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GEOLOGICAL REPORT

ON THE

GATAGA DISTRICT, 1979

LIARD - OMINECA MINING DIVISIONS

NORTHERN BRITISH COLUMBIA

N.T.S. 94 - C,E,F,K, AND L

BY

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CYPRUS ANVIL MINING CORPORATION

APRIL 29, 1980

OFFICE & FIELD WORK DONE DURING THE PERIOD: 1977 - 1980

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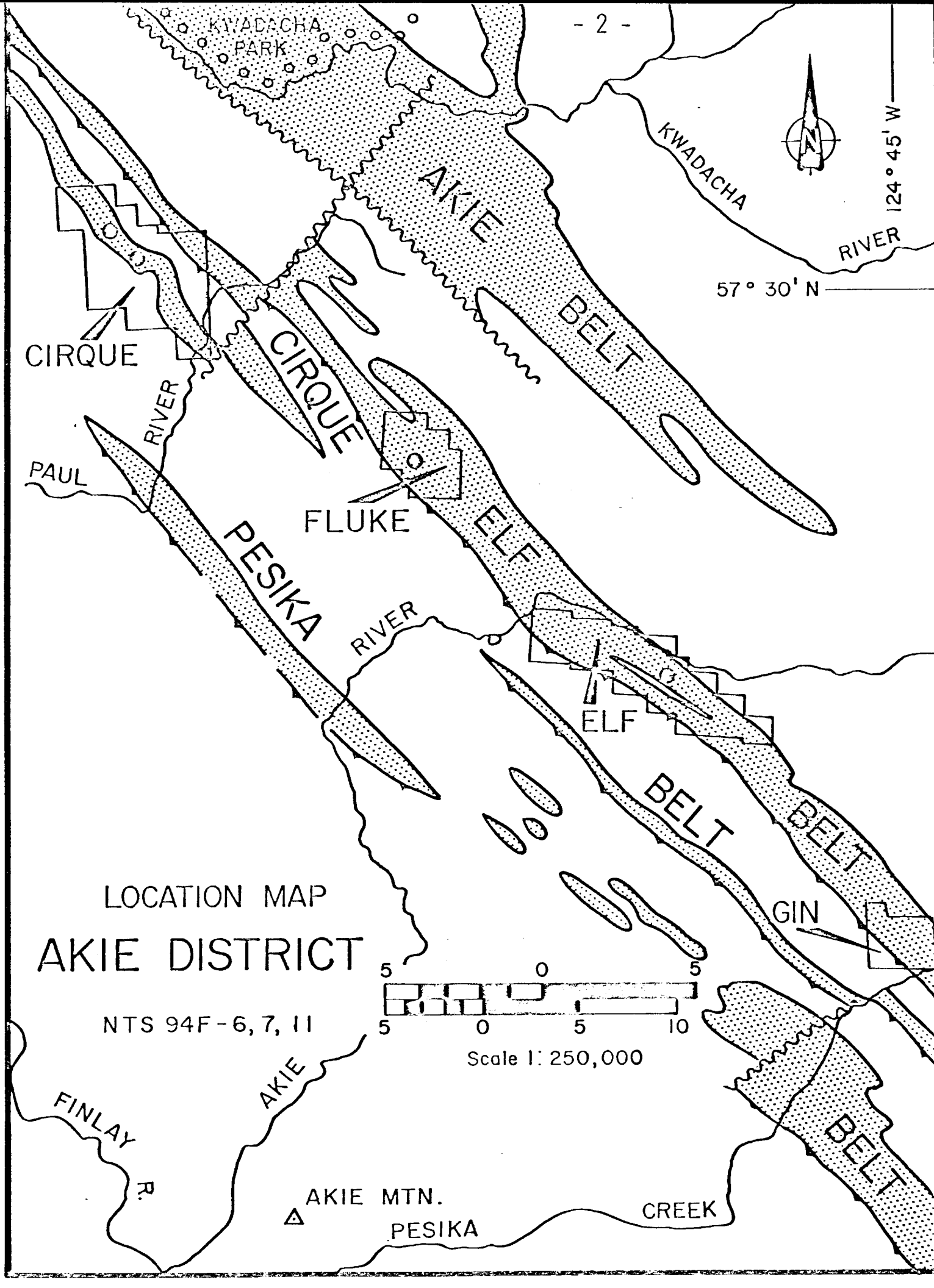
REGIONAL GEOLOGY

STRATIGRAPHIC AND GEOGRAPHIC SETTING

Strata underlying the Gataga Project area range in age from Middle Proterozoic to Early Mississippian. The strata that are of greatest importance to the project are those of latest Cambrian to Mississippian age, listed in Table I. The Late Devonian to Mississippian "Black Clastics" are in the youngest stratigraphic assemblage in northern British Columbia (Table I). They unconformably overlie Silurian dolomitic siltstone to mid-Devonian limestone and shale. Regional mapping by Gataga Project geologists and the Geological Survey of Canada (Gabrielse, 1977; Taylor, 1979; Taylor et al., 1979) has delineated four continuous to discontinuous belts of Black Clastics that extend from Braid Creek, on map sheet 94-L-1, southeasterly through Gataga Lakes and the Kwadacha Wilderness Park to the Ospika River, a distance of over 200 kilometres. The Black Clastics belts are named, from northeast to southwest, the Akie, the Elf, the Cirque and the Pesika. The Pesika is a composite, ill-defined belt of small synformal keels of Black Clastics. The belts are preserved in fundamental synclinal structures that are partly bounded by normal faults and west-dipping thrust faults that place Ordovician Kechika Group to Ordovician Road River and Silurian Siltstone strata structurally on top of the Black Clastics.

Unit 1, Kechika Group

Cecile and Norford (1979) described five subtle units of the Kechika Group that range in age from latest Cambrian to late Early Ordovician. Two map-units, 1A and 1B, are used in the Gataga Project area. The middle Kechika, 1A, is over 500 metres of light grey weathering limestone. It is characteristically phyllitic, nodular, argillaceous, and moderately


KWADACHA PARK
KWADACHA RIVER
124° 45' W
57° 30' N
AKIE BELT
CIRQUE
CIRQUE
RIVER
PAUL
FLUKE
PESIKA RIVER
ELF
ELF
BELT
BELT
BELT
GIN
LOCATION MAP
AKIE DISTRICT
NTS 94F-6, 7, 11
5 0 5
5 0 5 10
Scale 1: 250,000
FINLAY R.
AKIE
AKIE MTN.
PESIKA CREEK

resistant. The Upper Kechika, 1B, is light brownish-grey weathering limestone. It is grey, phyllitic, nodular to laminated, argillaceous to silty, dolomitic and cliff-forming. Part of the Upper Kechika Group is interdigitated with Road River Group shales on the eastern margin of the Akie Belt.

ROAD RIVER GROUP

The Road River Group includes basinal shaly strata that range in age from Early Ordovician to Early Devonian in the Gatage region (Cecile and Norford, 1979; Norford, 1979). Cecile and Norford (1979) divided the Ordovician part of the Road River strata into 5 units:

OR_5	interstratified shale and quartzite with minor dolomite.
OR_4	distinctive resistant rusty shales
OR_3	basalts, shale and silty shale, with dolomite slope breccias and debris flows associated with the Skoki shale-out
OR_2	yellow weathering limestones
OR_1	nodular calcareous shale

The Silurian part of the Road River Group includes two major units. The SL unit, Silurian Limestone, is 20 to 100 metres of thinly bedded buff-grey weathering grey limestone. The SD unit of Cecile and Norford (1979) is the Silurian Siltstone. The Silurian Siltstone includes silty dolostone, dolomitic siltstone and fossiliferous quartzite that lie between shales dated as latest Early Silurian and Early Devonian (ibid.). The uppermost Road River map-unit is Early Devonian grey graptolitic shale which overlies the Silurian Siltstone.

The Gatage Project geologists have divided the Road River Group

into five packages to facilitate mapping;

Unit 6 Lower to Middle Devonian limestone and shale.
Unit 5 Silurian Siltstone
Unit 4 Road River (restricted)
Unit 3 Skoki Formation shale-out
Unit 2 Ordovician Volcanics

Unit 3 is omitted from the following descriptions because it does not occur in the area of interest.

Unit 2, Ordovician Volcanics

Bright orange-weathering, buff and green calcareous basalt breccias; tuffs; and massive, amygdaloidal, subophitic flows overlie the Kechika Group, separated by a thin interval of recessive shale. The basalts are up to 100 or more metres thick. The breccias are composed of calcitic and choritic mafic fragments in a matrix of buff to cream argillaceous limestone and grey calcareous shale. The basalts and related sills occur only beneath the Elf Belt of Black Calstics.

Unit 4, Restricted Road River Group

The restricted Road River Group is divided into eight sub-units: 4A is buff to light grey weathering, black, graptolitic, well-cleaved shale. It is the most common of the Road River rock types. 4B is bioturbated silty dolomite that resembles the Silurian Siltstone. 4C is a well-cleaved silvery grey-weathering, locally rusty siliceous graptolitic shale that looks very much like the Gunsteel Formation. It contains beds of laminated and nodular barite.

4D and 4F are very similar and are mapped separately only where they can be seen in stratigraphic context. 4D occurs within the shales whereas 4F occurs near the top, underlying the Silurian Siltstone. 4D and 4F are 20 to 100 metres of thinly bedded buff-grey weathering grey limestone, equivalent to the SL unit of Cecile and Norford (1979).

The limestone beds are graded turbidites with minor cross laminae, some slope breccias and interbeds of black shale.

4F is quartzose sandstone turbidite with minor carbonate fossil fragments. It occurs only in the Akie Belt and the southern part of the Elf Belt of Black Clastics. 4G is black ribbon bedded chert often with limestone horizons and thin interbeds of black graptolitic shale. It crops out near the top of the Road River succession on Gataga Mountain at the northwest end of the Gataga district. 4H is massive bedded grey limestone at the same position as 4F, immediately beneath the Silurian Siltstone. It is seen mainly in drill core at the ELF property.

Unit 5, Silurian Siltstone

Unit 5A, orange to brown-grey weathering dark grey silty dolostone to dolomitic siltstone, is a distinctive marker formation throughout the project area. It has graptolites, siliceous sponge spicules and feeding trails. There are many different variants of this rock type:

5A1 bioturbated with irregular mottling, or large fan-shaped feeding trails
5A2 calcareous with abundant large diffuse pyrite nodules and laminae (Cirque drillcore)
5A3 graded quartzose sandstone with coral and sponge fragments (east of GIN Claims)
5A4 distinctively planar laminated
5A5 rhythmic massive graded beds
5A6 interbedded with black shale
5A7 intraformational breccia
5B laminated limestone

Variants 5A1, 5A4 and 5A5 are the most common. The siltstone is generally well-cleaved, so much so that in 5A1 the primary bedding is very difficult to recognize.

Unit 6, Early to Middle Devonian Limestone and Shale

Unit 6 includes a variety of limestones and shales that overlie the Silurian Siltstone and underlie the Late Devonian Akie Shale. Unit 6A, the Paul River Formation, is grey, massive to thick bedded limestone composed almost entirely of stromatoporoid, coral and crinoid debris with some fossils in growth position. The Paul River Formation occurs in two main areas: the Kwadacha Reef on the east margin of the ELF Belt, and the Pesika Reef on the western margin of the Pesika Belt. The Kwadacha Reef is over 300m thick near the headwaters of the Paul River. It thins toward the north, east, northeast, and pinches out entirely near the Akie River and the ELF property line. Similar fossiliferous limestones in the Nahanni map-area have latest Middle Devonian corals and conodonts (Gordey, 1979).

Unit 6H, dolomitic quartzite turbidites, occupies the same stratigraphic position as 6A, but about 25% of the section is interbedded black shales that contain Early Devonian graptolites (Norford, 1979). The turbidites have graded bedding, load casts, basal shale chip rip-ups and some fragments of the coral Favosites. Unit 6H is restricted to the Akie Belt.

Units 6B, 6C, and 6F are black graptolitic shales. In 6B there are interbeds of light grey-weathering dolomitic siltstone with fossil fragments. In 6C there are interbeds of thin grey fossiliferous limestones with Favosites corals, stromatoporoids and crinoids with twin axial canals. Unit 6C is a major component of the Pesika Belt and is interpreted as a distal equivalant of 6A.

Unit 6D is found only on the ELF Claims. It is thin to thick-bedded breccia of chert, quartz sand and shale chips interbedded with black abundantly graptolitic shale. The breccias are debris flows and graded turbidites with flame structure at the base.

Unit 6G was mapped on the east side of the CIRQUE Property, stratigraphically overlying the Kwadacha Reef. It is sooty grey-weathering,

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black siliceous shale to ribbon-banded porcellanite with diffuse siltstone laminae. These are ovoid limestone concretions from a few centimetres to over 10cm in diameter. This porcellanite gradationally overlies 6C silty shales which have fossiliferous limestone turbidites near the base. It is gradationally overlain by silty shale mapped as Akie shale. These ribbon porcellanites are possible lateral equivalents of the Gunsteel ribbon porcellanite, 8A. In this case they would be Late Devonian rather than Early Devonian in age, and the silty shale would also be younger.

BLACK CLASTICS

The mapping program, primarily concerned with the internal stratigraphy of the Black Clastics, has documented the presence of three widespread lithologic units. The early Late Devonian Akie Shale forms the base of the Black Clastics and consists of an irregular blanket of brown silty shale with interbedded siltstones. The late Devonian Gunsteel Formation, consisting of silvery-grey weathering black siliceous carbonaceous shale, chert and argillite, conformably overlies the Besa River. It is host for most known stratiform barite-sulphide mineral occurrences and most of the large stratiform barren barite deposits in this region.

The Mississippian Warneford Formation unconformably overlies the Gunsteel Formation and consists of interbedded silty shale and polymictic conglomerate.

Unit 7, Akie Shale Formation

The Akie Shale, possibly correlative with the Besa River Formation, unconformably overlies the Road River to Mid-Devonian succession within the four belts of Black Clastics. It is interpreted to reach thicknesses of over 500m within parts of these belts. There are five locally mappable members but the stratigraphic position is unclear. Many of the members are lithologically similar to the Warneford shales.

Unit 7A is well cleaved, grey weathering, laminated and commonly distinctly bedded grey silty shale. Unit 7B, the Pin-striped Shale, is distinctly laminated to banded rusty grey to light grey weathering, well cleaved, dark brown to black, soft shale with interlaminae and thin interbeds of shaly siltstone. The Pin-striped Shale is mapped mainly in and southeast of the ELF Group. Unit 7C is phyllitic, lenticular cleaved rusty brown weathering, soft black shale.

Some units mapped as 7D and 7E are of uncertain stratigraphic position. 7D is rusty brown weathering, soft black pyritic shale that forms very large slaty cleavage plates with indistinct laminae. 7E is light grey to grey, rusty-speckled weathering, black siltstone. The siltstone is generally quartzose and well indurated but in places is interbedded or intergradational with silty shales. Some of the 7E, particularly on the FLUKE, includes quartzose lithic sandstone. 7E is interpreted as turbidite deposits.

Unit 8, Gunsteel Formation

The Gunsteel Formation is typically silvery blue-grey (gunsteel) weathering, black, siliceous, laminated shale. Twenty-five units have been distinguished for mapping and logging core because this is the unit that hosts the stratiform barite, zinc and lead deposits. There are basically six important members that are mappable in the ELF. Unit 8W is the map label for undivided Gunsteel Formation.

The Ribbon Porcellanite, 8A, is gunsteel-weathering, laminated black siliceous shale and porcellanite with up to 80% silica. It is distinctly ribbon bedded with shale interbeds. In some places it is quite silty. There are limestone concretions up to several decimetres in diameter. This cliff-forming unit ranges from a few metres to hundreds of metres in thickness.

The Ribbon Porcellanite is overlain by the Pregnant Shale which has been mapped as Unit 8C underlying and adjacent to mineralization,

and 8S overlying the mineralization. It is gunsteel weathering finely laminated siliceous black shale with locally abundant laminae of pyrite and nodules of pyrite, barite, calcite and chert. There are interbeds of 8R: very fine-grained, finely laminated, more than 10% laminar banded pyrite interbedded with black silty siliceous shale.

The Pregnant Shale overlies the barite and lead-zinc sulphides, Units 8G to 8Q in the CIRQUE drill holes. These are described in detail in individual drill reports. The barite and lead-zinc sulphides are within the Pregnant Shale in the ELF drill holes. There is also a massive bed of black porcellanite, 8D, that occurs above the ore in CIRQUE drill holes. Unit 8D in outcrop is a useful marker bed near the top of 8C.

The top major Gunsteel unit is silvery grey-weathering, black graphitic shale with abundant light grey siltstone to chert granule conglomerate interbeds. This unit, when intersected in drill core, splits along graphitic partings and is termed "poker chip" shale, Unit 8T. In outcrop this unit tends to be cleaved into lenticular flakes and is termed phyllite, Unit 8U. The correct stratigraphic assignment of 8T and 8U is uncertain. The chert granule to pebble conglomerates in parts of the 8U map units suggest Warneford affinities, yet the weathering colour is gunsteel.

Unit 9, Warneford Formation

The Gunsteel Formation is unconformably overlain by rusty brown weathering silty shales and chert-pebble conglomerates of the Warneford Formation, map-unit 9. Units 9A and 9B are both shales. Unit 9A has indistinct bedding in the shales and interbeds of lithic sandstone and orange-weathering dolomitic siltstone. Unit 9B is distinctly laminated dark brown-grey silty shale. Units 9C and 9D are conglomerates and sandstones: Unit 9C is composed only of varicoloured chert whereas 9D is polymictic. The chert conglomerate beds are turbidites with flute and groove casts showing westerly derivation.

Unit 10, Triassic Shale

The topmost strata are Triassic, brown-grey, calcareous to non-calcareous, silty shale with some chert pebble conglomerates.

REGIONAL STRUCTURE

Rocks in the Gataga Project area were deformed mainly during the Laramide Orogeny from the Latest Cretaceous to Early Oligocene. The deformation is fundamentally influenced by the primary depositional troughs, faults and rock types. The four belts of Black Clastics occupy the cores of 2 to 5km-broad second-order synclinal structures within the 10 to 30km-wide first-order structural trough in the Kechika Group. The Kechika Group is tightly folded and thrusted internally but only the broad folds are readily mappable. The broad synclines generally have normal stratigraphic contacts on the east but are overthrust by Kechika Group on the west. The belts have internal third-order folds and thrusts on the scale of 0.5 to 2km. The folds in the Mid-Devonian limestone are open and box-like with tight keels. Isoclinal folds and thrusts dominate in the Road River and Silurian Siltstone where the Mid-Devonian limestone is missing. The thrusts are deeply rooted faulted folds with only the broken crests of anticlines exposed in the leading edges. The thrusts are commonly imbricated, causing repetition of the Silurian Siltstone underlain by a thin wedge of Road River shale. The change from folds in the East to thrusts in the West occurs approximately at the position of the barite-lead-zinc deposits within the CIRQUE and ELF Belts. Smaller-scale structures are discussed in the property descriptions. Most structures plunge toward the northwest in the southeast half of the area. Northwest of the CIRQUE Property, structures tend to plunge southeasterly. Axial planar cleavages and minor folds are well developed in the shaly strata.

There are two major normal fault arrays:

1) Normal faults trend approximately perpendicular to the Laramide structures. Southeast of the CIRQUE, these are down-thrown on the southeast side. Northwest of the CIRQUE the normal faults are down-thrown to the northwest. The net result of these normal faults is to minimize the effect of fold plunges on the stratigraphic level of Recent erosion. There is possible strike-slip movement on some of the faults. Gabrielse (pers. comm., 1980) suggested that the faults are Laramide in age; a response to relatively tensional stresses acting perpendicular to the direction maximum stress during the Laramide Orogeny. These normal faults have relatively insignificant effect on a regional scale but on the property scale, the offsets of 10 to 100 metres can be crucial.

2) Normal faults that trend roughly parallel to Laramide structures also have offsets of tens to hundreds of metres. They are recognized in regional maps where they tend to emphasize the depth of second-order synclines. They are also recognized in property maps and cross-sections of drill holes where they significantly offset some units. None have been yet documented to offset Pb-Zn-Ba mineral horizons.

REGIONAL PALEOGEOGRAPHY

The Antler Orogeny of the Western United States and Alaska is recorded by Upper Devonian westerly-derived flysch with associated chert, siltstones and shales along the west coast of North America. The Black Clastics of the Northern Cordillera are associated with this event of rapid subsidence and marine transgression.

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The four belts of Black Clastics of the Gataga area are within the southern tip of the first-order Selwyn Basin between the continental platform carbonates on the east and the salient of platformal carbonates on the west.

The thickness and position of the Late Middle Devonian Kwadacha and Pesika Reefs is thought to reflect differential restricted movement of fundamental crustal blocks bounded by growth faults that were active during the Middle Devonian. Growth faulting is also suggested by anomalously thick Black Clastics in the four order synclines and the local occurrence of Ordovician basalts within the Elf Belt. The thickness and facies distribution of the Akie Shale suggests that Late Devonian silty shale and siltstone to conglomeratic turbidite deposition was limited to the areas within, and controlled by fault-bounded troughs. Provenance of coarse clastics was local and possibly from both sides of the troughs. The finely laminated distal-turbidite shales could have been derived from a great distance. The order troughs are coincident with the four preserved belts of Black Clastics and are partly delineated by the zero edges of the Kwadacha and Pesika Reefs.

The Gunsteel Formation records relatively quiescent conditions marked by accumulation of graphitic siliceous shale interrupted by sporadic turbidites within the same second-order troughs. During continuous deposition of shale and sporadic turbidites, exhalations of metalliferous siliceous brines accumulated in small third-order basins adjacent to growth faults. The shales in these third-order basins are distinguished by increased thickness of the shales -- and the abundance of silica, pyrite nodules and laminae, barite nodules, calcite nodules and trace lead, zinc and barium contents relative to the rest of the Gunsteel Formation. After exhalations slowed or ceased, shale deposition continued as before, within the troughs.

The end of quiescent conditions is marked by the silty shales, chert-pebble conglomerates and sandstones of the Warneford Formation. This clastic expression of the Antler Orogeny was spread eastward across the area to blanket both troughs and highs.

Respectfully submitted,

C.W. JEFFERSON

April 29, 1980.

COMPARISON WITH THE VARISCAN FOLD BELT, GERMANY

Devonian strata of the Akie District of the Selwyn Basin are comparable in great detail with Devonian strata of the Variscan Fold Belt. The comparison must start with Devonian rocks because no autochthonous Silurian or older strata are preserved in the Variscan Belt. Similarities are as follows:

1. There are strong facies changes between Lower to Middle Devonian stromatoporoid limestone reefs and laterally equivalent shales. The reefs are asymmetrical in thickness.

2. Reefs and ore deposits are related to lineaments interpreted as growth faults.

3. The ore bodies are stratabound, syngenetic, and hosted by rusty to gunsteel-weathering black shales.

4. The shales underlying the ores are pinstriped, composed of siltstone-shale distal turbidites with interbeds of quartzose sandstone turbidites.

5. There are first-, second- and third-order depositional basins controlling the ore bodies.

6. The third-order basins are recognized by the anomalous thickness of the shales and the abundance of diagenetic chert nodules, bedded porcellanite, pyrite nodules, pyrite laminae, barite nodules and trace amounts of lead, zinc and barium. Evidence of the basins persist above the deposits.

7. There are fine to coarse turbidites interbedded with the massive to finely laminated sulphides and sulphates.

8. Metamorphic grade is low, but cleavage is well developed so that the shales are properly referred to as slates. They provide roofing material for most of the houses in the district in Germany.

9. The shale sequence in complexely deformed resulting in overturned folds, broken folds and thrust faults.

10. Volcanic strata occur in the same geographic area as the deposits but at different stratigraphic levels.

Differences are as follows:

1. There is a manganese halo about the German deposits but not the Akie deposits.

2. The closest known volcanic rocks in the Akie District are Ordovician whereas Devonian tuffs occur below and immediately overlie the Variscan deposits.

3. There is no Variscan analogue to the ribbon porcellanite, only thin silicious calcarious zones in the shales. The Akie District Gunsteel Formation is generally much more silicious than the Variscan equivalent (Weissenbach Shale).

4. The exhalative fluids in the Variscan deposits were strongly acid, so that no calcite is present in the third-order basins. Calcite is abundant in the Akie District.

5. There is a vent stockwork (Kniest) beneath the Variscan deposits. This has not been found in the Akie District.

6. There is a clear vertical to lateral separation of sulphides from sulphates in the Variscan deposits whereas the two are locally mixed in the Akie District. This suggests shallower third-order basins in the Akie District.

7. Much paleontological work has been done on the Variscan deposits so that they are accurately dated. The only paleontological control in the Akie District is from lower Late Devonian ammonoids within the barite unit.