14 different sections of the Gunsteel Formation (Table 2). Most of these samples were cherty argillites and siliceous shales. The analytical work included analyses for 17 elements. After rigorous statistical evaluation of the data, Lowey concluded that the siliceous rocks of the Gunsteel Formation were deficient in lead, zinc, iron and copper and enriched in barium with respect to the average black shale (Table 2). The statistical analysis for each element revealed many strongly skewed log normal distributions. This type of distribution is indicative of subpopulations within the main group. For such populations Lowey used the median value as the best representative value rather than the arithmetic mean, the former being less sensitive to extreme values.

Cherty argillites and siliceous shales were only enriched in lead and zinc in the immediate footwall of the barite-sulphide deposits. These rocks also had high organic carbon and phosphate contents, perhaps reflecting the proliferation of biological activity in the vicinity of exhalative centers. Also of note was an apparent enrichment in manganese in pelagic limestones proximal to the deposits. Manganese enrichment of shales has been documented in the vicinity of the Meggen, Tynagh and MacArthur River deposits (Finlow-Bates, 1980).

The stratigraphic interval that locally contains bedded barite and barite-sulphide deposits is enriched in barium, carbon and iron on a basin-wide scale. This enrichment is displayed as small sub-spherical nodules or radiating growths of barite, disseminations and laminae of pyrite and the presence of graphite on shear planes. During the course of mapping, the occurrence of nodular barite and pyrite, no matter how minor, was recorded as a possible guide to larger deposits. These occurrences are plotted on Figure 3A (in pocket) together with known showings and anomalous rock and silt geochemical samples. A listing of data for each occurrence is contained in Appendix E.

Lithogeochemical samples were collected at regular intervals from measured stratigraphic sections through the Gunsteel Formation (Lowey, 1984). One of the most complete sections is located along the eastern margin of the Kechika Trough. This section, 80-10, begins with quartz wacke beds at the base of the Devonian and extends up section into the Late Devonian to Mississippian shales of the Akie formation (Plate 1). The analytical data for samples collected from this section are given in Appendix F. Major oxide variations reflect the amount of detrital clay and biogenic silica present in the various rock types. Gunsteel strata are clearly more silica rich and contain less clay than overlying and underlying units. These rocks were clearly deposited in a starved basin environment where sedimentation rates were extremely low.

Lowey (1984) also completed petrographic studies of the samples used in the lithogeochemical study. Of particular concern was the source of silica in the siliceous shales and cherty argillites of the Gunsteel formation. Lowey concluded that the silica was of a non-detrital origin and probably originated from diagenetic and possibly biogenic processes within a starved basin setting. A similar conclusion was reached by Pigage (1986) who suggested diagenetic alteration of siliceous tests, specifically radiolarians, was the process responsible for silicification.

AKIE FORMATION LITHOGEOCHEMISTRY

Samples of shale from the Akie formation were also analyzed by Lowey (1984) and as part of this study (Table 2; Appendix D). These rocks have higher Al_2O_3 and K_2O and lower SiO_2 values than Gunsteel rocks, reflecting the presence of a higher detrital clay

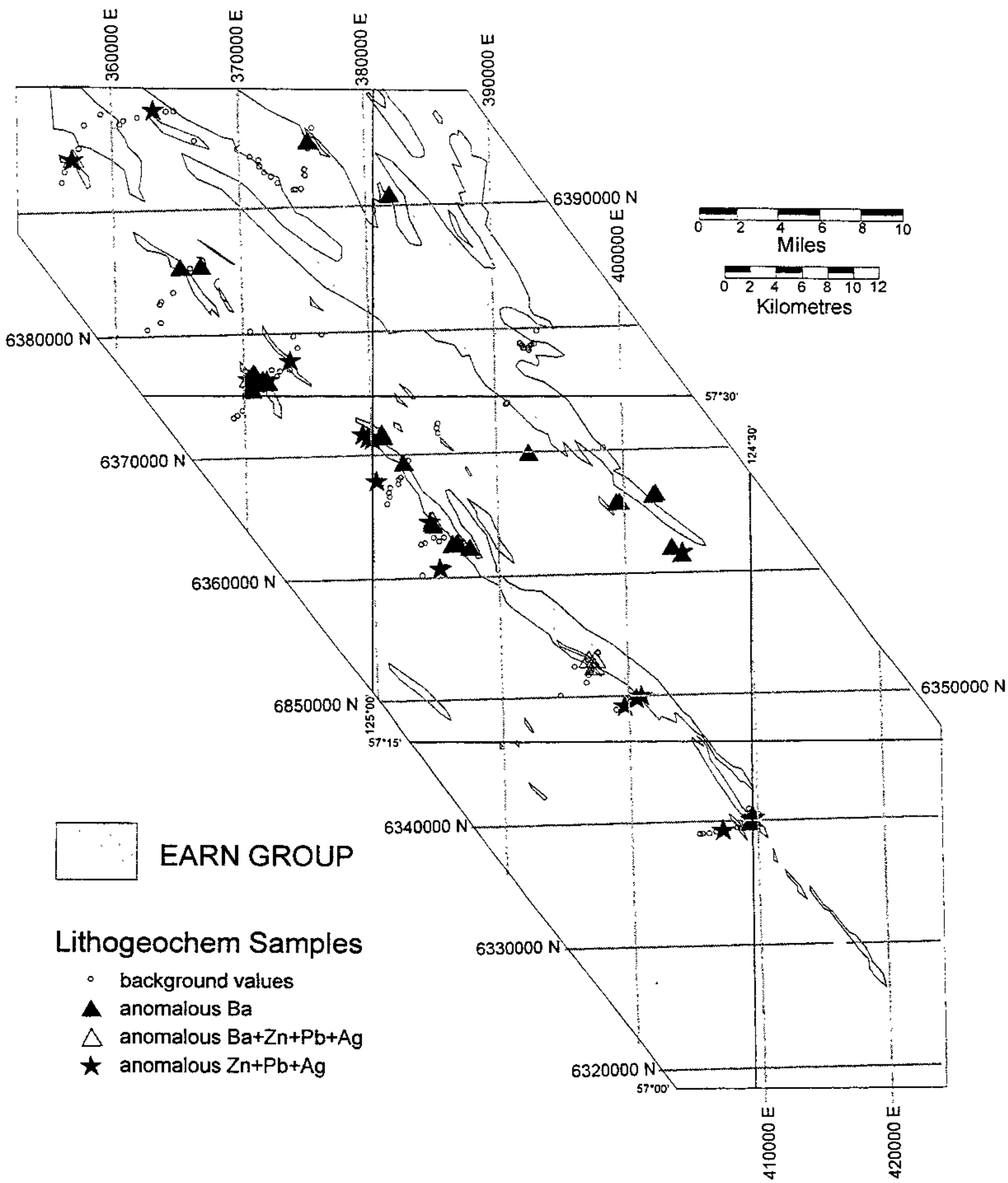


Figure 9. Location of anomalous lithogeochemical samples in the project area.

component. The Akie formation shales have much higher SiO_2 and lower Al_2O_3 than those of typical black shales.

STREAM AND SPRING GEOCHEMISTRY

During the 1979 and 1980 field seasons, Bruce Ballantyne of the Geological Survey of Canada collected samples for geochemical analysis from creeks, lakes and springs in the Akie River area. In particular, silt, water and heavy mineral samples were collected from creeks draining the Mt. Alcock, Cirque and Elf properties. Sample locations and analytical data for the Cirque property are given in Appendix G. The data shows the effects of downstream dispersion on the concentration of metals, with values decreasing rapidly away from the source. The data also shows that geochemical sampling is an effective tool in locating

Table 2. Average chemical composition, Earn Group, Gataga District.

Element	A	B	C	D	E	F	G	H	I	J	K
SiO_2 (wt %)	78.74	77.44	84.72	93.13	86.20	89.90	11.21	11.27	74.78	80.70	53.60
TiO_2 (wt %)	0.31	0.31	0.26	0.14	0.07	0.20	0.06	0.02	0.48	0.16	0.77
Al_2O_3 (wt %)	6.05	6.87	5.64	2.80	3.63	3.70	1.31	0.57	11.30	9.09	15.86
Fe_2O_3 (wt %)	2.10	1.19	1.10	0.65	0.67	1.14	0.50	0.31	1.67	0.88	9.29
K_2O (wt %)	1.28	1.69	1.16	0.50	1.42	0.70	0.32	0.10	2.86	2.49	3.01
P_2O_5 (wt %)	0.24	1.01	0.31	0.02	0.03	0.90	0.13	0.20	0.36	0.03	1.77
Ba (wt %)	3.10	0.46	0.18	0.11	0.24	na	4.15	6.64	0.30	0.38	0.23
Cu (ppm)	30.08	28.82	19.27	16.86	36.00	na	16.75	37.00	19.44	24.00	250.00
Zn (ppm)	103.23	49.27	85.84	32.50	72.00	na	431.25	89.00	129.22	34.00	165.00
Pb (ppm)	62.46	44.00	17.44	18.29	36.00	na	12.75	29.00	23.11	24.00	80.00
Ag (ppm)	1.16	1.7	1.00	1.4	na	na	0.65	na	1.28	na	na
Mn (ppm)	18.08	67.91	15.69	10.43	15.00	na	445.00	570.00	48.16	19.00	6700.00
Hg (ppb)	319.38	85.64	127.87	77.00	na	na	70.67	na	96.64	na	na
As (ppm)	22.58	16.03	11.21	2.40	na	na	8.45	na	8.65	na	na
Org. C (wt %)	na	4.57	3.79	na	3.08	na	0.17	na	3.18	na	na
No.	11	11	45	7	70		4	6	45	10	

A. Gunsteel formation, baritic, siliceous argillite (this study)
B. Gunsteel formation, siliceous black shale (this study)
C. Gunsteel formation, cherty argillite (this study)
D. Gunsteel formation, laminated chert (this study)
E. Gunsteel formation, cherty argillite (Lowey, 1984)
F. Average chert (Wedepohl, 1969)
G. Gunsteel formation, pelagic limestone (this study)
H. Gunsteel formation, pelagic limestone (Lowey, 1984)
I. Akie formation, shale (this study)
J. Akie formation, shale (Lowey, 1984)
K. Average pelagic clay (Meylan *et al.*, 1981)

sedimentary exhalative deposits in this type of terrain, providing sampling frequency is high enough.

Water and precipitates from active springs on the Cirque property were also sampled. Many of these springs are precipitating iron oxide to produce extensive areas of ferricrete. These precipitates typically have moderate to very high zinc and generally low lead values (Appendix G). This suggests that lead is generally immobile under normal groundwater conditions. However some springs did have anomalous lead, zinc and silver concentrations and these may be indicative of anomalous groundwater conditions that have resulted in the extraction and transport of lead from sulphide bodies at depth.

Although iron and zinc appear to be quite mobile, barium on the other hand is notably low in spring precipitates and waters. This is surprising given the abundance of barite in these rocks.

SULFUR ISOTOPES

Lowey (1984) determined sulfur isotope ratios for samples of barite and galena from major deposits in the Gataga district (Table3). The $\delta^{34}S$ values for barite ranged from +24 to +61 per mil while those for galena ranged from +10 to +18 per mil (Figure 11). The galena values are similar to those determined for Middle to Late Devonian sulphides at the Tom deposit in Selwyn basin and the Meggen and Rammelsberg deposits in Germany (Figure 11) but are less than the average value for contemporaneous seawater as determined by

Table 3. Sulphur Isotope Analyses, (Lowey 1984)

Property	Sample Description	$\delta^{34}S_{CD}$ (°/oo)	ΔPbS-$BaSO_4$	Temp (°C)
Mt. Alcock	barite, mineralized zone	+37.5	26.9	250°
	galena,	+10.6		
Yule	laminated barite	+49.0		
Cirque	coarse barite from kill zone	+43.0	25.0	280°
	galena in barite from kill zone	+18.0		
	nodular barite, E. of deposit	+37.9		
	nodular barite, E. of deposit	+50.7		
	nodular barite, E. of deposit	+46.6		
	nodular barite,	+46.6		
Pie	barite	+49.0		
	barite	+33.6		
	galena, no associated barite	+22.1		
Elf	barite, mineralized zone	+36.2	20.4	350°
	galena, mineralized zone	+15.8		
Kwadacha	bedded barite, 10M above base	+47.2		
	bedded barite, 5M above base	+56.6		
	bedded barite, at base	+50.7		
	nodular barite, at base	+24.4		
W. Spur Kwadacha	nodular barite	+61.7		

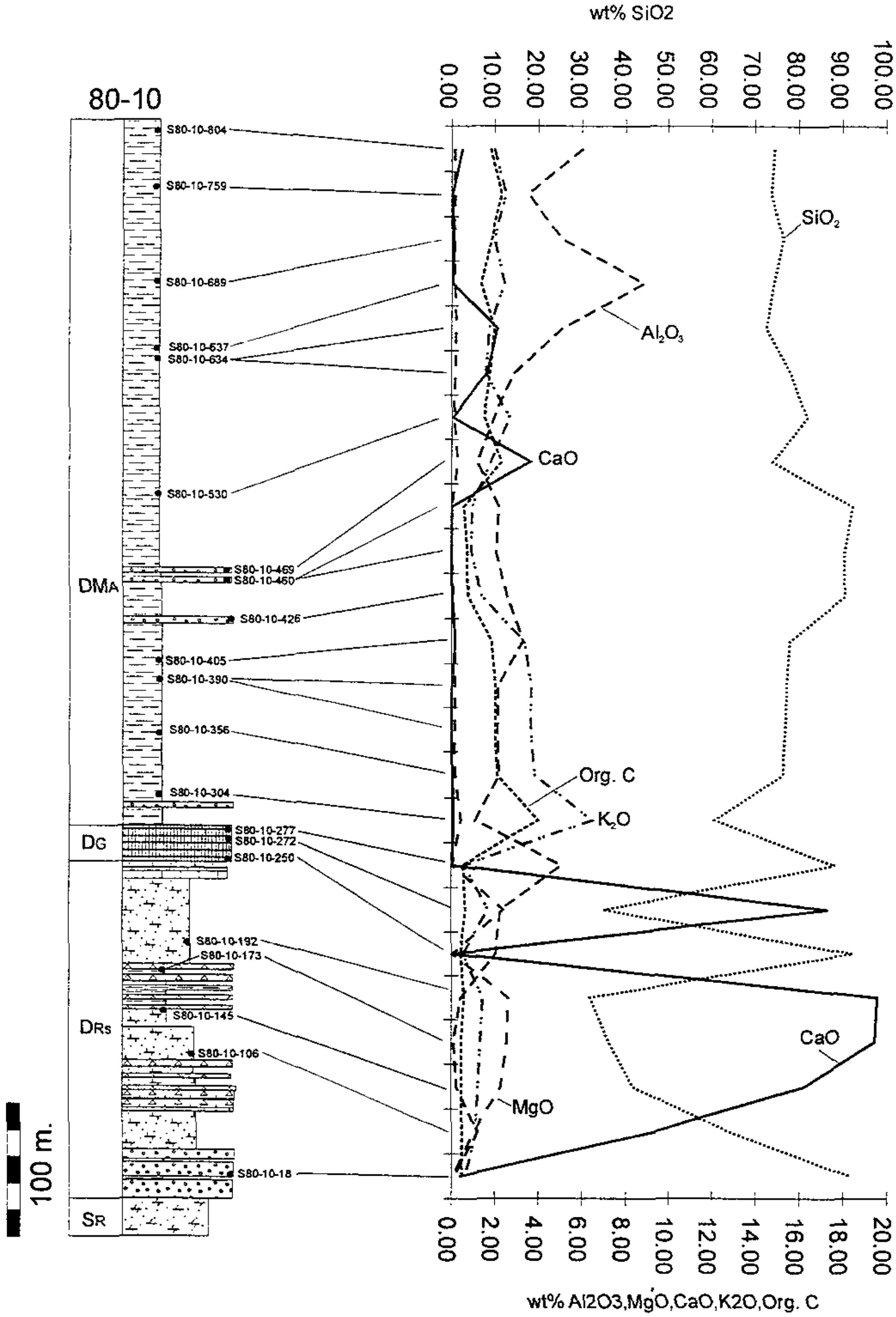


Figure 10. Plot showing variation in major oxide composition up section for measured stratigraphic column 80-10. Analytical data is tabulated in Appendix F. See Table 1 for explanation of map unit symbols.

analysis of evaporites (Figure 12). The $\delta^{34}S$ values for barite are significantly heavier than those determined for Selwyn basin barite (Figure 12) and also for contemporaneous marine sulfate (Claypool *et al.*,1980; Cecile *et al.*, 1983). A trend toward heavier $\delta^{34}S$ values with time was observed at the Kwadacha deposit (Table 3). The data are consistent with precipitation of barite in a very restricted marine basin.

Some of the heaviest $\delta^{34}S$ values obtained by Lowey (1984) were from nodular barite located near the

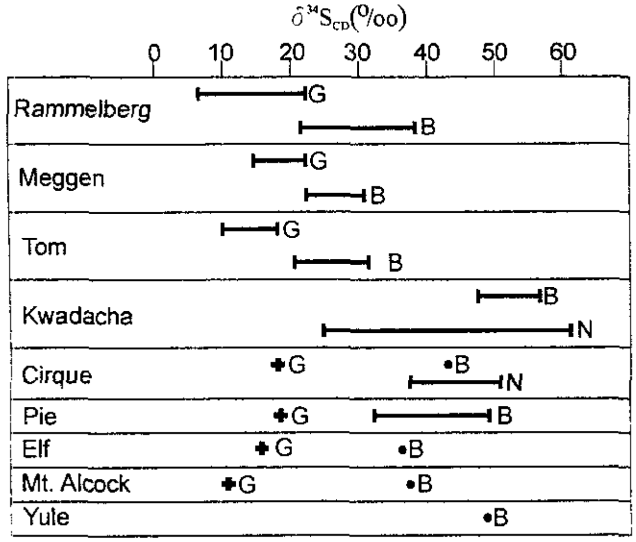


Figure 11. Plot of sulphur isotope values for deposits of the Akie River area. Shown for comparison are values for the Tom deposit in the Yukon and the Meggen and Rammelsberg deposits in Germany. B=barite; N=nodular barite; G=galena; horizontal bars show the range of values for two or more samples

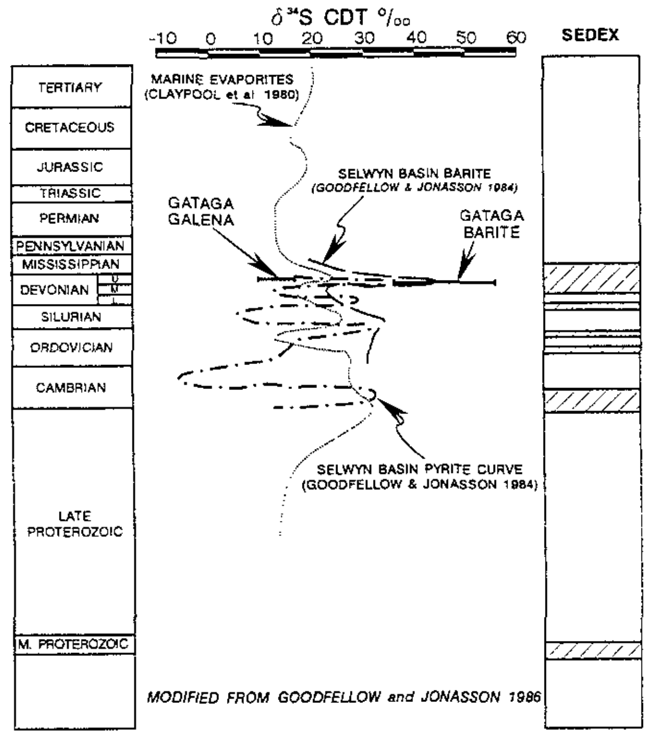


Figure 12. Variation of sulphur isotope values for Selwyn basin and Gataga district barite with time. Also shown is the sulphur isotope trend for contemporaneous marine evaporites as determined by Claypool *et al.*, 1980.

top of the Gunsteel section. This barite, which is probably early diagenetic, precipitated from pore waters. Such waters tend to have very high ^{34}S values because they incorporate lighter ^{32}S isotopes leached from diagenetic pyrite.

Lowey (1984) also graphically determined temperatures of mineral equilibration in the 250°C to 350°C range using barite-galena isotopic fractionation curves. This work also suggested that the degree of isotopic fractionation was inversely proportional to Sr/Ba ratios in barite. These ratios appear to be largely temperature dependent. There is also a corresponding increase in Sr content with increasing temperature.

PB ISOTOPES

Godwin *et al*, (1982) discussed the lead isotopic composition of sedimentary exhalative deposits of the Canadian Cordillera. Their study included samples from the Mt. Alcock, Cirque, Elf, Fluke and Pie deposits (Table 4). The lead isotopic values define well constrained curves that can be used to estimate ages of deposits. The lead isotopic values for contemporaneous carbonate hosted lead-zinc deposits is similar to those of shale hosted deposits implying a common genetic link. Godwin *et al.* (1982) concluded that the lead for these deposit evolved from an upper crustal sedimentary source rich in radiogenic lead.

Table 4. Pb isotope analyses of galena (Godwin *et al.*, 1982)

Property	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$
Mt. Alcock	18.984 (0.09)	15.764 (0.08)	39.561 (0.09)
Cirque	18.795 (0.08)	15.689 (0.08)	39.166 (0.08)
Elf	18.834 (0.09)	15.661 (0.09)	39.310 (0.04)
Fluke	18.846 (0.08)	15.714 (0.04)	39.477 (0.06)
Pie	18.888 (0.03)	15.739 (0.10)	39.526 (0.09)

Relative 1 standard deviation error (%) in brackets.

CHAPTER 4 MINERAL DEPOSITS

Sedimentary exhalative (SEDEX) massive sulphide deposits similar to those of the Gataga district are found in Proterozoic and Paleozoic basinal and platformal marine sedimentary strata worldwide (Gustafson and Williams, 1981; Large, 1981). There are no major Mesozoic or Cenozoic deposits of this type. Some of the best known and most extensively studied deposits are Mt. Isa and McArthur River (HYC) in Australia (Williams, 1976), the Meggen and Rammelsberg deposits in West Germany (Large, 1986; Krebs, 1981), and the Tynagh, Navan and Silvermines deposits in Ireland (Andrew and Ashton, 1985; Russell, 1983).

Numerous sedimentary exhalative massive sulphide and barite deposits are found in miogeoclinal strata of ancestral North America (Carne and Cathro, 1982; Morganti, 1981; MacIntyre, 1991). These sediments were deposited in structurally controlled basins and troughs that were located along a rifted continental margin. The deposits can be subdivided into five major groups based on age (MacIntyre, 1991). These are:

- **Middle Proterozoic** - example Sullivan camp
- **Cambrian-Ordovician** - example Kootenay Arc, Anvil camps
- **Middle Ordovician** - example Gataga district barite
- **Early Silurian** - example Howard's Pass district
- **Late Devonian-Mississippian** - example MacMillan Pass and Gataga districts

The known sedimentary exhalative deposits of the Gataga district are listed in Table 5; locations are shown in Figure 13. The most economically important deposits in the Akie River area, such as Stronsay (Cirque), Mt. Alcock, Elf, Fluke, Akie and Kwadacha are early Late Devonian in age. Other deposits such as Sika, CT, ERN and Reb are Early Silurian or Middle Ordovician in age.

CAMBRIAN-ORDOVICIAN DEPOSITS

Nodular phyllitic mudstones and limestones of the Kechika Group host minor occurrences of barite and phosphorite. Heather (1982) describes a barite horizon from the Sika property that is hosted by a silty section within the Kechika Group. This section underlies Ordovician to Silurian strata of the Road River Group. The barite is orange to beige in colour and locally contains detrital quartz grains. The quartz detritus was probably brought into the sedimentary basin by turbidity currents. Overall, the Kechika Group does not appear to be a favourable host for stratiform mineral deposits.

PHOSPHORITE OCCURRENCES

Cecile and Norford (1979) also report two areas of thin phosphorite sea-floor pavements in the Grey Peak area of Kwadacha Park. The phosphorite contained 2 to 25 percent fluorapatite and minor uranium. This mineralization occurs in nodular limy mudstone near the top of the Kechika Group in rocks of probable early Ordovician age.

MIDDLE ORDOVICIAN DEPOSITS

A major marine transgression occurred in Middle to Late Ordovician time, perhaps in response to crustal extension and basinl subsidence. During this period, black graptolitic mudstone and chert of the Road River Group was deposited throughout Selwyn Basin and the Kechika Trough. Mafic submarine volcanic rocks were extruded during the early stages of this marine transgression particularly along the eastern margin of the shale basin. These volcanics were probably extruded along major rifts that were parallel to the margin of the basin. In spite of these favourable indicators, the only sedimentary exhalative deposits of this age are the Reb and Aikie-Sika deposits of the Gataga district (MacIntyre, 1983; 1992).

REB

The Reb occurrence (Stewart, 1981) is located at the extreme southern end of the district, approximately 50 kilometres east of the northern tip of Williston Lake. Esperanza Exploration staked the claims in 1979 after prospectors discovered an outcrop of bedded pyrite in a limonite-stained outcrops exposed in a small tributary of the Ospika River. Esso Minerals Canada optioned the property in 1980; they did reconnaissance geologic mapping, prospecting, silt, heavy mineral, soil and rock geochemical surveys in the summers of 1980, 1981 and 1982 (Lomenda, 1982). This work defined several small lead-zinc soil, silt and rock geochemical anomalies. Heavy mineral concentrates from stream sediments contain up to 10 percent barium. The property has not been tested by drilling.

The eastern half of the Reb property is underlain by nodular phyllitic mudstone and limestone of the Cambro-Ordovician Kechika group. These rocks are in fault contact with Ordovician to Devonian shale, siltstone and limestone of the Road River and Earn Groups (Figure 13). The basal part of the Road River Group includes thin-bedded, platy-weathering limestone, limestone debris flows, dolomitic siltstone and sandstone. These rocks grade up section into Middle to Late Ordovician graptolitic black pyritic shale that contains thin interbeds of siltstone, pelagic dolostone, limestone and black chert. Silurian limestone

Table 5. Mineral Occurrences in the Akie River Area.

No.	Property	Minfile No.	Commodities	Unit	Description
1	Reb	94C-49	Fe	ORs	massive pyrite in black chert
2	Wil		Ba	ORs	nodular barite overlying quartz wacke
3	Sika (Aikie-Sika)	94F-22	Ba	ORs	barite bed up to 1 metre thick overlying quartz wacke
4			Ba	SR	barite interbedded with shale and dolostone
5	ERN	94F-1	Fe,Zn,Pb	SR	dolomite and quartzite breccia with massive pyrite, sphalerite
6	CT	94F-10	Ba,Fe,Zn	SR	barite bed with pyrite-sphalerite zones; dolomite breccia
7	Cirque (Stronsay)	94F-8	Ba,Fe,Zn,Pb,Ag	DG	barite and massive pyrite-sphalerite-galena up to 70 m. thick
8	Fluke	94F-9	Ba,Fe,Zn,Pb	DG	laminar banded pyrite with local high grade galena and sphalerite
9	Elf	94F-11	Ba,Pb,Zn,Ag	DG	nodular and laminated barite beds with massive galena, sphalerite
10	Mt. Alcock	94F-15	Ba,Pb,Zn,Ag	DG	barite with local high grade galena, sphalerite up to 11.5 m. thick
11	Akie	94F-31	Ba,Pb,Zn,Ag	DG	barite with local high grade galena, sphalerite
12	Kwadacha	94F-20	Ba	DG	massive and laminated barite up to 30 m. thick
13	Kwad		Ba	DG	nodular and laminated barite beds
14	Pie	94F-23	Ba, Cu	DG	nodular and laminated barite beds; coarse barite with trace of Cu
15			Pb,Ag	DG	massive galena vein
16	Del	94F-18	Ba	DG	nodular and laminated barite beds
17	Aki	94F-27	Fe	DG	pyritic shales and gossans with anomalous zinc
18	Gnome	94F-16	Ba	DG	nodular and laminated barite beds
19	Gin	94F-17	Ba	DG	nodular and laminated barite beds
20	Pesika	94F-25	Ba	DG	nodular and laminated barite beds
21	Yule	94F-13	Ba	DG	nodular and laminated barite beds
22	Pelly		Ba	DG	nodular barite beds
23	Fern		Ba	DG	nodular barite beds

See Figures 3, 3A (in pocket) and 13 for locations; See Table 1 for description of map units.

and dolomitic siltstone unconformably overlie these black shales. Farther to the southwest, Lower to Middle Devonian siltstone, shale and limestone sits disconformably on Silurian strata. The entire sequence has been folded along northwest trending fold axes.

The main showing on the Reb property is a massive, coarse-grained and finely laminated pyrite bed that is exposed over a 20-metre interval in a creek bed. Samples from this showing contain low to slightly anomalous concentrations of zinc and lead. Host rocks are interbedded black graptolitic shales, black cherts, and black quartzose siltstones of the Middle to Late Ordovician Road River Group (ORs). Near the occurrence, the Ordovician section contains significant amounts of chert, and has very little limestone, indicating a starved basin depositional environment.

SIKA (AIKIE-SIKA)

The Aikie-Sika showings (Cecile and Norford, 1979; Murrell, 1981) are located in a belt of basinal facies rocks that were deposited along the edge of the MacDonald Platform. This showing, which was first described by Cecile and Norford (1979), is comprised of a laterally extensive barite bed ranging from 0.5 to 2 metres thick. This bed occurs at or within one meter of the contact between quartz wacke turbidites and overlying late Middle Ordovician graptolitic black shales (Plate 3; Sections H-3, H-4 and 80-9, Appendix A). The quartz wacke turbidites occur as a westward thinning clastic wedge along the basin to platform transition zone. The barite horizon has a northwest-southeast strike length of a least 7 kilometres; it's southwest-northeast extent is difficult to determine because of folding, but is probably on the order of several kilometres. The barite bed is amazingly consistent in thickness over this distance. Unfortunately, there are no sulphides associated with this deposit and analyses of the barite indicate only background metal concentrations (Heather, 1982; Table 6).

Heather (1982) described the stratigraphic setting and morphology of barite from the Sika claims. The barite weathers a distinctive yellowish-orange to grey colour and has several different mineral textures, including wavy, laminar banded and lensoidal. Barite rosettes have also been reported. Although the barite occurs as a laterally extensive sheet, individual beds or lenses of barite within this sheet are separated by millimeter thin partings of carbonaceous and argillaceous sediment. These partings indicate starved basin pelagic sedimentation occurred between episodes of rapid barite deposition. In places, the barite occurs as coarse-grained veins that cross cut both bedded barite and overlying shale. This suggests recrystallization and remobilization occurred sometime after lithification. Soft sediment folding is also present locally and implies some tectonic activity may have accompanied barite deposition. In general massive, grey bedded barite grades up into whitish grey nodular barite. The nodular barite is probably diagenetic in origin.

The barite horizon occupies approximately the same stratigraphic position as a belt of submarine volcanics further to the west. Barite also occurs in Early Silurian rocks higher in the section and Cambro-Ordovician rocks lower in the section indicating exhalative activity was repeated in the same area over an extended period of time. This implies a common structural control that localized Cambro-Ordovician, Middle Ordovician and Early Silurian exhalative centers. This structural control

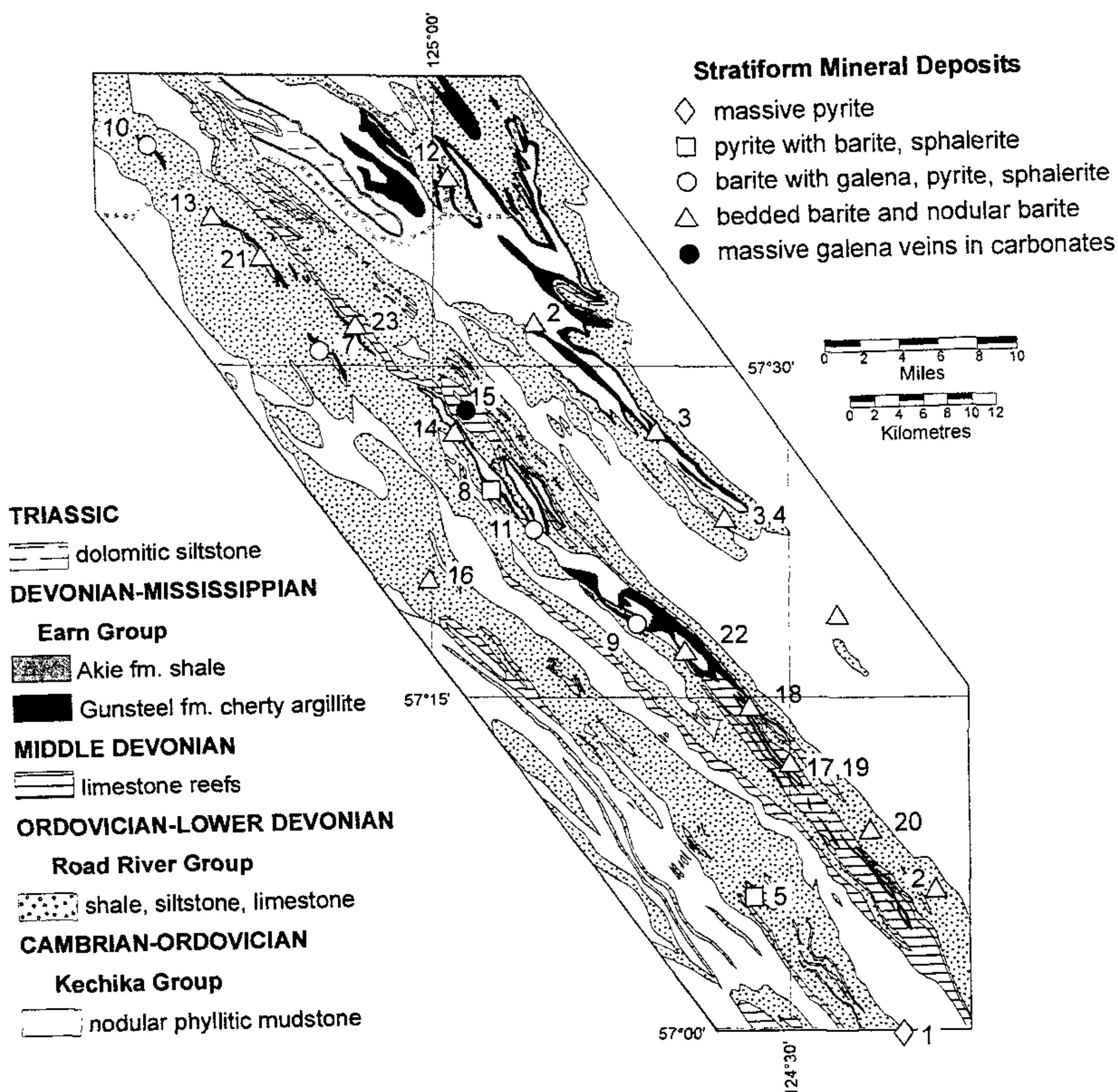


Figure 13. Generalized geology of the Akie River project area and location of stratiform mineral deposits discussed in this report. Deposit numbers correspond to those in Table 5.

may be related to reactivation of growth faults within the basin during periods of crustal extension.

WIL

The Wil property is approximately 10 kilometres northwest of the Aikie-Sika showing, within the same synclinorium of Ordovician to Devonian basinal facies rocks (Hodgson, 1980a). Here, a thin nodular barite horizon occurs at the base of a section of Middle to Late Ordovician Road River black shales. These rocks overlie a 5 meter thick unit of quartz wacke. This stratigraphic position is the same as that at the Aikie-Sika property. Heather (1982) suggests the Wil barite occurrence was located closer to the carbonate platform because there is more limestone and less quartz wacke in this section than at the Aikie Sika. The Wil nodular barite had relatively low to slightly anomalous metal concentrations (80WH-33, 80WH-33C, Appendix D). Elsewhere on the property, pyrite laminae and iron seeps are found in Lower Devonian clastic rocks (80WM-14-1, Appendix E). This suggests the property may also be prospective for stratiform barite-sulphide deposits in Devonian age rocks.

UNNAMED SHOWINGS

A small showing of barite was discovered east of the Cirque claims. This showing is comprised of thin laminae of barite in a black shale host and is interbedded with Middle Ordovician volcanics. This barite occurrence is probably slightly older than those on the Sika claims (Heather, 1982). Argillaceous limestones interbedded with the barite contain 1700 parts per million zinc and 700 parts per million manganese (80CQ-17D, Appendix D). The high zinc value may indicate potential for a sulphide facies along strike from the barite showing. High manganese is also found peripheral to sedimentary exhalative sulphide bodies (Gwosdz and Krebs, 1977).

TIMING OF MINERALIZATION

The timing of Middle Ordovician barite deposition corresponds roughly to the development of quartz rich turbidite fans along the basin to platform margin and submarine volcanism to the west. All of these events are probably related to rifting and basin subsidence during Middle to Late Ordovician time. On the Aikie-Sika property the barite horizon overlies quartz wackes that have graptolitic black shale interbeds. Graptolites from the upper beds are within the *Dicellograptus complanatus ornatus* zone, indicating the barite is late Middle to early Late Ordovician in age (Appendix B).

Barite also occurs in Early Silurian rocks higher up in the succession. This indicates that multiple episodes of barite deposition occurred in this part of the Kechika Trough. Reactivation of rifts that formed in Middle to Late Ordovician time may have been an important control on the localization of the Early Silurian deposits.

EARLY SILURIAN DEPOSITS

A period of starved basin sedimentation followed the Middle to Late Ordovician marine transgression. During this time limestone and carbonaceous chert were deposited within Selwyn Basin and Kechika Trough. These rocks contain Early Silurian graptolites and microfossils. They are also host to important sediment hosted exhalative deposits of the Howard's Pass district of eastern Selwyn Basin (Morganti, 1979, 1981; Norford and Orchard, 1983) and much smaller deposits in the southern part of the Gataga district (MacIntyre, 1983). The deposits appear to have formed by cyclical precipitation within restricted basins over an extended period of time.

Regionally there is little evidence of an Early Silurian rifting event, although a short lived marine transgression is recognized in the Kechika Trough. Here a thin stratigraphic succession nearly identical to that of the Howard's Pass district unconformably overlies Middle to Late Ordovician graptolitic shales. Deposition of starved basin chert and graphitic shale was terminated by influx of dolomitic detritus that heralded the start of a major marine regression and erosion of platformal carbonates surrounding Selwyn Basin and Kechika Trough.

Early Silurian limestone, cherty mudstone and carbonaceous shale similar to the host rocks at Howard's Pass also occur in the southern part of the Gataga district (MacIntyre, 1983). However, the sedimentary exhalative deposits hosted by these rocks are quite different from those of the Howard's Pass district; they contain mostly barite and less sulphide.

ERN

The ERN showing, which was discovered by Cominco Limited in 1980, is located on the headwall of a north facing cirque, south of Pesika Creek. In 1980 and 1981 Cominco conducted geological mapping, trenching and a geochemical survey on the property (Pride, 1981). This work has exposed a stratabound sulphide zone in the basal Silurian stratigraphic sequence.

The ERN property is underlain by folded Road River and Earn Group clastic and carbonate strata that range from Ordovician to Middle Devonian in age. Folds are truncated and offset by high angle normal and reverse faults. The mineralized interval, which is up to 12 metres thick and 100 metres long, occurs at the base of the Silurian section, immediately above Late Ordovician graptolitic black shales. This mineralized interval has been subdivided into six units (Pride, 1981a). The basal unit is comprised of dolostone and dolostone breccia that has been healed by massive pyrite. This unit is overlain by two units of sulphide bearing quartzite and quartzite breccia. The fourth unit, which is approximately 0.5 metres thick, is comprised of fine-grained pyrite with a silica-barite matrix that contains minor sphalerite. The fifth unit, which is also 0.5 metres thick, is a shale with chert, barite and pyrite laminae. The sequence is capped by a 2 metre thick bed of grey silty dolostone. Several 100 metres of grey shaly and flaser-bedded dolomitic siltstones overlie the mineralized interval.

CT

The CT showing (Pride, 1981a), which is located east of the ERN and closer to the platform margin, (Figure 3) is also hosted by Early Silurian limestone and chert (SRl). The showing, which is laterally extensive and up to 3 metres thick, is predominantly barite. Locally the mineralized interval is zoned with massive pyrite-sphalerite at the base grading up section into dolostone-pyrite-sphalerite breccia and massive barite-sphalerite. Syn-sedimentary slump structures are common within the sulphide layer. The immediate footwall of the mineralized zone is siliceous dolostone. These rocks unconformably overlie Middle to Late Ordovician pyritic black shales and mudstones. The footwall succession includes limestone, dolostone, quartz wacke and, further down section, orange-weathering ankeritic tuffs and flows. The mineralized zone is overlain by black pyritic mudstones and baritic laminated siltstones that contain Early Silurian

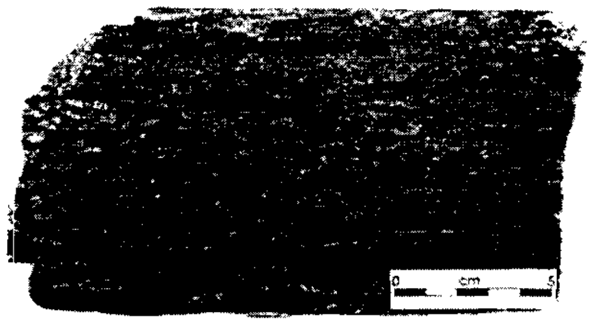


Plate 4. Dark grey, carbonaceous, cherty argillite of the Gunsteel formation with barite nodules (light grey).

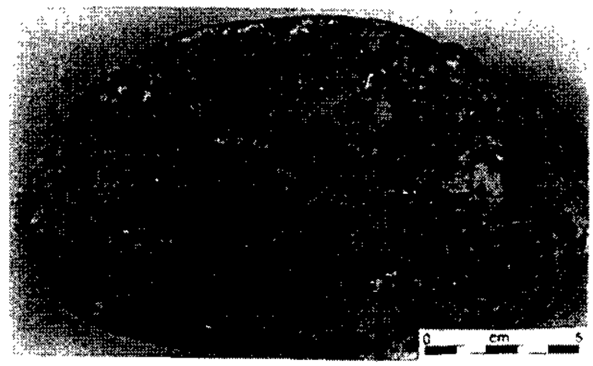


Plate 5. Coarse grained barite with interstitial galena (white) from the Cirque property.

graptolites. These rocks are unconformably overlain by a thick sequence of orange to tan-weathering bioturbated dolomitic siltstones.

The CT deposit probably formed in a seafloor half-graben located immediately west of the rifted margin of the MacDonald platform. Slump breccias, soft sediment deformation and rapid facies changes imply a tectonically active environment.

DEVONIAN-MISSISSIPPIAN BARITE-SULPHIDE DEPOSITS

The most economically important sedimentary exhalative deposits in the Gataga district are hosted by basinal facies rocks the Gunsteel formation (Figure 13; Table 5). The host rocks are not well exposed and baritic 'kill zones' and iron seeps are often the only surface indicators of mineralization.

Both barren barite and mixed barite-sulphide deposit types occur in the district. This bimodal distribution is also observed in the MacMillan Pass district of the Yukon (Dawson and Orchard, 1982). The sulphide bearing deposits such as Mt. Alcock, Cirque, Fluke and Elf, are restricted to a belt of Gunsteel rocks bounded by the Akie reef to the east and uplifted Ordovician and Silurian rocks to the west (Figure 13). The mineralogy of these deposits is simple; consisting of pyrite with varying proportions of sphalerite and galena in a barite host. Framboidal pyrite can be found in the least deformed deposits. Overall, copper content is very low with the exception of one of the Pie showings which has some malachite staining.

The footwall rocks for the deposits are typically rhythmically bedded black cherts or porcellanites, cherty mudstones, argillites and siliceous, carbonaceous shales with minor siltstone and pelagic limestone interbeds. Laminae of pyrite and bands of barite nodules are common near the deposits. The high silica, high carbon and low clastic content of these rocks suggest that they were deposited in a restricted marine basin with very low sedimentation rates.

The massive barite or barite-sulphide deposits grade laterally into thin (less than 10 metres) beds of carbonaceous, cherty mudstone and argillite that contain laminae and lenses of nodular barite (Plate 4). This mineralized zone is widespread within the basin and is an important stratigraphic marker. It typically occurs near the top of the Gunsteel formation where it is overlain by distal turbidites of the Akie formation. The basal beds of the Akie formation often contain carbonate nodules and pyrite laminae, particularly close to the barite-sulphide deposits. The stratigraphic position of the mineralized horizon also coincides with the transition from starved basin sedimentation, as represented by the Gunsteel formation, to a more open marine turbidite environment, as represented by the Akie formation. This early Late Devonian change in sedimentary environment is recognized throughout the Kechika Trough and Selwyn Basin and coincides with the beginning of uplift to the west and the progressive onlapping of fine-grained marine clastic sediments onto the carbonate platform to the east.

Sulphide and barite crystallinity and distribution vary from extremely fine-grained and delicately laminated to relatively coarse-grained and massive (Plate 5). Where foliation is at an oblique angle to bedding, barite becomes coarser grained with crystal growth parallel to foliation planes. Where folding is intense, all primary structures are obliterated and the barite appears to be completely recrystallized.

CIRQUE (STRONSAY)

The Cirque and South Cirque stratiform barite-sulphide deposits (now called the Stronsay deposit) are located at the divide between two branches of the Paul River (Figure 13; Figure 3A in pocket). The geology and geochemistry of these deposits has been described

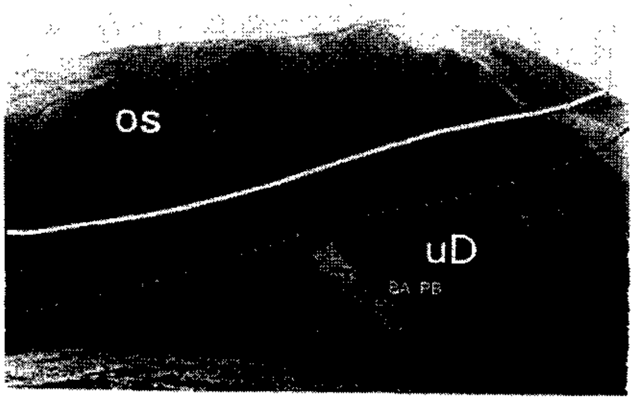


Plate 6. View northwest across the Cirque deposit. Ordovician to Silurian rocks of the Road River Group (OS) are thrust over a panel of Late Devonian carbonaceous cherty argillites of the Gunsteel formation (uD). The dashed line is the approximate surface trace of the barite-sulphide mineralized zone. The white weathering talus slope (T) is comprised of coarse-grained barite with galena (see Plate 5).

by Roberts (1977), Jefferson *et al.* (1983), Pigage (1986), and Gorzynski (1986). The Cirque and South Cirque are the largest and most economically important barite-sulphide deposits known in the Gataga district (Figure 3). The Cirque deposit, which is a southwest-dipping lens over 1000 metres long, 300 metres wide and 2 to 60 metres thick, is reported to have geological reserves of 38.5 million tonnes averaging 8.0 percent zinc, 2.2 percent lead and 47.2 grams per tonne silver. The South Cirque, which is a blind deposit located 500 metres south of the Cirque, has drill inferred resources of 15.5 million tonnes averaging 6.9 percent zinc, 1.4 percent lead and 32 grams per tonne silver. Both deposits are barite rich, with BaSO4 averaging 45 to 50 percent.

The history of the Cirque deposit dates back to 1976 when geologists working on the Cyprus Anvil-Hudson Bay Oil and Gas joint venture discovered mineralized float in the area. The surface expression of the Cirque deposit is restricted to a small ferricrete deposit at creek level and several prominent white weathering barite scree slopes occurring over a 1000 metre strike length on the west side of a cirque valley (Plate 6). Prospecting resulted in the discovery of white crystalline barite float with irregular patches of galena and minor sphalerite (Plate 5).

Cyprus Anvil-Hudson Bay Oil and Gas drilled the Cirque property between 1978 and 1982. This work resulted in the discovery of the Cirque and South Cirque deposits.

When the Cirque deposit was acquired by Curragh Resources in 1985 it was subsequently renamed the

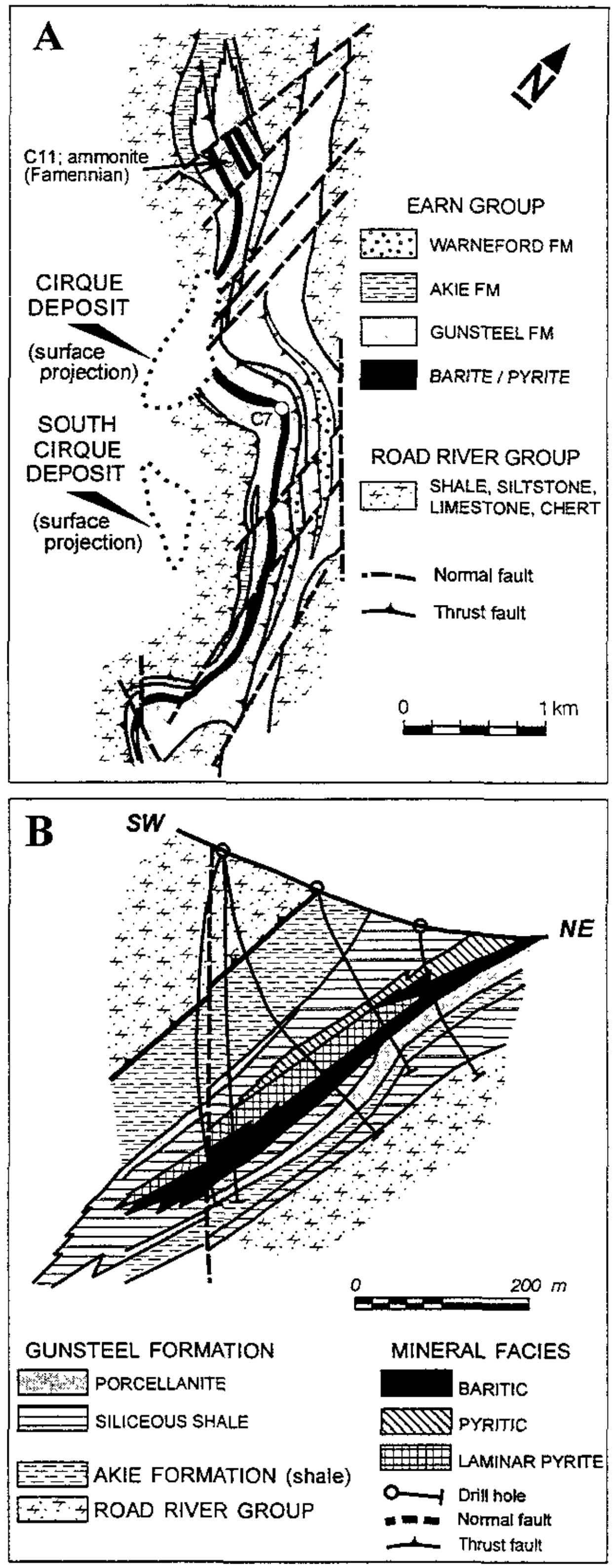


Figure 14. A. Geology of the Cirque property. B. Southwest-northeast section of the Cirque deposit. Modified after Jefferson *et al.*, (1983), Paradis *et al.*,(1998).

Stronsay deposit. In 1989 Austriana de Zinc purchased 15% of the deposit from Curragh. The $10 million received from this sale was used to finance underground exploration, additional diamond drilling, metallurgical testing and environmental studies between 1989 and 1991. Total expenditure on the property to the end of 1991 was $55 million (1990 dollars). In 1994, Curragh Resources went into receivership. The Cirque property was subsequently acquired from the receiver by Teck Corporation (25%), Cominco Limited (25%) and Korea Zinc Company (50%). After completing a feasibility study in 1995, the new owners decided to defer a production decision until the zinc market improves.

The Cirque and South Cirque deposits occur within a southwest-dipping panel or synclinal keel of carbonaceous cherty argillite, porcellanite and siliceous shale (Figure 14) of the Late Devonian Gunsteel formation. Dolomitic siltstone and black graptolitic shale of the Road River Group structurally overlie the Gunsteel host rocks as a series of imbricated thrust panels (Plates 2 and 6; Figure 14). A set of late normal faults offsets early thrust faults.

The Cirque deposit has three distinct mineral facies - pyritic, baritic and laminar banded pyrite (Pigage, 1986). The pyritic facies is predominantly interlaminated pyrite, sphalerite and galena with lesser barite. The baritic facies is predominantly barite (Ba > 40%) with laminae of pyrite, sphalerite and galena. Laminar-banded pyrite occurs mainly in the hangingwall of the deposit and has low zinc and lead values. Unlike other sedimentary exhalative deposits, barite appears to be concentrated at the base of the deposit rather than at the top (Figure 14). However, recent underground mapping of the ore body has shown that at least some of these enigmatic relationships can be explained by tight folding and structural imbrication of the deposit (Pigage, personal communication, 1991). The barite-sulphide lens, which is up to 70 metres thick (tectonic thickening?), thins laterally outward into barren bedded barite and finally into zones of nodular barite southeast of the deposit.

There is no definitive evidence of synsedimentary faulting, footwall alteration or stringer zone development at Cirque although a siltstone breccia in the mineralized zone may be related to slumping along a fault scarp. It is also possible that the coarsely crystalline barite-galena mineralization found at the northeast end of the deposit (Plate 5), and found as talus on surface (Plate 6), may represent a vein system that was a feeder to the main ore body. This conclusion is also supported by increasing Pb/Zn ratios in this direction as documented by Gorzynski (1986). The highest silver values also occur at the northeast end of the deposit (Jefferson *et al.*, 1983) as would be expected if this was the location of a vent zone.

The Cirque and South Cirque deposits, like those elsewhere in the Selwyn basin and Kechika trough, probably formed in a fault-bounded seafloor depression. These sub-basins were probably arranged along the axis of a northwest-trending half graben (Pigage, 1986).

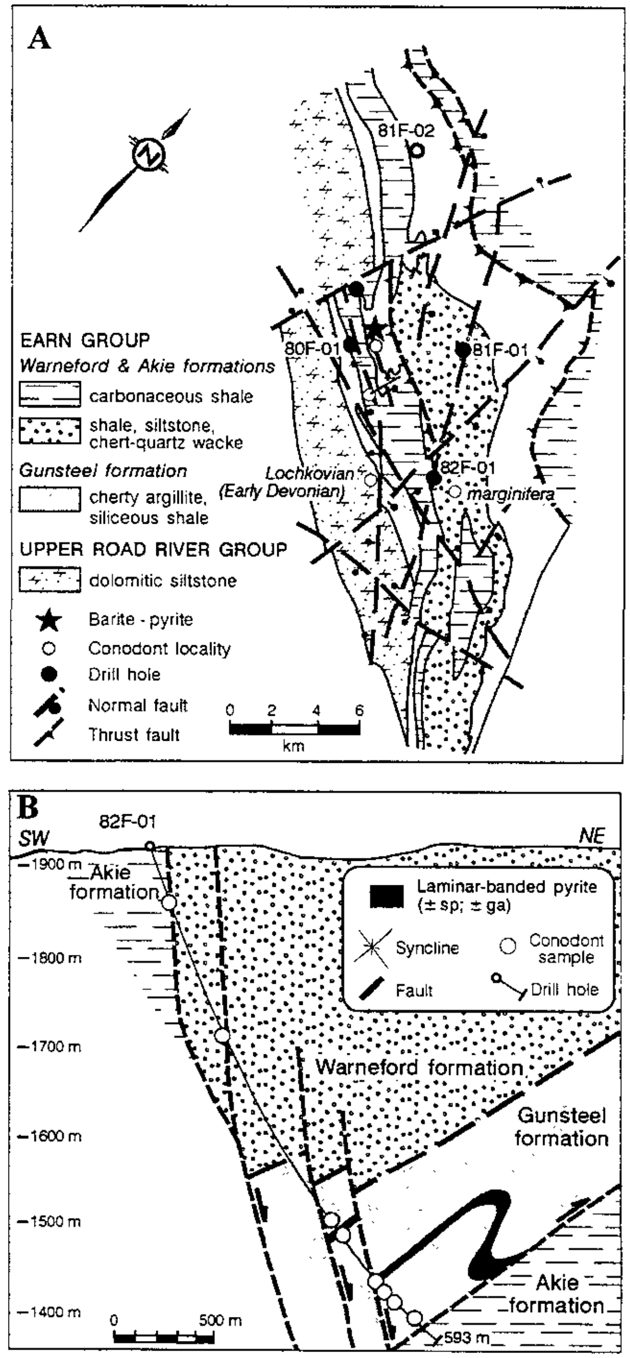


Figure 15. A. Simplified geology of the Fluke property. B. Northeast-southwest section. Modified after Paradis *et. al.*, 1998.

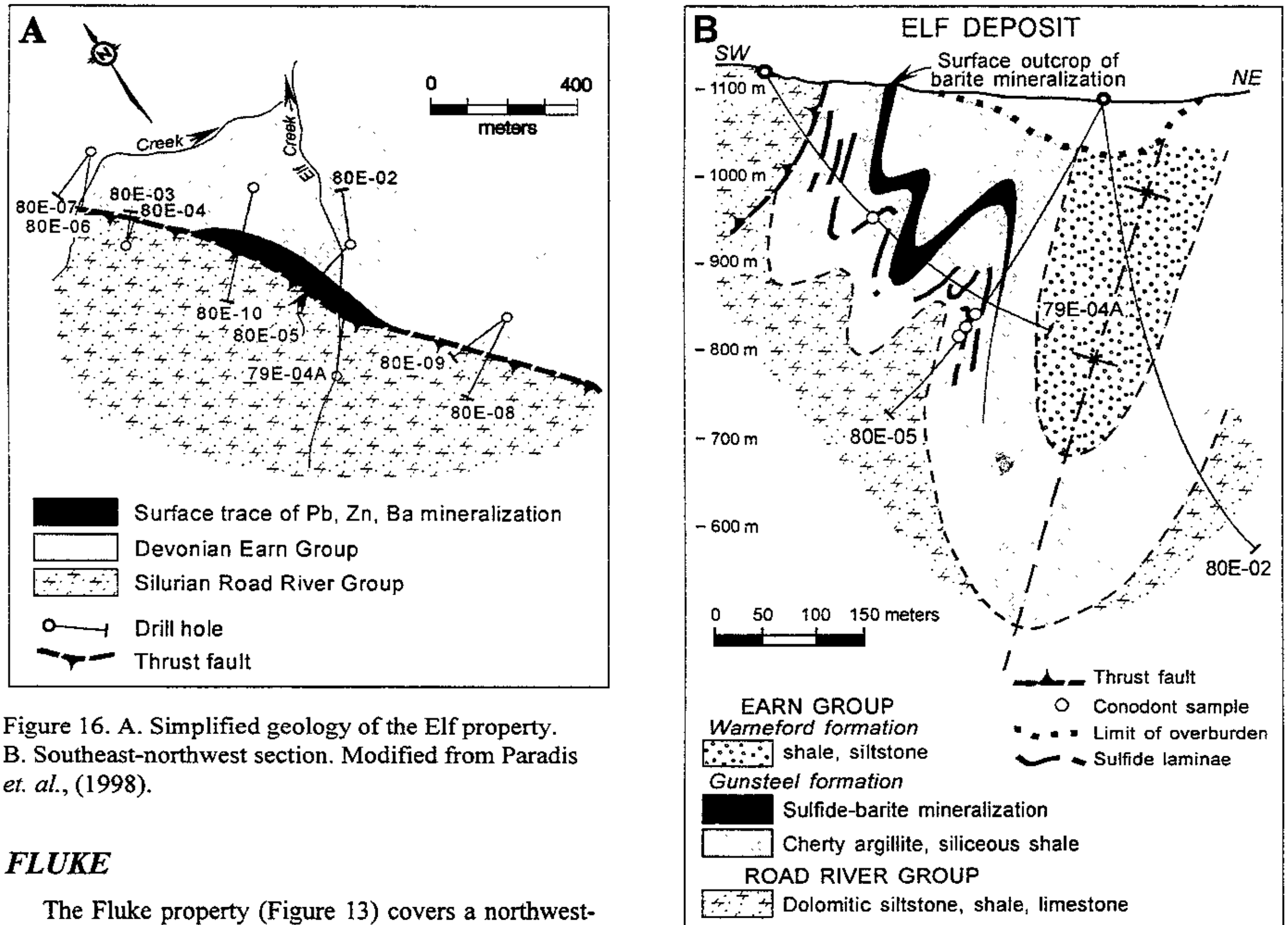


Figure 16. A. Simplified geology of the Elf property. B. Southeast-northwest section. Modified from Paradis *et. al.*, (1998).

FLUKE

The Fluke property (Figure 13) covers a northwest-trending synclinal keel of Gunsteel strata that is bounded by Silurian siltstone to southwest and Middle Devonian limestone to the northeast (Roberts, 1978). The Silurian rocks have been thrust northeastward over the Gunsteel syncline (Figure 13). The property was staked by Cyprus Anvil Mining in 1978 to cover a small showing of laminar-banded pyrite with galena-sphalerite rich bands that is exposed in a small northeast flowing tributary of the Akie River. Several nodular barite beds also crop out on the property. At surface, the mineralized interval is about 1 metre thick and dips to the west (Figure 15). The host rocks are intensely deformed carbonaceous cherty argillites and siliceous shales of the Late Devonian Gunsteel formation. Assays of up to 15 percent combined lead-zinc and 35 grams per tonne silver have been reported. Cyprus Anvil drilled the property in 1980, 1981 and 1982 (Figure 15). Only one drill hole intersected sulphide mineralization at approximately 200 metres down-dip from the surface showing (Paradis *et. al.*, 1998).

ELF

The Elf property was staked by Cyprus Anvil Mining Corporation in 1978 to cover an area of moderately anomalous stream sediment geochemistry and the occurrence of a boulder of white barite containing high grade galena and sphalerite in Elf creek (Roberts, 1979). Subsequent soil sampling resulted in discovery of an outcrop of bedded barite with high grade bands of galena and sphalerite (Plate 7) on the heavily timbered south facing slope north of Elf Creek. The mineralized zone has been exposed on surface by trenching and is up to 4 metres thick. A sulphide rich sample from this zone assayed 14.1 percent zinc, 25 percent lead and 106 grams per tonne silver (79EF-2H, Appendix D). Host rocks are carbonaceous cherty argillites and siliceous shales of the Gunsteel formation. The property was drill tested in 1979 and 1980. Drill holes intersected laminar-banded pyrite at depth (Figure 16); barite-sulphide mineralization similar to the surface showings was not intersected. The best drill intersection contains 13.8 percent combined Pb+Zn with 27 grams per tonne Ag over 11 metres (Paradis *et al.*, 1998).

Drilling and surface mapping suggests the Elf mineralization is contained within a steeply dipping, overturned fold limb that is overthrust to the west by Silurian dolomitic siltstones (Figure 16). Intense folding and structural imbrication of the Gunsteel host rocks has made defining the geometry of the mineralized interval difficult.

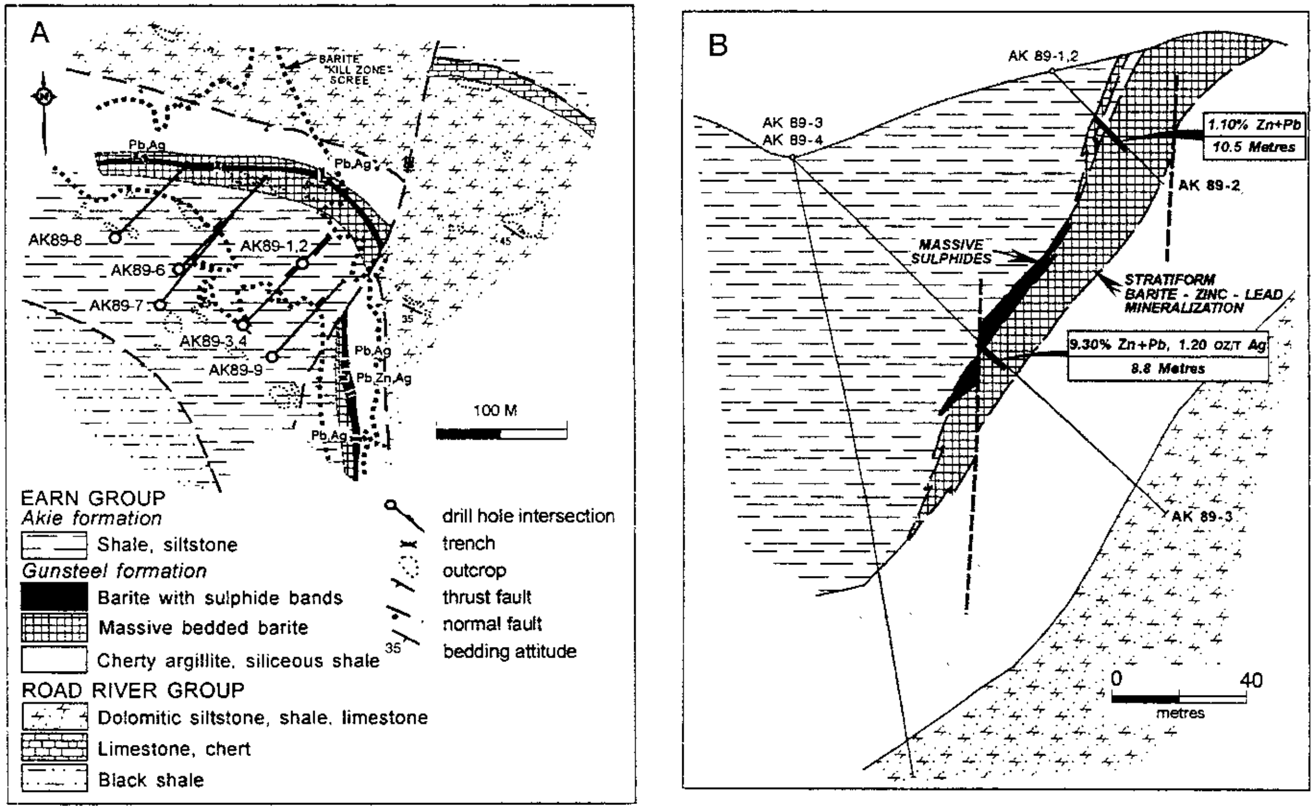


Figure 17. A. Geology of the Mt. Alcock showing. B. Southwest-northeast section. Modified from Murrell and Roberts, (1990).

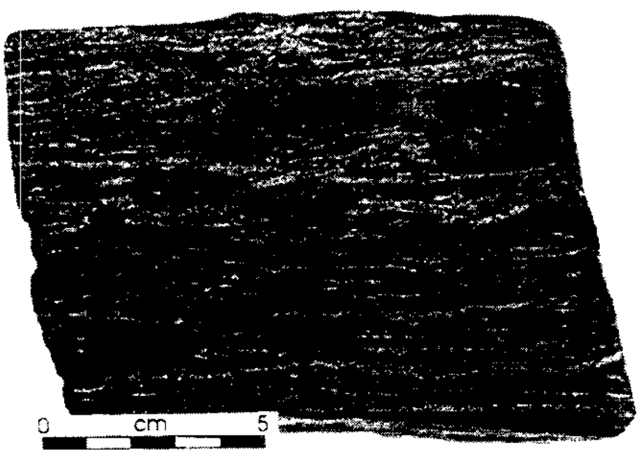


Plate 7. Bands of galena (white) and sphalerite in a dark grey barite host from the Elf showing. Similar mineralization occurs at Mt. Alcock.

MT. ALCOCK

The Mt. Alcock showing is located in Kwadacha Wilderness Park, in a small saddle along the crest of the ridge separating the Warneford and Kwadacha Rivers. The surface expression of the deposit is a prominent, white weathering baritic talus slope. The deposit is contained within a folded panel of Gunsteel cherty argillite and siliceous shale that dips 45 to 75 degrees southwest below a thrust panel of Silurian dolomitic siltstone (Murrell and Roberts, 1990). To the northeast, a high angle normal fault juxtaposes Devonian strata against Silurian siltstone (Figure 17). The bedded barite interval, which is well-exposed on surface, is up to 30 metres thick. Within this interval, there are 2 to 3 metre thick barite beds that contain diffuse bands of galena and sphalerite. Table 6 summarizes the assay results of 5 samples collected from Mt. Alcock (MacIntyre, 1980). In addition, sample 79Al-6A (Appendix D), which contained 54.41 percent Ba, 1900 ppm Zn, 3.0 percent Pb and 22 grams per tonne Ag, also had 340 ppm Cu and 10,000 ppb Hg. The elevated Cu and Hg values for this sample are unusual. The mineralization at Mt. Alcock is similar in appearance to that found on the surface at the Elf (Plate 7).

In 1989, Triumph Resources Limited initiated exploration of the Mt Alcock barite-lead-zinc prospect after receiving regulatory permits and posting a reclamation bond. Geochemical sampling of the property defined several targets, the largest of which was 2.4 kilometres long, up to 300 metres wide, and centered on known mineralization. Subsequently, 9 holes totalling 1,112 metres were drilled to test this

Table 6. Assay results, Mt. Alcock showing.

Sample No.	Ag (ppm)	Ba (%)	Pb (%)	Zn (%)
1	24	50.5	13.0	0.11
2	17	49.3	10.8	1.41
3	15	50.3	8.4	2.41
4	20	50.8	10.0	4.81
5	15	51.8	6.8	1.07

Grab samples from barite scree slope. Data from MacIntyre, 1980.

anomaly and the downdip extension of barite-sulphide mineralization exposed on surface (Figure 17). This work showed that the mineralized interval extends at least 230 metres along strike and for 130 metres downdip. The average drill intersection was 11.5 metres thick and consisted predominantly of barite with up to 10 percent banded galena and sphalerite. The best intersection contained 5.5 percent zinc, 3.8 percent lead, and 1.2 ounces per ton silver over an 8.8 metre interval (Murrell and Roberts, 1990).

An induced polarization survey was also completed. It defined an area of intense chargeability along strike and southeast of the main showing. In 1990, Triumph Resources drilled six holes totalling 1211 metres to test this target. No significant massive sulphide intercepts were obtained (Jensen, 1993). In 1992, Teck Corporation staked additional claims and did more soil sampling, geophysics and geologic mapping (Jensen, 1993).

AKIE

The Akie is the most recently discovered deposit in the Akie river area and was still being actively explored in 1996. The deposit was discovered by Metall Mining Corporation while prospecting claims optioned from Ecstall Mining Corporation. The property was originally staked by Rio Tinto Exploration in the early 1980's as the Dog claims (Hodgson, 1980). Although Rio Tinto obtained anomalous metal concentrations in soil samples, only nodular barite mineralization was found on the property and the claims were allowed to lapse.

In 1994, prospectors discovered a high grade zone of bedded massive sulphide in outcrop exposed by a recent slump in a steep northeast flowing creek. The discovery of the Cardiac Creek showing was followed by a diamond drilling program which resulted in discovery of the Akie deposit. The deposit is situated approximately half way between the Fluke and Elf deposits (Figure 13). Like others in the district the mineralization consists of laminated to massive pyrite and barite with minor sphalerite and galena (Baxter *et al.*, 1996; Paradis *et al.*, 1998). The deposit occurs

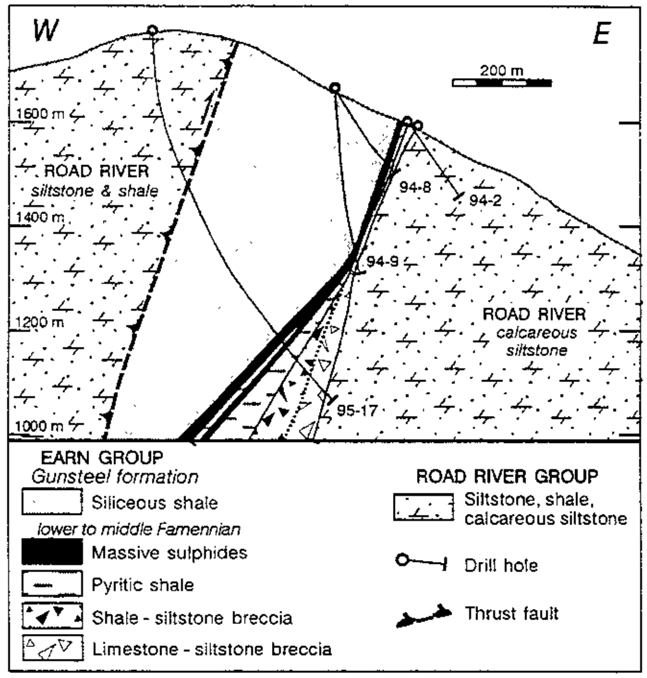


Figure 18. East-west section through the Akie deposit. Modified from Paradis *et al.*, 1998.

within a southwest dipping panel of Gunsteel formation cherty argillites and shale which structurally underlies a thrust panel of Silurian siltstone (Figure 18). Drilling to date indicates the deposit is sheetlike with a strike length of 1,600 metres, a dip extent of at least 800 metres and true thicknesses up to 30 metres.

Coarse grained sedimentary breccias occur in the stratigraphic footwall of the Akie deposit suggesting the presence of growth faults. Fragments from these breccias contain early Frasnian and early Fammennian age conodonts; others have conodonts typical of the Eifelian-Givetian boundary of the Middle Devonian (Paradis *et al.*, 1998). The presence of Middle Devonian conodonts in the breccias indicates erosion of old strata in Famennian or younger time (Paradis *et al.*, 1998).

DEVONIAN TO MISSISSIPPIAN BARITE DEPOSITS

The Late Devonian sedimentary exhalative horizon is present on a broad regional basis and is recognized by beds of nodular and laminated barite near the top of the Gunsteel succession. The most significant barite occurrences are the Kwadacha, Pesika, Del, Gin, Aki, Gnome, Pie, Yule and Kwad (Figure 13; Table 5). Even where visible barite is absent, siliceous and carbonaceous rocks at the same stratigraphic position typically have anomalously high barium concentrations (Appendix D).

Table 7. Geochemical analyses of barite samples from the Kwadacha barite deposit.

Metres above base	SiO_2 wt.%	TiO_2 wt.%	Al_2O_3(wt.%	Fe_2O3 wt.%	K_2O wt.%	P_2O_5 wt.%	Org C wt.%	Ba wt.%	Sr wt.%	Mn ppm	Ag ppm	Cu ppm	Pb ppm	Zn ppm	Co ppm	Ni ppm	Hg ppb
31.5	44.68	0.430	8.55	0.70	2.480	0.02	0.97	21.42	0.05	24	0.60	23	7	6	2	2	147
31.5	28.90	0.150	1.74	3.44	0.580	0.16	<0.10	36.01	0.07	7	0.30	35	4	67	1	5	142
29.1	40.62	0.110	0.88	0.22	0.190	0.05	0.50	32.85	0.03	7	0.30	7	5	10	1	6	28
28.9	43.18	0.080	0.30	0.16	0.030	0.02	0.10	32.18	0.04	9	0.30	5	4	23	1	8	15
28.8	37.07	0.120	0.90	0.57	0.190	0.07	0.32	35.05	0.04	8	0.30	18	5	93	2	33	18
28.3	28.58	0.110	0.65	0.38	0.100	0.05	0.20	40.91	0.04	6	0.30	14	5	45	1	19	23
28.0	30.97	0.110	0.62	0.20	0.100	0.05	0.39	39.17	0.04	2	0.30	8	5	18	1	13	20
27.9	33.68	0.130	1.08	0.52	0.200	0.07	0.32	36.89	0.04	5	0.30	28	6	67	4	24	53
27.4	25.08	0.100	0.45	0.11	0.050	0.04	0.47	38.54	0.09	50	0.30	4	4	16	1	6	15
27.3	0.86	0.130	0.39	0.19	0.080	0.05	<0.10	57.70	0.05	4	0.30	8	2	22	1	6	15
27.1	38.64	0.090	0.46	0.16	0.040	0.03	0.28	35.49	0.04	2	0.30	10	4	6	1	4	15
26.9	35.09	0.140	1.25	0.75	0.320	0.04	0.51	35.40	0.04	15	0.30	22	3	101	1	42	35
26.9	35.43	0.140	1.31	0.76	0.320	0.05	0.52	35.35	0.04	12	0.30	24	6	99	2	38	37
26.7	30.09	0.110	0.56	0.30	0.100	0.03	<0.10	40.23	0.04	2	0.30	9	5	26	1	14	15
26.0	5.37	0.130	0.39	0.15	0.080	0.08	<0.10	55.80	0.04	2	0.30	7	6	17	1	12	15
19.0	3.13	0.120	0.41	0.16	0.060	0.21	<0.10	56.18	0.12	5	0.60	9	4	42	1	12	15
10.0	21.84	0.100	0.44	0.10	0.040	0.02	<0.10	44.95	0.10	2	0.30	8	7	17	1	6	15
9.0	47.11	0.090	0.53	0.21	0.080	0.03	0.14	29.89	0.14	4	0.30	17	4	23	1	11	15
4.4	62.85	0.120	1.41	0.45	0.270	0.05	0.77	17.86	0.08	12	0.30	83	12	87	1	32	84

All analyses done in the B.C. Geological Survey Branch Analytical Laboratory.

KWADACHA

The Kwadacha deposit is the largest of the barite deposits known in the Gataga district. In contrast to others in the district, this deposit occurs close to the basin to shelf transition zone along the east side of the Kechika Trough (MacIntyre and Diakow, 1982). The Kwadacha barite deposit, like others in the district, is underlain by rhythmically bedded black cherty argillite of the Gunsteel formation (Figures 19A and 19B) and overlain by black shale of the Akie formation. The cherty argillites have thin silty shale and limestone debris flow interbeds. The Gunsteel rocks overlie a thin unit of limestone, calcarenite and minor quartz wacke. The limestone beds locally contain crinoid ossicles with double axial canals indicating a probable Lower to Middle Devonian age. Below these beds are typical, platy to thick-bedded, brown-weathering dolomitic siltstones of the Silurian Road River Group.

The deposit is comprised of a baritic interval up to 35 metres thick that contains massive and laminated beds of barite (Plate 8) The baritic interval is imbricated by thrust faults and folds along the crest of a north-trending ridge (Figures 19A and 19B). The barite beds are resistant and crop out as a series of jagged, low-amplitude, southwest-dipping hog backs. Two barite zones are present separated by a 10 to 15 metre thick interval of recessive, baritic black shale with occasional thin grey weathering limestone interbeds. The upper zone, which varies from 1 to 10 metres thick, consists of massive, finely laminated barite with thin argillaceous shale partings. The lower zone consists of 10 to 15 centimetre thick intervals of laminated and nodular barite interbedded with cherty argillite and siliceous shale.

The upper barite zone contains no visible sulphide mineralization but thin laminae of pyrite were found in the footwall siliceous shales. Low base metal concentrations were determined for samples of barite collected from a well exposed section through the deposit (Table 7).

KWAD

Cominco Limited staked the Kwad claims in 1979 to cover the southwest extension of the belt of Gunsteel rocks that host the Mount Alcock deposit. Follow up prospecting resulted in the discovery of several zones of nodular to bedded barite up to 10 metres thick (Waters, 1981). Although the host rocks are pyritic, no significant stratiform sulphide mineralization was discovered.

PIE

Rio Tinto Canadian Exploration Limited staked the Pie claims to cover an area of anomalous stream

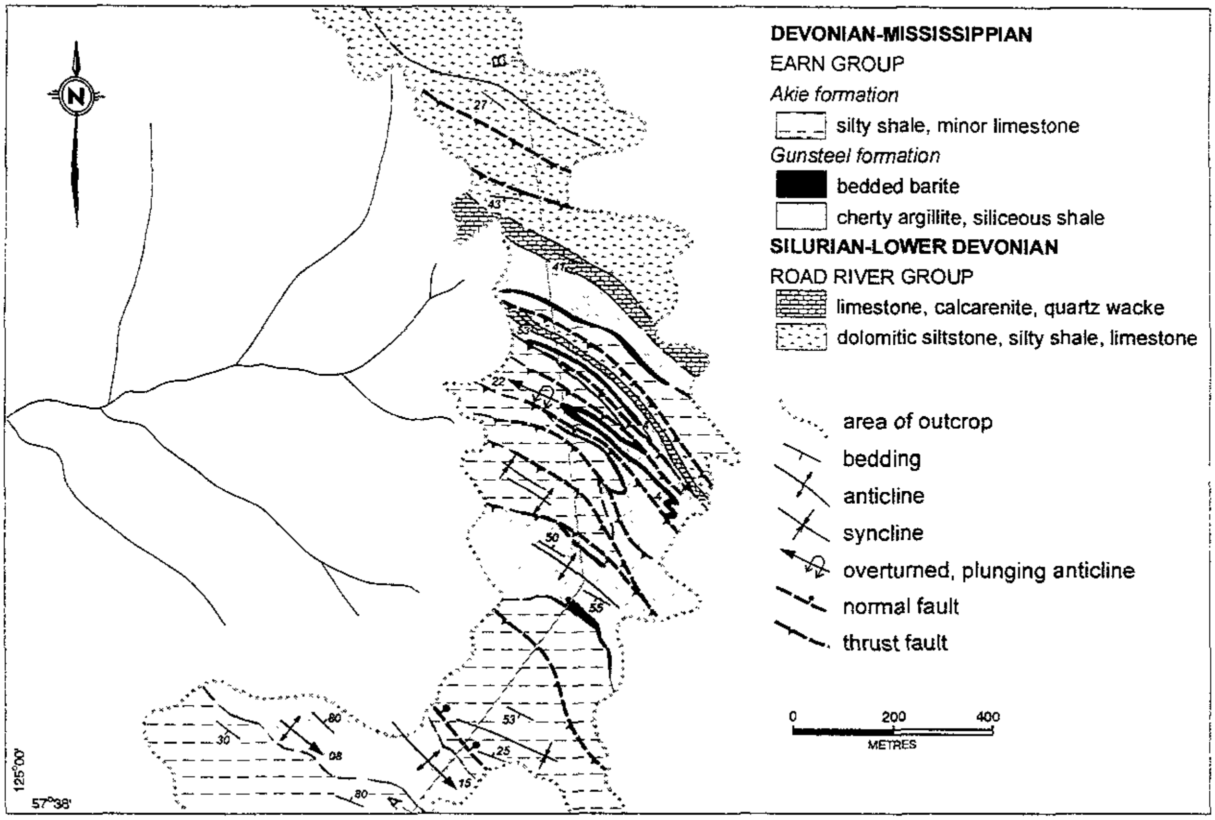


Figure 19A. Geology of the Kwadacha barite deposit. Modified from MacIntyre and Diakow, (1982).

sediment geochemistry that coincides with a panel of Gunsteel strata south of the Cirque property. These rocks are in stratigraphic contact with Middle Devonian limestones along the eastern half of the property and dip southwest below a thrust panel of Silurian to Ordovician rocks to the southwest. A number of barite beds are exposed in the southern part of the property and these are probably fault or fold repeats of the same horizon.

Trenching has exposed high grade galena and barite float at the contact between Middle Devonian limestone and overlying shales (Figure 3A, in pocket). Samples collected from this showing contained up to 68 percent lead with minor zinc and silver grades (PIE-1- PIE-6, Appendix D). The mineralization appears to be related to a fault zone and may be epigenetic in origin.

Coarsely crystalline barite from a small trench on the Pie claim is unusual because of its high copper content (up to 2900 ppm). The barite is stained with malachite and represents a distinct style of barite mineralization. These cross-cutting, epigenetic veins may be relatively high temperature compared to stratiform baritic mineralization. Samples from this occurrence also had unusually high nickel concentrations.

The Pie property was drill tested in 1980 (Hodgson and Thompson, 1980). Three of the holes intersected a south west dipping zone of pyritic Gunsteel shales containing nodular to bedded barite that stratigraphically overlies Middle Devonian limestone of the Akie Reef. Two drill holes tested an area with high grade galena float but failed to intersect significant mineralization.

DEL

The Del claims were staked by Cominco Limited to cover a barite kill zone and gossan on a ridge northwest of the Akie River (Pride, 1981). The property is underlain by folded and thrust-imbricated panels of Gunsteel and Road River strata (Figure 3A, in pocket). The barite zone, which is located on the west side of the property, is comprised of nodular and massive barite up to 2 metres thick. Barite float is also found in the vicinity of the showing. Samples of the gossan zone are reported to contain anomalous concentrations of lead and zinc but no sulphide mineralization has been found on the property. Felsic dikes containing disseminated pyrite are also reported, and apparently cut rocks as young as Devonian.

AKI

Aquitaine Company of Canada staked the Aki claims in 1977 to cover gossans that occur within a panel of Gunsteel strata (Figure 13, Figure 3A in pocket). This panel also hosts the Gnome and Elf

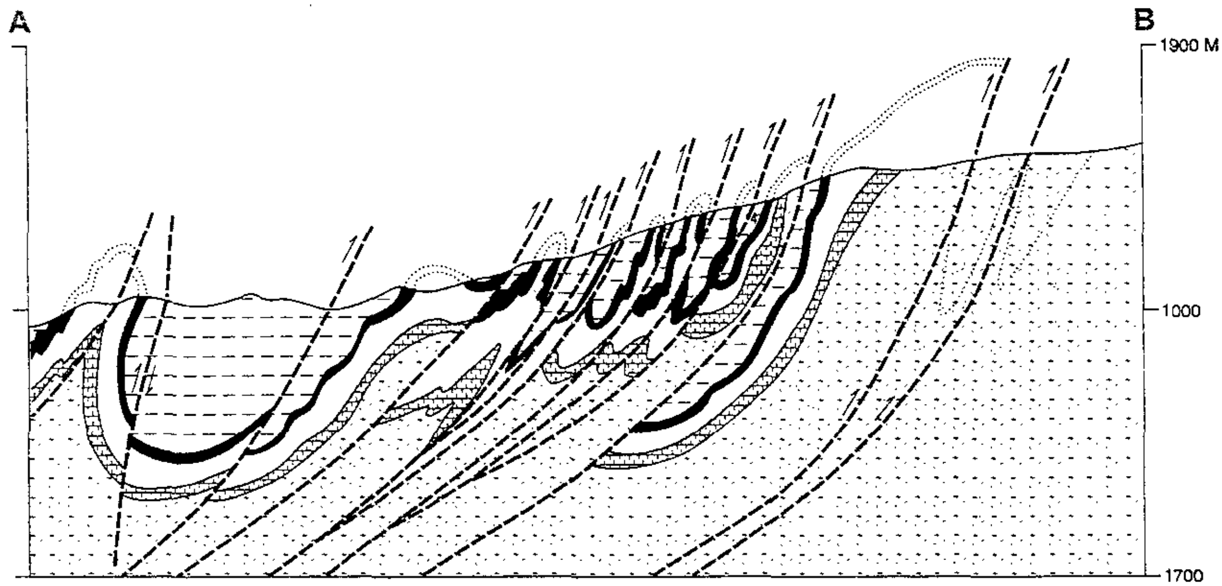


Figure 19B. Southwest-northeast section through the Kwadacha deposit. See Figure 19A for location and legend.

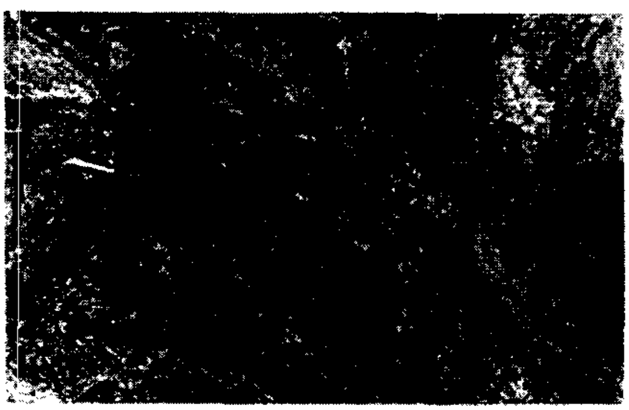


Plate 8. Thin bedded barite, Kwadacha deposit. Dark bands are shaly mudstone. Rock hammer for scale.

showings, which are located north of the property, and the Gin showing, which is to the south. Three of the gossans are up to 300 metres long; geochemical sampling returned up to 2 percent zinc and low lead and barium (Coutellier, 1980). Although disseminated pyrite was observed in Gunsteel shales, no bedded sulphide or barite mineralization was found.

GNOME

Cominco Limited staked the Gnome property to cover an area of anomalous silt geochemistry located in the headwaters of a north flowing tributary of the Akie River (Figure 13, Figure 3A in pocket). The same northwest trending belt of Gunsteel rocks that hosts the Elf deposit transects this area. Springs emanating from sections of pyritic shale are actively precipitating iron oxide and forming extensive ferricrete deposits. Although several nodular barite zones occur near the top of the Gunsteel section, no significant bedded mineralization has been found (Pride, 1980).

GIN

Cyprus Anvil Mining Corporation staked the Gin group to cover a northwest-striking and southwest-dipping barite horizon discovered on a ridge near the headwaters of Pesika Creek. Cherty argillites and siliceous shales of the Gunsteel formation are the host rocks (Roberts and Simpson, 1980). The best exposure is in a small saddle along the crest of a west trending ridge. East of the showing is a well-exposed near-vertical section of Early Devonian limestone debris flows and graptolitic black shales that sit stratigraphically above brown weathering Silurian siltstone.

PESIKA

Cominco Limited staked the Pesika claims to cover an area of lead-zinc-barium silt anomalies on tributaries of the Ospika River, and an area of gossans associated with a belt of Gunsteel strata (Figure 13, Figure 3A in pocket). Bedded and nodular barite occur near the top of a section of cherty argillites belonging to the Gunsteel formation (Pride, 1980a). This horizon can be traced for several kilometres. The host Gunsteel succession overlies a relatively thin unit of Middle Devonian limestone.

YULE

Rio Tinto Canadian Exploration limited staked the Yule claims to cover two parallel, northwest trending belts of Gunsteel strata, both of which host zones of nodular barite (Figure 13, Figure 3A in pocket). The eastern belt dips southwest and stratigraphically overlies Middle Devonian limestone of the Akie Reef. An overturned anticline of Silurian and Ordovician Road River rocks has been thrust northeastward over the folded Gunsteel succession (Hodgson, 1980b). Gunsteel rocks stratigraphically overlie Silurian siltstone on the upper limb of the overturned anticline and also contain nodular barite beds. The host cherty argillites are tightly folded, especially near a major thrust fault along the southeastern boundary of the belt.

PELLY

Cominco Limited staked the Pelly group of claims to cover an area of silt sediment samples containing anomalous concentrations of lead and zinc that is located southeast and along strike from the Elf occurrence (Figure 13, Figure 3A in pocket). The property is underlain by a series of imbricated thrust panels containing folded rocks of the Gunsteel formation. To the west the Gunsteel rocks are structurally overlain by the Road River Group; to the northeast, they stratigraphically overlie Silurian siltstone. Follow-up work failed to locate any significant sulphide or barite mineralization on the property, in spite of favourable stratigraphy (Pride, 1980b).

FERN

Cominco Limited staked the Fern group of claims to cover a zinc-barium heavy mineral anomaly near the headwaters of the Paul River (Figure 13, Figure 3A in pocket). The claim group is located 4 kilometres north of the Cirque deposit. The claims cover a belt of Gunsteel strata that lie structurally below a northeast directed thrust panel of Road River strata. To the northeast the Gunsteel rocks lie stratigraphically above Middle Devonian limestone of the Akie reef. No mineralization has been reported from this property (Pride, 1980c).

TIMING OF MINERALIZATION

The timing of Devonian barite-sulphide mineralization in the Gataga district is discussed in Irwin (1990) and Paradis *et al.* (1998). They conclude that the deposits formed in a stratigraphic sequence

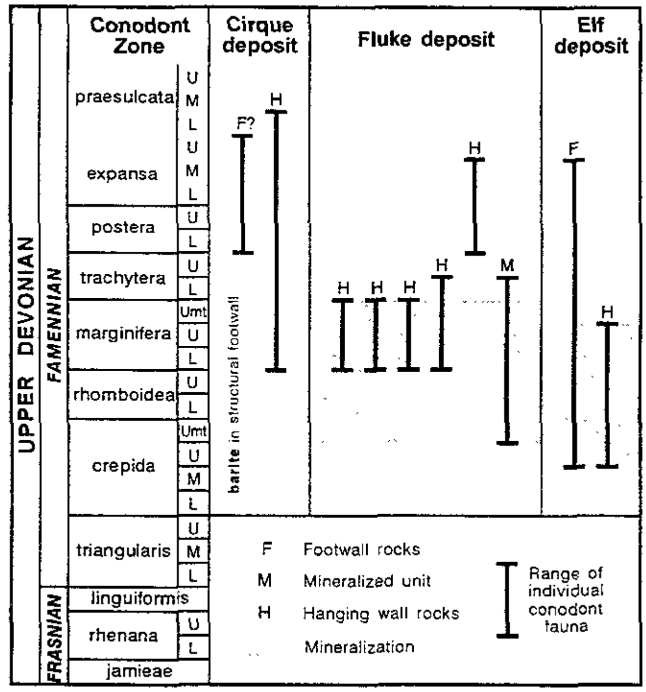


Figure 20. Conodont range for Famennian faunas recognized in the Akie River district. Figure modified from Paradis *et al.*, 1998. Abbreviations: L=Lower, M=Middle, U=Upper and Umt=Uppermost.

from which conodont species and assemblages range in age from the Upper *triangularis* Zone to the Lower *praesulcata* Zone of the early to late Famennian, a time span of no more than 7 million years (Figure 20). Barite beds stratigraphically below the Cirque deposit contain the ammonoid *Ponticeras* (Jefferson *et al.* 1983), an index fossil for the earliest Late Devonian (Frasnian) and a limestone bed in the footwall sequence of the Pesika barite deposit yielded a conodont fauna of similar age, further evidence that barite-sulphide mineralization in the district is Frasnian or younger. In the Driftpile Creek area barite-sulphide beds are bracketed by Famennian conodonts (Irwin and Orchard, 1989; Irwin 1990) and a similar age is implied for deposits of the southern part of the district. By contrast deposits of the Macmillan Pass district are Frasnian in age (Irwin and Orchard, 1989) implying slightly different timing for deposition of barite and sulphide in the Selwyn Basin and Kechika Trough.

CHAPTER 5 REGIONAL METALLOGENY

Formation of sedimentary exhalative deposits occurred during specific time periods in the evolution of the earth's crust (Large, 1980). One of the most important of these was the Devono-Mississippian, which is well represented in the Selwyn Basin and Kechika Trough of the Canadian Cordillera (Carne and Cathro, 1982; Abbott *et al.*, 1986; Turner, 1988; Nelson and MacIntyre, 1989; Dawson *et al.*, 1996). The global nature of this metallogenic event implies a common link in the formation of sedimentary exhalative deposits. The almost universal association of these deposits with periods of rifting within intracratonic to marginal restricted marine basins suggests correlation with periods of crustal attenuation and basin subsidence. This subsidence resulted in the formation of restricted second and third order basins with stagnant water columns that were favourable sites for the ponding of exhaled brines and formation of sulphide and barite beds on the seafloor (Goodfellow, 1987).

SEDIMENTARY ENVIRONMENT

Within the outer miogeocline of Selwyn Basin and Kechika Trough, sedimentary exhalative barite and barite-sulphide deposits are hosted by blue-grey weathering siliceous shales and carbonaceous cherts of the Middle to Late Devonian Lower Earn Group. These rocks have a low percentage of detrital material and accumulated slowly, possibly at rates as low as 40 centimetres per million years (Jefferson *et al.*, 1983). The high silica content of the host rocks is probably due to diagenetic alteration of tests of siliceous organisms such as radiolarians (Pigage, 1986). The high carbon content is consistent with low sedimentation rates and an anoxic sedimentary environment. Laminae and nodules of barite, pyrite and carbonate are also widespread, particularly near the top of the Gunsteel formation, and are positive indicators of a favourable depositional environment for sedimentary exhalative deposits. Barite deposits are widespread in time equivalent strata throughout the Cordillera (Murchey and Madrid, 1987).

RIFT ASSOCIATION

In the Selwyn Basin and Kechika Trough, formation of sedimentary exhalative deposits typically coincided with periods of crustal extension and rifting as indicated by rapid facies changes, sudden appearance of intraformational slump breccias, conglomerates and coarse clastic turbidites, rapid thickening of sedimentary units and local submarine volcanic activity (Abbott *et al.* 1986). These rifting events occurred near the end of an extensive period of starved basin sedimentation and shallow water carbonate build-up.

During periods of extension and basinal subsidence, listric normal faults often develop in the attenuated crust (Coward, 1986; Lister *et al.*, 1986) producing linear half grabens that are ideal sites for the accumulation of exhaled brines. The geometry of the listric faults provides natural channelways for the migration of intraformational brines to the seafloor. The type of deposit formed would depend on the physiochemical conditions at the site of exhalation. For example, shale-hosted deposits would form if discharge occurred in a starved basin environment whereas carbonate-hosted deposits might form if the fluids were discharged into a carbonate rich shelf environment. The formation of Mississippi Valley type deposits might also accompany brine expulsion if the fluid channelways intersected solution cavities in carbonate banks along the margins of the basin (Jackson and Beales, 1967). This may explain the diversity of sedimentary environments in which the sedimentary exhalative deposits are found and why both sedimentary exhalative and Mississippi Valley type deposits are found in the same districts. The conditions at the discharge site, for example, sulphidic versus oxygenated seawater, may control whether barite-rich or sulphide-rich deposits are formed.

In the Gataga district, evidence for both synsedimentary faulting and the original configuration of the sub-basins hosting barite-sulphide deposits is difficult to determine because of intense folding and thrust imbrication of the host rocks. However, the trend of many of these thrust faults is parallel to that of the carbonate reefs and other major facies boundaries within the basin. This suggests the thrusts are reactivated listric normal faults that originally bounded tilted fault blocks. Northeast-directed compression of the trough has resulted in shortening and imbrication of the Paleozoic rocks and their contained barite-sulphide deposits (McClay *et al.*, 1988, 1989).

TIMING OF MINERALIZATION AND TECTONIC EVOLUTION

The timing of Late Devonian sedimentary exhalative mineralization in the Selwyn Basin and the Kechika Trough is roughly coincident with the end of starved basin sedimentation and the beginning of a major tectonic event that greatly modified the pattern of continental margin sedimentation from Alaska to Mexico. Known as the Caribooan or Antler orogeny it is recognized in Selwyn Basin and Kechika Trough by the sudden appearance of coarse clastic turbidites derived, for the first time, from westerly and northerly source areas (Struik, 1981, 1987; Gordey *et al.*, 1987; Thompson *et al.*, 1987; Eisbacher, 1983). Within the outer miogeocline, rapid facies changes, eastward prograding clastic wedges of chert pebble conglomerate, slump breccias and anomalous

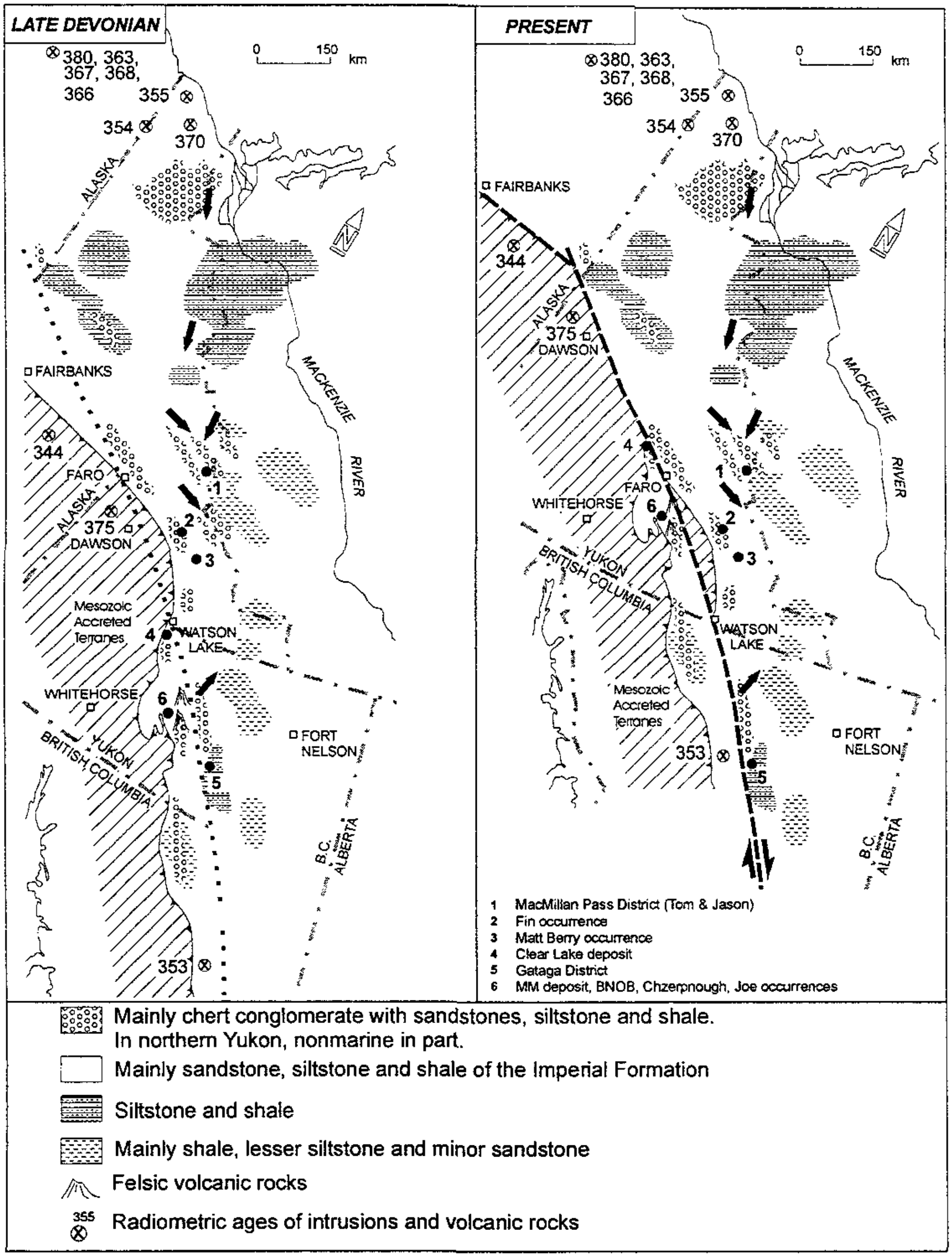


Figure 21. Late Devonian paleogeography and current configuration of Selwyn Basin and Kechika Trough. Also shown are paleocurrent directions and location of radiometric age date sample. Modified from Abbott et al., (1986).

thickening of sedimentary sequences are typical of the Upper Earn group. These features are evidence of extensive uplift and erosion along the western margin of the basin (Figure 21). Alkalic volcanism, emplacement of plutons and formation of volcanogenic massive sulphide deposits accompanied this tectonic event, particularly in the outer miogeocline (Mortenson, 1982: Mortenson and Godwin, 1982; Okulitch, 1985).

Contemporaneous with uplift and coarse clastic sedimentation within the outer miogeocline, deposition of fine-grained clastic sediment and chert advanced progressively eastward across the carbonate platform.

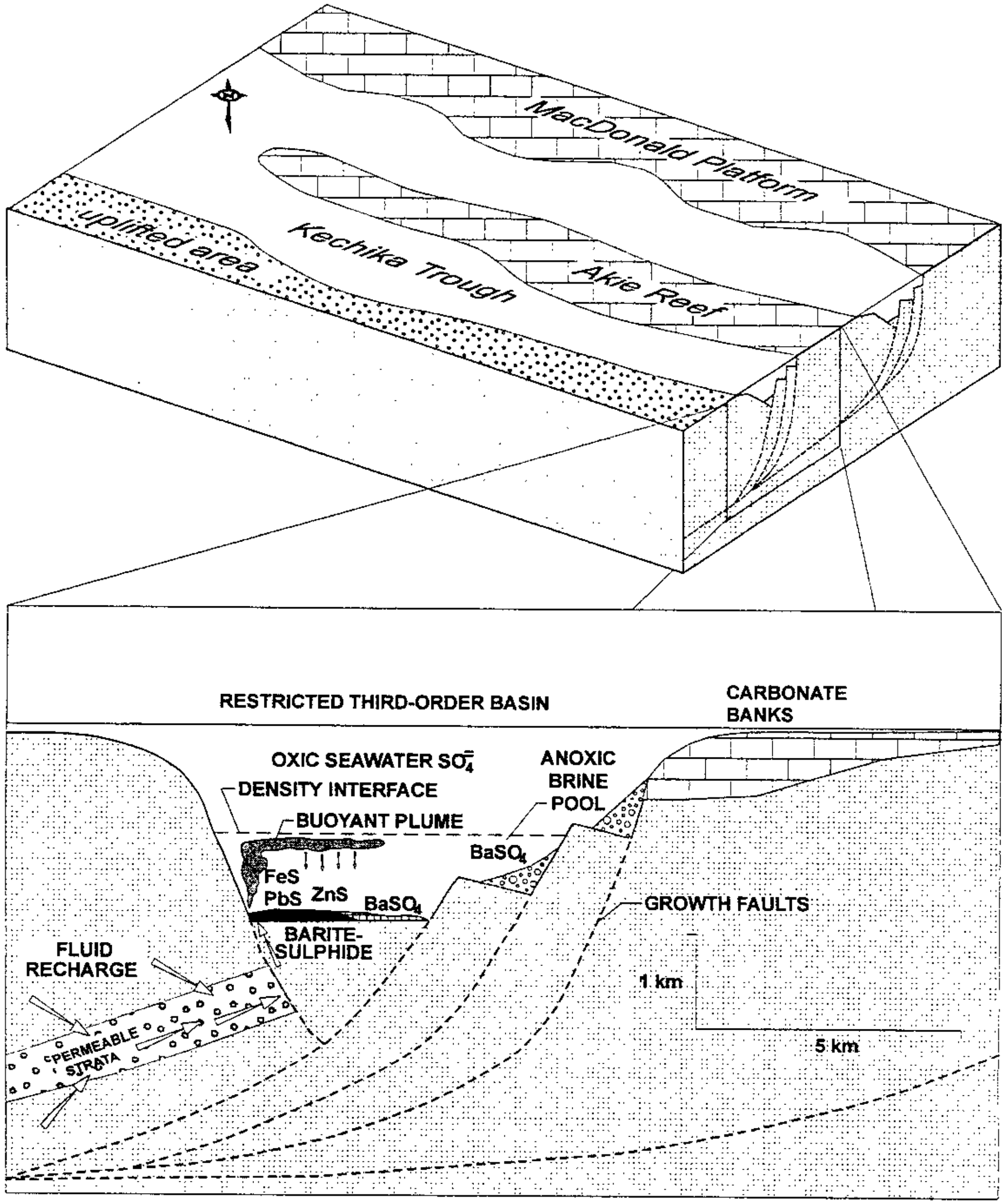


Figure 22. Late Devonian paleogeographic setting of the Gataga district and proposed genetic model for formation of sedimentary exhalative deposits in the district.

This suggests a front of basinal subsidence and subsequent rifting advanced eastward in Late Devonian to Mississippian time. Formation of sedimentary exhalative deposits may have accompanied this tectonic front in response to elevated heat flows and escape of brines from subterranean reservoirs.

PALEOGEOGRAPHIC RECONSTRUCTION

The facies relationships that have been defined in the Gataga district suggest the Middle to Late Devonian paleogeographic reconstruction shown in Figure 22. In this model the barite-sulphide deposits formed in restricted troughs or grabens that were separated by uplifted areas. In the southern part of the district, carbonate banks developed along these uplifted blocks to form the Akie and Pesika reefs. These reefs bounded a northwest-trending trough that was the site of starved basin sedimentation and barite-sulphide mineralization. Adjacent troughs, which may have been shallower, lack significant concentrations of sulphides but host important stratiform barite deposits. Growth faults bounding these troughs may also have been the site of higher heat flow thus favouring hydrothermal convection. A similar model has been proposed by Turner and Einaudi (1986) for formation of deposits in the Macmillan Pass district. The paleotectonic setting of the Gataga district is similar to that described for the Meggan and Rammelsberg district of Germany (Krebs, 1981; Large, 1986).

CHAPTER 6 DISCUSSION

GENETIC MODELS

Gustafson and Williams (1981), Large (1981,1983), Morganti (1981) and others have reviewed the geologic characteristics and genetic models for sedimentary exhalative deposits. The physiochemical controls on formation of the deposits have been discussed by Finlow-Bates (1980), Russell *et al.* (1981), Russell (1983), Lydon (1983), Lydon *et al.* (1986), and Goodfellow and Jonasson (1986a,b). The consensus amongst these authors is that the deposits form by precipitation of sulphide and sulphate minerals from metalliferous brines exhaled along active submarine faults. Metals and fluids are most likely derived from the sedimentary pile either by normal dewatering during basin subsidence or by hydrothermal leaching during periods of elevated heat flow and convective circulation of seawater through the sedimentary pile. These conclusions are consistent with the model proposed for formation of the deposits of the Gataga district (Figure 22).

Two modern day submarine geothermal systems are often cited as examples of the processes that may have formed ancient sedimentary exhalative deposits - Guaymas Basin and the Red Sea. The former involves focused discharge above sills emplaced into a wet sedimentary pile. Sulphide mounds accumulate at the discharge point by chimney growth, collapse and replacement (Koski, 1986; von Dame, 1986). Recharge of the convection cell takes place along faults that bound the pull-apart basin (Lonsdale and Becker, 1985). Although this model appears valid for some sedimentary exhalative deposits, it is unlikely to be applicable to the Gataga district because of the absence of coeval magmatic rocks, footwall hydrothermal alteration and stockwork feeder zones. Further, the generally fine-grained, interlaminated relationship of barite and sulphides is not consistent with a model that involves the buildup and internal replacement of mineralogically zoned sulphide mounds near a focused discharge site. A more likely model is that the deposits formed by alternating sulphide and sulphate precipitation from a metal rich brine pool. In this model metal-bearing, heated brines are discharged from fault-controlled vents that bound a half graben and give rise to buoyant plumes that spread laterally below a density interface (Figure 22). Barite and sulphide are precipitated from this plume in response to the physiochemical conditions of the depositional basin, for example availability of reduced sulphur. In this way thin laminae of barite and sulphide can be deposited over a relatively wide area. This is more like the modern Red Sea system where brines are periodically exhaled into an anoxic submarine brine pool or deep, and precipitate sulphide, oxide, sulphate and carbonate minerals in response to changing brine pool chemistry and the degree of mixing with the overlying oxic water column (Shanks and Bischoff, 1980; Zierenberg and Shanks, 1986). The brine pools have dissolved metal concentrations much in excess of reduced sulfur, are accumulating precipitated sediment at a rate of 100 centimetres per 1000 years (compared to 5 to 10 centimetres per 1000 years for clastic sediment elsewhere in the Red Sea) and are devoid of any biologic activity. Influx of new brine results in soft sediment disruption of the metalliferous sediment near the vent site and formation of epigenetic veins in underlying strata. Slump breccias and soft sediment deformation are triggered by tectonic activity along the steep graben walls that bound the deep.

Although the Red Sea system is a plausible analogue for formation of the sedimentary exhalative deposits of the Gataga district, there are some important differences. The Red Sea is believed to be floored by basaltic rocks and a sheeted dike complex generated by spreading along an axial rift trough. Also, the metalliferous sediments precipitated in the Atlantis II deep are copper and zinc rich and have low lead and barium concentrations. This probably reflects interaction of hydrothermal fluids with basalts flooring the trough, a conclusion that is also supported by isotopic ratios (Zierenberg and Shanks, 1986). By contrast, there is no evidence for Late Devonian magmatic activity within the Kechika Trough, although there is a belt of Middle Ordovician submarine volcanics that is probably rift related. The very high salinities of the Red Sea brine pools are also atypical and probably result from dissolution of evaporites within the area of fluid recharge.

SOURCE OF METALS

The zinc, lead and barium that characterize sedimentary exhalative deposits formed in intracratonic and marginal basins is believed to be derived from the underlying sedimentary pile or crystalline basement rocks (Badham, 1981). This conclusion is based on the general absence of a magmatic source in most areas and the relatively radiogenic nature of lead and strontium in these deposits, which suggests an upper crustal origin (Godwin and Sinclair, 1982; Godwin *et al.*, 1982; Modene and Ryan, 1986). Interaction of heated basinal fluids with clastic material derived from a cratonic source could produce radiogenic fluids rich in iron, lead, zinc and barium.

Lydon *et al.* (1986) proposed a model for formation of the Macmillan Pass deposits that derives the mineralizing fluids and contained metals from the Hadrynian Grit unit that is believed to lie 2 to 5 kilometres below this part of Selwyn Basin. Elsewhere in Selwyn Basin, extensive albitization of feldspar in the Grit unit has been observed, suggesting this unit may have acted as a permeable reservoir or aquifer for heated brines. These grits also have radiogenic $Sr^{87/86}$ values similar to those found in carbonate and barite associated with sedimentary exhalative deposits, further supporting this hypothesis (Goodfellow and Jonasson, 1986a,b). The Hadrynian grits may also be the source of metals for deposits of the Gataga district.

If heated, metalliferous brines originated from deep-seated reservoirs, their circulation and escape was probably triggered by periods of rifting and basinal subsidence. Elevated heat flow would accompany such crustal attenuation and would be highest along major rifts. Convective circulation near the seafloor could result in recharge and mixing of sulphate bearing seawater with the escaping brines; this would dilute and cool the fluids in the subsurface. In this way seawater sulphate could be added to the fluid system near its discharge point, providing the necessary components to precipitate sulphate minerals in the vent zone. This model is favoured for formation of epigenetic barite at the Cirque deposit.

SOURCE OF SULPHUR

Heavy $\delta^{34}S$ values in sulphide and sulphate mineral phases, similar to those obtained by Lowey (1984) are believed to be due to progressive reduction of sulphate to H_2S within a restricted, possibly stratified anoxic water column. The heavy values result from preferential removal of ^{32}S by formation of diagenetic pyrite and related phases. This model is consistent with the host lithologies of the Gataga deposits, which also indicate a starved, strongly reducing basinal environment.

Some of the heaviest $\delta^{34}S$ values obtained by Lowey (1984) were from nodular barite located near the top of the Gunsteel section. This barite, which is probably early diagenetic in age probably precipitated from pore waters. Such waters tend to be become extremely enriched in ^{34}S due to removal of ^{32}S by pyrite precipitation during sediment compaction and lithification.

NATURE OF MINERALIZING FLUIDS

No fluid inclusion studies have been done on deposits of the Gataga district. However, studies at other sedimentary exhalative deposits indicate the mineralizing fluids had salinities in the 4 to 29 weight percent NaCl range and were between 200°C and 250°C. Gardner and Hutcheon (1985) obtained salinities ranging from 4 to 14 weight percent, with a mean of 9.1 weight percent for the Jason deposit. A brine of this temperature and moderate salinity would be quite buoyant and would rise as a plume above the site of exhalation. If the brine pool was stratified, the plume would spread out beneath the density interface and upon cooling and mixing with seawater, precipitate sulphide and barite over a wide area.

Turner *et al.* (1989) determined strontium isotope ratios of carbonate and barite samples from the Jason deposit of the Macmillan Pass district and concluded that barite precipitated by mixing of hydrothermal fluid with a stable brine pool.

The presence of pyrobitumen in many sedimentary exhalative deposits, including epigenetic barite at the Cirque, is probably due to cracking of detrital organic material in host sediments by contact with heated brines (Simoneit and Lonsdale, 1982; Simoneit, 1986).

EXPLORATION GUIDELINES

Sedimentary exhalative deposits are restricted to intracratonic basins and miogeoclines older than Mid Paleozoic. As we have discussed, this type of deposit formed at certain time periods in the evolution of the earth's crust and our next challenge is to outline the extent of rocks of appropriate age. Good geologic mapping and paleontological studies are critical to this task. Next, within the belts of appropriate age, there is a need to focus on favourable lithologies that might indicate a rifted, starved basin environment, for example, highly reduced carbonaceous siliceous shales, cherts and pelagic limestones. The occurrences of laminae and disseminations of pyrite and/or barite in these rocks would be favourable indicators of exhalative activity within the basin.

Sedimentary exhalative deposits are often associated with rifting and subsidence within the host basin. Evidence for such tectonic activity includes rapid facies changes, anomalous thickening of sediments, sudden appearance of lenses of intraformational breccias and conglomerates within a starved basin succession, and onset of rift related submarine volcanism. Many sedimentary exhalative deposits are located at or near the transition from starved basin sedimentation to open marine turbidite deposition and this contact also represents a favourable target. In the Gataga district this transition is the contact between the Gunsteel and Akie formations.

Perhaps one of the best indicators of a favourable tectonic setting is the occurrence of a major fault zone. Compression of a rifted continental margin sequence, especially where half grabens have developed as a result of listric normal faulting, would naturally result in localization of fault movement along existing zones of structural weakness. The present configuration of major thrust faults in the Gataga district may reflect reactivations of ancient continental margin rifts that were important in the localizing sedimentary exhalative deposits. The fact that many of the major deposits in the district, including the Cirque, occur in panels of Earn Group rocks that lie beneath major southwest dipping imbricate thrust faults supports this conclusion. The areas adjacent to major thrust faults in the district should be thoroughly prospected for evidence of sedimentary exhalative activity.

CONCLUSION

The geology and mineral deposits of the Gataga district suggest;

1. exhalative activity occurred during the Middle Ordovician, Early Silurian and Late Devonian periods;
2. the barite-sulphide deposits formed in anoxic, starved sub-basins within a subsiding trough;
3. exhalative centers were localized along rifts that were later reactivated as thrust faults;
4. the statiform barite-sulphide and barite deposits of the district formed by repeated exhalation of relatively buoyant, metal-bearing basinal fluids into a stratified brine pool occupying a fault-bounded seafloor depression (modified Red Sea model);
5. the metals were probably derived from Hadrynian arkosic grits that acted as reservoirs and aquifers for expelled pore fluids. These fluids migrated upward to the seafloor when growth faults tapped the reservoirs.

REFERENCES

Abbott, J.G., Gordey, S.P. and Tempelman-Kluit, D.J., (1986): Setting of stratiform, sediment-hosted Pb-Zn deposits in Yukon and Northeastern British Columbia, *in* Mineral Deposits of Northern Cordillera, J. Morin (editor); *Canadian Institute of Mining and Metallurgy*, Special Volume 37, pages 1-18.

Andrew, C.J. and Ashton, J.H. (1985): Regional setting, geology and metal distribution patterns of Navan orebody, Ireland, Transactions of the Institution of Mining and Metallurgy, volume 94, pages B66-B93.

Badham, J.P.N., (1981): Shale-hosted Pb-Zn deposits: products of exhalation of formation waters?; *Transactions of the Institute of Mining and Metallurgy*, Section B., volume 90, pages B70-B76.

Baxter, P., Kapusta, J., Morrison, I., and Wells, G. (1996): Cardiac Creek Zn-Pb-Ag deposit, Akie property (abstract); Cordillera Roundup, 1996, *British Columbia-Yukon Chamber of Mines*, Abstracts, pages 1-2.

Campbell, R.B., (1967): Reconnaissance geology of Glenlyon map area, Yukon Territory; *Geological Survey of Canada*, Memoir 352.

Carne, R.C. (1978): Driftpile lead-zinc district; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 6666.

Carne, R.C. and Cathro, R.J., (1981): Sedimentary exhalative (sedex) Zn-Pb-Ag deposits, northern Canadian Cordillera; *Canadian Institute of Mining and Metallurgy*, Bulletin 75, pages 66-78.

Cathles, L.M., (1986): A tectonic/hydrodynamic view of basin-related mineral deposits, *in* The Genesis of Stratiform Sediment-Hosted Lead and Zinc Deposits: Conference Proceedings, R.J.W. Turner and M.T. Einaudi, (editors); *Stanford University Publications*, p.171-174

Cecile, M.P. and Norford, B.S., (1979): Basin to platform transition, Lower Paleozoic strata of Ware and Trutch map areas, northeastern British Columbia; Current Research, Part A, *Geological Survey of Canada*, Paper 79-1A, pages 219-226.

Cecile, M.P., Shakur, M.A., and Krouse,H.R., (1983): The isotopic composition of western Canadian barites and the possible derivation of oceanic sulphate ^{34}S and ^{18}O age curves; *Canadian Journal of Earth Sciences*, volume 20, pages 1528-1535.

Claypool, C.E., Holster, W.T., Saki, I.R. and Zak, I., (1980): The age curves for sulphur and oxygen isotopes in marine sulfate and their mutual interpretation; *Chemical Geology*, volume 28, pages 199-260.

Coutellier, G.R., (1980): Geological and geochemical report on the Akie Group, Akie River Area; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8478, 6 pages.

Coward, M.P., (1986): Heterogeneous stretching, simple shear and basin development; *Earth and Planetary Science Letters*, volume 80, pages 325-336.

Davies, E.J.L., (1966): Ordovician and Silurian of the northern Rocky Mountains between Peace and Muskwa rivers, British Columbia, unpublished Ph.D. thesis; *University of Alberta.*

Dawson, K.M. and Orchard, M.J., (1981): Regional metallogeny of the Northern Cordillera: biostratigraphy, correlation and metallogenic significance of bedded barite occurrences in eastern Yukon and western District of Mackenzie, Current Research, Part C; *Geological Survey of Canada*, Paper 82-1C, pages 31-35.

Dawson, K.M., Panteleyev, A., Sutherland Brown, A. and Woodsworth, G.J (1996): Regional Metallogeny, Chapter 19 *in* Geology of the Cordilleran Orogen in Canada, H.Gabrielse and C.J. Yorath (editors); *Geological Survey of Canada*, Geology of Canada, number 4, pages 707-768 (also, *Geological Society of America*, The Geology of North America, volume G-2)

Eisbacher, G.H., (1983): Devonian-Mississippian sinistral transcurrent faulting along the cratonic margin of western North America: A hypothesis; *Geology*, v.11, pages 7-10.

Finlow-Bates, T., (1980): The chemical and physical controls on the genesis of submarine exhalative orebodies and their implications for formulating exploration concepts - a review; *Geologische Jahrbuch*, volume 40, p.131-168.

Fritz, W.H., (1979): Cambrian stratigraphy in the northern Rocky Mountains, British Columbia; *in* Current Research, Part B, *Geological Survey of Canada*, Paper 79-1B, pages 99-109.

Gabrielse, H., (1961): Geological map of the Kechika map area, *Geological Survey of Canada*, Open File Report 483

Gabrielse, H., (1975): Geology of Fort Grahame (East 1/2) map area, British Columbia: *Geological Survey of Canada*, Paper 75-33.

Gabrielse, H., (1977): Geological map of Ware (West 1/2) and Toodoggone river map-areas; *Geological Survey of Canada*, Open File Report 483.

Gabrielse, H., (1981): Stratigraphy and structure of Road River and associated strata in Ware (west half) map area, northern Rocky Mountains, British Columbia; *in* Current Research, Part A, *Geological Survey of Canada*, Paper 81-1a, pages 201-207.

Gabrielse, H., (1984): Major dextral transcurrent displacements along the northern Rocky Mountain trench and related lineaments in north-central British Columbia; *Geological Society of America Bulletin*, volume 96, pages 1-24

Gardner, H.D. and Hutcheon, I., (1985): Geochemistry, mineralogy and geology of the Jason Pb-Zn deposits, Macmillan Pass, Yukon, Canada; *Economic Geology*, volume 80, pages 1257-1276.

Godwin, C.I. and Sinclair, A.J., (1981): Average lead isotope growth curves for shale-hosted zinc-lead deposits, Canadian Cordillera; *Economic Geology*, volume 77, pages 675-690

Godwin, C.I., Sinclair, A.J. and Ryan, B.J., (1981): Lead isotope models for the genesis of carbonate-hosted Zn-Pb, shale-hosted Ba-Zn-Pb, and silver-rich deposits in the northern Canadian Cordillera; *Economic Geology*, volume 77, pages 82-94

Goodfellow, W.D. and Jonasson, I.R., (1984): Ocean stagnation and ventilation defined by $\delta^{34}S$ secular trends in pyrite and barite, Selwyn Basin, Yukon; *Geology*, volume 12, pages 583-586.

Goodfellow, W.D. and Jonasson, I.R., (1986a): Geology and geochemistry of the Howards Pass Zn-Pb Deposits, Yukon: Constraints on metal source, migration and concentration; *in* The Genesis of Stratiform Sediment-Hosted Lead and Zinc Deposits: Conference Proceedings, R.J.W. Turner and M.T. Einaudi, (editors), *Stanford University Publications*, pages 22-29

Goodfellow, W.D., (1987): Anoxic stratified oceans as a source of sulphur in sediment-hosted stratiform Zn-Pb Deposits (Selwyn Basin, Yukon, Canada); *Chemical Geology*, volume 65, pages 359-382.

Goodfellow, W.D., and Jonasson, I.R., (1986b, Environment of formation of the Howards Pass (XY) Zn-Pb Deposit, Selwyn Basin, Yukon; *in* Mineral Deposits of Northern Cordillera, J. Morin (editor), *Canadian Institute of Mining and Metallurgy*, Special Volume 37, pages 19-50.

Gordey, S.P., (1981): Stratigraphy, structure and tectonic evolution of southern Pelly Mountains in the Indigo Lake area, Yukon Territory, *Geological Survey of Canada*, Bulletin 318, 44 pages.

Gordey, S.P., Abbott, J.G., and Orchard, M.J., (1981): Devono-Mississippian (Earn Group) and younger strata in east-central Yukon; *in* Current Research, Part B, *Geological Survey of Canada*, Paper 82-1B, pages 93-100.

Gordey, S.P., Abbott, J.G., Templeman-Kluit, D.J. and Gabrielse, H., (1987): "Antler" clastics in the Canadian Cordillera; *Geology*, volume 15, pages 103-107.

Gorzynski, G.A., (1986): Geology and lithogeochemistry of the Cirque stratiform sediment-hosted Ba-Zn-Pb-Ag deposit, northeastern British Columbia; unpublished M.Sc. thesis, *University of British Columbia*, Vancouver, 129 pages

Gustafson, L.B. and Williams, N., (1981): Sediment-hosted stratiform deposits of copper, lead, and zinc; *Economic Geology*, 75th Anniversary Volume, pages 139-178

Gwosdz, W., and Krebs, W., (1977): Manganese halo surrounding Meggan ore deposit, Germany; *Transactions of the Institute of Mining and Metallurgy*, Section B, 86: B-673-677

Heather, K.B., (1981): Ordovician geology and related bedded barite occurrences of the Driftpile Creek - Akie River region of northwestern B.C.; unpublished B.Sc. thesis, *University of British Columbia*, Vancouver, 141 pages

Hodgson, G.D., (1980): Dog claims, Omineca M.D., Geology, 1980; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8673, 7 pages.

Hodgson, G.D., (1980a): Wil claims: Geology and geochemistry; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8316, 10 pages

Hodgson, G.D., (1980b): Yule claims, B.C., Omineca M.D., Geology, geochemistry and geophysics, 1980; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8608, 11 pages.

Hodgson, G.D. and Thompson, J.F.H., (1980): Pie Claims, B.C., Omineca M.D., Geology, drilling, etc. 1980; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8647

Irvine, T.N. and Barager, W.R.A. (1971): A guide to the chemical classification of the common volcanic rocks; *Canadian Journal of Earth Sciences*, volume 8, pages 523-548.

Irwin, S.E.B., (1990): Late Devonian conodont biostratigraphy of the Earn Group with age constraints for stratiform mineral deposits, Selwyn and Kechika basins, northern British Columbia and Yukon; unpublished M.Sc. thesis, *University of British Columbia*, 311 pages

Irwin, S.E.B. and Orchard, M.J., (1989): Conodont biostratigraphy and constraints on Upper Devonian mineral deposits in the Earn Group, northern British Columbia and Yukon; *in* Current Research, Part E, *Geological Survey of Canada*, Paper 89-1E, pages 13-19.

Jackson, S.A. and Beales, F.W., (1967): An aspect of sedimentary basin evolution: the concentration of Mississippi Valley-type ores during late stages of diagenesis; *Bulletin of Canadian Petroleum Geology*, volume 15, pages 383-433.

Jackson D.E., Steen, B., and Sykes, D., (1965): Stratigraphy and graptolite zonation of the Kechika and Sandpile groups in northeastern British Columbia; *Bulletin of Canadian Petroleum Geology*, volume 13, pages 139-154.

Jefferson, C.W., Kilby,D.B., Pigage, L.C. and Roberts, W.J., (1983): The Cirque barite-lead-zinc deposits, northeast British Columbia; *in* Short Course in Sediment-hosted Stratiform Lead-zinc Deposits, D.F. Sangster, (editor), *Mineralogical Association of Canada*, pages 121-140

Jensen, S. (1993): Geological, geochemical and geophysical assessment report on the Mt. Alcock property, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 22787.

Koski, R.A., (1986): Character and Mineralogy of Hydrothermal Deposits, Guaymas Basin Geothermal System; *in* The Genesis of Stratiform Sediment-Hosted Lead and Zinc Deposits: Conference Proceedings, R.J.W. Turner and M.T. Einaudi, (editors), *Stanford University Publications*, pages 125-128

Krebs, W., (1981): The geology of the Meggen ore deposit; *in* Handbook of Strata-Bound and Stratiform Ore Deposits, K.H. Wolfe (editor), *Elsevier Scientific Publishing Co.*, Amsterdam, pages 509-549.

Large, D., (1986): The paleotectonic setting of Rammelsberg and Meggan, Germany: A basin analysis study; *in* The Genesis of Stratiform Sediment-Hosted Lead and Zinc Deposits: Conference Proceedings, R.J.W. Turner and M.T. Einaudi, (editors), *Stanford University Publications*, pages 109-112.

Large, D.E., (1980): Geological parameters associated with sediment-hosted, submarine exhalative Pb-Zn deposits: an empirical model for mineral exploration; *Geologische Jahrbuch*, volume 40, pages 59-129.

Large, D.E., (1981): Sediment-hosted submarine exhalative sulphide lead-zinc deposits - a review of their geological characteristics and genesis; *in* Handbook of Stratabound and Stratiform Ore Deposits, K.E. Wolfe, (editor), *Elsevier Scientific Publishing Co.*, Amsterdam, pages 459-507.

Large, D.E., (1983): Sediment-hosted massive sulphide lead-zinc deposits; *in* Short Course in Sedimentary Stratiform Lead-zinc Deposits, D.F. Sangster, (editor), *Mineralogical Association of Canada*, pages 1-29.

Lister, C.S., Etheridge, M.A., and Symonds, P.A., (1986): Detachment faulting and the evolution of passive continental margins; *Geology*, volume 14, pages 246-250.

Lomenda, M., (1982 Reb Claims; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 10831.

Lonsdale, P.F. and Becker, K., (1985): Hydrothermal plumes, hot springs and conductive heat flow in the Southern Trough of Guaymas basin; *Earth Planetary Science Letters*, volume 73, pages 211-225.

Lowey, J.F., (1984): A lithogeochemical study of the Akie Ba-Pb-Zn mineral district, northeastern, British Columbia; unpublished M.Sc. thesis, *University of Calgary*, 175 pages.

Lydon, J.W., (1983): Chemical parameters controlling the origin and deposition of sediment-hosted, stratiform lead-zinc deposits; *in* Short Course in Sedimentary Stratiform Lead Zinc Deposits, D.F. Sangster, (editor), *Mineralogical Association of Canada*, pages 175-250.

Lydon, J.W., Goodfellow, W.D. and Jonasson, I.R., (1986): Stratiform baritic deposits of the Selwyn Basin: Geology, geochemistry, and genesis; *in* The Genesis of Stratiform Sediment-Hosted Lead and Zinc Deposits: Conference Proceedings, R.J.W. Turner and M.T. Einaudi, (editors), *Stanford University Publications*, pages 99-103.

MacIntyre, D.G. and Diakow, L., (1981): Kwadacha barite deposit; Geological Fieldwork 1981, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1982-1, pages 149-155.

MacIntyre, D.G., (1980): Driftpile Creek - Akie River project; Geological Fieldwork 1979, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1980-1, pages 55-67.

MacIntyre, D.G., (1981): Geology of the Akie river Ba-Pb-Zn mineral district; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Preliminary Map 44.

MacIntyre, D.G., (1981): Geologic setting of recently discovered stratiform barite-sulphide deposits in northeast British Columbia; *Canadian Institute of Mining and Metallurgy Bulletin*, volume 75, no. 80, pages 99-113.

MacIntyre, D.G., (1983): Geology and stratiform barite-sulphide deposits of the Gataga District, northeastern British Columbia; *in* Short Course on Sediment Hosted Stratiform Lead-Zinc Deposits, D.F. Sangster (editor), *Mineralogical Association of Canada*, pages 85-120.

MacIntyre, D.G. (1991): Sedex - Sedimentary-exhalative deposits, in Ore Deposits, Tectonics and Metallogeny in the Canadiamn Cordillera, W.J. McMillan, (coordinator), *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1991-4, pages 25-69.

MacIntyre, D.G. (1992): Geological setting and genesis of sedimentary exhalative barite and barite-sulfide deposits, Gataga district, northeastern British columbia; *Exploration and Mining Geology*, volume 1, pages 1-20.

MacQueen, R.W., and Thompson, R.I., (1978): Carbonate-hosted lead-zinc occurrences in northeastern British Columbia with emphasis on the Robb Lake deposit, *Canadian Journal of Earth Sciences*, volume 15, pages 1737-1762.

McClay, K.R., Insley, M.W. and Anderton, R., (1989): Inversion of the Kechika Trough, northeastern British Columbia, Canada; *in* Inversion Tectonics, Cooper, M.A. and Williams, G.D.

(editors), *Geological Society Special Publications* No. 44, pages 235-257.

McClay, K.R., Insley, M.W., Way, N.A., and Anderton, R., (1988): Tectonics and mineralization of the Kechika Trough, Gataga area, northeastern British Columbia; Current Research, Part E, *Geological Survey of Canada*, Paper 88-1E, pages 1-12.

Modene, J.S. and Ryan, B.D., (1986): Sulphur and lead isotope evidence for formation of stratiform Zn-Pb-Ag deposits by metalliferous brine exhalation into stagnating sulfide-rich bottom-waters, Anvil Range, Yukon; *in* The Genesis of Stratiform Sediment-Hosted Lead and Zinc Deposits: Conference Proceedings, R.J.W. Turner and M.T. Einaudi, (editors), *Stanford University Publications*, pages 94-98.

Morganti, J.M., (1979): The geology and ore deposits of the Howards Pass area, Yukon and Northwest Territories: The origin of basinal sedimentary stratiform sulphide deposits; unpublished Ph.D. thesis, *University of British Columbia*, 317 pages.

Morganti, J.M., (1981): Sedimentary-type stratiform ore deposits; Some models and a new classification; *Geoscience Canada*, volume 8, pages 65-75.

Mortensen, J.A., (1981): Geological setting and tectonic significance of Mississippian felsic metavolcanics rocks in the Pelly Mountains, southeastern Yukon Territory; *Canadian Journal of Earth Sciences*, volume 19, pages 8-22

Mortensen, J.K., and Godwin, C.I., (1981): Volcanogenic massive sulphide deposits associated with highly alkaline rift volcanics in the southeastern Yukon Territory; *Economic Geology*, volume 77, pages 1225-1230

Murchey, B.L. and Madrid R.J., (1987): Paleozoic bedded barite associated with Paleozoic chert in western North America; *in* Siliceous Sedimentary Rock-Hosted Ores and Petroleum, J.R. Hein (editor), *van Nostrand Reinhold Co., Inc.*, New York.

Murrell, M.R., (1981): Geological and geochemical report on the Aikie-Sika Group, Akie river area; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 9911, 4 pages.

Murrell, M.R. and Roberts, W., (1990): Summary Report, 1989 exploration program on the Mt. Alcock property; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report (unnumbered), 23 pages.

Nelson, J. and MacIntyre, D.G., (1989): Metallogeny of northeastern British Columbia; *Geoscience Canada*, volume 15, pages 113-116.

Norford, B.S., (1979): Lower Devonian graptolites in the Road River formation, northern British Columbia, 94B,C,F; Current Research, Part A, *Geological Survey of Canada*, Paper 79-1A, pages 383-384.

Norford, B.S. and Orchard, M.J., (1983): Early Silurian age of lead-zinc mineralization at Howards Pass, Yukon Territory and District of Mackenzie; review of local biostratigraphy of Road River Formation and Earn Group; *Geological Survey of Canada*, Paper 83-18, 16 pages

Norford, B.S., Gabrielse, H., and Taylor, G.C., (1967): Stratigraphy of Silurian carbonate rocks of the Rocky Mountains, northern British Columbia; *Bulletin of Canadian Petroleum Geology*, volume 14, pages 504-519.

Okulitch, A.V., (1985): Paleozoic plutonism in southeastern British Columbia; *Canadian Journal of Earth Sciences*, volume 11, pages 1409-1424.

Paradis, S, Nelson, J.L., and Irwin, S.E.B. (1998): Age constraints on theDevonian shale-hosted Zn-Pb-Ba deposits, Gataga District, Northeastern British Columbia, Canada; *Economic Geology*, volume 93, pages 184-200.

Pearce, J.A. and.Cann, J.R (1973): Tectonic setting of basic volcanic rocks determined using trace element analyses; *Earth and Planetary Science Letters*, volume 19, pages 290-300.

Pearce, J.A.and Norry, M.J., (1979): Petrogenetic Implications of Ti, Zr, Y, and Nb variations in volcanic rocks; *Contributions to Mineralogy and Petrology*, volume 69, pages 33-47.

Pelzer, E.E., (1966): Mineralogy, geochemistry and stratigraphy of the Besa River shale, British Columbia; *Canadian Petroleum Geology Bulletin*, volume 14, pages 273-321.

Pigage, L.C., (1986): Geology of the Cirque barite-zinc-lead-silver deposits, Northeastern British Columbia; *in* Mineral Deposits of Northern Cordillera, J. Morin (editor), *Canadian Institute of Mining and Metalurgy*, Special Volume 37, pages 71-86.

Price, R.A., (1986): The southeastern Canadian Cordillera: thrust faulting, tectonic wedging and delamination of the lithosphere; *Journal of Structural Geology*, volume 9, pages 239-254.

Pride, K.R., (1980): Geological and geochemical report on the Gnome Group, Akie river area; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8334, 5 pages.

Pride, K.R., (1980a): Geological and geochemical report on the Pesika Group, Ospika River area; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8329, 6 pages.

Pride, K.R., (1980b, Geological and geochemical report on the Pelly group, Akie river area; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8451, 5 pages.

Pride, K.R., (1980c, Geological and geochemical report on the Fern Group, Paul River area; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8450, 5 pages.

Pride, K.R., (1981): Geological and geochemical report on the Del Group, Akie river Area; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 9672, 5 pages.

Pride, K.R., (1981a): Geological and geochemical report on the Ern Group, Pesika creek area, Omineca M.D.; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 9905, 11 pages.

Roberts, W.J., (1977): Geological and geochemical report on the Cirque Group; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 6743.

Roberts, W.J., (1979): Geological report on the Elf Group; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 7303, 10 pages.

Roberts, W.J., (1978): Geological and geochemical report on the Fluke Group; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 7270, 14 pages.

Roberts, W.J. and Simpson, J.G., (1980): Geochemical soil sampling on the Gin Claims; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8369, 5 pages.

Russell, M.J., (1983): Major sediment-hosted exhalative zinc + lead deposits: formation from hydrothermal convection cells that deepen during crustal extension; *in* Short Course in Sediment-hosted Stratiform Lead-zinc Deposits, D.F. Sangster, (editor), *Mineralogical Association of Canada*, pages 251-282.

Russell, M.J., Solomon, M., and Walsh, J.L., (1981): The genesis of sediment-hosted, exhalative zinc plus lead deposits; *Mineralium Deposita*, volume 16, pages 113-127.

Shanks, W.C.,III, and Bischoff, J.L., (1980): Geochemistry, sulphur isotope composition, and accumulation rates of Red Sea geothermal deposits, *Economic Geology*, volume 75, pages 445-459.

Simoneit, B.R.T. and Lonsdale, P.F., (1981): Hydrothermal petroleum in mineralized mounds at the seabed of Guaymas Basin; *Nature*, volume 295, page 198.

Simoneit, B.R.T., (1986): Organic Metamorphism and Transport of Hydrocarbons, Guaymas Basin Geothermal System, *in* The Genesis of Stratiform Sediment-Hosted Lead and Zinc Deposits: Conference Proceedings, R.J.W. Turner and M.T. Einaudi, (editors), *Stanford University Publications*, pages 145-148.

Stewart, A.B., (1981 Geology and soil geochemistry report on the Reb 1-8 claims, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 9848, 17 pages.

Struik, L.C., (1981): A re-examination of the type area of the Devono-Mississippian Cariboo Orogeny, central British Columbia; *Canadian Journal of Earth Sciences*, volume 18, pages 1767-1775.

Struik, L.C., (1987): The ancient western North American margin: an Alpine rift model for the East-Central Cordillera; *Geological Survey of Canada*, paper 87-15, 19 pages.

Taylor, G.C., (1979): Geological map of the Ware east half and Trutch map-areas; *Geological Survey of Canada*, Open File Report 609.

Taylor, G.C. and MacKenzie, W.S., (1970): Devonian stratigraphy of northeast British Columbia; *Geological Survey of Canada*, Bulletin 186.

Taylor, G.C. and Stott, D.F., (1973): Tuchodi Lakes map-area, British Columbia; *Geological Survey of Canada*, Memoir 373.

Taylor, G.C., Cecile, M.P., Jefferson, C.W., and Norford, B.S., (1979): Stratigraphy of Ware (east half) map area, northeastern British Columbia; Current Research, Part A, *Geological Survey of Canada*, paper 79-1A, pages 227-231.

Tempelman-Kluit, D.J., (1977): Stratigraphy and structural relations between the Selwyn Basin, Pelly Cassiar Platform, and Yukon Crystalline Terrane in the Pelly Mountains, Yukon; *in* Report of Activities, Part A *Geological Survey of Canada*, paper 76-1A, pages 223-227.

Thompson, R.I., (1981): The nature and significance of large 'blind' thrusts within the northern Rocky Mountains of Canada; *in* Thrust and Nappe Tectonics, McClay, K.R. and Price, N.J. (editors), *Geological Society*, London, pages 449-462.

Thompson, R.I., Mercier, E. and Roots, C., (1987): Extension and its influence on Canadian Cordilleran passive-margin evolution; *in* Continental Extension Tectonics, Coward, M.P., Dewey, J.F. and Hancock, P.L. (editors), *Geological Society of America*, Special Publication 28, pages 409-417.

Turner, R.J.W. and Einaudi, M.T., (1986): The geological setting and genesis of the south zone stratiform Pb-Zn-Barite deposits, MacMillan Pass, Yukon; *in* The Genesis of Stratiform Sediment-Hosted Lead and Zinc Deposits: Conference Proceedings, R.J.W. Turner and M.T. Einaudi, (editors), *Stanford University Publications*, pages 5-10.

Turner, R.J.W., (1988): Massive sulphide deposits of the mid-Paleozoic age; *Mining Review*, volume 8, pages 43-47.

Turner, R.J.W., Goodfellow, W.D. and Taylor, B.E., (1989): Isotopic geochemistry of the Jason stratiform sediment-hosted zinc-lead deposit, Macmillan Pass, Yukon; Current Research, Part E, *Geological Survey of Canada*, Paper 89-1E, pages 21-30.

Von Dame, K.L., (1986): Geochemistry of Fluids in the Guaymas Basin Geothermal System, in The Genesis of Stratiform Sediment-Hosted Lead and

Zinc Deposits: Conference Proceedings, R.J.W. Turner and M.T. Einaudi, (editors), *Stanford University Publications*, p.131-132.

Waters, B.C., (1981): Geology, geochemistry South Kwad Property, Omineca M.D.; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 9727, 8 pages.

Wedepohl, K.H., (1969): Handbook of Geochemistry Volume 1, *Springer-Verlag*, Heidelberg, 442 pages

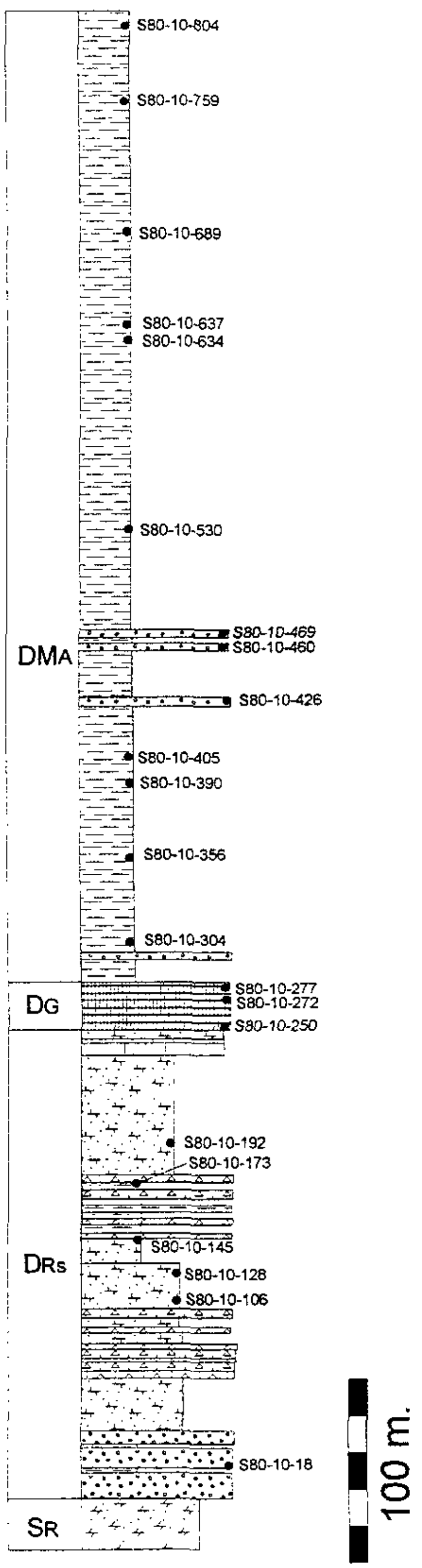
Williams, N. (1976): The formation of sedimentary-type stratiform sulfide deposits, unpublished Ph.D. thesis, *Yale University*, 330 pages.

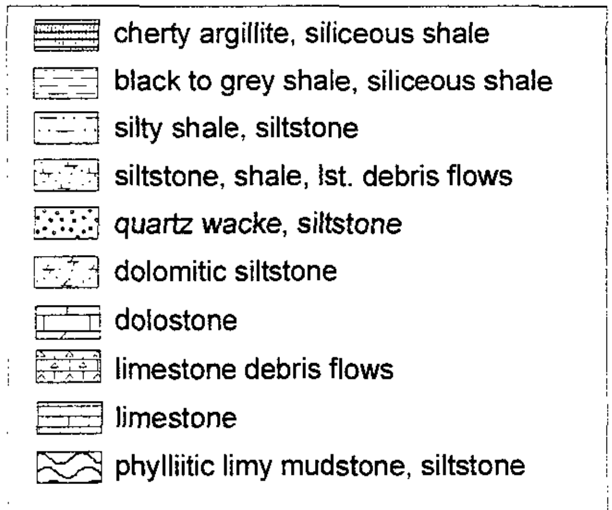
Zierenberg, R.A. and Shanks, W.C., (1986): Genesis of metalliferous sediment in the Atlantis II deep, Red Sea; *in* The Genesis of Stratiform Sediment-Hosted Lead and Zinc Deposits: Conference Proceedings, R.J.W. Turner and M.T. Einaudi, (editors), *Stanford University Publications*, pages 115-117.

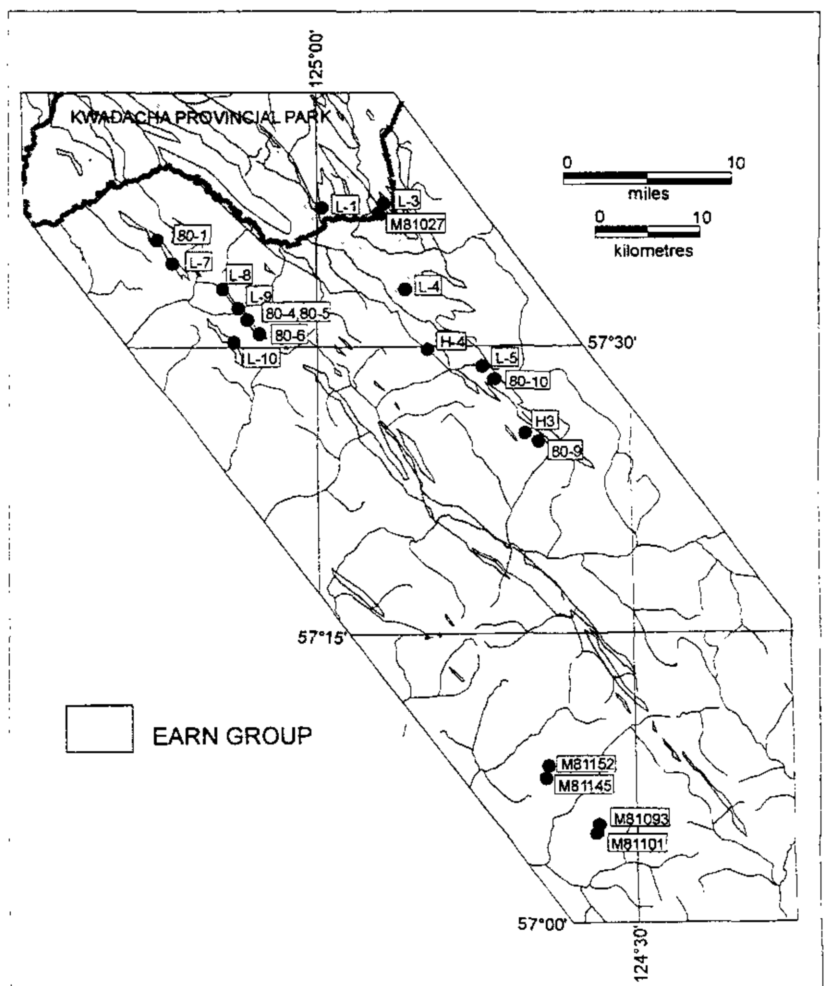
APPENDICES

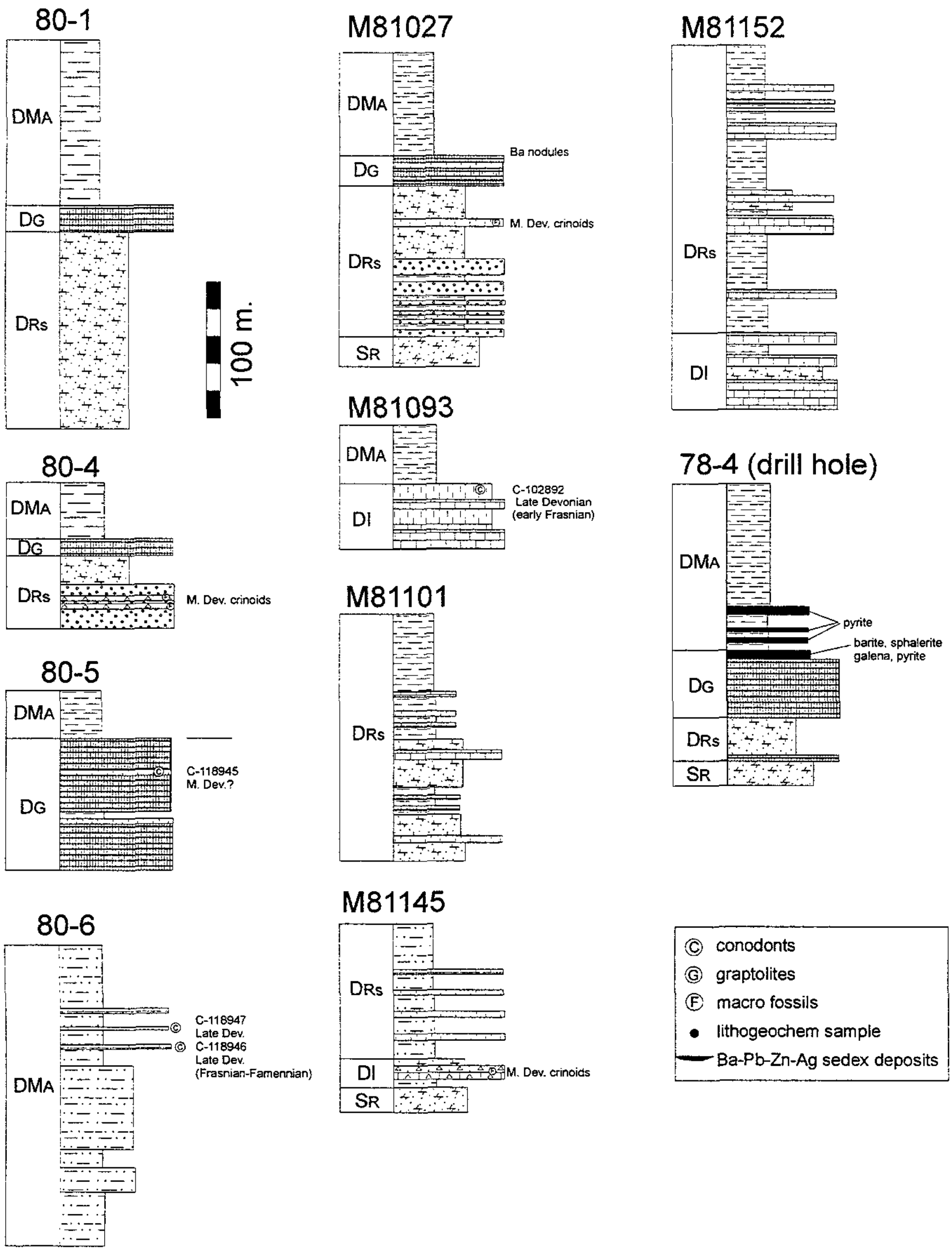
APPENDIX A
Detailed stratigraphic columns

Columns prefixed with "80" and "M81" were measured by D. MacIntyre in 1980 and 1981. See Table 1 for description of map unit symbols.

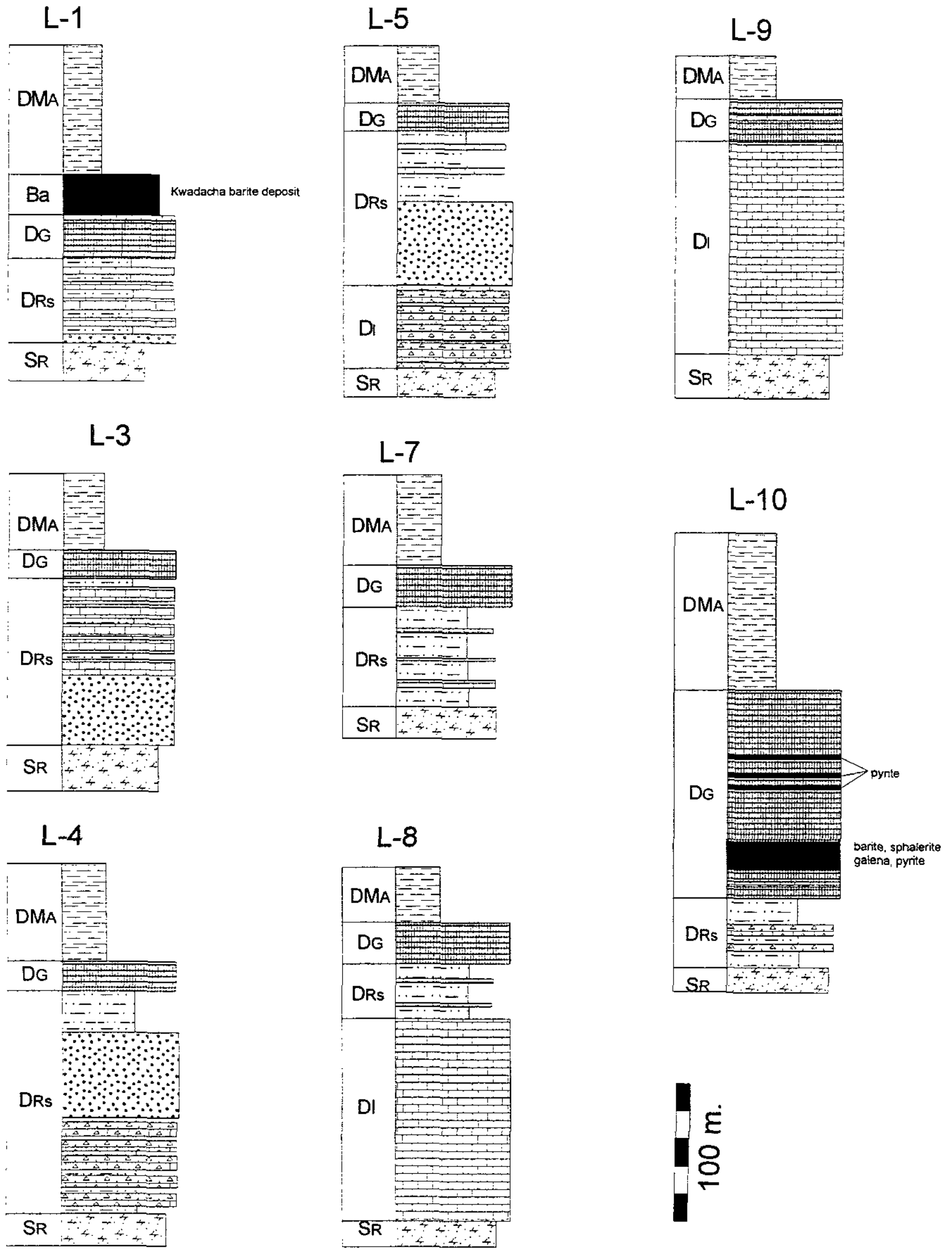




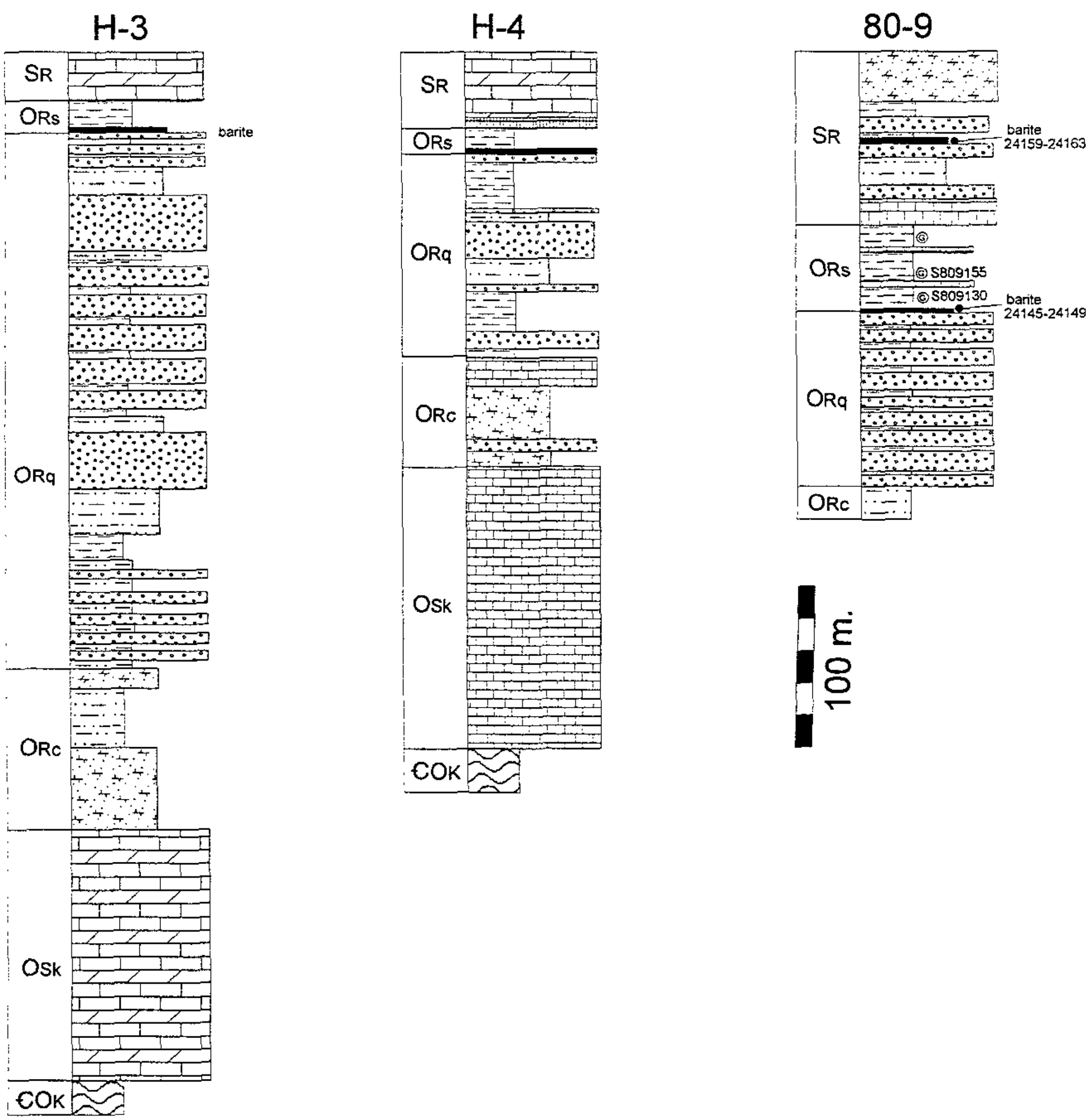



80-1
DMA
DG
DRs
100 m.
M81027
DMA
DG
Ba nodules
DRs
M. Dev. crinoids
SR
M81152
DRs
DI
80-4
DMA
DG
DRs
M. Dev. crinoids
M81093
DMA
DI
C-102892
Late Devonian
(early Frasnian)
78-4 (drill hole)
DMA
pyrite
barite, sphalerite
galena, pyrite
DG
DRs
SR
80-5
DMA
DG
C-118945
M. Dev.?
M81101
DRs
80-6
DMA
C-118947
Late Dev.
C-118946
Late Dev.
(Frasnian-Famennian)
M81145
DRs
DI
M. Dev. crinoids
SR
conodonts
graptolites
macro fossils
lithogeochem sample
Ba-Pb-Zn-Ag sedex deposits

Stratigraphic columns measured by J. Lowey as part of her M.Sc. thesis study (Lowey, 1984).



Stratigraphic columns measured by K. Heather as part of his B.Sc. thesis study (Heather, 1982).



APPENDIX B
Fossil Identifications

Brachiopods were identified by Dr. B.S. Norford (BSN) and Dr. E.T. Tozer (ETT) of the Geological Survey of Canada. Graptolites were identified by Dr. B.S. Norford. Conodonts were identified by Dr. M. Orchard, Geological Survey of Canada, Vancouver, B.C. Please check with these researchers for any possible revisions. Note: Only samples submitted for identification have a locality or report no.

Brachiopods

Station No.	N.T.S. Map	Easting	Northing	Fossil Identification	Age	GSC Locality or Report No.
M81-138	94F/02	400324	6332583	inarticulate brachiopod ?	not diagnostic	
80-06-210	94F/11	374671	6376294	inarticulate brachiopod	not diagnostic	C-D-5 1981-BSN
80KM-5	94F/11	390341	6393096	inarticulate brachiopod	not diagnostic	C-D-5 1981-BSN
79AL-24	94F/11	362936	6397803	*Halobia* sp.	Carnian, Lower or Middle Norian	Tr 4 1980 ETT
79AL-28	94F/11	365189	6397394	*Monotis* s.s. sp.	Upper Norian, Cordilleranus *Zone*	Tr 4 1980 ETT
80WM-5	94F/07	398791	6369629	orthid brachiopod	Silurian to Early Devonian	C-D-5 1981-BSN

Conodonts

Station No.	N.T.S. Map	Easting	Northing	Fossil Identification	Age	GSC Locality or Report No.
M81-182	94F/02	407814	6329811	ramiform elements		C-102876
M81-5	94F/10	387610	6393036	ramiform elements	Devonian	C-102874
M81-93	94F/02	405311	6329112	ramiform elements	Devonian	C-102892
80-06-187	94F/11	374671	6376294	*Palmatolepis* sp. ramiform elements	Late Devonian; Frasnian-early Famennian	C-118946
80-06-210	94F/11	374671	6376294	*Polygnathus* sp. indet. *Palmatolepis* sp. indet.	Late Devonian	C-118947
M81-5	94F/10	387610	6393036	*Polygnathus* sp. *Polygnathus cristatus* Hinde *Polygnathus dengleri* Bischoff & Ziegler *Schmidtognathus*? sp. *"Spathognathodus"* sp. *Polygnathus asymmetricus ovalis* Ziegler & Klapper *Icriodus sp.* *Palmatolepis disparalvea* Orr and Klapper	M.-L.Devonian; late Givetian -early Frasnian	C-102874
M81-236	94F/01	417582	6330059	*Polygnathus* cf. P. cristatus Hinde *Polygnathus* sp. *Ozarkodina* cf. O. *semialternans* Wirth	M.-L.Devonian; late Givetian-early Frasnian	C-102879
80SM-4	94F/07	404842	6363269	*Belodella* sp. *Polygnathus* sp. *Polygnathus linguiformis* Hinde group	Middle Devonian	C-102885
M81-189	94F/02	407189	6329286	*Periodon* sp. microgastropod inarticulate brachiopod coniform elements ramiform elements indet.	Ordovician	C-102872
M81-188	94F/02	407298	6329328	quadriramate element microgastropod geniculate and non-geniculate coniform elements	Ordovician	C-102875
80WH-4	94F/07	396103	6368528	ramiform elements	Ordovician	C-102880

Station No.	N.T.S. Map	Easting	Northing	Fossil Identification	Age	GSC Locality or Report No.
M81-281	94F/02	398011	6339912	coniforms *Periodon* sp.	Ordovician	C-118946
M81-32	94F/11	376969	6393662	*Icriodus* sp. Polygnathus dengleri Bischoff & Ziegler *Polygnathus asymmetricus* Bischoff & Ziegler subspp *Palmatolepis punctata* (Hinde)	Late Devonian; early Frasnian; asymmetricus zone	C-102891
M81-93	94F/02	405311	6329112	*Ancryodella rotundiloba* (Bryant) Polygnathus sp.	Late Devonian; early Frasnian	C-102892
80WH-4	94F/07	396103	6368528	*Belodella* sp. *Polygnathus laticostatus* *Polygnathus linguiformis* Hinde group *Palmatolepis glabra* group	E.-M. Devonian boundary; late Emsian-early Eifelian	C-102880
M81-182	94F/02	407814	6329811	*Polygnathus linguiformis linguiformis* Hinde *Ozarkodina* cf. *O. brevis* Bischoff & Ziegler *Icriodus* sp.	late Middle Devonian; Givetian	C-102876
79CQ-19	94F/11	373908	6377726	*Polygnathus* sp. indet. *Polygnathus linguiformis* Hinde group	probably Middle Devonian	C-102882
80-05-64	94F/11	373914	6377566	*Polygnathus linguiformis* Hinde group ramiform elements	probably Middle Devonian	C-118945

Graptolites

79DM-16	94F/11	365977	6385273	graptolites		
79DM-17	94F/11	366371	6384919	graptolites		
79EF-30	94F/07	395898	6352436	graptolites		
79FD-12	94F/07	386896	6360951	graptolites		
79FD-17	94F/07	385132	6362881	graptolites		
79FD-19	94F/07	385610	6363035	graptolites		
79PI-11	94F/07	381254	6367219	graptolites		
79PI-21	94F/07	382373	6367728	graptolites		
80BM-4	94F/07	390691	6373164	graptolites		
80CM-7	94F/11	366773	6377503	graptolites		
80CQ-10	94F/11	372901	6378340	graptolites		
80CQ-16	94F/11	376607	6380181	graptolites		
80CQ-23	94F/11	376115	6379367	graptolites		
80PI-7	94F/06	379240	6371250	graptolites		
80PI-49	94F/07	385401	6371367	graptolites		
80PK-12	94F/06	377374	6366643	graptolites		
80SH-5	94F/07	403162	6361340	graptolites		
80SH-6	94F/07	403193	6361232	graptolites		
80SH-7	94F/07	403096	6361169	graptolites		
80SH-11	94F/07	403773	6360753	graptolites		
80SH-15	94F/07	404722	6360761	graptolites		
80SH-18	94F/07	404186	6361162	graptolites		
80SH-26	94F/07	399295	6365451	graptolites		
80CQ-15	94F/11	373260	6376689	*Dicellograptus* sp.	late Middle Ordovician, *Caradoc*	C-D-5 1981 BSN
80CQ-23	94F/11	376115	6379367	biserial graptolites	probably M. Ordovician to Early Silurian	C-D-5 1981-BSN
79DM-15	94F/11	365754	6385409	graptolites	Devonian	

Station No.	N.T.S. Map	Easting	Northing	Fossil Identification	Age	GSC Locality or Report No.
80BM-10	94F/07	390626	6373089	graptolites	Devonian	
80WM-5	94F/07	398791	6369629	graptolites	Devonian	
80WM-6	94F/07	398925	6369615	graptolites	Devonian	
M81-322	94F/02	394908	6341781	graptolites, poorly preserved	Devonian?	
M81-369	94F/01	413626	6322244	graptolites	Devonian	
MF81-96	94F/02	392559	6342860	graptolites, *monograptus*?	Devonian? or Ordovician?	
79GN-6	94F/01	410100	6340360	graptolites	Early Devonian, Pragian	
80WM-6	94F/07	398925	6369615	*Monograptus yukonensis* Jackson and Lenz	Early Devonian, Pragian	C-D-5 1981-BSN
80WM-10	94F/07	398689	6370147	*Monograptus yukonensis* Jackson and Lenz	Early Devonian, Pragian	C-D-5 1981-BSN
79DM-15	94F/11	365754	6385409	*Monograptus* cf. *M. yukonensis* Jackson and Lenz	probably Early Devonian, Pragian	O-M-8 1980-BSN
79GN-6	94F/01	410100	6340360	*Monograptus* sp. cf. *M. yukonensis* Jackson and Lenz	Early Devonian, Pragian	O-M-8 1980-BSN
79YL-3	94F/11	370537	6379991	graptolite fragments	Early Ordovician to Early Devonian	O-M-8 1980 BSN
80SM-17	94F/07	404273	6361518	*Climacograptus*? sp.	Early Silurian, probably Early Llandovery	C-D-5 1981-BSN
80SM-17	94F/07	404273	6361518	*Glyptograptus*? sp *Monograptus* 2 spp. *M.* aff. *M. acinaces* Tornquist	Early Silurian, probably Early Llandovery	C-D-5 1981-BSN
79CQ-18	94F/11	374311	6378709	*Monograptus* sp.	Early Silurian to Early Devonian	O-M-8 1980-BSN
79FD-20	94F/07	386126	6362579	*Spathiocaris* cf. *S. bipartita* (Woodward)	Late Devonian or Early Mississippian	O-M-8 1980-BSN
80YH-1	94F/11	369691	6380325	*Leptograptus* sp. *Dicellograptus* sp. *D. complantus ornatus* Elles and Wood *Glyptograptus* cf. *G. altus* Ross and Berry *Orthograptus* sp.	Late Ordovician, Ashgill	C-D-5 1981 BSN
79PI-9	94F/07	381201	6367055	*Climacograptus*? sp.	probably Middle or Late Ordovician	O-M-8 1980-BSN
80SH-14	94F/07	404376	6361084	graptolites		
80PI-7	94F/06	379240	6371250	*Glossograptus* sp.	Middle Ordovician	C-D-5 1981-BSN
80SH-11	94F/07	403773	6360753	*Orthograptus* sp. *Glossograptus* sp. *Glyptograptus*? sp *Cryptograptus* sp. *Climacograptus* sp.	Middle Ordovician, Caradoc probably	C-D-5 1981-BSN
79CQ-4	94F/11	370745	6375377	graptolites	Ordovician	
79CQ-17	94F/06	369906	6373464	graptolites	Ordovician	
79EF-31	94F/07	395977	6352555	graptolites	Ordovician	
79FD-7	94F/07	385222	6360563	graptolites	Ordovician	
79FD-18	94F/07	385375	6362993	graptolites	Ordovician	
79PI-7	94F/07	380606	6367116	graptolites	Ordovician	
79PI-9	94F/07	381201	6367055	graptolites	Ordovician	
79PI-14	94F/07	381095	6365617	graptolites	Ordovician	
79PI-19	94F/07	381974	6366985	graptolites	Ordovician	
79YL-4	94F/11	370663	6380120	graptolites	Ordovician	
80CQ-6	94F/11	376062	6377618	graptolites	Ordovician	
80CQ-15	94F/11	373260	6376689	graptolites	Ordovician	
80CQ-28	94F/11	375953	6379158	graptolites	Ordovician	
80SH-39	94F/07	399524	6365429	graptolites	Ordovician	
80SH-44	94F/07	402660	6366124	graptolites	Ordovician	

Station No.	N.T.S. Map	Easting	Northing	Fossil Identification	Age	GSC Locality or Report No.
80SM-18	94F/07	404678	6361819	graptolites	Ordovician	
80SM-19	94F/07	404901	6361848	graptolites	Ordovician	
80WH-29	94F/07	392980	6369927	graptolites	Ordovician	
80WH-30	94F/07	392953	6369851	graptolites	Ordovician	
80WH-32	94F/07	392775	6369764	graptolites	Ordovician	
80YH-1	94F/11	369691	6380325	graptolites	Ordovician	
80YH-2	94F/11	369743	6380202	graptolites	Ordovician	
80YH-4	94F/11	370000	6380109	graptolites	Ordovician	
JL81-132	94F/01	409432	6343599	graptolites	Ordovician?	
JL81-144	94F/01	410633	6320105	graptolites	Ordovician	
M81-254	94F/01	420984	6331317	*graptolites*	*Ordovician ?*	
M81-281	94F/02	398011	6339912	graptolites, biserial	Ordovician	
M81-339	94F/01	416787	6334841	graptolites	Ordovician?	
M81-349	94F/01	417423	6318310	graptolites	Ordovician	
M81-351	94F/01	417195	6318125	graptolites, biserial	Ordovician	
M81-359	94C/16	417940	6317628	graptolites	Ordovician	
MF81-18	94F/01	411648	6327558	graptolites	Ordovician	
MF81-82	94F/02	393603	6343849	graptolites	Ordovician	
MF81-100	94F/02	391999	6342620	graptolites	Ordovician?	
MF81-114	94F/01	413296	6328949	graptolites	Ordovician	
80SM-20	94F/07	403994	6361662	graptolites	Silurian ?	
80WM-5	94F/07	398791	6369629	*Monograptus* sp.	Silurian to Early Devonian	C-D-5 1981-BSN
80WM-6	94F/07	398925	6369615	*Monograptus* sp.	Silurian to Early Devonian	C-D-5 1981-BSN
79FD-17	94F/07	385132	6362881	*Climacograptus*? sp. *Glossograptus* sp. *Isograptus* sp.	early Middle Ordovician	O-M-8 1980-BSN
79FD-12	94F/07	386896	6360951	*Phyllograptus*? sp. *Phyllograptus*? sp.	probably late Early or early Middle Ordovician	O-M-8 1980-BSN
79EF-34	94F/07	399850	6348787	*Isograptus* sp.	late Early to early Middle Ordovician	O-M-8 1980-BSN
79FD-12	94F/07	386896	6360951	*Tetragraptus* sp. *Tristichiograptus* sp.	late Early to early Middle Ordovician	O-M-8 1980-BSN
79PI-9	94F/07	381201	6367055	Isograptus? sp.	probably late Early to early Middle Ordovician	O-M-8 1980-BSN
79DM-7	94F/11	363367	6382170	*Diagoniella*? sp. *Monograptus* sp.	Silurian, probably late Early or early Middle	O-M-8 1980-BSN
80BM-10	94F/07	390626	6373089	*Dicellograptus* sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981 BSN
80CQ-10	94F/11	372901	6378340	*Dicellograptus* sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981 BSN
80CQ-27	94F/11	375953	6379158	*Leptograptus*? sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981 BSN
80SH-14	94F/07	404376	6361084	*Dicellograptus* sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981 BSN
80SH-39	94F/07	399524	6365429	*Dicellograptus* sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981 BSN
80SH-44	94F/07	402660	6366124	*Dicellograptus* sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981 BSN
80SM-17	94F/07	404678	6361819	*Dicellograptus* sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981 BSN
80WH-1	94F/07	399128	6370109	*Dicellograptus* sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981 BSN
80BM-10	94F/07	390626	6373089	*Climacograptus* sp. *Orthograptus* sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981-BSN
80CQ-27	94F/11	375953	6379158	*Orthograptus* sp. *Climacograptus*? sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981-BSN

Station No.	N.T.S. Map	Easting	Northing	Fossil Identification	Age	GSC Locality or Report No.
80SH-7	94F/07	403096	6361169	*Orthograptus* sp. *Climacograptus* ex gr. *C. bicornis* Hall *Glyptograptus*? sp	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981-BSN
80SH-14	94F/07	404376	6361084	*C.* cf. *C. bicornis longispina* Hall *Orthograptus* sp. *Glyptograptus*? sp *Climacograptus* ex gr. *C. bicornis* Hall	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981-BSN
80SH-39	94F/07	399524	6365429	*Orthograptus* sp. *Climacograptus* ex gr. *C. bicornis* Hall	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981-BSN
80SH-44	94F/07	402660	6366124	*Climacograptus* ex gr. *C. bicornis* Hall *Glyptograptus*? sp *Orthograptus* sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981-BSN
80SM-17	94F/07	404678	6361819	*Orthograptus* sp. *Climacograptus* sp.	late M. or Late Ordovician, Caradoc or Ashgill	C-D-5 1981-BSN
80WH-1	94F/07	399128	6370109	*Dicranograptus* sp. *Climacograptus* ex gr. *C.* bicornis Hall	late M. to Late Ordovician, Caradoc or Ashgill	C-D-5 1981-BSN
80CQ-6	94F/11	376062	6377618	*Dicellograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981 BSN
80CQ-16	94F/11	376607	6380181	*Dicellograptus* sp.	late Middle Ordovician, Caradoc	C-D-5 1981 BSN
80SH-18	94F/07	404186	6361162	*Leptograptus* sp. *Leptograptus* sp. *Dicellograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981 BSN
80WH-29	94F/07	392980	6369927	*Dicellograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981 BSN
80WH-32	94F/07	392775	6369764	*Dicellograptus* sp.	late Middle Ordovician, Caradoc	C-D-5 1981 BSN
80BM-4	94F/07	390691	6373164	*Climacograptus* sp. *Glyptograptus*? sp	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80CQ-6	94F/11	376062	6377618	*Orthograptus* sp. *Dicranograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80CQ-10	94F/11	372901	6378340	*Orthograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80CQ-15	94F/11	373260	6376689	*Glyptograptus*? sp *Dicranograptus* sp. *Orthograptus* sp. *Climacograptus* ex gr. *C. bicornis* Hall	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80CQ-16	94F/11	376607	6380181	*Glyptograptus*? sp *Climacograptus* sp. *Dicranograptus* sp. *Orthograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80KM-4	94F/11	390543	6393301	*Dicranograptus* sp. *Glyptograptus*? sp	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80SH-5	94F/07	403162	6361340	*Orthograptus* sp. *Climacograptus* ex gr. *C. bicornis* Hall *Dicranograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80SH-6	94F/07	403193	6361232	*Orthograptus* sp. *Dicranograptus* cf. *D. kirki* Ruedemann *Climacograptus* sp. *Glyptograptus*? sp	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80SH-18	94F/07	404186	6361162	*Glyptograptus*? sp *Orthograptus* sp. *Climacograptus*? sp. *Dicranograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981-BSN

Station No.	N.T.S. Map	Easting	Northing	Fossil Identification	Age	GSC Locality or Report No.
80SH-18	94F/07	404186	6361162	*Orthograptus* sp. *Climacograptus* ex gr. *C. bicornis* Hall *Dicranograptus* sp. *Glossograptus*? sp. *Glyptograptus*? sp	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80SM-19	94F/07	404901	6361848	*Dicranograptus* sp. *Climacograptus* sp. *Orthograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80WH-29	94F/07	392980	6369927	*Orthograptus* sp. *Climacograptus* ex gr. *C. bicornis* Hall *Dicranograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80WH-32	94F/07	392775	6369764	*Dicranograptus* sp. *Orthograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981-BSN
80YH-4	94F/11	370000	6380109	*Climacograptus* sp. *Dicranograptus* sp. *Orthograptus* sp.	late M. Ordovician, Caradoc	C-D-5 1981-BSN
79FD-18	94F/07	385375	6362993	*Dicellograptus* sp.	Middle Ordovician	O-M-8 1980 BSN
79FD-17	94F/07	385132	6362881	*Glyptograptus*? sp	early Middle Ordovician	O-M-8 1980-BSN
79FD-18	94F/07	385375	6362993	*Glyptograptus*? sp *Climacograptus*? sp.	Middle Ordovician	O-M-8 1980-BSN
79FD-18	94F/07	385375	6362993	*Dicellograptus*? sp.	Middle or Late Ordovician	O-M-8 1980 BSN
MF81-24	94F/01	410762	6327288	graptolites	probably Devonian	
M81-335	94F/01	411621	6340726	graptolites	probably Early Devonian	
80BH-34	94F/07	388483	6373372	*Glyptograptus*? sp *Climacograptus*? sp. *Orthograptus*? sp.	probably Middle or Late Ordovician	C-D-5 1981-BSN
80SH-15	94F/07	404722	6360761	*Orthograptus*? sp. *Climacograptus*? sp.	probably M. or Late Ordovician	C-D-5 1981-BSN
80WH-30	94F/07	392953	6369851	*Climacograptus*? sp. *Orthograptus* sp.	probably M. or Late Ordovician	C-D-5 1981-BSN
79EF-31	94F/07	395977	6352555	*Orthograptus*? sp.	probably Middle or Late Ordovician	O-M-8 1980-BSN
79YL-4	94F/11	370663	6380120	*Orthograptus*? sp.	probably M. or Late Ordovician	O-M-8 1980-BSN
80PI-49	94F/07	385401	6371367	*Orthograptus*? sp. *Pterograptus*? sp. or *Clonograptus*? sp.	probably Middle Ordovician	C-D-5 1981-BSN
80PK-12	94F/06	377374	6366643	*Orthograptus*? sp.	probably Ordovician	C-D-5 1981-BSN
80SH-26	94F/07	399295	6365451	*Orthograptus*? sp.	probably Ordovician	C-D-5 1981-BSN
79PI-7	94F/07	380606	6367116	graptolite fragments, diplograptid graptolite	probably Ordovician	O-M-8 1980-BSN
79PI-21	94F/07	382373	6367728	*Monograptus*? sp.	probably Silurian	O-M-8 1980-BSN
80WM-10	94F/07	398689	6370147	*Monograptus* sp.	probably Silurian, possibly Devonian	C-D-5 1981-BSN

Crinoid ossicles

80FM-1	94F/07	388171	6363204	crinoid ossicles, two-hole		
80PI-15	94F/07	381641	6371033	crinoid ossicles, two-hole		
M81-338	94F/01	416744	6334683	crinoid ossicles, one-hole		
79AL-11	94F/07	362077	6397081	crinoid ossicles, one-hole	Devonian	
79GN-6	94F/01	410100	6340360	crinoid ossicles, one-hole	Devonian	
80WM-5	94F/07	398791	6369629	crinoid ossicles, two-hole	Devonian	
JL81-93	94F/07	385993	6363266	crinoid ossicles, two-hole	Devonian	
JL81-123	94F/01	419382	6328422	crinoid ossicles, two-hole	Devonian	
JL81-123	94F/01	420732	6328037	crinoid ossicles, two-hole	Devonian	
LD81-7	94F/10	381735	6389806	crinoid ossicles, one-hole	Devonian	

Station No.	N.T.S. Map	Easting	Northing	Fossil Identification	Age	GSC Locality or Report No.
LD81-23	94F/10	381296	6391323	crinoid ossicles, two-hole	Devonian	
M81-1	94F/10	387234	6393005	crinoid ossicles, two-hole	Devonian	
M81-2	94F/10	387393	6392989	crinoid ossicles, one-hole	Devonian	
M81-21	94F/10	387867	6386807	crinoid ossicles, two-hole	Devonian	
M81-25	94F/10	387924	6387112	crinoid ossicles, one-hole	Devonian	
M81-28	94F/10	387957	6388078	crinoid ossicles, two-hole	Devonian	
M81-145	94F/02	400934	6333418	crinoid ossicles, two-hole	Devonian	
M81-149	94F/02	401106	6333812	crinoid ossicles, two-hole	Devonian	
M81-239	94F/01	417731	6330182	crinoid ossicles, two-hole	Devonian	
M81-241	94F/01	417804	6330276	crinoid ossicles, two-hole	Devonian	
M81-257	94F/01	414454	6336549	crinoid ossicles, two-hole	Devonian	
M81-291	94F/02	398820	6340756	crinoid ossicles, one-hole	Devonian?	
M81-326	94F/02	394467	6340632	crinoid ossicles, two-hole	Devonian	
M81-328	94F/02	394040	6340207	crinoid ossicles, one-hole	Devonian	
M81-335	94F/01	411621	6340726	crinoid ossicles, one-hole	Devonian	
M81-370	94F/01	413461	6322280	crinoid ossicles, one-hole	Devonian	
M81-371	94F/01	413384	6322270	crinoid ossicles, one-hole	Devonian	
M81-372	94F/01	413312	6322195	crinoid ossicles, one-hole	Devonian	
M81-373	94F/01	413222	6322153	crinoid ossicles, one-hole	Devonian	
M81-374	94F/01	413130	6322066	crinoid ossicles, one-hole	Devonian	
MF81-3	94F/10	381020	6391056	crinoid ossicles, two-hole	Devonian	
MF81-6	94F/10	381193	6391149	crinoid ossicles, two-hole	Devonian	
MF81-10	94F/10	381373	6391267	crinoid ossicles, two-hole	Devonian	
MF81-29	94F/01	409744	6326582	crinoid ossicles, two-hole	Devonian	
MF81-40	94F/02	404001	6335754	crinoid ossicles, one-hole	Devonian	
MF81-102	94F/01	416351	6332010	crinoid ossicles, two-hole	Devonian	
MF81-105	94F/01	416125	6331882	crinoid ossicles, two-hole	Devonian	
JL81-140	94F/01	410232	6320370	crinoid ossicles, one-hole	Ordovician	
MF81-115	94F/01	413883	6328953	crinoid ossicles, one-hole	Ordovician	
MF81-25	94F/01	410622	6327285	crinoid ossicles, one-hole	probably Devonian	

Reef fossils - corals etc.

79CQ-18	94F/11	374311	6378709	coral, bryozoan, crinoid fragments		
80BH-39	94F/07	388078	6373434	corals, crinoids, bryozoans, stromatoporoids		
80DM-15	94F/11	374004	6377595	coral, bryozoan, crinoid fragments in limestone		
80KW-8	94F/11	368737	6385803	corals, crinoids, bryozoans, stromatoporoids		
80PM-5	94F/07	381086	6372038	coral, bryozoan, crinoid fragments		
80PM-7	94F/07	380838	6372398	coral, bryozoan, crinoid fragments		
80PM-21	94F/07	380324	6372381	coral, bryozoan, crinoid fragments		
79AL-11	94F/07	362077	6397081	coral, bryozoan, crinoid	Devonian	
79AL-14	94F/07	361043	6397021	coral, bryozoan, crinoid	Devonian	
79AL-16	94F/07	360819	6396812	coral, bryozoan, crinoid	Devonian	
79PI-23	94F/07	382973	6369298	coral, bryozoan, crinoid fragments	Devonian	
80DM-12	94F/11	374957	6377989	coral, bryozoan, crinoid fragments in limestone	Devonian	
80DM-14	94F/11	373914	6377566	coral, bryozoan, crinoid fragments in limestone	Devonian	
80KW-2	94F/11	368181	6385736	corals, crinoids, bryozoans, stromatoporoids	Devonian	
80KW-5	94F/11	368514	6385633	corals, crinoids, bryozoans, stromatoporoids	Devonian	

Station No.	N.T.S. Map	Easting	Northing	Fossil Identification	Age	GSC Locality or Report No.
80PM-8	94F/07	380961	6372491	coral, bryozoan, crinoid fragments	Devonian	
80PM-12	94F/07	381444	6371417	coral, bryozoan, crinoid fragments	Devonian	
M81-93	94F/02	405311	6329112	corals ?	Devonian	
M81-112	94F/02	406216	6330088	corals	Devonian	
M81-145	94F/02	400934	6333418	coral fragments	Devonian	
M81-147	94F/02	401023	6333628	coral fragments	Devonian	
M81-149	94F/02	401106	6333812	coral fragments	Devonian	
M81-152	94F/02	401227	6333996	corals, crinoids, bryozoans, stromatoporoids	Devonian	
M81-159	94F/02	401731	6334681	corals, crinoids, bryozoans, stromatoporoids	Devonian	
M81-161	94F/02	401870	6334738	coral fragments	Devonian	
M81-185	94F/02	407552	6329525	corals fragments	Devonian	
M81-196	94F/02	406152	6327618	coral fragments	Devonian	
M81-198	94F/02	406307	6327703	coral fragments	Devonian	
M81-219	94F/02	396317	6337933	coral fragments	Devonian?	
M81-335	94F/01	411621	6340726	coral fragments	Devonian	
M81-370	94F/01	413461	6322280	coral fragments	Devonian	
MF81-37	94F/02	403561	6335187	coral fragments	Devonian	
MF81-38	94F/02	403735	6335433	coral fragments	Devonian	
80DM-10	94F/11	368848	6386014	coral, bryozoan, crinoid fragments in limestone	Ordovician	
80DM-11	94F/11	368376	6385836	coral, bryozoan, crinoid fragments in limestone	Ordovician	
M81-210	94F/02	397292	6339259	coral fragments	Ordovician?	

Shell fragments

79GN-7	94F/01	409756	6339971	shell detritus in debris flow		
79KW-8	94F/11	372070	6392575	brachiopod, Halobia and Monotis	Triassic	
80BM-19	94F/10	393715	6378786	shell hash		
80DM-1	94F/11	366958	6386347	shell detritus in debris flow		
80DM-2	94F/11	366818	6386206	shell hash in calcarenite		
80KM-2	94F/11	390821	6393512	shell hash		
80KM-5	94F/11	390341	6393096	shell hash		
80KM-3	94F/11	390903	6393517	echinoderm debris	not diagnostic	C-D-5 1981 BSN
79AL-23	94F/11	362833	6397768	problematic tiny conical shell	probably Late Cambrian to Late Triassic	O-M-8-1980-BSN
80KM-6	94F/11	390140	6392883	crinoid, coral and shell fragments	Devonian	
80PM-10	94F/07	380976	6371881	*shell hash in calcarenite*	*Devonian*	
80WM-5	94F/07	398791	6369629	shell detritus in limestone debris flow	Devonian	
80WM-7	94F/07	399034	6369665	shell hash in calcarenite	Devonian	
JL81-124	94F/01	412310	6333834	shell hash	Devonian?	
M81-38	94F/11	377100	6393463	may be belemnites (Tentaculites?)	Devonian	
M81-146	94F/02	400991	6333501	shell hash	Devonian	
M81-218	94F/02	396476	6337952	shell hash	Devonian?	
M81-248	94F/01	419234	6330746	shell hash	Devonian ?	
M81-250	94F/01	419626	6330920	shell hash	Devonian?	
M81-327	94F/02	394219	6340283	*shell hash*	*Devonian*	
M81-365	94F/01	413869	6322276	shell hash, crinoid fragments	Devonian	
80BM-22	94F/10	393584	6379570	shell hash	Ordovician	
79AL-24	94F/11	362936	6397803	brachiopod, Halobia and Monotis	Triassic	

Station No.	N.T.S. Map	Easting	Northing	Fossil Identification	Age	GSC Locality or Report No.
79AL-27	94F/11	363882	6397898	brachiopod, Halobia and Monotis	Triassic	
79AL-28	94F/11	365189	6397394	brachiopod, Halobia and Monotis	Triassic	
79AL-30	94F/11	366066	6396772	brachiopod, Halobia and Monotis	Triassic	

Sponges

79EF-21	94F/07	394954	6350327	sponge		
79DM-16	94F/11	365977	6385273	undetermined sponge	not diagnostic	O-M-8 1980-BSN
79EF-21	94F/07	394954	6350327	Protospongia? sp.	possibly Silurian	O-M-8 1980-BSN
80WM-5	94F/07	398791	6369629	sponge spicules	Silurian to Lower Devonian	C-D-5 1981-BSN
79AL-10	94F/07	362137	6397161	Protospongia? sp.	possibly Silurian	O-M-8-1980-BSN

Feeding Trails

79CQ-6	94F/11	370737	6375212	feeding trails		
79EF-36	94F/07	400260	6348927	feeding trails		

APPENDIX C
Whole Rock Analyses and CIPW Norms, Ordovician Volcanic Rocks

Oxides as Determined (wt. %)

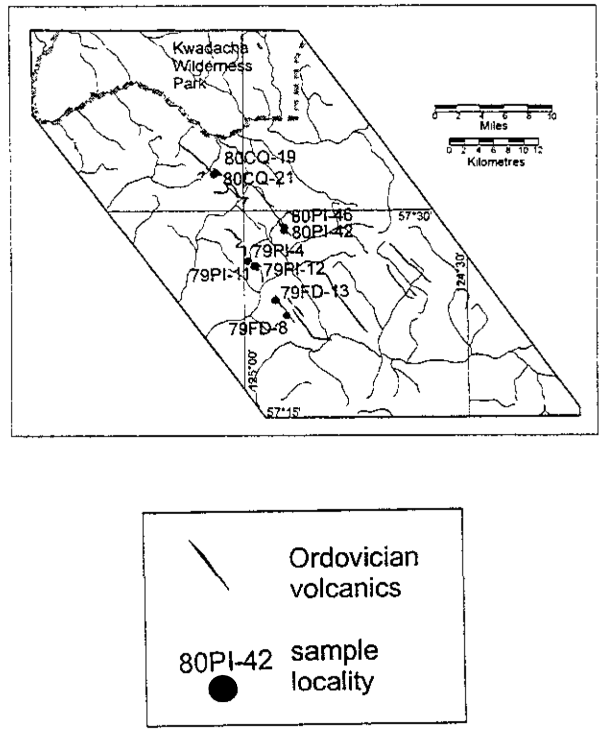
	79FD 8	*79FD 13*	*79FD 13B*	*79PI 4*	*79PI 4C*	*79PI 11*	*79PI 12*	*80CQ 19A*	*80CQ 21B*	*80CQ 21A*	*80CQ 21*	*80PI 42A*
SiO_2	58.07	41.55	30.80	53.32	48.07	52.31	49.82	43.91	37.89	44.41	40.81	36.86
TiO_2	1.10	2.11	1.22	1.21	1.26	1.01	1.16	1.68	1.91	2.00	1.93	2.86
Al_2O_3	6.42	10.70	7.63	14.67	16.12	15.18	19.38	10.25	12.39	14.06	13.63	11.65
Fe_2O_3	0.09	0.29	0.39	0.77	0.94	0.63	0.90	0.72	0.86	2.38	1.58	12.42
FeO	5.65	1.48	3.75	5.91	7.21	6.73	6.77	3.41	6.99	7.10	8.00	9.44
MnO	0.04	0.09	0.13	0.04	0.03	0.07	0.03	0.07	0.16	0.14	0.13	0.18
MgO	7.95	4.12	8.33	7.19	13.05	8.65	9.07	5.62	3.37	7.68	7.80	8.50
CaO	8.38	14.64	16.58	4.35	1.48	5.71	0.28	11.35	15.07	6.62	9.04	11.63
Na_2O	0.03	0.05	0.05	1.62	1.53	2.11	1.48	0.05	0.73	0.16	0.10	0.49
K_2O	0.31	7.26	5.19	3.37	2.17	1.96	4.45	3.22	2.85	2.48	2.55	2.26
P_2O_5	0.40	0.94	0.18	0.25	0.25	0.08	0.08	1.15	0.11	0.32	0.18	0.32
CO_2	6.78	14.34	23.30	2.90	0.18	0.26	0.26	15.20	11.90	5.00	7.20	6.70
H_2O-	2.87	1.28	0.90	4.30	5.34	4.74	5.87	1.96	3.53	5.78	2.69	4.65
H_2O+	0.33	0.32	0.14	0.42	1.04	0.48	0.51	0.50	0.35	0.94	0.71	0.79
Total	98.42	99.17	98.59	100.32	98.67	99.92	100.06	99.09	98.11	99.07	96.35	108.75

CIPW Normative Composition - Volatile Free

	79FD 8	*79FD 13*	*79FD 13B*	*79PI 4*	*79PI 4C*	*79PI 11*	*79PI 12*	*80CQ 19A*	*80CQ 21B*	*80CQ 21A*	*80CQ 21*	*80PI 42A*
Q	32.81	0.00	0.00	8.54	4.58	3.52	6.25	8.70	0.00	6.54	0.00	0.00
C		0.00	38.10	56.13	1.13	9.95	0.00	12.65	0.00	0.00	0.00	0.00
or	2.07	0.00	0.00	21.48	13.92	12.26	28.15	23.37	0.00	16.78	17.57	13.07
ab	0.29	0.00	0.00	14.78	14.05	18.90	13.40	0.52	0.00	1.55	0.99	0.00
an	18.62	9.05	7.10	21.52	6.20	27.71	0.93	22.40	26.87	34.72	34.07	23.73
lc	0.00	40.42	32.39	0.00	0.00	0.00	0.00	0.00	16.04	0.00	0.00	0.59
ne	0.00	0.28	0.31	0.00	0.00	0.00	0.00	0.00	4.06	0.00	0.00	2.32
di	20.51	43.44	30.37	0.00	0.00	1.40	0.00	29.81	52.36	0.39	13.68	26.67
hy	22.17	0.00	0.00	28.26	46.61	33.04	34.70	6.76	0.00	30.90	21.24	0.00
ol	0.00	-5.47	14.26	0.00	0.00	0.00	0.00	0.00	-3.38	0.00	5.04	8.61
wo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.73	0.00	0.00	0.00
cs	*0.00*	*4.18*	*19.78*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*13.05*	*0.00*	*0.00*	*0.00*
mt	0.15	0.00	0.76	1.20	1.48	0.97	1.40	1.28	1.51	3.95	2.67	18.64
il	2.36	3.99	3.12	2.48	2.60	2.03	2.36	3.92	4.41	4.35	4.27	5.62
hm	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
tn	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ap	1.05	2.63	0.57	0.63	0.63	0.20	0.20	3.29	0.31	0.85	0.49	0.77
AN=	98.48	100.00	100.00	59.28	30.61	59.45	6.47	97.73	100.00	95.73	97.19	100.00

Oxides as Determined (wt. %)

	80PI 42	80PI 46C	80PI 46D	80PI 46B	80PI 46
SiO2	37.35	32.72	32.68	37.11	36.34
TiO2	2.88	1.49	2.37	1.80	2.68
Al2O3	11.68	10.13	10.08	11.61	11.10
Fe2O3	2.25	5.65	1.05	0.39	0.90
FeO	8.65	1.98	8.32	4.63	9.67
MnO	0.17	0.14	0.16	0.10	0.13
MgO	8.64	3.08	7.14	4.71	6.79
CaO	12.18	18.75	13.76	13.44	10.20
Na2O	0.44	0.06	0.12	0.78	0.15
K2O	2.49	3.81	2.28	5.05	2.40
P2O5	0.30	0.13	0.23	1.74	0.45
CO2	6.80	17.70	16.00	15.20	12.70
H2O-	4.20	2.44	3.98	1.48	3.57
H2O+	0.69	0.82	0.70	0.38	0.69
Total	98.72	98.90	98.87	98.42	97.77



CIPW Normative Composition - Volatile Free

Q	0.00	0.00	0.00	0.00	0.00
C	0.00	53.64	0.00	0.00	0.00
or	0.88	0.00	0.00	0.00	17.55
ab	0.00	0.00	0.00	0.00	1.57
an	25.91	20.69	25.88	16.31	27.88
lc	12.57	22.65	13.51	28.76	0.00
ne	2.32	0.35	0.70	4.39	0.00
di	33.31	8.34	48.45	41.74	25.50
hy	0.00	0.00	0.00	0.00	2.05
ol	14.21	4.19	9.42	0.64	16.27
wo	0.00	0.00	0.38	15.12	0.00
cs	0.00	26.89	18.14	4.79	0.00
mt	3.75	3.23	1.95	0.69	1.61
il	6.29	3.63	5.76	4.20	6.30
hm	0.00	5.02	0.00	0.00	0.00
ap	0.80	0.39	0.69	4.98	1.30
AN=	100.00	100.00	100.00	100.00	94.67

Sample locations and descriptions:

Station		NTS map	Easting	Northing	Property	Lithology
79FD	8	94F/07	385348	6360517	DOG/FLUKE CLAIMS	mafic tuff
79FD	13	94F/07	383872	6362558	FLUKE CLAIMS	mafic tuff
79PI	4	94F/07	380371	6367900	PIE CLAIMS	mafic tuff
79PI	11	94F/07	381254	6367219	PIE CLAIMS	mafic tuff
79PI	12	94F/07	381464	6367222	PIE CLAIMS	mafic tuff
80CQ	19	94F/11	376497	6379829	CIRQUE CLAIMS	mafic tuff
80CQ	21	94F/11	376282	6379571	CIRQUE CLAIMS	mafic tuff
80PI	42	94F/07	385436	6372256	E. OF PIE CLAIMS	mafic tuff
80PI	46	94F/07	385344	6371889	E. OF PIE CLAIMS	ankeritic flow

APPENDIX D
Lithogeochemical data grouped by map unit.

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
Cambrian - Ordovician - Kechika Group - nodular, phyllitic limestone and mudstone																		
79EF 4	94F/07	396771	6350987	9.87	0.02	1.03	0.96	0.15	0.28	0.01	8	54	11	0	1600	15	0.5	
79FD 1	94F/07	383724	6360113	12.08	0.03	1.28	0.52	0.24	0.09	0.01	10	30	25	0	396	15	4.4	
			Mean	10.98	0.03	1.16	0.74	0.20	0.19	0.01	9	42	18	0	998	15	2.5	
			STD	1.56	0.01	0.18	0.31	0.06	0.13	0.00	1	17	10	0	851	0	2.8	
Cambrian - Ordovician - Kechika Group - nodular, limy siltstone																		
79EF 24	94F/07	395341	6350608	53.50	0.46	11.76	2.85	3.81	0.17	0.08	13	43	12	0	435	21	2.4	
79EF 25	94F/07	395291	6350823	49.16	0.26	7.69	3.06	1.84	0.13	0.02	11	46	14	0	691	15	0.7	
79EF 32	94F/07	399085	6348711	34.99	0.18	6.85	1.86	2.27	0.13	0.04	10	30	10	0	1500	43	3.2	
79FD 10	94F/07	385800	6360728	41.29	0.16	6.06	1.82	2.41	0.15	0.05	9	48	8	0	669	15	0.5	
79FD 15	94F/07	384163	6362646	49.66	0.25	8.64	2.70	3.27	0.14	0.06	11	28	5	0	900	15	1.7	
79GN 34	*94F/02*	*405510*	*6338317*	*39.87*	*0.23*	*6.80*	*3.20*	*1.48*	*0.15*	*0.02*	*12*	*52*	*9*	*1*	*1200*	*15*	*1.4*	
			Mean	44.75	0.26	7.97	2.58	2.51	0.15	0.05	11	41	10	0	899	21	1.7	
			STD	7.09	0.11	2.06	0.60	0.88	0.02	0.02	1	10	3	0	391	11	1.0	
Cambrian - Ordovician - Kechika Group - altered tuff																		
79FD 15A	94F/07	384231	6362799	38.63	2.98	17.95	16.30	2.90	0.91	0.16	33	102	6	0	243	15	9.4	
Lower - Middle Ordovician - Road River Group - massive limestone																		
79CQ 14A	94F/06	369524	6373229	5.29	0.03	0.75	0.68	0.19	0.07	0.04	5	20	10	0	1200	15	1.3	
79EF 35	94F/07	400011	6348916	10.57	0.03	1.23	0.49	0.93	0.03	0.05	4	12	5	0	107	15	1.5	
79EF 35 *	94F/07	400015	6348915	10.47	0.03	1.19	0.49	0.91	0.03	0.05	5	12	4	0	108	15	1.2	
			Mean	8.78	0.03	1.06	0.55	0.68	0.04	0.05	5	15	6	0	472	15	1.3	
			STD	*3.02*	*0.00*	*0.27*	*0.11*	*0.42*	*0.02*	*0.01*	*1*	*5*	*3*	*0*	*631*	*0*	*0.2*	
Lower - Middle Ordovician - Road River Group - shale interbedded with limestone																		
79CQ 11	94F/06	369304	6373130	61.93	0.27	4.21	2.02	1.74	0.06	0.04	17	86	10	0	191	45	6.3	
79PI 5	94F/07	380276	6368125	61.50	0.16	2.87	1.63	1.14	0.08	0.03	21	347	21	0	347	80	7.2	
			Mean	61.72	0.22	3.54	1.83	1.44	0.07	0.04	19	217	16	0	269	63	6.8	
			STD	*0.30*	*0.08*	*0.95*	*0.28*	*0.42*	*0.01*	*0.01*	*3*	*185*	*8*	*0*	*110*	*25*	*0.6*	
Lower - Middle Ordovician - Road River Group - limy siltstone interbedded with limestone																		
79CQ 12	94F/06	369233	6373039	38.43	0.21	3.95	1.94	1.65	0.07	0.03	16	36	11	0	233	38	7.4	
79CQ 14	94F/06	369524	6373229	36.60	0.26	7.98	2.52	2.97	0.15	0.05	13	28	7	0	1200	15	3.6	
79EF 23	94F/07	395241	6350397	26.72	0.10	1.88	0.84	0.87	0.04	0.10	11	14	10	0	258	30	0.7	
79EF 30	*94F/07*	*395937*	*6352476*	*44.40*	*0.57*	*4.96*	*6.47*	*1.90*	*0.08*	*0.06*	*6*	*18*	*2*	*0*	*910*	*15*	*1.2*	
79EF 34	94F/07	399870	6348786	18.52	0.02	0.51	0.99	0.11	0.07	0.01	8	1200	2	0	163	145	2.9	
79PI 6E	94F/07	380269	6368223	26.21	0.06	1.42	0.68	0.63	0.03	0.11	9	23	11	0	352	51	1.8	
79PI 10	94F/07	381391	6366747	45.84	0.29	6.33	2.19	2.66	0.09	0.05	39	550	22	1	41			
			Mean	33.82	0.22	3.86	2.23	1.54	0.08	0.06	15	267	9	0	451	49	2.9	
			STD	10.23	0.19	2.75	2.00	1.06	0.04	0.04	11	456	7	0	432	49	2.4	
Lower - Upper Ordovician - Road River Group - laminated limestone and limy mudstone																		
79EF 5	94F/07	396932	6351598	23.36	0.10	2.21	0.86	1.21	0.04	0.03	8	22	8	0	158	24	2.3	
79EF 33	94F/07	399728	6348744	16.18	0.10	2.15	0.95	1.12	0.09	0.05	5	30	3	0	362	15	1.4	
79FD 2	94F/07	383895	6360037	24.04	0.17	4.69	1.69	0.73	0.11	0.01	10	28	9	0	339	34	8.7	
79FD 16	94F/07	384895	6363082	14.74	0.04	1.00	0.52	0.51	0.04	0.06	5	18	3	0	169	15	1.0	
79PI 11	94F/07	381291	6367178	17.08	0.05	1.75	0.84	0.69	0.07	0.05	9	41	8	0	9			
			Mean	19.08	0.09	2.36	0.97	0.85	0.07	0.04	7	28	6	0	207	22	3.4	
			STD	4.31	0.05	1.39	0.43	0.30	0.03	0.02	2	9	3	0	145	9	3.6	
Middle - Upper Ordovician - Road River Group - quartz wacke, siltstone																		
80-9-105	94F/07	404652	6361426	93.85	0.09	1.66	0.22	0.17	0.14	0.01	3	62	7	0	28	20	1.3	0.06
80-9-110B	94F/07	404651	6361426	81.80	0.09	1.01	0.40	0.13	0.07	0.01	5	170	10	0	246	20	3.2	0.08
80SH 14H2	94F/07	404649	6361436	93.55	0.10	1.11	0.47	0.30	0.05	0.12	5	11	12	1	12	0		
			Mean	89.73	0.09	1.26	0.36	0.20	0.09	0.05	4	81	10	1	95	13	2.3	0.07
			STD	6.87	0.01	0.35	0.13	0.09	0.05	0.06	1	81	3	0	131	12	1.3	0.01

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
Middle - Upper Ordovician - Road River Group - cherty argillite																		
79EF 38	94F/07	400413	6349185	76.42	0.13	2.59	0.70	0.79	2.08	0.06	60	281	6	3	89	214	19.9	
79PI 9	94F/07	381238	6367028	82.24	0.19	3.54	2.47	0.05	0.07	0.02	15	615	10	0	349	59	0.5	
79PI 15	94F/07	381237	6365835	71.96	0.18	3.18	1.74	1.20	0.16	0.07	10	54	40	0	481	48	3.7	
			Mean	76.87	0.17	3.10	1.64	0.68	0.77	0.05	28	317	19	1	306	107	8.0	
			STD	5.15	0.03	0.48	0.89	0.58	1.14	0.03	28	282	19	1	199	93	10.4	
Lower - Upper Ordovician - Road River Group - argillaceous limestone																		
79CQ 17A	94F/06	369939	6373517	21.01	0.03	0.78	0.80	0.36	0.05	0.01	5	14	5	0	626	15	3.1	
80CQ 17D	94F/11	404653	6361436	17.17	0.10	1.48	4.81	0.45	0.08	0.05	38	1700	18	0	700	211		0.42
			Mean	19.09	0.07	1.13	2.81	0.41	0.07	0.03	22	857	12	0	663	113	3.1	0.42
			STD	2.72	0.05	0.49	2.84	0.06	0.02	0.03	23	1192	9	0	52	139		
Middle - Upper Ordovician - Road River Group - shale, silty shale																		
79EF 31	94F/07	396006	6352586	52.67	0.30	5.93	1.41	3.56	0.07	0.15	8	11	20	1	166	55	5.9	
79EF 37A	94F/07	400409	6349023	55.68	0.32	6.70	1.09	2.06	0.11	0.13	19	158	20	1	156	59	9.5	
79PI 13	94F/07	381605	6367156	55.25	0.29	6.11	2.57	2.23	0.09	0.07	30	32	34	2	36			
79PI 13B	94F/07	381608	6367156	58.93	0.29	5.72	2.64	2.10	0.09	0.08	55	53	69	4	46			
79PI 13C	94F/07	381607	6367156	59.01	0.28	5.54	2.46	2.03	0.09	0.07	42	47	43	2	46			
			Mean	56.31	0.30	6.00	2.03	2.40	0.09	0.10	31	60	37	2	90	57	7.7	
			STD	2.69	0.02	0.45	0.73	0.66	0.01	0.04	19	57	20	1	65	3	2.5	
Middle-Upper Ordovician - Road River Group - baritic shale																		
80-9-110	94F/07	404660	6361436	63.38	0.79	12.56	2.89	4.38	0.15	1.34	33	685	56	2	142	246		0.53
Middle-Upper Ordovician - Road River Group - siliceous shale																		
79EF 37	94F/07	400407	6349021	77.42	0.49	12.02	0.81	3.09	0.02	0.32	27	65	49	4	16	106	5.4	
79FD 17	94F/07	385228	6362904	80.22	0.43	8.13	1.98	3.13	1.98	0.08	54	52	25	2	74	89	18.4	
79FD 18	94F/07	385473	6363007	69.49	0.60	12.85	1.68	5.41	1.68	0.30	12	123	29	1	34	158	14.9	
79PI 2	94F/07	380250	6367536	80.97	0.49	7.93	1.31	2.44	0.04	0.18	13	138	9	2	34			
79PI 14	94F/07	381115	6365595	75.90	0.28	9.13	1.83	2.87	0.06	0.33	67	270	20	1	40			
79PI 16	94F/07	381446	6366436	76.89	0.34	6.96	1.46	2.07	0.07	0.16	13	9	2	0	190	15	0.5	
79PI 20	94F/07	382192	6367452	77.50	0.56	8.80	0.65	3.75	0.02	0.28	12	14	21	1	24	213	3.6	
79CQ 25	94F/11	372994	6376763	76.14	0.49	10.69	0.96	3.60	0.06	0.06	38	16	29	1	20	48	2.5	
79YL 3	94F/11	370569	6379988	79.70	0.42	8.64	0.36	3.36	0.02	0.13	4	23	6	1	10	233	0.7	
			Mean	77.14	0.46	9.46	1.23	3.30	0.44	0.20	27	79	21	1	49	123	6.6	
			STD	3.39	0.10	1.97	0.56	0.95	0.79	0.11	22	86	14	1	56	82	7.2	
Middle-Upper Ordovician - Road River Group - siltstone																		
79PI 13A	94F/07	381480	6367209	50.92	0.12	1.54	2.92	0.43	0.19	0.03	28	58	41	3	568	56	4.1	
80-9-100	94F/07	404652	6361425	49.73	0.03	1.61	0.42	0.22	0.07	0.01	5	2600	24	0	516	140	0.8	0.11
			Mean	50.33	0.07	1.58	1.67	0.32	0.13	0.02	17	1329	33	2	542	98	2.5	0.11
			STD	0.84	0.07	0.05	1.77	0.15	0.08	0.01	16	1797	12	2	37	59	2.3	
Ordovician - Road River Group - ankeritic volcanics																		
80CQ 12	94F/11	374104	6379565	17.56	0.72	3.41	7.76	1.08	0.05		11	18	3	0				
80CQ 19B	94F/11	376497	6379829	15.76	0.84	5.38	8.59	1.52	0.05		28	16	4	0				
80CQ 19C	94F/11	376497	6379829	11.14	0.84	4.30	8.98	1.17	0.05		27	16	3	0				
80CQ 20	94F/11	376376	6379681	23.77	1.18	6.12	5.92	1.47	0.05		12	13	3	0				
80CQ 22	94F/11	376228	6379477	24.95	0.63	3.93	10.20	1.14	0.06		16	19	11	0				
			Mean	18.64	0.84	4.63	8.29	1.28	0.05		19	16	5	0				
			STD	5.74	0.21	1.10	1.59	0.20	0.00		8	2	3	0				
Middle Ordovician - Road River Group - chert interbedded with ankeritic volcanics																		
80PI 48	94F/07	385447	6371481	92.76	0.15	2.61	0.87	0.16	0.05		8	67	10	0				
Middle Ordovician - Road River Group - dioritic sills and submarine flows (mOv)																		
79EF 28	94F/07	395855	6352217	44.99	2.09	16.20	9.94	5.28	0.41	0.35	47	116	3	0	530	15	3.6	
79EF 29	94F/07	395869	6352342	41.22	0.28	9.82	2.69	8.14	0.18	0.47	2	13	3	0	1300	15	1.1	
79PI 8	94F/07	380776	6367416	53.18	1.05	15.14	8.40	3.42	0.13	0.25	63	72	10	1	81			
			Mean	46.46	1.14	13.72	7.01	5.61	0.24	0.36	37	67	5	1	637	15	2.4	
			STD	6.11	0.91	3.42	3.82	2.38	0.15	0.11	32	52	4	0	617	0	1.8	

Middle Ordovician - Road River Group - highly altered flows (mOv)

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
79FD 8A	*94F/07*	*385377*	*6360454*	*44.78*	*1.47*	*13.95*	*6.87*	*5.70*	*0.24*	*0.61*	*75*	*100*	*4*	*0*	*313*	*15*	*0.5*	
80PI 46	94F/07	385344	6371889	36.34	2.68	11.10	0.90	2.40	0.45	0.07	58	95	3	0				
80PI 46B	94F/07	385344	6371889	37.11	1.80	11.61	0.39	5.05	1.74	0.06	74	12	3	0				
80PI 46C	94F/07	385344	6371889	32.72	1.49	10.13	5.65	3.81	0.13	0.04	44	13	4	0				
80PI 46D	94F/07	385344	6371889	32.68	2.37	10.08	1.05	2.28	0.23	0.06	53	77	4	1				
			Mean	36.73	1.96	11.37	2.97	3.85	0.56	0.17	61	59	4	0	313	15	0.5	
			STD	4.94	0.54	1.58	3.04	1.54	0.67	0.25	13	44	1	0				

Middle Ordovician - Road River Group - limestone interbedded with volcanics

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
80PI 46A	94F/07	385344	6371889	3.48	0.02	0.17	13.18	0.01	0.05	0.00	195	14	11	0	0	0	0.0	
80CQ 19	*94F/11*	*376497*	*6379829*	*18.84*	*0.41*	*2.67*	*8.70*	*0.67*	*0.05*	*0.00*	*11*	*18*	*3*	*0*	*0*	*0*	*0.0*	
			Mean	11.16	0.22	1.42	10.94	0.34	0.05	0.00	103	16	7	0	0	0	0.0	
			STD	10.86	0.28	1.77	3.17	0.47	0.00	0.00	130	3	6	0	0	0	0.0	

Middle Ordovician - Road River Group - mafic submarine tuff)

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
79FD 8	94F/07	385377	6360454	50.01	1.02	5.36	5.55	0.17	0.23	0.02	39	577	8	1	482	58	0.5	
79FD 8	94F/07	385348	6360517	58.07	1.10	6.42	0.09	0.31	0.40		44	1030	9	1				
79FD 8 *	94F/07	385382	6360460	49.50	1.02	5.31	5.50	0.17	0.23	0.02	37	2600	10	1	494	57	0.5	
79FD 13	94F/07	383872	6362558	41.55	2.11	10.70	0.29	7.26	0.94		65	79	5	0				
79FD 13A	94F/07	383920	6362421	58.39	1.24	7.06	2.76	5.34	0.31	0.19	17	17	8	0	735	16	1.4	
79FD 13B	*94F/07*	*383872*	*6362558*	*30.80*	*1.22*	*7.63*	*0.39*	*5.19*	*0.18*		*44*	*14*	*3*	*0*				
79PI 4	94F/07	380371	6367900	53.32	1.21	14.67	0.77	3.37	0.25		66	66	3	1				
79PI 4A	94F/07	380397	6367893	49.96	1.12	13.72	9.20	4.16	0.14	0.16	66	75	2	0	407	15	0.5	
79PI 4B	94F/07	380397	6367892	42.01	1.96	9.07	6.61	2.22	0.40	0.10	50	40	4	0	684	16	3.1	
79PI 4C	94F/07	380371	6367900	48.07	1.26	16.12	0.94	2.17	0.25		40	56	3	0				
79PI 4D	94F/07	380398	6367893	42.97	1.51	13.35	9.44	2.22	0.23	0.13	64	124	2	0	437	15	0.5	
79PI 6	94F/07	380269	6368223	57.25	0.58	5.01	2.71	1.82	0.16	0.14	18	23	4	0	681	17	1.0	
79PI 11	94F/07	381254	6367219	52.31	1.01	15.18	0.63	1.96	0.08		60	67	3	0				
79PI 12	94F/07	381501	6367159	29.67	0.67	8.12	1.18	3.53	0.23	0.15	33	30	17	1	41			
79PI 12	94F/07	381464	6367222	49.82	1.16	19.38	0.90	4.45	0.08		4	58	3	1				
*79PI 12 **	*94F/07*	*381501*	*6367159*	*31.58*	*0.83*	*8.84*	*1.22*	*3.85*	*0.35*	*0.16*	*37*	*37*	*20*	*1*	*45*			
80PI 42	94F/07	385436	6372256	37.35	2.88	11.68	2.25	2.49	0.30	0.12	59	140	5	0				
80PI 42A	94F/07	385436	6372256	36.86	2.86	11.65	12.42	2.26	0.32		60	137	6	0				
80CQ 19A	94F/11	376497	6379829	43.91	1.68	10.25	0.72	3.22	1.15	0.05	5	6	3	0				
80CQ 21	94F/11	376282	6379571	40.81	1.93	13.63	1.58	2.55	0.18	0.06	53	137	3	0				
80CQ 21A	94F/11	376282	6379571	44.41	2.00	14.06	2.38	2.48	0.32	0.08	69	88	6	0				
80CQ 21B	94F/11	376282	6379571	37.89	1.91	12.39	0.86	2.85	0.11	0.07	62	46	3	0				
			Mean	44.84	1.47	10.89	3.11	2.91	0.31	0.10	45	248	6	0	445	28	1.1	
			STD	8.62	0.63	3.93	3.49	1.72	0.26	0.05	20	574	5	0	256	20	1.0	

Middle Ordovician - Road River Group - bedded barite

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
80-9-110A	94F/07	404652	6361426	1.42	0.02	0.43	0.17	0.11	0.07	50.00	3	24	5	0	4	99	4.3	0.19
80-9-110E	94F/07	404662	6361436	0.40	0.13	0.47	0.21	0.15	0.02	54.89	9	82	4	1	5	140		
80-9-110F	94F/07	404662	6361436	0.08	0.13	0.22	0.37	0.10	0.02	57.35	2	18	6	0	5	23		
80-9-110G	94F/07	404662	6361436	0.36	0.14	0.41	0.22	0.15	0.02	57.59	6	262	3	0	65	155		
80-9-110H	94F/07	404662	6361436	1.16	0.14	0.41	0.24	0.15	0.03	57.16	8	370	4	0	38	214		
80-9-110I	94F/07	404662	6361436	0.50	0.12	0.38	0.16	0.09	2.40	51.91	8	121	5	0	15	15		
80SH 14B	94F/07	404649	6361436	3.47	0.16	1.06	0.83	0.33	0.06	55.02	20	203	8	1	9	31		0.60
80SH 14D	94F/07	404649	6361436	1.12	0.14	0.43	0.20	0.18	0.04	57.88	6	49	2	0	8	15		0.14
80SH 14E	94F/07	404649	6361436	3.81	0.16	1.00	0.25	0.36	0.04	55.34	8	15	7	1	4	41		0.89
80SH 14H	94F/07	404649	6361435	0.64	0.13	0.53	0.07	0.14	0.02	55.22	4	2	9	1	2	36		0.14
80SH 14H1	94F/07	404649	6361436	0.12	0.14	0.46	0.07	0.10	0.03	58.99	4	2	6	1	2	44		0.10
80SH 14H3	94F/07	404649	6361436	0.41	0.14	0.41	0.04	0.12	0.02	59.29	7	4	7	0	2	79		
80SH 14H4	94F/07	404649	6361436	0.65	0.14	0.38	0.04	0.17	0.01	59.01	3	2	6	1	2	15		
80SH 41B	94F/07	399728	6365667	2.57	0.14	0.60	0.15	0.21	0.03	56.25	4	2	6	1	2	15		
80SH 41C	94F/07	399728	6365667	1.14	0.13	0.18	0.06	0.04	0.03	57.44	7	42	5	1	65	15		
80SH 41F	94F/07	399728	6365667	4.99	0.14	0.53	0.09	0.23	0.07	54.86	4	2	5	0	2	15		
80SH 41G	94F/07	399728	6365667	3.07	0.15	0.47	0.17	0.16	0.04	57.45	3	2	8	0	2	15		
80SH 43A	94F/07	402654	6366148	11.44	0.12	0.54	0.30	0.15	0.98	50.16	13	127	6	0	15	15		0.16
80SH 43B	94F/07	402655	6366148	9.02	0.13	0.54	0.43	0.14	0.38	52.59	12	232	5	0	21	15		0.10
80SH 43C	94F/07	402654	6366149	3.47	0.13	0.51	0.80	0.12	0.25	55.21	12	80	20	1	5	18		0.12
80WH 33	94F/07	392643	6369779	9.46	0.15	0.87	0.23	0.27	0.07	51.97	11	44	2	1	5	15		

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
80WH 33C	94F/07	392643	6369780	11.27	0.14	0.76	0.36	0.28	0.08	50.49	13	113	7	1	12	23		
			Mean	3.21	0.13	0.53	0.25	0.17	0.21	55.28	8	82	6	1	13	48	4.3	0.27
			STD	3.71	0.03	0.22	0.21	0.08	0.53	2.94	4	102	4	0	19	55		0.28
Middle Ordovician - Road River Group - shaly barite																		
80SH 14C	94F/07	404649	6361435	33.28	0.25	3.34	1.33	1.28	0.15	30.93	53	65	5	2	10	164		4.23
80SH 14G	94F/07	404649	6361436	19.05	0.30	3.89	0.88	1.67	0.10	40.04	36	48	7	3	12	135		3.56
80SH 41A	94F/07	399728	6365667	15.59	0.17	1.40	0.31	0.63	0.03	47.67	7	17	6	0	7	15		
80SH 41A *	94F/07	399496	6365626	15.53	0.17	1.38	0.32	0.64	0.03	47.49	7	20	4	0	8	15		
80SH 41D	94F/07	399728	6365667	30.75	0.19	2.20	0.34	1.08	0.27	34.07	4	2	13	0	4	15		
80SH 41E	94F/07	399728	6365667	31.09	0.16	0.87	0.55	0.54	0.05	49.90	5	13	2	0	5	23		
80SH 45B	94F/07	402654	6366148	36.10	0.16	1.36	0.82	0.50	0.08	32.47	17	104	7	1	10	59		3.28
			Mean	25.91	0.20	2.06	0.65	0.91	0.10	40.37	18	38	6	1	8	61		3.69
			STD	8.85	0.05	1.14	0.38	0.45	0.09	8.02	19	36	3	1	3	63		0.49
Early Silurian - Road River Group - dolostone																		
79CQ 9	94F/11	371104	6375045	8.38	0.03	0.63	0.40	0.30	0.03	0.01	8	13	4	0	180	17	3.9	
79DM 16	94F/11	366031	6385192	4.32	0.04	0.79	0.45	0.31	0.04	0.02	7	98	2	0	92	21	0.5	
79YL 1A	94F/11	369999	6380147	10.50	0.04	0.82	0.30	0.28	0.06	0.02	9	68	1	1	353	28	0.5	
			Mean	7.73	0.04	0.75	0.38	0.30	0.04	0.02	8	60	2	0	208	22	1.6	
			STD	3.14	0.01	0.10	0.08	0.02	0.02	0.01	1	43	2	0	133	6	2.0	
Early Silurian - Road River Group - silty dolostone																		
79AL 10	94F/07	362097	6397204	34.61	0.18	3.36	1.34	1.32	0.05	0.06	44	240	12	1	143			
79AL 17	94F/07	360704	6396704	42.73	0.19	3.91	0.83	1.50	0.06	0.04	36	750	13	1	183			
79FD 5	94F/07	384231	6360158	32.20	0.15	3.69	0.67	1.16	0.07	0.08	9	11	4	0	442	21	0.7	
79PI 21	94F/07	382312	6367682	36.85	0.04	1.43	0.67	0.85	0.02	0.03	8	28	12	0	287	16	1.6	
79PI 21 *	94F/07	382280	6367654	35.88	0.05	1.45	0.66	0.84	0.03	0.03	8	24	10	0	260	18	1.4	
79AL 4	94F/11	356707	6393641	36.14	0.21	4.82	1.09	1.05	0.14	0.13	7	28	11	0	430	15	1.0	
79CQ 8	94F/11	370969	6375094	32.13	0.03	0.60	0.24	0.19	0.03	0.01	8	22	7	0	122	15	1.3	
79CQ 8 *	94F/11	370964	6375102	32.44	0.03	0.66	0.25	0.19	0.03	0.01	8	19	4	0	120	17	2.5	
79CQ 54	94F/11	371522	6375616	28.46	0.06	1.42	1.80	0.43	0.04	0.04	14	30	27	1	1400	38	3.4	
79CQ 54 *	94F/11	371527	6375615	28.25	0.06	1.19	1.80	0.41	0.04	0.04	13	34	33	1	1600	66	4.2	
79DM 4	94F/11	362650	6380425	30.11	0.17	4.13	1.12	1.03	0.06	0.13	9	51	6	0	288	15	1.3	
79DM 8	94F/11	363569	6382332	36.15	0.21	4.86	0.99	1.45	0.10	0.08	7	16	6	0	720	15	1.8	
79DM 9	94F/11	363727	6382624	35.90	0.20	4.84	0.95	1.21	0.10	0.14	9	22	13	1	820	15	1.2	
			Mean	33.99	0.12	2.80	0.95	0.89	0.06	0.06	14	98	12	1	524	23	1.9	
			STD	3.97	0.08	1.69	0.49	0.46	0.04	0.05	12	205	9	0	486	16	1.1	
Early Silurian - Road River Group - dolomitic siltstone																		
79GN 24	94F/02	408454	6339255	49.51	0.30	7.23	1.53	2.68	0.09	0.09	14	30	21	0	228	34	2.4	
79GN 26	94F/02	407717	6339053	71.36	0.24	5.85	1.19	1.68	0.44	0.06	6	4	8	0	175	15	4.2	
79AL 12	94F/07	361975	6396970	63.29	0.36	7.73	1.84	2.48	0.09	0.06	10	16	11	1	276			
79EF 9B	94F/07	397110	6351925	59.87	0.38	8.23	5.01	2.93	0.11	0.11	7	11	9	0	180	24	2.3	
79EF 10	94F/07	397153	6352043	59.82	0.39	8.48	1.40	2.82	0.11	0.13	8	108	10	0	182	21	0.7	
79EF 18	94F/07	395049	6349821	64.98	0.41	9.48	1.54	3.27	0.30	0.14	11	138	25	0	178	30	4.7	
79EF 19	94F/07	394706	6349954	71.64	0.23	7.61	1.44	1.83	0.12	0.09	6	19	14	0	160	15	0.5	
79EF 20	94F/07	394804	6350225	47.97	0.26	5.94	1.51	1.86	0.06	0.17	11	25	10	0	235	22	2.6	
79FD 4	94F/07	384103	6360168	59.23	0.37	8.21	1.64	2.36	0.10	0.08	11	73	13	0	262	22	6.9	
79FD 19	94F/07	385736	6363074	45.37	1.50	9.19	6.60	2.98	0.56	0.15	40	59	6	0	800	15	0.5	
79AL 1	94F/11	356089	6392206	62.85	0.43	9.15	2.86	2.79	0.06	0.51	30	34	6	0	263	38	1.9	
79AL 2	94F/11	356336	6393029	59.74	0.37	7.79	1.90	2.30	0.11	0.06	8	39	11	0	233	16	2.7	
79AL 3	94F/11	356613	6393484	63.94	0.43	8.81	1.91	3.28	0.14	0.08	13	112	14	0	185	34	7.2	
79AL 4A	94F/11	356707	6393642	68.20	0.43	9.56	2.37	3.27	0.17	0.08	14	124	11	0	171	15	1.9	
79CQ 6	94F/11	370758	6375170	57.64	0.38	6.95	2.44	3.43	0.04	0.23	15	34	15	1	239	55	4.1	
79CQ 7	94F/11	370841	6375102	52.45	0.26	4.49	1.62	2.75	0.06	0.08	12	36	13	0	231	27	5.3	
79CQ 18A	94F/11	374317	6378656	47.90	0.30	6.18	1.28	2.89	0.10	0.13	25	279	13	0	135	65	11.5	
79DM 1	94F/11	362403	6380195	61.96	0.41	8.39	1.89	2.68	0.11	0.06	8	18	10	0	226	15	1.4	
79DM 2	94F/11	362487	6380251	64.59	0.38	8.62	1.70	2.98	0.10	0.06	8	30	15	0	175	15	2.1	
79DM 3	94F/11	362558	6380336	59.69	0.39	8.14	1.86	3.07	0.10	0.07	9	105	16	0	248	15	2.3	
79DM 6	94F/11	363635	6380897	65.81	0.34	8.19	1.48	2.99	1.07	0.08	14	47	10	0	193	15	4.7	
79DM 7	94F/11	363429	6382073	55.52	0.38	7.55	2.18	3.07	0.09	0.07	10	20	15	0	292	21	3.4	
79DM 7A	94F/11	363432	6382074	65.56	0.44	9.24	2.27	3.40	0.08	0.06	11	18	13	0	212	23	3.0	

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO_2 (wt%)	TiO_2 (wt%)	Al_2O_3 (wt%)	Fe_2O_3 (wt%)	K_2O (wt%)	P_2O_5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
79DM 10	94F/11	364530	6383155	64.43	0.46	10.25	2.40	3.23	0.09	0.06	7	38	6	0	221	62	1.5	
79DM 10 *	94F/11	364558	6383162	65.01	0.46	10.20	2.43	3.23	0.09	0.06	7	34	7	0	217	15	1.3	
79DM 12	94F/11	365171	6384978	59.59	0.37	7.96	1.72	3.56	0.11	0.09	13	142	19	1	265	25	2.2	
79DM 17	94F/11	366425	6384858	66.82	0.39	8.39	2.38	2.97	0.07	0.12	13	182	13	1	250	49	0.9	
79KW 11	94F/11	375943	6396094	58.01	0.26	6.76	1.54	3.93	0.09	0.13	13	20	18	0	257			
79KW 12	94F/11	375874	6395533	55.54	0.32	7.28	2.61	3.50	0.08	0.07	14	25	18	1	319			
79KW 12A	94F/11	375871	6395495	47.78	0.20	4.85	1.10	2.64	0.08	0.07	12	222	11	0	208			
79YL 1	94F/11	369994	6380147	56.26	0.34	7.21	2.78	2.67	0.08	0.08	12	28	10	0	310	40	2.3	
			Mean	59.75	0.39	7.87	2.14	2.89	0.16	0.11	13	67	13	0	243	28	3.1	
			STD	6.97	0.22	1.41	1.10	0.51	0.20	0.08	7	67	4	0	113	15	2.4	

Early Silurian - Road River Group - cherty argillite

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO_2 (wt%)	TiO_2 (wt%)	Al_2O_3 (wt%)	Fe_2O_3 (wt%)	K_2O (wt%)	P_2O_5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
79FD 6B	94F/07	385155	6360440	83.73	0.04	2.32	0.29	0.95	0.11	0.02	6	33	8	0	90	25	0.7	
80-9-155	94F/07	404652	6361428	75.79	0.14	2.77	0.40	0.97	0.11	0.06	30	418	9	0	149	89	5.0	5.88
			Mean	79.76	0.09	2.55	0.35	0.96	0.11	0.04	18	226	9	0	120	57	2.9	5.88
			STD	5.61	0.07	0.32	0.08	0.01	0.00	0.03	17	272	1	0	42	45	3.0	

Early Silurian - Road River Group - chert

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO_2 (wt%)	TiO_2 (wt%)	Al_2O_3 (wt%)	Fe_2O_3 (wt%)	K_2O (wt%)	P_2O_5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
79CQ 13B	94F/06	369100	6372928	91.02	0.05	4.28	0.27	0.25	0.57	0.02	23	58	7	1	16	31	3.7	
79AL 5B	94F/11	356798	6393777	92.74	0.05	1.77	0.24	0.28	1.62	0.03	16	97	15	1	14	79	0.5	
79CQ 10	94F/11	371154	6374958	89.98	0.05	1.70	0.21	0.24	2.06	0.02	22	21	3	1	16	15	3.4	
			Mean	*91.25*	*0.05*	*2.58*	*0.24*	*0.26*	*1.42*	*0.02*	*20*	*59*	*8*	*1*	*15*	*42*	*2.5*	
			STD	1.39	0.00	1.47	0.03	0.02	0.77	0.01	4	38	6	0	1	33	1.8	

Early Silurian - Road River Group - argillaceous limestone

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO_2 (wt%)	TiO_2 (wt%)	Al_2O_3 (wt%)	Fe_2O_3 (wt%)	K_2O (wt%)	P_2O_5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
79CQ 13	94F/06	369084	6372919	19.30	0.03	0.48	0.19	0.18	0.02	0.03	5	7	2	0	119	15	3.2	
79EF 22	94F/07	395125	6350480	10.26	0.02	0.48	0.43	0.30	0.03	0.04	6	12	2	0	237	25	0.5	
79FD 6E	94F/07	385154	6360433	27.09	0.06	1.45	0.71	0.64	0.03	0.11	8	25	12	0	345	66	1.0	
79AL 5	94F/11	356799	6393777	26.90	0.08	2.02	0.69	0.92	0.05	0.03	6	42	10	0	333	15	0.5	
79AL 5C	94F/11	356795	6393775	13.74	0.05	1.26	0.59	0.55	0.04	0.04	5	285	12	0	500	28	1.6	
79CQ 2	94F/11	370648	6375441	14.31	0.04	0.84	0.64	0.30	0.54	0.02	6	14	10	0	345	15	4.5	
79CQ 35	94F/11	371452	6375943	7.59	0.02	0.52	0.35	0.19	0.06	0.03	9	15	13	0	358	0	1.1	
79DM 11	94F/11	364644	6383259	13.90	0.04	0.89	0.35	0.31	0.10	0.10	6	42	5	0	196	24	3.6	
79YL 2	94F/11	369999	6380149	9.21	0.03	0.56	0.19	0.18	0.04	0.01	4	39	2	0	85	17	0.5	
79YL 4	94F/11	370688	6380040	13.45	0.07	1.64	1.02	0.55	0.07	0.04	10	50	10	0	256	29	2.8	
			Mean	15.58	0.04	1.01	0.52	0.41	0.10	0.05	7	53	8	0	277	23	1.9	
			STD	6.83	0.02	0.55	0.26	0.25	0.16	0.03	2	83	5	0	124	17	1.5	

Early Silurian - Road River Group - shale

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO_2 (wt%)	TiO_2 (wt%)	Al_2O_3 (wt%)	Fe_2O_3 (wt%)	K_2O (wt%)	P_2O_5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
79CQ 13C	94F/06	369100	6372928	47.70	0.08	3.05	0.75	2.12	0.04	0.05	8	41	11	0	140	15	4.4	
79CQ 13D	94F/06	369101	6372928	66.01	0.36	6.98	1.61	3.38	0.05	0.08	8	17	11	0	192	19	6.3	
79CQ 13E	94F/06	369100	6372928	56.81	0.09	3.22	0.46	1.91	1.11	0.05	9	129	11	0	197	57	4.9	
79CQ 13F	94F/06	369100	6372928	55.28	0.09	5.55	1.71	3.22	0.04	0.06	9	12	13	0	225	27	7.4	
79FD 6A	94F/07	385154	6360440	64.86	0.05	1.46	0.33	0.39	0.10	0.08	12	27	8	1	152	37	1.4	
79FD 6C	94F/07	385154	6360440	49.00	0.22	5.30	0.79	2.55	5.60	0.08	17	24	9	1	128	35	1.4	
79PI 21A	94F/07	382315	6367678	66.03	0.60	10.45	2.07	5.26	0.14	0.22	25	32	30	0	156	80	9.8	
80-9-210	94F/07	404612	6361350	63.19	0.15	2.60	0.61	1.76	0.04	0.46	10	50	27	0	383	15		
79AL 5A	94F/11	356795	6393777	64.35	0.21	5.51	0.90	2.68	2.42	0.11	23	314	120	1	133	56	3.7	
79CQ 26	94F/11	372749	6376370	65.93	0.40	7.07	1.85	3.20	0.05	0.09	21	27	16	1	178	65	1.0	
79CQ 27	94F/11	372666	6376244	61.61	0.54	9.84	2.14	4.36	0.07	0.10	24	24	20	2	176	88	2.5	
			Mean	60.07	0.25	5.55	1.20	2.80	0.88	0.13	15	63	25	1	187	45	4.3	
			STD	6.84	0.19	2.90	0.68	1.32	1.73	0.12	7	89	32	0	71	26	2.9	

Early Silurian - Road River Group - bedded barite

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO_2 (wt%)	TiO_2 (wt%)	Al_2O_3 (wt%)	Fe_2O_3 (wt%)	K_2O (wt%)	P_2O_5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
80-9-210B	94F/07	404612	6361349	4.06	0.10	0.53	0.07	0.13	0.02	42.70	3	21	4	0	21	15		
80-9-210E	94F/07	404612	6361350	8.85	0.14	0.56	0.12	0.26	0.05	51.27	2	27	4	0	21	15		
80SH 19	94F/07	403836	6361950	1.07	0.14	0.48	0.16	0.16	0.03	58.17	5	8	7	1	2	22		
80SH 19A	94F/07	403836	6361950	2.02	0.14	0.49	0.15	0.15	0.06	56.29	8	2	7	1	6	15		
80SH 19B	94F/07	403836	6361950	5.32	0.13	0.53	0.40	0.09	0.07	55.37	16	110	11	1	2	15		0.14
80SH 19C	94F/07	403836	6361950	4.14	0.12	0.36	0.47	0.05	0.07	56.26	19	144	9	1	2	22		
80SH 19D	94F/07	403836	6361950	3.11	0.13	0.38	0.38	0.14	0.06	56.54	8	59	4	1	2	15		
			Mean	4.08	0.13	0.48	0.25	0.14	0.05	53.80	9	53	7	1	8	17		0.14
			STD	2.53	0.01	0.08	0.16	0.07	0.02	5.34	6	55	3	0	9	3		

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
Early Silurian - Road River Group - baritic shale																		
79CQ 5	94F/11	370707	6375293	65.41	0.43	8.37	1.99	3.30	0.07	1.05	6	35	10	0	280	15	0.5	
Early Silurian - Road River Group - shaly barite																		
80-9-210A	94F/07	404612	6361349	19.02	0.16	1.51	1.60	0.81	0.14	42.86	11	5200	4	0	14	727		
80-9-210C	94F/07	404612	6361349	13.00	0.15	1.13	0.56	0.59	0.10	45.79	8	2100	5	0	63	250		
80-9-210D	94F/07	404612	6361349	27.93	0.17	1.99	0.34	1.12	0.03	34.32	6	44	6	0	94	15		
			Mean	19.98	0.16	1.54	0.83	0.84	0.09	40.99	8	2448	5	0	57	331		
			STD	7.51	0.01	0.43	0.67	0.27	0.06	5.96	3	2596	1	0	40	363		
Lower - Middle Devonian - Road River Group - siliceous shale interbedded with limestone debris flows																		
79GN 6C	94F/01	410164	6340439	72.20	0.06	1.95	0.47	0.94	0.11	0.04	16	45	14	1	121	64	7.1	
Lower - Middle Devonian - Road River Group - limestone debris flows																		
79GN 6A	94F/01	410295	6340452	28.19	0.06	1.46	0.76	0.65	0.17	0.04	16	69	16	1	280	47	12.1	
Lower - Middle Devonian - Road River Group - shale interbedded with imestone debris flows																		
79GN 5	94F/01	410143	6340289	51.29	0.07	2.35	0.87	1.26	0.08	0.06	15	120	18	1	300	83	8.8	
79GN 6B	94F/01	410296	6340451	43.45	0.04	1.30	0.43	0.45	0.13	0.04	11	113	13	1	175	44	12.2	
79GN 25	94F/02	407715	6339057	33.80	0.07	1.82	0.38	0.23	0.12	0.01	22	126	75	0	227	59	4.8	
80-10-106	94F/07	398508	6370031	63.99	0.10	2.37	0.76	1.14	2.00	0.01	41	10	19	1	104	137	8.8	1.20
80BM 22	94F/10	393530	6379553	53.14	0.05	2.29	0.14	1.39	0.12	0.03	5	7	4	0	80	20	1.0	0.17
			Mean	49.13	0.06	2.03	0.52	0.89	0.49	0.03	19	75	26	1	177	69	7.1	0.69
			STD	11.28	0.02	0.46	0.30	0.52	0.84	0.02	14	61	28	0	90	45	4.3	0.73
Lower - Middle Devonian - Road River Group - limy siltstone																		
79AL 14A	94F/07	361014	6397055	30.08	0.08	1.64	0.35	0.57	0.05	0.04	11	77	10	0	72			
80-10-145	94F/07	398508	6370031	41.74	0.06	2.42	0.41	1.22	0.07	0.01	6	4	8	0	236	20	2.2	0.23
80-10-173	94F/07	398508	6370032	36.08	0.05	2.24	0.31	1.33	0.07	0.01	7	22	6	0	248	20	0.9	0.09
			Mean	35.97	0.06	2.10	0.36	1.04	0.06	0.02	8	34	8	0	185	20	1.6	0.16
			STD	5.83	0.02	0.41	0.05	0.41	0.01	0.02	3	38	2	0	98	0	0.9	0.10
Lower - Middle Devonian - Road River Group - quartz wacke, siltstone																		
80-10-18	94F/07	398508	6370031	91.72	0.04	2.34	0.37	0.61	0.07	0.01	22	84	14	0	29	20	2.7	0.10
Lower - Middle Devonian - limestone																		
79AL 11B	94F/07	362026	6397129	2.10	0.01	0.57	0.16	0.15	0.02	0.01	7	25	8	0	40			
79AL 11C	94F/07	362026	6397128	4.51	0.02	0.73	0.31	0.21	0.07	0.01	8	31	6	0	34			
79PI 23	94F/07	383028	6369327	0.49	0.01	0.14	0.09	0.03	0.09	0.01	5	11	11	0	35	54	0.5	
79PI 23A	94F/07	383028	6369327	0.94	0.01	0.12	0.08	0.02	0.08	0.01	5	15	10	0	41	18	0.5	
79PI 23C	94F/07	383036	6369330	0.76	0.01	0.09	0.06	0.02	0.06	0.01	5	12	11	0	50	19	0.5	
			Mean	1.76	0.01	0.33	0.14	0.09	0.06	0.01	6	19	9	0	40	30	0.5	
			STD	1.66	0.00	0.30	0.10	0.09	0.03	0.00	1	9	2	0	6	21	0.0	
Lower - Middle Devonian - Road River Group - shale																		
79GN 32	94F/02	406242	6338846	60.80	0.21	4.66	0.66	1.12	0.08	0.15	16	137	9	1	191	86	9.6	
Lower - Middle Devonian - Road River Group - limy siltstone																		
79GN 7	94F/01	410152	6340210	34.09	0.13	2.91	0.78	1.39	0.10	0.07	21	56	16	1	270	45	4.9	
80-10-192	94F/07	398508	6370030	31.88	0.14	2.79	0.78	1.42	0.07	0.01	17	7	10	1	244	76	2.2	0.42
PIE-7	94F/07	379283	6371269	38.68	0.01	0.19	0.36	0.04	0.01	0.02	23	156	150	0	134	43		0.30
			Mean	34.88	0.09	1.96	0.64	0.95	0.06	0.03	20	73	59	1	216	55	3.6	0.36
			STD	3.47	0.07	1.54	0.24	0.79	0.05	0.03	3	76	79	0	72	19	1.9	0.08
Middle - Upper Devonian - Earn Group, Gunsteel Formation - siliceous argillite, baritic																		
79GN 14	94F/02	409512	6339706	77.40	0.21	5.67	6.80	0.63	0.26	2.04	87	122	6	3	34	137	51.7	
79GN 14 *	94F/02	409513	6339707	76.55	0.21	5.61	6.53	0.63	0.26	2.05	87	120	6	3	32	166	58.1	
79FD 26	94F/07	387684	6362325	86.42	0.12	6.21	1.11	2.34	1.11	1.47	8	32	15	0	11	31	8.7	
FLUKE-5	94F/07	384803	6364247	84.97	0.16	5.83	0.37	1.92	0.05	2.05	8	52	223	1	7	137	13.1	
FLUKE-8	94F/07	384803	6364247	70.04	0.41	5.97	2.88	0.68	0.11	7.73	15	401	210	3	19	2000	45.4	
79CQ 3C	94F/11	370624	6375472	79.73	0.37	6.18	0.68	1.45	0.68	3.19	31	36	123	1	11	143	15.1	
79CQ 30	94F/11	372012	6375925	81.82	0.27	4.03	1.58	0.82	0.09	3.02	23	192	13	0	6	225	16.1	
79CQ 33	94F/11	371732	6375883	75.74	0.54	8.73	2.13	1.93	0.18	4.09	36	41	23	1	10	173	13.8	

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
79CQ 36	94F/11	370948	6375826	78.96	0.28	4.41	1.25	0.81	0.08	3.56	14	153	10	0	10	222	11.4	
79CQ 37	94F/11	370858	6376552	76.97	0.35	7.44	2.20	1.71	0.11	1.80	40	37	10	1	46	348	11.3	
79CQ 38	*94F/11*	*370879*	*6376719*	*77.34*	*0.40*	*6.55*	*0.89*	*1.09*	*0.13*	*4.47*	*20*	*47*	*52*	*1*	*18*	*150*	*17.0*	
79CQ 42A	94F/11	371713	6376152	76.95	0.34	6.06	0.42	1.34	0.04	3.24	13	50	64	1	13	330	16.2	
79CQ 46	94F/11	371627	6376086	80.75	0.31	5.95	0.46	1.26	0.05	1.63	9	59	57	1	18	90	15.7	
			Mean	78.74	0.31	6.05	2.10	1.28	0.24	3.10	30	103	62	1	18	319	22.6	
			STD	4.20	0.11	1.18	2.17	0.57	0.31	1.69	27	103	76	1	12	512	17.0	

Middle - Upper Devonian - Earn Group, Gunsteel Formation - cherty argillite

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
79GN 3	94F/01	409656	6340478	87.43	0.24	5.29	0.76	1.35	0.03	0.27	9	9	26	1	8	47	7.0	
79GN 10	94F/01	409891	6340064	78.54	0.17	5.04	2.13	0.19	0.12	0.65	35	243	28	1	9	134	12.2	
79GN 12	94F/01	409659	6339893	82.12	0.43	8.86	1.18	1.96	0.05	0.66	35	120	46	3	12	68	16.0	
79GN 14A	*94F/02*	*409512*	*6339706*	*84.63*	*0.29*	*6.32*	*0.64*	*1.26*	*0.02*	*0.19*	*16*	*8*	*15*	*1*	*21*	*242*	*6.0*	
79GN 21	94F/02	409036	6339585	87.76	0.22	5.49	0.37	1.09	0.02	0.08	11	19	7	0	12	51	1.9	
79GN 33	94F/02	405751	6338842	82.27	0.38	8.27	2.16	1.38	0.17	0.45	45	42	12	1	22	34	5.7	
79AL 14	94F/07	361014	6397055	89.15	0.14	2.70	0.61	0.63	0.02	0.04	17	144	8	1	11			
79AL 15	94F/07	361005	6396977	86.18	0.27	5.18	0.55	1.41	0.02	0.07	16	45	15	1	12	70	3.5	
79EF 17	94F/07	395017	6349617	85.35	0.30	6.01	0.36	1.28	0.02	0.25	7	10	11	1	15	41	2.6	
79EF 39	94F/07	400608	6349406	84.44	0.39	8.48	0.61	2.29	5.02	0.16	7	17	17	1	14	111	2.5	
80-10-250	94F/07	398508	6370032	92.16	0.06	2.10	0.15	0.51	0.07	0.01	6	3	10	1	4	73	4.0	2.02
80-10-277	94F/07	398508	6370032	88.33	0.08	2.67	0.20	0.59	0.07	0.01	7	3	5	1	4	39	4.2	5.07
80BM 1	94F/07	391032	6373788	89.95	0.09	2.51	0.10	0.53	0.07	0.04	3	5	4	1	17	192	6.9	3.81
80BM 11	*94F/10*	*392860*	*6378223*	*77.67*	*0.19*	*4.14*	*0.39*	*1.72*	*0.07*	*0.05*	*9*	*65*	*5*	*1*	*7*	*271*	*18.1*	*11.88*
80BM 26	94F/10	392866	6378022	85.19	0.13	3.25	0.17	0.89	0.18	0.01	3	10	3	0	6	24	6.5	5.74
80BM 26	94F/10	392867	6378033	86.06	0.14	3.22	0.14	0.89	0.19	0.01	3	11	3	0	7	37	6.5	5.92
80BM 27	94F/10	392438	6378226	88.55	0.16	3.24	0.65	0.94	0.46	0.01	13	21	5	1	10	98	5.8	1.96
79AL 19B	94F/11	357931	6396692	84.00	0.28	6.14	0.61	1.13	0.02	0.32	6	12	10	0	11	158	1.9	
79AL 19C	94F/11	357930	6396692	82.46	0.43	8.48	1.35	1.75	0.04	0.29	10	81	13	0	13	64	8.1	
79AL 20	94F/11	359244	6397524	83.10	0.34	6.79	1.11	1.63	0.03	0.16	8	10	13	0	20	143	5.2	
79AL 20A	94F/11	359245	6397524	87.42	0.28	5.58	0.54	1.29	0.02	0.17	10	9	14	0	14	111	2.7	
79CQ 20A	94F/11	373847	6377521	83.94	0.37	7.55	1.06	1.67	0.03	0.16	42	91	50	1	16	73	6.8	
79CQ 20B	94F/11	373904	6377624	80.78	0.27	6.31	2.15	1.12	0.35	0.26	92	91	30	1	11	161	46.2	
79CQ 23	*94F/11*	*373757*	*6376883*	*81.36*	*0.44*	*8.71*	*0.81*	*1.74*	*0.04*	*0.23*	*22*	*15*	*7*	*1*	*11*	*29*	*4.9*	
79CQ 32	94F/11	371846	6375832	86.79	0.30	5.07	4.77	1.05	0.11	0.27	47	723	47	3	13	179	23.1	
79CQ 34A	94F/11	371491	6376113	80.70	0.42	8.42	0.42	1.78	0.02	0.95	24	33	135	1	21	76	4.0	
79DM 13A	94F/11	365278	6385092	83.25	0.17	4.02	0.87	0.75	2.41	0.33	32	65	10	1	8	73	7.2	
79KW 1B	94F/11	369931	6394457	84.75			0.47	0.55		0.23	8	8	8	1	11			
79KW 2	94F/11	370909	6394138	82.50			2.09	0.89		0.18	46	45	10	1	28			
79KW 2 *	94F/11	370909	6394135	82.55			2.03	0.86		0.19	48	44	8	0	24			
79KW 3	94F/11	370963	6393894	87.15			1.23	0.40		0.09	44	53	6	1	16			
79KW 4	94F/11	371146	6393754	86.22	0.22	4.73	2.95	0.70	0.05	0.10	30	97	9	1	16	109	11.7	
79KW 8	94F/11	372074	6392672	82.45	0.22	7.81	1.93	1.06	0.35	0.06	9	35	12	0	77	15	6.8	
79KW 16	*94F/11*	*375396*	*6394958*	*85.31*	*0.29*	*7.51*	*0.93*	*1.95*	*0.02*	*0.06*	*6*	*9*	*4*	*0*	*18*			
79KW 18	94F/11	375620	6394498	89.88	0.18	4.02	0.58	1.13	0.01	0.08	4	9	11	1	19			
79KW 21	94F/11	375362	6392397	82.37	0.45	8.31	1.11	1.62	0.07	0.11	10	32	13	4	14	75	12.8	
79KW 21 *	94F/11	375344	6392393	82.07	0.45	8.55	1.14	1.60	0.07	0.10	9	33	11	3	15	79	12.0	
80-4-10	94F/11	373901	6377413	84.49	0.11	2.98	0.59	0.56	2.00	0.10	35	750	3	2	12	119	17.0	2.99
80-4-15	94F/11	373901	6377413	89.93	0.05	1.76	0.28	0.20	0.07	0.06	20	747	3	0	25	54	7.6	1.21
80-4-25	94F/11	373901	6377413	89.44	0.14	3.54	0.17	0.64	0.07	0.21	5	21	5	1	14	242	5.8	2.27
80-4-49	94F/11	373902	6377413	82.86	0.38	8.63	0.47	1.82	0.07		4	13	6	1	14	59	3.9	2.53
80-4-52	94F/11	373902	6377413	88.59	0.18	4.72	1.92	0.88	0.18		13	9	5	1	10	43	7.5	1.63
80-4-56	94F/11	373902	6377413	90.21	0.22	5.09	0.32	0.99	0.07		12	9	5	0	10	37	2.5	1.81
CIRQUE PS	94F/11	372289	6376939	75.63	0.32	6.91	3.25	1.69	0.07	0.01	15	22	59	3	28	745	60.1	4.00
CIRQUE PS	94F/11	372291	6376936	76.58	0.33	6.92	3.25	1.69	0.07	0.06	14	22	58	2	26	683	58.8	4.02
			Mean	84.72	0.26	5.64	1.10	1.16	0.31	0.18	19	86	17	1	16	128	11.2	3.79
			STD	3.77	0.12	2.16	1.01	0.52	0.89	0.19	18	183	23	1	11	154	14.0	2.70

Middle - Upper Devonian - Lower Earn Group - Gunsteel Formation (muDG) - massive laminar banded sulphide,

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
79EF 2H	94F/07	396943	6352925	5.32	0.06	0.95	2.10	0.16	0.02	15	250	14.1%	25.0%	106	103	56.0	12.5	
ELF-4	94F/07	396887	63562870	0.00	0.00	0.00	0.00	0.00	0.00	12	383	.012%	15.0%	93	0	0.0	0.0	
			Mean							14	317	7.1%	20.0	100				
			STD							2	94	.99%1	7.07	9				

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
Middle - Upper Devonian - Earn Group, Gunsteel Formation - black to dark grey laminated chert																		
79AL 15A	94F/07	380921	6396911	93.67	0.05	1.12	0.56	0.22	0.01	0.04	26	80	21	3	11			
79CQ 19	94F/11	373944	6377647	93.68	0.12	2.03	0.43	0.43	0.01	0.06	18	27	30	1	9	100	3.7	
79DM 20A	94F/11	366865	6385372	93.20	0.12	3.70	0.32	0.43	0.02	0.19	5	10	4	1	5	72	1.1	
79KW 5A	94F/11	371652	6393638	93.86	0.35	3.60	1.58	0.58	0.03	0.09	11	30	10	0	18			
79KW 6	94F/11	371713	6393149	91.15	0.15	3.52	0.45	0.64	0.01	0.26	22	39	29	5	16			
79KW 15A	94F/11	375531	6395163	93.31	0.10	2.57	0.90	0.81	0.03	0.04	26	9	4	0	10			
79YL 5	94F/11	370894	6380170	93.03	0.11	3.03	0.34	0.39	0.02	0.08	10		30	0	4	59	2.4	
			Mean	93.13	0.14	2.80	0.65	0.50	0.02	0.11	17	33	18	1	10	77	2.4	
			STD	0.92	0.10	0.96	0.45	0.19	0.01	0.08	8	26	12	2	5	21	1.3	
Middle - Upper Devonian - Earn Group, Gunsteel Formation - limestone																		
80DM 20B	94F/07	380913	6371549	0.03	0.04	0.23	0.22	0.01	0.10	16.30	5	319	6	0	436	131	<50	0.15
79CQ 19A	94F/11	373944	6377647	20.40	0.10	2.15	0.88	0.49	0.25	0.09	32	270	34	1	397	61	9.8	0.00
79KW 15	94F/11	375515	6395159	8.37	0.05	1.60	0.52	0.53	0.08	0.10	17	36	8	1	940			
80-4-13	94F/11	373902	6377413	16.04	0.06	1.26	0.36	0.23	0.07	0.09	13	1100	3	1	7	20	7.1	0.37
			Mean	11.21	0.06	1.31	0.50	0.32	0.13	4.15	17	431	13	1	445	71	8.5	0.17
			STD	8.96	0.03	0.81	0.28	0.24	0.08	8.10	11	463	14	0	383	56	1.9	0.19
Middle - Upper Devonian - Earn Group, Gunsteel Formation - massive galena, Pie showing																		
PIE-1	94F/07	380142	6371026	0.95	0.01	0.23	0.01	0.03	0.01	0.03	30	2800	59%	1	4	2000	<50	0.36
PIE-2	94F/07	380002	6371110	3.54	0.01	0.43	1.30	0.08	0.01	0.05	39	5200	64%	2	9	2000	<50	0.33
PIE-3	94F/07	379819	6371192	4.72	0.01	0.31	0.88	0.04	0.01	0.02	27	6600	36%	6	6	1000	<50	0.80
PIE-4	94F/07	379552	6371347	0.71	0.01	0.26	1.17	0.03	0.01	0.01	13	6400	67%	1	9	1500	<50	0.57
PIE-5	94F/07	379436	6371467	1.45	0.01	0.25	1.03	0.03	0.01	0.01	17	4500	68%	6	9	2000	<50	0.40
PIE-6	94F/07	379393	6371693	3.15	0.01	0.31	0.90	0.06	0.01	0.05	35	3600	64%	1	5	2000	<50	0.40
			Mean	2.42	0.01	0.30	0.88	0.05	0.01	0.03	27	4850	60%	3	7	1750		0.48
			STD	1.62	0.00	0.07	0.46	0.02	0.00	0.02	10	1515	12%	2	2	418		0.18
Middle - Upper Devonian - Earn Group, Gunsteel Formation - shale with barite nodules and thin laminae																		
79EF 2D	94F/07	396923	6352896	53.06	0.52	2.49	4.96	0.76	0.18	17.15	166	167	1700	80	8	1000	16.3	
79EF 2I	94F/07	396943	6352925	70.41	0.60	10.79	1.47	3.85	0.06	6.17	16	101	2700	9	74	320	6.9	
79FD 21	94F/07	386407	6362590	42.64	0.29	5.37	1.87	1.06	1.87	28.24	30	129	12	0	98	510	17.0	
80PI 24	94F/07	381044	6371057	59.50	0.32	5.39	0.92	1.26	0.06	16.08	24	27	18	0	18	166	<50	
80PI 39A	94F/07	382620	6369193	49.17	0.34	5.41	1.80	0.75	0.12	21.03	24	83	22	0	22	106	<50	1.30
80PI 39C	94F/07	382620	6369193	52.67	0.35	5.57	1.36	1.10	0.09	19.01	15	101	23	0	17	240	<50	1.46
80PI 39D	94F/07	382621	6369194	38.39	0.24	3.34	0.98	0.81	0.08	30.19	12	39	30	0	10	35	<50	0.79
FLUKE-10	94F/07	384802	6364247	55.55	0.37	5.15	8.79	0.36	0.13	9.37	28	13200	90	5	80	5000	108.9	
FLUKE-7	94F/07	384803	6364247	57.21	0.37	5.33	8.09	0.39	0.13	10.72	46	1600	35	7	62	1500	129.7	
KWAD 4.4	94F/10	381994	6390717	62.85	0.12	1.41	0.45	0.27	0.05	17.86	83	87	12	0	12	84	<50	0.77
KWAD 9.0	94F/10	381994	6390717	47.11	0.09	0.53	0.21	0.08	0.03	29.89	17	23	4	0	4	15	<50	0.14
KWAD 28.8	94F/10	381994	6390717	37.07	0.12	0.90	0.57	0.19	0.07	35.05	18	93	5	0	8	18	<50	0.32
KWAD 28.9	94F/10	381994	6390717	43.18	0.08	0.30	0.16	0.03	0.02	32.18	5	23	4	0	9	15	<50	0.10
KWAD 29.1	94F/10	381994	6390718	40.62	0.11	0.88	0.22	0.19	0.05	32.85	7	10	5	0	7	28	<50	0.50
KWAD1.5A	94F/10	381994	6390718	44.68	0.43	8.55	0.70	2.48	0.02	21.42	23	6	7	1	24	147	<50	0.97
79CQ 49	94F/11	371430	6376028	43.26	0.17	3.07	0.25	0.66	0.07	14.76	15	125	16	1	415	103	2.0	
79CQ 51	94F/11	371507	6375863							19.63	45	40	130	10				
79CQ 51	94F/11	371515	6375826	23.71	0.07	1.20	0.43	0.12	0.11	7.61	10	48	11	1	1800	50	2.6	
79DM 14	94F/11	365286	6385270	39.55	0.24	3.48	0.59	0.55	0.08	30.91	24	35	6	0	8	93	7.0	
79DM 20	94F/11	366866	6385372	40.05	0.25	3.02	0.67	0.35	0.10	31.02	8	18	1	0	6	149	5.5	
			Mean	47.40	0.27	3.80	1.82	0.80	0.17	21.56	31	798	242	6	141	504	32.9	0.71
			STD	10.84	0.15	2.81	2.58	0.94	0.41	9.19	36	2940	690	18	412	1154	49.6	0.48
Middle - Upper Devonian - Earn Group, Gunsteel Formation - pyritic shale																		
79CQ 31	94F/11	371932	6375836	68.27	0.21	3.93	19.47	0.70	0.54	0.41	110	2700	56	1	130	110	19.1	
Middle - Upper Devonian - Earn Group, Gunsteel Formation - siliceous black shale																		
79EF 2	94F/07	396924	6352900	63.10	0.36	8.27	1.68	2.89	0.10	0.11	10	45	13	0	219	28	0.7	
79EF 12	94F/07	397229	6352146	65.46	0.40	9.33	1.55	3.07	0.09	0.12	12	54	10	0	172	33	0.5	
79EF 13	94F/07	397256	6352265	67.85	0.24	6.59	1.36	1.92	0.07	0.09	11	35	13	1	195	16	0.6	
79EF 13B	94F/07	397262	6352263	74.47	0.17	4.01	0.69	0.87	5.61	0.55	14	22	14	1	14	40	6.6	
79EF 40	94F/07	400685	6349520	80.36	0.48	10.14	0.44	2.11	0.02	0.70	90	186	166	12	58	133	6.5	

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
79FD 23	94F/07	386775	6362643	82.31	0.41	8.07	0.99	1.70	0.99	1.14	11	9	156	1	12	76	17.3	
79FD 24	94F/07	387061	6362633	82.70	0.31	7.10	1.67	1.48	1.67	0.61	6	12	30	0	27	85	15.7	
79PI 22	94F/07	382392	6367993	86.83	0.21	4.52	0.59	1.03	0.04	0.25	6	20	8	0	11	61	5.4	
80BM 2	94F/07	390933	6373705	86.23	0.15	2.81	0.13	0.68	0.07	0.79	7	15	4	1	11	144	6.9	4.57
79CQ 2B	94F/11	370562	6375449	83.29	0.27	6.40	2.36	1.16	2.36	0.28	90	77	38	1	14	194	100.7	
79CQ 28A	94F/11	372427	6376179	79.25	0.39	8.31	1.67	1.67	0.10	0.37	60	67	32	1	14	132	15.4	
			Mean	77.44	0.31	6.87	1.19	1.69	1.01	0.46	29	49	44	2	68	86	16.0	4.57
			STD	8.44	0.11	2.30	0.68	0.78	1.72	0.33	34	51	59	3	84	58	28.7	
Middle - Upper Devonian - Earn Group, Gunsteel Formation - limy siltstone																		
80-10-272	94F/07	398508	6370032	35.22	0.17	3.25	0.91	1.68	0.07	0.01	19	16	11	1	241	92	4.3	2.29
Middle - Upper Devonian - Earn Group, Gunsteel Formation - orange weathering, pyritic siltstone or tuff																		
79GN 33A	94F/02	405752	6338842	42.62	0.33	6.26	6.10	1.19	0.12	0.38	17	180	12	1	1900	55	3.9	
79GN 33A *	94F/02	405751	6338842	42.51	0.33	6.36	6.25	1.19	0.10	0.37	16	176	12	1	1900	35	3.8	
79DM 19	94F/11	366877	6385280	42.67	0.31	6.62	13.45	0.29	0.15	0.09	15	238	12	0	1900	34	5.4	
			Mean	42.60	0.32	6.41	8.60	0.89	0.12	0.28	16	198	12	1	1900	41	4.4	
			STD	0.08	0.01	0.19	4.20	0.52	0.03	0.16	1	35	0	0	0	12	0.9	
Middle - Upper Devonian - Earn Group, Gunsteel Formation - massive bedded barite																		
80PI 12	94F/07	380914	6371113	0.63	0.11	0.04	0.21	0.01	0.01	54.18	1500	3500	2	0	2	846	<50	<0.1
80PI 12C	94F/07	380909	6371112	3.18	0.11	0.24	0.04	0.01	0.01	53.86	24	69	2	0	2	15	<50	<0.1
80PI 12D	*94F/07*	*380907*	*6371112*	*1.78*	*0.12*	*0.18*	*0.11*	*0.01*	*0.01*	*57.62*	*187*	*67*	*2*	*0*	*7*	*15*	*<50*	*<0.1*
80PI 12D *	94F/07	380909	6371112	1.48	0.12	0.06	0.11	0.01	0.01	58.15	179	69	2	0	2	15	<50	<0.1
80PI 12E	94F/07	380907	6371112	0.95	0.12	0.08	0.07	0.01	0.01	58.02	547	391	2	0	2	252	<50	<0.1
80PI 14A	94F/07	381363	6371057	3.26	0.11	0.25		0.02	0.02	54.87	2	10	2	0	7	15	<50	<0.1
80PI 23	94F/07	381017	6371209	6.56	0.15	0.95	0.15	0.13	0.03	54.28	6	8	5	0	5	30	<50	0.18
80PI 23A	94F/07	381018	6371208	9.17	0.14	0.71	0.23	0.11	0.03	53.11	5	6	4	0	4	37	<50	0.10
80PI 23B	94F/07	381018	6371208	7.31	0.13	0.65	0.23	0.06	0.04	53.58	6	29	10	0	4	39	<50	<0.1
80PI 23C	94F/07	381019	6371208	4.24	0.13	0.51	0.23	0.03	0.04	55.69	6	14	4	0	7	30	<50	0.12
80PM 2	94F/07	380945	6371574	0.10	0.14	0.25	0.27	0.04	0.05	51.34	3	189	5	0	99	19	<50	<0.1
80DM 20	94F/07	380909	6371554	0.08	0.11	0.30	0.11	0.02	0.02	54.39		156	5	0	5	15	<50	<0.1
80DM 20A	94F/07	380913	6371550	0.08	0.11	0.10		0.01	0.01	63.41		23	2	0	15	15	<50	<0.1
80DM 20A *	94F/07	380933	6371614	0.08	0.12	0.10	0.05	0.01	0.01	63.14	1	23	2	0	14	15	<50	<0.1
80PM 23	94F/07	381011	6371326	1.50	0.12	0.42	0.15	0.05	0.02	56.03	15	666	2	0	43	300	<50	<0.1
80PM 24A	94F/07	381043	6371213	3.02	0.12	0.17	0.07	0.01	0.01	55.81	39	339	2	0	14	15	<50	<0.1
KWAD 19.0	94F/10	381994	6390717	3.13	0.12	0.41	0.16	0.06	0.21	56.18	9	42	4	1	5	15	<50	<0.1
KWAD 26.0	94F/10	381994	6390717	5.37	0.13	0.39	0.15	0.08	0.08	55.80	7	17	6	0	2	15	<50	<0.1
KWAD 27.3	94F/10	381994	6390718	0.86	0.13	0.39	0.19	0.08	0.05	57.70	8	22	2	0	4	15	<50	<0.1
			Mean	2.78	0.12	0.33	0.15	0.04	0.04	56.17	150	297	3	0	13	90		0.13
			STD	2.69	0.01	0.24	0.07	0.04	0.05	3.08	374	795	2	0	23	200		0.04
Middle - Upper Devonian - Earn Group, Gunsteel Formation - bedded barite with bands of galena, minor sphalerite																		
79EF 15	94F/07	397529	6352712	0.01	0.09	0.21	0.07	0.01	0.08	36.76	26	80	6%	10	32	18	0.7	
79EF 15 *	94F/07	397230	6352153	0.01	0.09	0.24	0.07	0.01	0.08	39.78	26	74	6%	10	32	15	0.5	
ELF-1	94F/07	397504	6352694							51.50	35	37	30%	15				
ELF-2	94F/07	396887	6352870							30.07	88	1408	32%	33				
ELF-3	94F/07	396887	6352870							47.13	70	687	17%	13				
79AL 6A	94F/11	356923	6393932	0.11	0.12	0.18	0.44	0.01	0.01	54.41	340	1900	3%	22	2	10000	5.9	
CIRQUE-1	94F/11	370500	6376000							57.03	15	13	2%	10				
CIRQUE-2	94F/11	370500	6376000							51.34	6	581	10%	17				
CIRQUE-3	94F/11	370500	6376000							56.52	5	133	26%	10				
			Mean	0.04	0.10	0.21	0.19	0.01	0.06	47.17	68	546	15%	16	22	3344	2.4	
			STD	0.06	0.02	0.03	0.21	0.00	0.04	9.54	106	685	12%	8	17	5764	3.1	
Middle - Upper Devonian - Earn Group, Gunsteel Formation - laminated barite with argillaceous bands																		
80PI 31A	94F/07	382620	6369193	16.76	0.14	1.12	0.20	0.14	0.04	47.60	10	6	6	0	2	16	<50	<0.1
80PI 39	94F/07	382620	6369193	15.72	0.17	2.06	0.36	0.41	0.04	44.24	5	16	16	1	9	27	<50	0.19
80PI 39B	94F/07	382621	6369193	14.82	0.17	1.73	0.07	0.40	0.04	48.06	6	28	14	0	8	15	<50	0.10
KWAD 10.0	94F/10	381994	6390717	21.84	0.10	0.44	0.10	0.04	0.02	44.95	8	17	7	0	2	15	<50	<0.1
KWAD 26.7	94F/10	381994	6390718	30.09	0.11	0.56	0.30	0.10	0.03	40.23	9	26	5	0	2	15	<50	<0.1
KWAD 26.9	94F/10	381994	6390718	35.43	0.14	1.31	0.76	0.32	0.05	35.35	24	99	6	0	12	37	<50	0.52
KWAD26.9*	94F/10	381994	6390699	35.09	0.14	1.25	0.75	0.32	0.04	35.40	22	101	3	0	15	35	<50	0.51
KWAD 27.1	94F/10	381994	6390718	38.64	0.09	0.46	0.16	0.04	0.03	35.49	10	6	4	0	2	15	<50	0.28

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
KWAD 27.4	94F/10	381994	6390717	25.08	0.10	0.45	0.11	0.05	0.04	38.54	4	16	4	0	50	15	<50	0.47
KWAD 27.9	94F/10	381994	6390717	33.68	0.13	1.08	0.52	0.20	0.07	36.89	28	67	6	0	5	53	<50	0.32
KWAD 28.0	94F/10	381994	6390717	30.97	0.11	0.62	0.20	0.10	0.05	39.17	8	18	5	0	2	20	<50	0.39
KWAD 28.3	94F/10	381994	6390718	28.58	0.11	0.65	0.38	0.10	0.05	40.91	14	45	5	0	6	23	<50	0.20
KWAD 31.5	94F/10	381994	6390717	28.90	0.15	1.74	3.44	0.58	0.16	36.01	35	67	4	0	7	142	<50	<0.1
			Mean	27.35	0.13	1.04	0.57	0.22	0.05	40.22	14	39	7	0	9	33		0.33
			STD	7.94	0.03	0.56	0.89	0.17	0.03	4.63	10	34	4	0	13	35		0.15
Middle - Upper Devonian - Earn Group, Gunsteel Formation - bedded Barite with sphalerite, minor malachite																		
80PI 12A	94F/07	404653	6361436	1.92	0.10	0.15	0.88	0.01	0.01	46.45	2900	7.8%	2%	1	4	12000	<50	<0.1
80PI 12B	94F/07	404653	6361436	2.18	0.10	0.24	0.76	0.01	0.01	44.66	1500	7.8%	2%	0	2	10000	<50	<0.1
			Mean	2.05	0.10	0.20	0.82	0.01	0.01	45.56	2200	7.8%	2%	0	3	11000		
			STD	0.18	0.00	0.06	0.08	0.00	0.00	1.27	990	0	0	0	1	1414		
Middle - Upper Devonian - Earn Group, Gunsteel Formation - bedded barite with galena, sphalerite rich bands																		
79EF 1C	94F/07	396931	6352925	0.36	0.11	0.05	0.13	0.04	0.06	51.78	28	1.85%	2.67%	7		2	0.5	
79EF 2B	94F/07	396925	6352900	0.12	0.10	0.42	0.97	0.05	0.05	42.93	88	2.55%	7.0%	22	12	12000	5.4	
			Mean	0.24	0.11	0.24	0.55	0.05	0.06	47.36	58	2.2%	4.83%	14	12	6001	3.0	
			STD	0.17	0.01	0.26	0.59	0.01	0.01	6.26	42	.495%	3.06%	11		8484	3.5	
Late Devonian-Mississippian - Earn Group, Akie Formation - shale																		
79GN 9	94F/01	409969	6340113	67.38	0.75	16.67	4.61	3.34	0.10	0.20	24	97	16	0	66	47	7.2	
80-10-304	*94F/07*	*398508*	*6370031*	*60.67*	*0.87*	*19.89*	*3.86*	*6.48*	*0.07*	*0.01*	*23*	*14*	*15*	*1*	*57*	*44*	*5.9*	*1.09*
80BM 28	94F/10	392340	6378434	66.84	0.67	18.36	0.98	5.23	0.07	0.05	5	15	6	0	50	35	7.7	1.67
79CQ 28	94F/11	372427	6376179	66.00	0.81	21.01	0.62	3.46	0.02	0.87	12	44	14	1	16	77	14.6	
			Mean	65.22	0.78	18.98	2.52	4.63	0.07	0.28	16	43	13	0	47	51	8.9	1.38
			STD	3.09	0.08	1.89	2.01	1.51	0.03	0.40	9	39	5	0	22	18	3.9	0.41
Late Devonian-Mississippian - Earn Group, Akie Formation - pyritic shale																		
79GN 4	94F/01	409862	6340333	65.20	0.61	12.55	12.00	1.48	0.12	0.13	30	192	13	1	250	25	8.2	
79GN 19	94F/02	409339	6339524	58.10	1.03	20.29	7.55	3.64	0.21	0.32	34	108	5	0	800	18	4.9	
79EF 9	94F/07	397094	6351936	60.79	0.45	8.82	12.95	2.10	0.08	0.17	90	43	26	1	41	219	19.0	
80WM 1A	94F/07	404653	6361436	40.89	0.10	5.94	30.50	1.38	0.01	0.06	159	200	48	7	31	258		0.90
79AL 21	94F/11	363359	6397725	34.07	0.34	6.88	43.75	1.35	0.10	0.14	51	1300	24	1	1600			
			Mean	51.81	0.51	10.90	21.35	1.99	0.10	0.16	73	369	23	2	544	130	10.7	0.90
			STD	13.54	0.35	5.83	15.28	0.97	0.07	0.10	54	525	16	3	668	126	7.4	
Late Devonian-Mississippian - Earn Group, Akie Formation - siliceous shale																		
79GN 11	94F/01	409752	6339965	76.53	0.63	12.04	0.49	2.93	0.03	0.89	42	80	69	8	18	142	5.1	
79GN 1	94F/02	409453	6340708	72.01	0.65	13.78	3.77	2.75	0.22	0.19	21	91	22	1	46	49	7.9	
79GN 13	94F/02	409590	6339821	75.13	0.53	12.56	2.29	2.72	0.11	0.98	45	181	49	5	39	114	15.4	
79EF 7	94F/07	397009	6351798	73.74	0.56	12.31	1.70	3.88	0.06	0.26	17	39	30	1	30	180	7.3	
79EF 9A	94F/07	397094	6351936	68.40	0.34	7.71	0.93	2.34	0.12	0.11	8	27	12	0	183	15	1.0	
79EF 14A	94F/07	397359	6352345	76.41	0.60	11.68	1.51	2.51	0.08	0.23	14	41	16	1	33	119	9.4	
79EF 16	94F/07	397732	6353541	73.19	0.58	12.48	2.58	3.34	0.22	0.42	21	156	30	2	32	67	11.3	
79EF 41	94F/07	400883	6349507	76.41	0.25	13.76	1.68	3.61	0.23	0.18	8	109	25	0	25	15	7.2	
79EF 41A	94F/07	400874	6349509	77.77	0.20	12.55	1.79	4.50	0.20	0.42	7	74	6	0	29	15	3.4	
79EF 42	94F/07	401088	6349746	77.19	0.64	13.56	0.89	3.11	0.03	0.38	155	287	201	16	16	166	9.1	
79EF 43	94F/07	401329	6349775	75.84	0.67	14.56	1.81	3.16	0.10	0.22	15	68	13	1	14	110	9.4	
79FD 20	94F/07	386248	6362609	62.70	0.82	18.47	4.20	4.65	4.20	0.42	28	55	11	1	51	69	8.1	
79FD 21A	94F/07	386405	6362590	77.06	0.57	11.26	0.52	2.99	0.52	0.94	25	9	17	0	9	555	3.7	
79FD 22	94F/07	386508	6362576	74.00	0.66	12.28	3.20	3.05	3.20	0.42	32	88	13	1	16	63	10.7	
79FD 25A	94F/07	387230	6362704	77.22	0.23	12.68	1.68	4.54	1.68	0.41	8	28	30	0	24	17	5.8	
79FD 26A	94F/07	387689	6362325	77.55	0.25	12.34	1.81	3.77	1.81	0.61	5	30	33	0	35	8	3.6	
80-10-356	94F/07	398507	6370032	76.28	0.46	10.59	0.93	3.83	0.07	0.01	8	11	5	1	48	87	8.5	2.19
80-10-390	94F/07	398508	6370031	77.37	0.43	10.24	1.03	3.68	0.07	0.05	3	7	15	0	47	66	11.8	2.17
80-10-390	94F/07	398508	6370031	77.03	0.44	10.24	1.01	3.68	0.07	0.05	5	8	15	0	48	78	10.8	2.16
80-10-405	94F/07	398508	6370032	77.94	0.41	9.22	0.92	3.34	0.14	0.04	4	9	12	0	49	90	7.8	3.29
80-10-469	94F/07	398508	6370032	73.97	0.46	11.57	1.27	1.80	0.07	0.05	14	9	11	1	125	44	11.0	1.18
80-10-530	94F/07	398510	6370033	81.81	0.35	7.41	0.66	2.67	0.07	0.06	3	11	20	1	33	200	12.5	1.94
80-10-634	94F/07	398508	6370032	78.08	0.38	8.84	0.65	1.57	0.12	0.05	8	6	5	0	97	90	12.5	2.91
80-10-634A	94F/07	398510	6370033	72.68	0.40	9.87	0.85	1.72	0.07	0.06	20	13	10	0	187	90	10.7	5.11
80-10-637	94F/07	398510	6370033	74.28	0.24	6.74	0.63	2.44	0.24	0.06	3	4	13	0	23	195	8.9	8.87
80-10-759	94F/07	398510	6370033	73.85	0.45	11.63	0.76	2.54	0.14	0.10	7	13	9	1	28	96	11.9	3.54

FIELD NO.	NTS MAP	UTM EAST	UTM NORTH	SiO2 (wt%)	TiO2 (wt%)	Al2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	P2O5 (wt%)	Ba (wt%)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)	Mn (ppm)	Hg (ppb)	As (ppm)	org C (wt%)
80-10-804	94F/07	398510	6370033	74.53	0.36	9.00	0.58	1.97	0.14	0.06	3	6	8	0	37	31	13.5	6.04
FLUKE-11	94F/07	384803	6364247	72.21	0.45	9.49	2.68	2.52	0.12	0.12	30	1600	21	1	156	34	9.6	
FLUKE-3	94F/07	384803	6364247	77.26	0.39	9.06	0.94	1.98	0.05	0.87	5	130	90	0	30	133	13.2	
FLUKE-6	94F/07	384802	6364247	76.62	0.47	10.19	2.93	2.68	0.16	0.15	51	1200	30	2	122	61	14.8	
FLUKE-9	94F/07	384803	6364246	76.50	0.54	10.85	2.88	2.77	0.16	0.33	29	880	25	1	150	47	10.7	
80BM 15	94F/10	393312	6378523	74.82	0.47	12.20	0.51	3.66	0.18	0.04	4	4	8	0	31	122	11.3	1.64
80BM 30	94F/10	392177	6378586	74.64	0.41	10.52	0.80	3.06	0.14	0.04	5	5	7	0	25	117	11.4	4.65
79DM 13	94F/11	365268	6385084	71.35	0.55	14.90	2.88	3.05	0.05	0.38	29	100	12	0	30	83	6.1	
79DM 15B	94F/11	365822	6385337	81.58	0.52	10.02	0.84	2.40	0.03	0.55	15	32	20	2	12	104	4.0	
79DM 18	94F/11	366751	6385063	83.44	0.50	9.29	0.39	1.74	0.05	0.85	23	28	20	2	11	136	0.9	
79DM 19B	94F/11	366862	6385278	80.61	0.41	10.11	0.44	2.01	0.05	0.51	3	11	9	0	13	137	9.9	
79DM 20B	94F/11	366866	6385374	77.80	0.48	10.52	1.41	2.07	0.03	0.35	5	35	11	0	18	102	2.9	
79KW 5	94F/11	371652	6393637	61.19	0.00	0.00	0.88	0.09	0.00	0.01	10	30	11	1	120			
79KW 20A	94F/11	375275	6392831	77.53	0.66	11.98	1.43	3.06	0.12	0.12	13	9	26	2	17			
79KW 21A	94F/11	375309	6392390	69.21	0.43	10.06	4.18	1.91	0.46	0.52	31	90	4	1	42			
79KW 24	94F/11	374421	6391237	67.18	0.78	15.21	6.67	3.09	0.11	0.26	50	106	8	0	21	54	7.7	
80-4-33	94F/11	373901	6377413	73.15	0.59	13.62	0.87	3.05	0.07	0.37	6	15	8	0	20	20	7.4	2.55
80-4-42	94F/11	373902	6377413	73.99	0.54	14.11	0.90	3.04	0.07	0.55	7	13	15	1	14	100	3.4	1.62
80-4-70	94F/11	373902	6377413	67.01	0.79	16.96	3.48	3.44	0.18	0.00	30	67	15	0	13	38	11.6	0.96
			Mean	74.78	0.48	11.30	1.67	2.86	0.36	0.30	19	129	23	1	48	97	8.6	3.18
			STD	4.45	0.16	2.94	1.30	0.87	0.82	0.28	25	312	32	3	48	88	3.7	2.09

Late Devonian-Mississippian - Earn Group, Warneford Formation - quartz wacke

79EF 44	94F/07	401628	6349769	91.43	0.12	2.93	3.46	0.37	0.10	0.03	30	788	5	0	14	23	9.2	
79EF 45	94F/07	401620	6349777	93.54	0.16	3.88	0.49	0.68	0.02	0.09	13	12	5	0	4	15	3.4	
80-10-426	94F/07	398508	6370032	90.49	0.11	3.79	0.24	1.39	0.07	0.03	3	4	2	0	17	73	2.7	2.57
80-10-460	94F/07	398508	6370032	90.46	0.08	3.75	0.23	0.93	0.07	0.05	3	11	8	0	17	47	3.9	2.08
80-10-460A	94F/07	398508	6370032	92.30	0.10	2.86	0.20	0.95	0.07	0.04	4	4	8	0	13	51	3.0	2.19
80BM 14	94F/10	393088	6378465	91.26	0.14	3.23	0.17	0.92	0.07	0.01	4	41	3	1	13	83	13.6	1.70
79AL 18	94F/11	357461	6394854	90.23	0.13	5.29	0.67	0.68	0.02	0.15	9	9	10	0	5	29	3.3	
79AL 19	94F/11	357930	6396692	91.42	0.12	3.17	1.20	0.41	0.04	0.10	23	103	52	0	10	62	7.4	
79AL 19A	94F/11	357931	6396692	94.61	0.06	2.62	0.44	0.20	0.02	0.16	18	33	11	0	4	19	6.1	
79CQ 29	94F/11	372222	6376089	92.50	0.11	1.35	0.44	0.19	0.02	0.40	14	13	14	1	8	79	3.3	
79CQ 29A	94F/11	372222	6376089	94.14	0.16	2.44	0.58	0.33	0.04	0.29	11	5	9	1	7	41	1.6	
79CQ 29B	94F/11	372222	6376089	92.14	0.17	2.32	0.67	0.37	0.03	0.82	20	11	12	1	7	46	3.6	
79CQ 29C	94F/11	372222	6376089	90.07	0.14	2.96	0.42	0.26	0.02	0.22	15	11	12	1	6	51	2.4	
79CQ 43	94F/11	371673	6376121	91.29	0.14	3.06	0.62	0.31	0.05	0.31	12	32	11	0	4	65	2.9	
79CQ 45	94F/11	371655	6376084	92.73	0.18	2.75	0.48	0.53	0.03	0.27	13	8	22	1	4	74	1.0	
79KW 22	94F/11	374996	6391296	93.32	0.21	3.54	1.68	0.58	0.13	0.06	11	90	10	1	21			
79KW 23	94F/11	374564	6391244	89.09	0.25	4.46	2.70	0.67	0.15	0.06	11	91	8	1	21			
			Mean	91.82	0.14	3.20	0.86	0.58	0.06	0.18	13	74	12	1	10	51	4.5	2.14
			STD	1.53	0.05	0.89	0.92	0.33	0.04	0.20	7	187	11	0	6	22	3.3	0.36

APPENDIX E
Mineral occurrences in the Akie River area

N.T.S. Map	Station	Easting	Northing	Property or Area	Map Unit	Min. Type	Metals	Description
94F/11	79AL-10-1	356102	6392082	MT. ALCOCK	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/11	79AL-10-4	356673	6393514	MT. ALCOCK	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/11	79AL-10-7	356941	6393703	MT. ALCOCK	DG	Beds	Ba,Pb, Zn,Ag	Barite, medium bedded to laminated, diffuse bands of galena, sphalerite
94F/07	79AL-16-11	362077	6397081	MT. LUKE	DI	Zn Oxide	Zn?	Hydrozincite?
94F/11	79AL-17-21	362599	6397636	MT. HOLBEN	DMA	Diss.	Fe	Pyrite, disseminated, nodules
94F/11	79CQ-1-3	370681	6375501	CIRQUE CLAIMS	ORs	Vein		Quartz, veins, barren
94F/11	79CQ-1-5	370704	6375315	CIRQUE CLAIMS	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/11	79CQ-1-7	370836	6375149	CIRQUE CLAIMS	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/11	79CQ-1-8	370962	6375124	CIRQUE CLAIMS	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/06	79CQ-2-11	369291	6373099	CIRQUE PROPERTY	ORc	Vein		Calcite, veins, barren
94F/06	79CQ-2-14	369501	6373178	CIRQUE PROPERTY	ORc	Diss.	Fe	Pyrite, disseminated, nodules
94F/11	79CQ-23-42	371718	6376186	CIRQUE CLAIMS	DG	Nodules	Ba	Barite, nodular, blebby
94F/11	79CQ-23-49	371420	6376071	CIRQUE CLAIMS	DG	Beds	Ba	Barite, bedded, laminated, barren
94F/11	79CQ-23-50	371444	6376038	CIRQUE CLAIMS	DG	Seam	Coal	Metanthracite seam
94F/11	79CQ-23-51	371507	6375863	CIRQUE CLAIMS	DG	Nodules	Ba	Barite, nodular, blebby
94F/11	79CQ-4-22	373678	6377398	E. OF CIRQUE DEPOSIT	DRs	Diss.	Fe	Pyrite, disseminated, nodules
94F/11	79CQ-6-27	372652	6376300	CIRQUE CLAIMS	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/11	79CQ-6-31	372212	6376134	CIRQUE CLAIMS	DG	Gossan	Fe	Gossan, limonite, hematite
94F/11	79CQ-6-33	371720	6375937	CIRQUE CLAIMS	DG	Nodules	Ba	Barite, nodular, blebby
94F/11	79CQ-6-34	371475	6376164	CIRQUE CLAIMS	DG	Laminae	Fe	Barite, nodular, blebby
94F/11	79CQ-6-34	371475	6376164	CIRQUE CLAIMS	DG	Nodules	Ba	Pyrite, laminae
94F/11	79CQ-6-37	370845	6376635	CIRQUE CLAIMS	DG	Nodules	Ba	Barite, nodular, blebby
94F/11	79DM-15-13	365210	6385190	MT. YUEN	DMA	Breccia		Quartz healed breccia, stockwork
94F/11	79DM-15-14	365229	6385348	MT. YUEN	DG	Nodules	Ba	Barite, nodular, blebby
94F/11	79DM-15-18	366698	6385148	MT. YUEN	DMA	Breccia		Quartz healed breccia, stockwork
94F/11	79DM-15-19	366803	6385366	MT. YUEN	DMA	Nodules	Ba	Barite, nodular, blebby
94F/11	79DM-15-20	366845	6385454	MT. YUEN	DG	Nodules	Ba	Barite, nodular, blebby
94F/11	79DM-3-1	362322	6380303	MT. YUEN	SR	Vein		Quartz-calcite vein, barren
94F/11	79DM-3-7	363367	6382170	MT. YUEN	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/07	79EF-11-12	397169	6352114	ELF SHOWING	DG	Nodules	Ba	Barite, nodular, blebby
94F/07	79EF-11-13	397230	6352226	ELF SHOWING	DRs	Laminae	Fe	Pyrite, laminae
94F/07	79EF-11-14	397315	6352306	ELF SHOWING	DMA	Laminae	Fe	Pyrite, laminae
94F/07	79EF-11-15	397504	6352694	ELF SHOWING	DG	Float	Ba,Pb	Barite with galena, float
94F/07	79EF-11-6	396928	6351658	ELF SHOWING	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/07	79EF-11-8	397021	6351826	ELF SHOWING	DMA	Diss.	Fe	Pyrite, disseminated, nodules

N.T.S. Map	Station	Easting	Northing	Property or Area	Map Unit	Min. Type	Metals	Description
94F/07	79EF-11-9	397068	6351895	ELF SHOWING	DMA	Diss.	Fe	Barite, nodular, blebby
94F/07	79EF-11-9	397068	6351895	ELF SHOWING	DMA	Nodules	Ba	Pyrite, disseminated, nodules
94F/07	79EF-12-19	394867	6349955	ELF SHOWING	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/07	79EF-12-28	395808	6352198	ELF SHOWING	DG	Vein	Cu	Calcite vein, trace chalcopyrite, malachite
94F/07	79EF-12-29	395831	6352324	ELF SHOWING	ORv	Vein		Quartz-calcite vein, barren
94F/07	79EF-13-36	400260	6348927	S. OF ELF CREEK	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/07	79EF-13-38	400361	6349139	S. OF ELF CREEK	ORs	Concretion	Fe	Iron concretions
94F/07	79EF-13-41	400827	6349462	S. OF ELF CREEK	DG	Gossan	Fe	Gossan, limonite, hematite
94F/07	79EF-13-41	400827	6349462	S. OF ELF CREEK	DG	Vein		Quartz, veins, barren
94F/07	79EF-13-45	402274	6349692	S. OF ELF CREEK	DMW	Vein		Quartz, veins, barren
94F/07	79FD-14-21	386316	6362577	FLUKE CLAIMS	DMA	Diss.	Fe	Pyrite, disseminated, nodules
94F/07	79FD-14-21	386316	6362577	FLUKE CLAIMS	DMA	Nodules	Ba	Barite, nodular, blebby
94F/07	79FD-14-25	387149	6362688	FLUKE CLAIMS	DMA	Diss.	Fe	Pyrite, disseminated, nodules
94F/07	79FD-9-8	385348	6360517	DOG/FLUKE CLAIMS	ORv	Diss.	Fe	Pyrite, disseminated, nodules
94F/01	79GN-20-4	409703	6340158	GIN CLAIMS	DMA	Diss.	Fe	Pyrite, disseminated, nodules
94F/01	79GN-20-5	409846	6340232	GIN CLAIMS	DRs	Diss.	Fe	Pyrite, disseminated, nodules
94F/02	79GN-21-14	409160	6339825	GIN CLAIMS	DG	Nodules	Ba	Barite, nodular, blebby
94F/02	79GN-21-16	409099	6339711	GIN CLAIMS	DG	Breccia		Quartz healed breccia, stockwork
94F/02	79GN-21-18	408975	6339624	GIN CLAIMS	DMA	Diss.	Fe	Pyrite, disseminated, nodules
94F/02	79GN-22-31	406531	6338871	W. OF GIN CLAIMS	DRs	Vein	Cu	Calcite vein, trace chalcopyrite, malachite
94F/11	79KW-18-4	371180	6393706	KWADACHA RIDGE	DG	Diss.	Fe	Pyrite, disseminated, nodules
94F/11	79KW-19-21	375298	6392310	KWADACHA RIDGE	DMA	Diss.	Fe	Pyrite, disseminated, nodules
94F/11	79KW-19-21	375298	6392310	KWADACHA RIDGE	DMA	Laminae	Fe	Pyrite, laminae
94F/07	79PI-7-1	380071	6367404	PIE CLAIMS	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/07	79PI-7-3	380393	6367671	PIE CLAIMS	ORv	Vein	Cu	Calcite vein, trace chalcopyrite, malachite
94F/07	79PI-7-5	380248	6368143	PIE CLAIMS	ORc	Vein		Quartz-calcite vein, barren
94F/07	79PI-7-6	380230	6368213	PIE CLAIMS	ORv	Laminae	Fe	Pyrite, laminae
94F/07	79PI-7-8	380757	6367462	PIE CLAIMS	CaCO3	Trav.		Travertine
94F/07	79PI-8-21	382373	6367728	PIE CLAIMS	SR	Diss.	Fe	Pyrite, disseminated, nodules
94F/10	80BH-20-26	392320	6378618	WIL CLAIMS		Gossan	Fe	Gossan, limonite, hematite
94F/10	80BH-20-27	392074	6378736	WIL CLAIMS		Seep	Fe	Iron seep
94F/07	80BM-16-1	391007	6373700	WIL CLAIMS	DG	Vein		Quartz vein stockwork, barren
94F/07	80BM-17-5	391055	6373408	WIL CLAIMS		Seep	Fe	Iron seep
94F/10	80BM-18-11	393166	6378036	WIL CLAIMS	DG	Vein		Quartz-calcite vein, barren
94F/11	80CM-22-10	366401	6377289	W. OF CIRQUE CLAIMS	ORc	Vein		Quartz-siderite veins in grey siltstone, barren
94F/11	80CQ-28-17	376550	6380044	CIRQUE CLAIMS	ORv	Nodules	Ba	Barite, nodular, blebby
94F/11	80CQ-3-7	376067	6377879	SE OF CIRQUE	ORv	Vein		Calcite, veins, barren
94F/11	80DM-1-4	366638	6386003	YULE CLAIMS	DMA	Diss.	Fe	Ferricrete

N.T.S. Map	Station	Easting	Northing	Property or Area	Map Unit	Min. Type	Metals	Description
94F/11	80DM-1-4	366638	6386003	YULE CLAIMS	DMA	Ferricrete	Fe	Pyrite, disseminated, nodules
94F/11	80DM-1-5	366565	6386236	YULE CLAIMS	DMA	Nodules	Ba	Barite, nodular, blebby
94F/07	80FD-10-6	388073	6363548	FLUKE CLAIMS	DMA	Seep	Fe	Iron seep
94F/07	80FD-9-2	388509	6363994	FLUKE CLAIMS	DMA	Seep	Fe	Iron seep
94F/07	80FM-9-1	388171	6363204	FLUKE CLAIMS	DRs	Diss.	Fe	Pyrite, disseminated, nodules
94F/07	80FM-9-2	388119	6363154	FLUKE CLAIMS	DRs	Ferricrete	Fe	Ferricrete
94F/10	80KM-24-9	381866	6390668	KWADACHA BARITE	DG	Beds	Ba	Barite, bedded, laminated, barren
94F/11	80KW-1-5	368514	6385633	YULE CLAIMS	DI	Diss.	Fe	Pyrite, disseminated, nodules
94F/11	80KW-2-15	367390	6385711	YULE CLAIMS	DRs	Seep	Fe	Iron seep
94F/11	80KW-2-17	367383	6385705	YULE CLAIMS	DMA	Ferricrete	Fe	Ferricrete
94F/11	80KW-2-18	367377	6385699	YULE CLAIMS	DMA	Seep	Fe	Iron seep
94F/07	80PI-21-31	382253	6369039	FLUKE CLAIMS	DG	Beds	Ba	Barite, bedded, laminated, barren
94F/07	80PI-21-39	382623	6369277	FLUKE CLAIMS	DG	Nodules	Ba	Barite, nodular, blebby
94F/07	80PI-22-42	385436	6372256	E. OF PIE CLAIMS	ORv	Vein	Cu	Calcite vein, trace chalcopyrite, malachite
94F/07	80PI-7-12	380956	6371082	PIE CLAIMS	DRs	Beds	Ba	Barite, bedded, laminated, barren
94F/07	80PI-7-13	380834	6370951	PIE CLAIMS	DRs	Seep	Fe	Iron seep
94F/07	80PI-7-14	381381	6371069	PIE CLAIMS	DRs	Beds	Ba	Barite, float, barren
94F/07	80PI-8-23	381317	6369477	PIE CLAIMS	DG	Beds	Ba	Barite, bedded, laminated, barren
94F/07	80PI-8-23	381317	6369477	PIE CLAIMS	DG	Nodules	Ba	Barite, nodular, blebby
94F/07	80PM-5-1	380901	6371572	PIE CLAIMS	DRs	Beds	Ba	Barite, bedded, laminated, barren
94F/07	80PM-5-10	380976	6371881	PIE CLAIMS	DRs	Vein		Quartz-calcite vein, barren
94F/07	80PM-5-13	381147	6371485	PIE CLAIMS	DRs	Ferricrete	Fe	Ferricrete
94F/07	80PM-5-2	380977	6371558	PIE CLAIMS	DG	Beds	Ba,(Cu)	Barite, trace of malachite
94F/07	80PM-5-6	380954	6372066	PIE CLAIMS		Gossan	Fe	Gossan, limonite, hematite
94F/07	80PM-6-22	380256	6372490	PIE CLAIMS	DI	Vein		Calcite, veins, barren
94F/07	80PM-7-23	380947	6371304	PIE CLAIMS	DRs	Float	Ba, Zn	Barite with sphalerite, recrystallized float in creek
94F/07	80PM-7-24	381013	6371069	PIE CLAIMS	DG	Beds	Ba	Barite, discontinuous lenses in shale
94F/07	80SH-11-7	403096	6361169	SIKA CLAIMS	ORs	Beds	Ba	Barite, bedded, laminated, barren
94F/07	80SH-11-8	403006	6361100	SIKA CLAIMS	SR	Beds	Ba	Barite, bedded, laminated, barren
94F/07	80SH-12-14	404376	6361084	SIKA CLAIMS	ORs	Beds	Ba	Barite, bedded, laminated, barren
94F/07	80SH-13-19	403469	6361923	SIKA CLAIMS	SR	Beds	Ba	Barite, bedded, laminated, barren
94F/07	80SH-25-41	399698	6365650	SIKA-AKIE CLAIMS	ORs	Beds	Ba	Barite, interbedded with siltstone, barren
94F/07	80SH-26-43	402660	6366124	SIKA-AKIE CLAIMS	ORs	Nodules	Ba	Barite, nodular, blebby
94F/07	80SM-11-3	404533	6363031	SIKA/AKIE CLAIMS	DRs	Travertine		Travertine
94F/07	80SM-11-5	405022	6363394	SIKA/AKIE CLAIMS	DRs	Travertine		Travertine
94F/07	80WH-23-33	392578	6369753	W. OF WIL CLAIMS	ORs	Nodules	Ba	Barite, nodular, blebby
94F/07	80WM-14-1	398383	6369564	WIL CLAIMS	DRs	Ferricrete	Fe	Ferricrete
94F/07	80WM-14-1	398383	6369564	WIL CLAIMS	DRs	Laminae	Fe	Pyrite, laminae
94F/07	80WM-14-8	399117	6369708	WIL CLAIMS	DRs	Vein		Quartz vein, barren
94F/07	80WM-15-9	398519	6369760	WIL CLAIMS		Seep	Fe	Iron seep
94F/07	F81-1-3	380574	6356904	DEL CLAIMS	OSk	Vein		Quartz veins cutting grey limestone
94F/11	JL81-11-74	365231	6385545	YULE CLAIMS	DG	Beds	Ba	Barite, bedded, laminated, barren

N.T.S. Map	Station	Easting	Northing	Property or Area	Map Unit	Min. Type	Metals	Description
94F/07	JL81-12-82	380428	6371332	PIE CLAIMS	DG	Beds	Ba	Barite, bedded, laminated, barren
94F/07	JL81-12-83	380460	6371351	PIE CLAIMS	DG	Beds	Ba	Barite, bedded, laminated, barren
94F/07	JL81-13-87	381849	6369424	S. OF PIE CLAIMS	DG	Beds	Ba	Barite, bedded, laminated, barren
94F/07	JL81-13-91	381725	6369229	S. OF PIE CLAIMS	DG	Beds	Ba	Barite, bedded, laminated, barren
94F/11	JL81-17-112	371932	6375359	CIRQUE CLAIMS	DG	Nodules	Ba	Barite, nodular, blebby
94F/11	JL81-17-113	371882	6375335	CIRQUE CLAIMS	DG	Nodules	Ba	Barite, nodular, blebby
94F/11	JL81-17-114	371786	6375268	CIRQUE CLAIMS	DG	Nodules	Ba	Barite, nodular, blebby
94F/11	JL81-17-115	371647	6375189	CIRQUE CLAIMS	DG	Nodules	Ba	Barite, nodular, blebby
94F/11	JL81-18-116	371751	6375035	CIRQUE CLAIMS	DG	Diss.	Fe	Barite, nodular, blebby
94F/11	JL81-18-116	371751	6375035	CIRQUE CLAIMS	DG	Nodules	Ba	Pyrite, disseminated, nodules
94F/11	JL81-18-117	371776	6374996	CIRQUE CLAIMS	DG	Diss.	Fe	Barite, nodular, blebby
94F/11	JL81-18-117	371776	6374996	CIRQUE CLAIMS	DG	Nodules	Ba	Pyrite, disseminated, nodules
94F/11	JL81-18-120	371854	6374716	CIRQUE CLAIMS	DG	Nodules	Ba	Barite, nodular
94F/01	JL81-19-123	418812	6327776	OSPIKA CLAIMS	DG	Beds	Ba	Barite bed approximately 1 metre thick in section of cherty argillite
94F/01	JL81-20-124	413683	6334313	OSPIKA CLAIMS	SR	Vein		Quartz veins cutting rusty shale
94F/02	JL81-21-126	408291	6343237	PESIKA CLAIMS	DRs	Vein		Quartz veins in rusty weathering black shale
94F/02	JL81-21-127	408443	6343393	PESIKA CLAIMS	DG	Nodules	Ba	Barite nodules in black cherty argillite
94F/02	JL81-21-128	408618	6343459	PESIKA CLAIMS	DG	Nodules	Ba	Barite nodules in black cherty argillite
94F/02	JL81-21-129	409167	6343310	PESIKA CLAIMS	DRs	Diss.	Fe	Pyrite in rusty weathering black shale
94F/01	JL81-21-131	409416	6343497	PESIKA CLAIMS	SR	Vein		Quartz veins at contact between Silurian siltstone and Devonian limestone
94F/11	JL81-7-53	370716	6375972	CIRQUE VALLEY	DG	Beds	Ba,Pb, Zn,Ag	Barite, medium bedded to laminated, diffuse bands of galena, sphalerite
94F/11	JL81-8-59	371460	6375795	SE OF CIRQUE	DG	Nodules	Ba	Barite, nodular, blebby
94F/11	JL81-8-62	371536	6376091	SE OF CIRQUE	DG	Nodules	Ba	Barite, nodular, blebby
94F/10	LD81-1-2	381585	6389683	KWADACHA BARITE	DMA	Beds	Ba	Barite, bedded, laminated, barren
94F/10	LD81-1-3	381637	6389707	KWADACHA BARITE	DG	Beds	Ba	Well laminated barite with shaly partings
94F/10	LD81-1-4	381671	6389776	KWADACHA BARITE	DG	Beds	Ba	Laminated barite underlain by cherty argillite
94F/10	LD81-1-5	381684	6389789	KWADACHA BARITE	DG	Nodules	Ba	Nodular barite in fault zone
94F/10	LD81-1-6	381710	6389807	KWADACHA BARITE	DG	Beds	Ba	Thin 7 centimetre bed of finely laminated barite in cherty argillite
94F/10	LD81-1-7	381735	6389806	KWADACHA BARITE	DG	Beds	Ba	Thin to medium bedded and laminated barite, 3 to 4 metres thick
94F/10	LD81-2-13	381822	6389937	KWADACHA BARITE	DG	Beds	Ba	Laminated and bedded barite, 1 mm. to 1 metre thick
94F/10	LD81-3-15	381823	6389957	KWADACHA BARITE	DRs	Beds	Ba	Thinly bedded whitish grey barite
94F/10	LD81-3-16	381829	6389975	KWADACHA BARITE	DG	Beds	Ba	well exposed 50 metre section of thin bedded to laminated barite with shaly partings
94F/10	LD81-3-17	381849	6389994	KWADACHA BARITE	DG	Beds	Ba	Finely laminated barite, some zones of nodular barite

N.T.S. Map	Station	Easting	Northing	Property or Area	Map Unit	Min. Type	Metals	Description
94F/10	LD81-5-26	381456	6390726	KWADACHA BARITE	DMA	Beds	Ba	Barite, bedded, laminated, barren
94F/10	M81-1-2	387393	6392989	N. KWADACHA RIVER	DRs	Vein		Barren calcite veins cutting crinoidal limestone
94F/02	M81-10-153	401380	6334084	N. OF PESIKA CRK.	SR	Diss.	Fe	Pyrite nodules in orange weathering, flaser bedded dolomitic siltstone
94F/02	M81-11-190	407111	6329224	N. OF ERN SHOWING	DRs	Diss.	Fe	Pyrite in rusty weathering silty shale
94F/02	M81-11-191	406808	6329092	N. OF ERN SHOWING	DRs	Diss.	Fe	Pyrite in rusty weathering silty shale
94F/02	M81-12-203	405989	6329190	ERN CLAIMS	SR	Laminae	Fe	Massive to laminated pyrite in matrix of quartz wacke breccia
94F/01	M81-14-236	417582	6330059	N. OF CT CLAIMS	DG	Beds	Ba	Thin barite bands and laminae in cherty argillite
94F/01	M81-15-263	413592	6336375	PESIKA CLAIMS	SR	Diss.	Fe	Pyrite nodules in cream to pink, flaser bedded dolomitic siltstone
94F/01	M81-15-266	413190	6336341	PESIKA CLAIMS	SR	Gossan	Fe	Heavy limonite staining in black shale
94F/01	M81-15-277	412040	6335876	PESIKA CLAIMS	DRs	Vein		Quartz in section of rusty weathering black shale
94F/02	M81-16-282	398139	6339995	SW OF PELLY CLAIMS	SR	Diss.	Fe	Pyrite concretions in thick flaser bedded dolomitic siltstone
94F/02	M81-16-300	398322	6342644	SW OF PELLY CLAIMS	SR	Diss.	Fe	Pyrite nodules in thick bedded dolomitic siltstone
94F/02	M81-16-303	399174	6342865	SW OF PELLY CLAIMS	OSk	Diss.	Fe	Pyrite cubes in creamy grey banded limestone
94F/02	M81-16-308	399462	6343735	SW OF PELLY CLAIMS	COk	Vein		Quartz veins cutting nodular phyllitic mudstone
94F/02	M81-17-318	395061	6342105	SW OF PELLY CLAIMS	DG	Nodules	Ba	Barite? nodules in rusty weathering siltstone or silty shale
94F/02	M81-17-322	394908	6341781	SW OF PELLY CLAIMS	DRs	Vein		Quartz veins at contact between Devonian shales and Ordovician limestone
94F/01	M81-18-329	410754	6340793	AKI CLAIMS	DRs	Vein		Quartz veins at fault contact between Devonian shale and Silurian siltstone
94F/10	M81-2-17	387549	6385840	N. KWADACHA RIVER			Ferricrete	Ferricrete forming near spring emanating from black shale
94F/01	M81-20-347	417573	6318453	REB PROPERTY	ORc	Vein		Quartz float in talus at contact between nodular phyllitic mudstone and platy siltstone
94C/16	M81-20-359	417940	6317628	REB PROPERTY	ORs	Laminae	Fe	Laminated pyrite bands in black siliceous graptolitic shale
94F/01	M81-21-362	414243	6322700	N. OF REB PROPERTY	SR	Diss.	Fe	Pyrite nodules in flaser bedded dolomitic siltstone
94F/01	M81-21-365	413869	6322276	N. OF REB PROPERTY	SR	Vein		Heavy quartz veining in siltstone-shale-calcarenite section
94F/11	M81-5-48	0	0	KWADACHA BARITE	DG	Beds	Ba	laminated barite at top of cherty argillite section
94F/11	M81-5-49	0	0	KWADACHA BARITE	DG	Beds	Ba	sheared and veined barite at contact with shale
94F/02	M81-5-54	406297	6338762	GIN CLAIMS	DRs	Gossan	Fe	Gossan in fissile black shale
94F/02	M81-5-55	406444	6338732	GIN CLAIMS	DG	Gossan	Fe	Gossan in fissile black shale
94F/02	M81-5-56	406520	6338672	GIN CLAIMS	DRs	Gossan	Fe	Gossan in very fissile black shale
94F/02	M81-5-58	406598	6338477	GIN CLAIMS	DMA	Vein		Quartz veins cutting black shale
94F/02	M81-5-61	406760	6338280	GIN CLAIMS	DG	Vein		Quartz veins cutting rusty black shale
94F/02	M81-5-67	407323	6337661	GIN CLAIMS	DG	Beds	Ba	Barite? bands in grey rusty weathering silty shale
94F/02	M81-7-94	405214	6329044	ERN CLAIMS	DRs	Gossan	Fe	Limonite staining in black talcy shale
94F/01	M81-8-115	409481	6340280	E. OF GIN CLAIMS	DG	Nodules	Ba	Blebby and banded barite float in talus debris
94F/01	M81-8-115	409481	6340280	E. OF GIN CLAIMS	DG	Vein		Quartz float in talus

N.T.S. Map	Station	Easting	Northing	Property or Area	Map Unit	Min. Type	Metals	Description
94F/01	M81-8-120	410406	6340494	E. OF GIN CLAIMS	DRs	Vein		Quartz veins cutting quartz wacke, float in talus
94F/10	MF81-1-6	381193	6391149	KWADACHA BARITE	DG	Beds	Ba	Barite, laminated, 0.25 m section at contact with cherty argillite and limestone
94F/10	MF81-1-8	381289	6391211	KWADACHA BARITE	DG	Beds	Ba	thin laminae in cherty argillite and siliceous shale
94F/10	MF81-1-9	381328	6391229	KWADACHA BARITE	DG	Beds	Ba	thin laminae in cherty argillite and siliceous shale
94F/01	MF81-2-30	409634	6326540	S. OF PESIKA CRK.	DRs	Gossan	Fe	Gossan in rusty weathering black shale
94F/02	MF81-3-37	403562	6335193	N. OF PESIKA CRK.	DRs	Vein		Vuggy quartz veins cutting quartz wacke and Silurian siltstone
94F/02	MF81-5-78	393769	6343995	SE OF AKIE RIVER	ORc	Vein		Quartz veins cutting nodular phyllitic mudstone
94F/02	MF81-5-89	393234	6343252	SE OF AKIE RIVER	SR	Vein		Quartz vein separating Silurian siltstone and Ordovician limestone
94F/02	MF81-5-95	392642	6342923	SE OF AKIE RIVER	SR	Diss.	Fe	Pyrite cubes in Silurian siltstone
94F/02	MF81-5-96	392559	6342860	SE OF AKIE RIVER	SR	Diss.	Fe	Quartz float in talus
94F/02	MF81-5-96	392553	6342873	SE OF AKIE RIVER	SR	Vein		Pyrite cubes in chloritized volcanics
94F/02	MF81-5-97	392464	6342796	SE OF AKIE RIVER	OSk	Vein		Intense quartz veining in limestone
94F/01	MF81-6-104	416196	6331925	W. OF OSPIKA RIVER	DRs	Vein		Quartz veins at contact between cherty argillite and black shales
94F/01	MF81-7-113	413036	6328223	W. OF OSPIKA RIVER	COk	Vein		Quartz veining in nodular phyllitic mudstone of the Kechika formation
94F/11	MF81-8-131	376788	6389240	E. OF KWADACHA PARK	DMA	Diss.	Fe	very pyritic black shales
94F/11	MF81-8-133	377144	6389691	E. OF KWADACHA PARK	DMA	Gossan	Fe	Gossan in black shale section

APPENDIX F
Analytical data for measured section S-80-10

	Metres above base														
	804	**759**	**689**	**637**	**634**	**634**	**530**	**469**	**460**	**460**	**426**	**405**	**390**	**390**	**356**
SiO2	74.53	73.85	76.36	74.28	72.68	78.08	81.81	73.97	92.30	90.46	90.49	77.94	77.37	77.03	76.28
TiO2	0.360	0.453	0.314	0.238	0.402	0.379	0.352	0.458	0.097	0.084	0.110	0.413	0.429	0.435	0.462
AL2O3	9.00	11.63	9.17	6.74	9.87	8.84	7.41	11.57	2.86	3.75	3.79	9.22	10.24	10.24	10.59
FeO	0.17	0.17	0.12	0.12	0.14	0.17	0.09	0.19	0.19	0.33	0.19	0.33	0.54	0.30	0.59
Fe2O3	0.39	0.57	0.42	0.50	0.70	0.47	0.56	1.06	0.01	0.13	0.03	0.55	0.43	0.68	0.27
MnO	0.004	0.005	0.004	0.004	0.024	0.009	0.004	0.015	0.004	0.004	0.004	0.006	0.006	0.004	0.005
MgO	0.71	0.81	0.62	0.66	1.02	0.89	0.54	1.39	0.15	0.15	0.25	0.81	0.86	0.85	0.81
CaO	0.49	0.04	0.06	0.04	2.11	1.63	0.05	3.62	0.02	0.03	0.02	0.16	0.02	0.02	0.04
Na2O	0.044	0.063	0.039	0.037	0.030	0.026	0.026	0.024	0.010	0.009	0.015	0.043	0.046	0.044	0.046
K2O	1.965	2.536	1.960	2.439	1.720	1.574	2.672	1.798	0.954	0.932	1.390	3.338	3.679	3.681	3.829
P2O5	0.14	0.14	0.07	0.24	0.07	0.12	0.07	0.07	0.07	0.07	0.07	0.14	0.07	0.07	0.07
TOTAL	91.54	94.49	93.18	89.30	93.54	95.70	95.76	97.92	97.90	97.44	97.88	96.24	96.98	96.39	96.09
H2O-	1.11	1.19	1.31	1.72	1.77	0.94	0.65	0.72	0.35	0.38	0.49	1.03	0.93	0.92	0.87
H2O+	2.97	3.47	3.01	2.46	3.41	2.95	1.86	3.47	0.97	1.17	1.14	2.65	2.77	2.55	2.68
S	0.02	0.02	0.04	0.06	0.02	0.01	0.02	0.04	0.02	0.03	0.01	0.03	0.02	0.01	0.01
Mn	37	28	24	23	187	97	33	125	13	17	17	49	47	48	48
Org. C	6.04	3.54	5.08	8.87	5.11	2.91	1.94	1.18	2.19	2.08	2.57	3.29	2.17	2.16	2.19
Ag	0.30	0.70	0.30	0.30	0.30	0.30	0.80	1.10	0.30	0.30	0.30	0.30	0.30	0.30	0.50
Cu	3	7	3	3	20	8	3	14	4	3	3	4	3	5	8
Pb	8	9	4	13	10	5	20	11	8	8	2	12	15	15	5
Zn	6	13	9	4	13	6	11	9	4	11	4	9	7	8	11
Co	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ni	51	33	37	5	26	16	5	26	10	11	18	16	6	7	15
Hg	31	96	20	195	90	90	200	44	51	47	73	90	66	78	87
As	13.5	11.9	7.9	8.9	10.7	12.5	12.5	11.0	3.0	3.9	2.7	7.8	11.8	10.8	8.5
Ba	0.06	0.10	0.28	0.06	0.06	0.05	0.06	0.05	0.04	0.05	0.03	0.04	0.05	0.05	0.01
Sr	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C	5.95	3.47	3.93	8.55	5.01	4.88	1.95	1.01	2.11	1.94	2.34	3.18	1.99	2.03	2.05
F	150	185	200	190	300	400	190	470	60	60	60	150	225	170	275
V	2000	1700	1160	62	480	460	90	1800	82	75	137	335	110	95	242
Unit	DMA	DMA	DMA	DMA	DMA	DMA	DMA	DMA	uDMW	uDMW	uDMW	DMA	DMA	DMA	DMA
Rock	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1

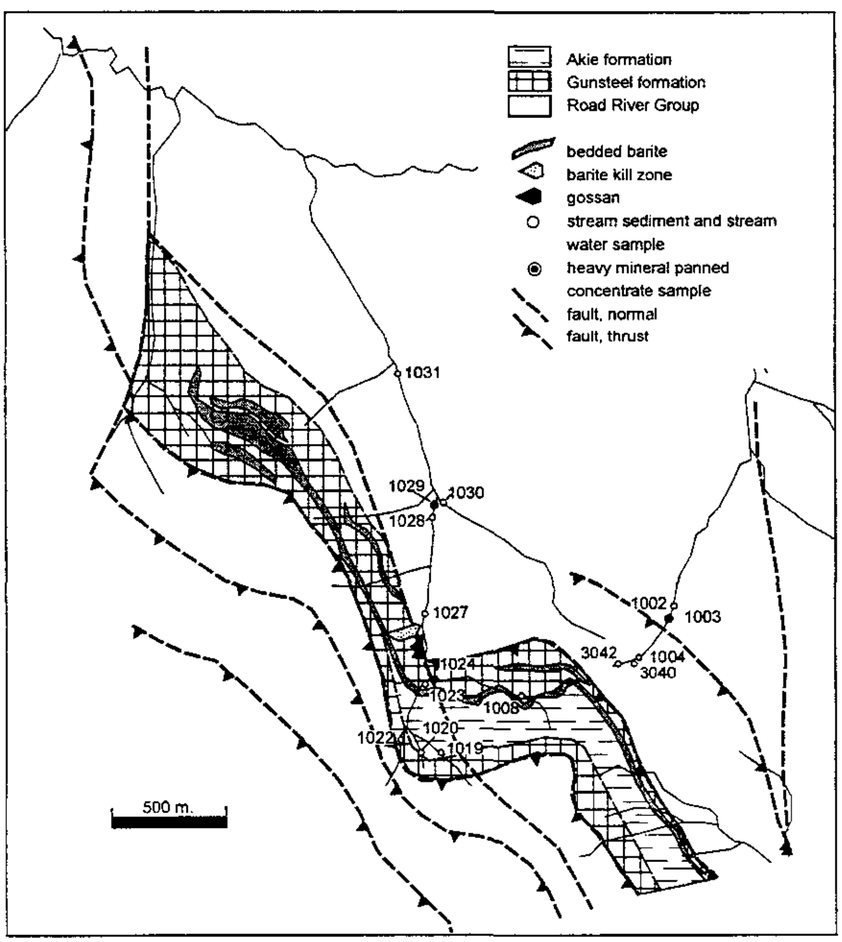
Rock codes: 1=siliceous shale, 2=quartz wacke, 3=cherty argillite, 4=limy siltstone, 5=graptolitic shale

	Metres above base								
	304	**277**	**272**	**250**	**192**	**173**	**145**	**106**	**18**
SiO2	60.67	88.33	35.22	92.16	31.88	36.08	41.74	63.99	91.72
TiO2	0.867	0.079	0.173	0.062	0.143	0.047	0.057	0.099	0.035
Al2O3	19.89	2.67	3.25	2.10	2.79	2.24	2.42	2.37	2.34
FeO	0.74	0.14	0.17	0.14	0.26	0.15	0.27	0.09	0.09
Fe2O3	3.04	0.04	0.73	0.00	0.49	0.14	0.11	0.66	0.27
MnO	0.007	0.004	0.032	0.004	0.033	0.031	0.029	0.010	0.004
MgO	2.14	0.21	12.08	0.15	13.06	12.88	11.44	5.09	0.29
CaO	0.09	0.04 li		0.01	19.54	19.44	16.25	9.30	0.36
Na2O	0.112	0.015	0.036	0.015	0.036	0.018	0.031	0.031	0.015
K2O	6.478	0.590	1.680	0.514	1.423	1.331	1.222	1.140	0.610
P2O5	0.07	0.07	0.07	0.07	0.07	0.07	0.07	2.00	0.07
TOTAL	99.07	95.17	72.45	95.85	70.67	73.05	74.22	86.35	96.22
H2O-	0.79	0.68	0.26	0.17	0.09	0.06	0.07	0.49	0.06
H2O+	5.03	2.28	0.92	0.42	0.57	0.62	0.57	1.09	0.37
S	0.02	0.10	0.70	0.10	0.46	0.02	0.03	0.10	0.02
Mn	57	4	241	4	244	248	236	104	29
Org. C	1.09	5.07	2.29	2.02	0.42	0.09	0.23	1.20	0.10
Ag	0.50	0.60	0.80	0.60	0.80	0.30	0.30	1.00	0.30
Cu	23	7	19	6	17	7	6	41	22
Pb	15	5	11	10	10	6	8	19	14
Zn	14	3	16	3	7	22	4	10	84
Co	6	1	1	1	1	1	1	1	1
Ni	29	37	28	16	10	5	1	85	10
Hg	44	39	92	73	76	20	20	137	20
As	5.9	4.2	4.3	4.0	2.2	0.9	2.2	8.8	2.7
Ba	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sr	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C	0.95	4.74	8.93	1.97	8.18	7.63	6.72	4.02	0.18
F	505	265	900	275	750	350	375	2300	60
V	108	335	137	275	50	18	15	285	20
Unit	DMA	DG	DG	DG	DRs	DRs	DRs	DRs	DRs
Rock	1	3	4	3	4	4	4	5	2

APPENDIX G
Analytical data for silt, heavy mineral and gossan samples from the Cirque property.

Sample	Zn	Cu	Pb	Ni	Co	Ag	Mn	Fe %	Mo	Cd	V	Hg *	Pb	Ba	As
Silt Sample Analyses															
1002	2800	124	32	420	132	0.4	2750	3.65	17	23	160	130	200	5000	29.2
1004	425	54	28	70	20	0.2	460	2.35	13	2	220	95	100	4970	28.6
1008	245	33	280	29	4	1.2	90	7.85	41	1	320	198	200	4970	15.1
1019	400	39	35	52	8	0.8	345	1.65	7	4	240	128	100	3515	11.1
1020	220	32	24	52	6	0.2	295	1.60	12	2	240	161	200	13700	9.2
1022	11000	42	4650	62	10	11.0	295	4.05	11	83	100	2876	4667	51500	10.4
1023	370	23	225	15	2	0.8	45	12.00	32	1	810	336	200	13700	39.6
1027	3250	40	420	78	12	1.4	590	6.50	19	16	300	391	400	10200	20.8
1028	3450	39	530	82	10	1.4	555	5.55	18	17	320	632	400	9589	20.0
1030	1100	55	39	156	20	0.6	520	3.20	18	6	200	156	200	11000	26.6
1031	4250	46	340	131	16	1.0	715	4.75	16	21	230	469	300	9589	22.4
Heavy Mineral Analyses															
1003	1800	93	25	285	78	0.1	1950	3.35	15	10	190	112	50	9545	31.0
1024	300	26	155	18	4	0.4	45	9.10	38	1	660	179	260	44000	35.5
1029	4500	38	1700	78	10	3.8	550	5.10	22	22	300	824	1982	100000	22.5
Gossan Analyses															
3040	490	61	37	83	44	0.4	1000	4.65	17	1	180	169	100	9286	28.2
3042	1500	38	7	96	6	1.4	65	29.25	9	1	110	140	100	1286	16.5
3043	*140*	*19*	*64*	*4*	*1*	*0.2*	*50*	*23.50*	*19*	*1*	*940*	148	*100*	*40000*	*70.0*
3044	75	5	1	1	1	0.1	15	31.75	2	1		20	100	100	20.6
3045	14500	7	1	180	46	0.1	3000	33.50	8	6	25	49	100	1023	2.6
3046	16000	8	1850	15	4	1.4	115	31.25	5	110	135	530	1545	2000	26.5

All values in ppm except Hg in ppb and Fe in percent. Samples collected by Bruce Ballantyne, Geological Survey of Canada. Analyses done in the Geological Survey of Canada laboratory, Ottawa



British Columbia
Ministry of Energy and Mines
Energy and Minerals Division
Geological Survey Branch

Geological Survey Branch

FIGURE 3A

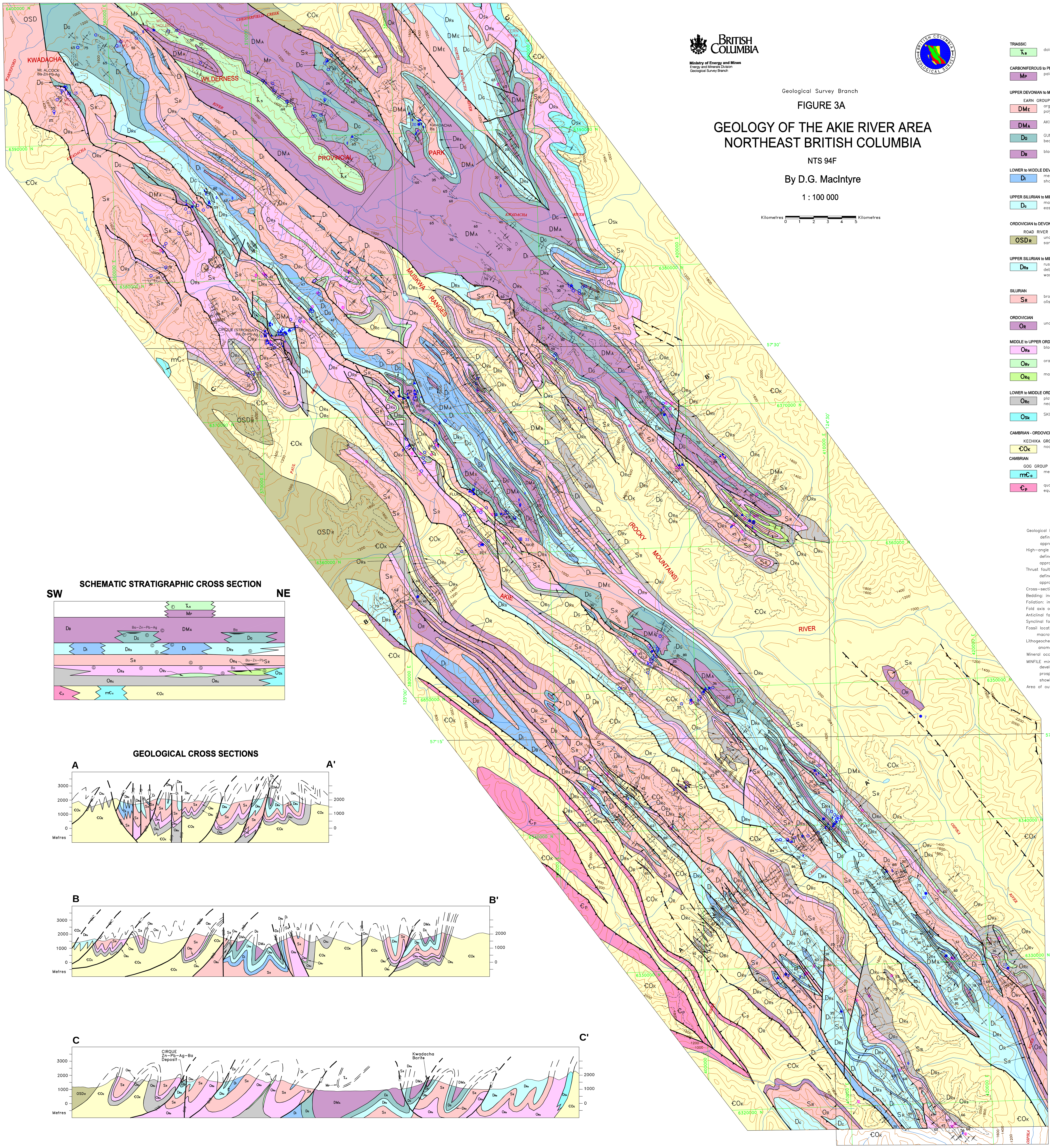
GEOLOGY OF THE AKIE RIVER AREA NORTHEAST BRITISH COLUMBIA

NTS 94F

By D.G. MacIntyre

1 : 100 000

Kilometres 0 1 2 3 4 5 Kilometres



LEGEND

TRIASSIC

$\mathrm{Ŧ}_s$ — dolomitic siltstone, minor limestone, dolostone.

CARBONIFEROUS to PERMIAN

MP — pale grey to greenish grey chert

UPPER DEVONIAN to MISSISSIPPIAN

EARN GROUP

DME — argillite, slate, shale, locally carbonaceous and pyritic; chert arenite and pebble conglomerate, polymicitic conglomerate; limestone

DMA — AKIE FORMATION: brown weathering silty shale; minor siltstone.

DG — GUNSTEEL FORMATION: blue grey–weathering chert, cherty mudstone, argillite, shale; nodular and bedded barite +/– sulphides; minor pelagic limestone.

DB — black, siliceous shale, minor sandstone and pebble conglomerate, barite.

LOWER to MIDDLE DEVONIAN

DI — medium to thick–bedded micritic and bioclastic limestone reefs and carbonate buildups; minor shaly argillite and chert; limestone, dark grey, argillaceous .

UPPER SILURIAN to MIDDLE DEVONIAN

Dc — mainly limestone in western part of 94F; basal quartzites, shale and limestone debris flows in eastern part of 94F.

ORDOVICIAN to DEVONIAN

ROAD RIVER GROUP

OSDR — undivided. shale, black, graptolitic, mainly Ordovician; siltstone, tan, platy, mainly Silurian; sandstone, calcareous shale

UPPER SILURIAN to MIDDLE DEVONIAN

DRs — rusty–weathering black silty shale, limy siltstone; lower section includes interbedded limestone debris flows, crinoidal siltstone, calcarenite, graptolitic black shale, quartzose conglomerate and wacke near carbonate platform and reefs; basal chert.

SILURIAN

SR — brown to buff weathering dolomitic siltstone; platy, flaser–bedded; minor quartz wacke, limestone olistostromes; includes basal unit of dolostone, mudstone, black chert and argillite

ORDOVICIAN

OR — undivided shale, limestone, siltstone, limestone debris flows.

MIDDLE to UPPER ORDOVICIAN

ORs — black graptolitic shale, minor black chert, siltstone.

ORv — orange weathering ankeritic tuffs, altered flows and sills.

ORq — mainly quartz wacke turbidites with minor interbeds of graptolitic black shale

LOWER to MIDDLE ORDOVICIAN

ORc — platy, laminated buff to cream weathering, limy siltstone, mudstone; limestone and debris flows near base.

OSk — SKOKI FORMATION: medium to thin–bedded dolostone, limestone, limy mudstone; crinoidal.

CAMBRIAN - ORDOVICIAN

KECHIKA GROUP

€OK — nodular, wavy–banded phyllitic siltstone, limestone, shale,minor green tuff.

CAMBRIAN

GOG GROUP

m€c — medium to thick–bedded limestone patch reefs, minor quartz wacke.

€p — quartzite, orange–weathering dolostones, minor siltstone, shale; may locally include Lynx Formation equivalents.

SYMBOLS

Geological boundary
- defined
- approximate

High–angle fault, ball on downdropped side
- defined
- approximate

Thrust fault, teeth in direction of dip
- defined
- approximate

Cross–section line — A A'

Bedding: inclined, vertical, overturned

Foliation: inclined, vertical

Fold axis of minor fold (arrow indicates plunge)

Anticlinal fold: upright, overturned

Synclinal fold: upright, overturned

Fossil location: age determined (with GSC number)
- macrofossil, conodonts, graptolites — F C G

Lithogeochem sample: background values
- anomalous Ba;Ba+Zn+Pb+Ag;Zn+Pb+Ag

Mineral occurrence: barite, pyrite, Fe–oxide — Fe

MINFILE mineral occurrence with number
- developed prospect
- prospect
- showing

Area of outcrop

SCHEMATIC STRATIGRAPHIC CROSS SECTION

SW NE

GEOLOGICAL CROSS SECTIONS

A A'

B B'

C C'

MINFILE Mineral Occurrences

No.	Name	Commodities	Type	Age
1	ERN	Zn,Pb,Ba	SEDEX	Middle Ordovician
2	WEDGE	Cu	Vein	?
7	AKIE RIVER	Cu	Vein	?
8	CIRQUE (STRONSAY)	Zn,Pb,Ag	SEDEX	Late Devonian
9	FLUKE	Pb,Zn,Ag,Ba	SEDEX	Late Devonian
10	CT	Zn,Pb,Ba	SEDEX	Early Silurian
11	ELF	Pb,Zn,Ba,Ag	SEDEX	Late Devonian
13	YULE	Ba	SEDEX	Late Devonian
15	MT. ALCOCK	Zn,Pb,Ag,Ba	SEDEX	Late Devonian
16	GNOME	Ba	SEDEX	Late Devonian
17	GIN	Ba	SEDEX	Late Devonian
18	DEL	Ba	SEDEX	Late Devonian
20	KWADACHA	Ba	SEDEX	Late Devonian
22	SIKA (AIKIE–SIKA)	Ba	SEDEX	Middle Ordovician
23	PIE	Ba,Pb,Zn,Cu	SEDEX, Vein	Late Devonian
25	PESIKA	Ba	SEDEX	Late Devonian
26	DEL EAST	Ba,Pb	SEDEX	Late Devonian
27	AKI	Zn,Ag	SEDEX	Middle Ordovician
30	FAMILY	Cu,Zn	SEDEX	?
31	AKIE	Pb,Zn,Ag	SEDEX	Late Devonian

SOURCES OF MAP DATA

Mapping by D. MacIntyre, K. Heather, J. Lowey, K. Downing and L. Diakow, 1979–1981, B.C. Geological Survey Branch, Victoria, B.C. Map compiled by D. MacIntyre from published and unpublished sources, between September 1994 and January 1995. The following references were used extensively;

Gabrielse, H., 1977, Geological map of Ware (West 1/2) and Toodoggone river map–areas; Geological Survey of Canada, Open file 483.
MacIntyre, D.G., 1980: Geology of the Akie river Ba–Pb–Zn district, B.C. Ministry of Energy, Mines and Petroleum Resources, Preliminary Map 44.
MacIntyre, D.G. 1981: Geology of the Akie river Ba–Pb–Zn District, B.C. Ministry of Energy, Mines and Petroleum Resources, Preliminary Map 50.
Taylor, G.C., 1979: Geological map of the Ware east half and Trutch map areas, Geological Survey of Canada, Open File 609.

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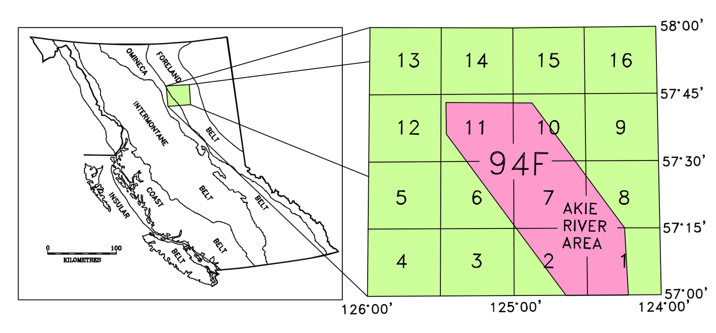

Universal Transverse Mercator Projection, North American Datum 1927. Base map digitized from 1:50 000 scale topographic maps published by the Surveys and Mapping Branch, Energy, Mines and Resources, Canada. Contour interval is 200 metres.