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Preliminary Geology of Fenwick Creek (105D/3) & Alligator Lake (105D/6) Map Areas

by

R. A. Doherty, C.J. R. Hart,
Aurum Geological Consultants Inc.

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PREFACE

The Wheaton River area was first prospected before the Klondike gold rush of 1898. Gold-silver and antimony-silver veins were worked intermittently until high grade gold-silver veins were discovered in the early 1980's and brought into production.

Metamorphic sedimentary and plutonic rocks of Paleozoic and older (?) Yukon Crystalline Terrane are the oldest rocks in the area. Mesozoic sediments and volcanics of the Whitehorse Trough are intruded and metamorphosed by Cretaceous granitic rocks. Eocene subaerial felsic to intermediate volcanic complexes are important targets for epithermal mineral deposits. Recent basalt flows are the youngest rocks exposed in the area.

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ABSTRACT

Fenwick Creek (105D/3) and Alligator Lake (105D/6) map areas, located southwest of Whitehorse, Yukon, were mapped at 1:50,000 scale during the 1987 field season. The map areas are within the Teslin Plateau and the Boundary Ranges physiographic regions.

Cretaceous Coast Plutonic Complex and Upper Triassic volcanic and sedimentary rocks of the Whitehorse Trough are separated by the 40 km long 140° trending "Tally-Ho Shear Zone." East of the shear zone, limestone containing late Upper Triassic conodonts is interbedded with volcanics previously mapped as Mesozoic volcanics, and now considered part of the Lewes River Group.

Mount Skukum and Bennett Lake are two Eocene volcanic complexes in the map area. The volcanic stratigraphy of the Skukum Complex has been reinterpreted and a number of previously unreported rhyolite porphyry plugs and related flows were mapped in other areas outside the main volcanic complexes.

U-Pb age dating on zircon concentrates from three plutons was completed. Megacrystic feldspar granodiorite, dated at 220 +/- 5 Ma, intrudes the Lewes River Group volcanics. The granodiorite forms a regionally extensive northwest trending late Triassic batholith and is interpreted as the plutonic root of the Lewes River Arc. The Ibex Alaskite, a high level discordant pluton that intrudes late Cretaceous (?) felsic volcanics is 58 +/-1 Ma. Mt. Anderson granite-granodiorite is 119 +/- 5ma.

Three types of mineral occurrences have been recognized in the area: 1. epithermal gold-silver veins, 2. silver-antimony +/- gold veins, and 3. gold-silver-telluride veins. Epithermal gold-silver veins are hosted in Eocene volcanics. Antimony-silver veins in faults cutting late Triassic to Tertiary granites and the gold-silver-telluride veins are spatially related to the " Tally-Ho Shear Zone."

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INTRODUCTION

Location and Access

Fenwick Creek (105D/3) and Alligator Lake (105D/6) map-areas have a common boundary approximately 55 km southwest of Whitehorse. Access is provided by the south Klondike Highway and the Annie Lake road which leads into the Wheaton River valley to Mount Skukum and Skukum Creek. The Mount Skukum minesite is approximately 1 hour by vehicle from Whitehorse.

Secondary 4x4 roads and "cat" trails lead to Alligator Lake; Thompson Creek and Gold Hill-Mineral Hill; Partridge Pass and Mount Stevens; Mount Wheaton and Dickson Hill; Becker Creek and Carbon Hill; Summit Pass; Vesuvius Hill and Towle Creek; Butte Creek; Skukum Creek; and Berney Creek. An old tote trail leads up the Watson River past the big bend to access the old Charleston mine workings southwest of Mount Skukum.

The southern half of Fenwick Creek map sheet (105D/3) is accessible by boat along the West Arm of Bennett Lake or alternatively by helicopter. The northern half of Alligator Lake map-sheet (105D/6) can be reached using the road to the Whitehorse Coal workings on the southeast side of Mount Granger.

Glaciation and Glacial Deposits

Several glacial advances have been described in this part of Whitehorse map-area by Wheeler (1961). The latest advance of the Cordilleran ice sheet reached elevations of up to 6500' (1980 m). The ice sheet moved primarily northerly or northeasterly and probably flowed most easily through the Wheaton, Watson, Corwin and Alligator Lake valleys. The erosional effects of this glaciation accentuated the topographic relief by forming U shaped valleys, cirques and aretes.

Erosional and depositional features associated with deglaciation include overflow channels and canyons, kame terraces, eskers, hummocky terrane and proglacial lake sediments. Proglacial lakes have left successive horizontal strand lines which can be observed on the sides of valleys between 3200'(975 m) and 3800'(1160 m) above sea level at Becker Creek, Mt. Kopje, Vesuvius Hill, Alligator Mountain and Hodnett Lakes. Thick accumulations of varved lacustrine sediments were deposited in the Wheaton River valley between Vesuvius Hill and Skukum Creek, along the Watson River valley, and northeast of Alligator Lake.

The latest period of alpine glaciation rejuvenated cirques above 4500' (1370 m). Cirques were carved into north-facing slopes, forming steep headwalls separated by sharp serrated aretes and horn peaks. Meltwater from receding glaciers subsequently carved steep channels through thick deposits of drift and alluvium.

Previous Work

Reconnaissance geological investigations in the Fenwick Creek (105D/3) map-area began in 1906 when D.D. Cairnes visited the Union mine on Idaho Hill west of Annie Lake (Cairnes 1910). The first topographic and geological map of the area was completed in 1909 and published as G.S.C. Memoir #31 (Cairnes 1912).

Other reports on the mineral occurrences in the Wheaton River and Windy Arm districts were published in G.S.C. Summary Reports by MacLean (1914), Cairnes (1916, 1917), Cockfield and Bell (1926, 1944), and Bostock (1938, 1941).

Regional 1:250,000 scale mapping of the Whitehorse map sheet (105/D) was begun in 1946 by Fyles and Cockfield, continued in 1947 by J.R. Johnson and completed between 1948 and 1951 by J. O. Wheeler, and published as Memoir #312, (Wheeler 1961).

Bennett Lake Cauldron Subsidence Complex was mapped at 1:25,000 scale by Lambert (1974), who documented two nested cauldrons, a central dome, ring dykes and radial fracture patterns related to two resurgent cycles of felsic volcanism.

In 1978, Morrison compiled information on the mineral deposits south of Whitehorse and on age dates of the intrusive rocks (Morrison 1979; Morrison et al. 1979).

Thesis work completed on and about the Mount Skukum volcanic complex included geological mapping at 1:25,000 scale (Pride 1985a) and petrological and geochemical studies on the rhyolite ring intrusions (Smith 1982) and the structure and volcanic stratigraphy in the Skukum Complex (Smith 1983; Pride 1985a, 1986). Studies of the mineralization and fluid inclusions of the Skukum gold deposit were completed by McDonald (1986) and on the mineral occurrences east of Mount Skukum by Rucker (1987).

Present Investigation

Scope of Study

A two year geological mapping contract was awarded to Aurum Geological Consultants Inc. under the Canada-Yukon Economic Development Agreement (Contract YEDA 01/87). Four 1:50,000 map sheets; Carcross (105D/2), Fenwick Creek (105D/3), Alligator Lake (105D/6), and Whitehorse (105D/10): will be mapped by the end of 1988.

The object is to aid the exploration industry in the search for ore deposits by producing accurate 1:50,000 scale geological bedrock maps, and developing models to help understand the relationship between mineralization and geological elements. The authors would appreciate any updated data, corrections or comments on the maps from industry geologists working in the area.

This Open File reports on the bedrock geology of Fenwick Creek (105D/3) and Alligator Lake (105D/6) map areas.

Field Methods

Two hundred and twenty-two man days of traverses were completed between May and September 1987. Traverses were chosen to maximize the number of geological contacts encountered. Attention was given to economically significant mineral deposits in the area. Field information was plotted on aerial photographs and transferred to a 1:50 000 base map.

Information was compiled from previous mapping projects, thesis work, non-confidential property assessment reports and information known to Aurum employees from previous projects in the area.

More Eocene rhyolite and andesite dykes exist than are shown on the maps. Those dykes mapped are large enough to be represented at map scale, or represent a swarm of smaller dykes trending parallel to those shown on the maps.

Faults and lithological contacts were not projected through areas of Quaternary overburden.

Acknowledgements

The authors would like to kindly acknowledge the assistance of numerous individuals and companies active in the area. Special thanks go to Tom Garagan of Aurum Geological Consultants Inc. for discussions on some aspects of the

local geology. Pat Garagan helped out on a number of traverses during the summer and spent time compiling maps at the beginning of the project. Nicole Hulstein carefully undertook the drafting of the geology maps including our numerous and last minute changes. Roger Hulstein prepared the first draft of the mineral occurrence tables for the area.

Discussions with Peter von Gaza of the University of Alberta on the remote sensing imagery in the area proved very useful and informative. Mitch Mihalynuk and Jonathan Rouse of the British Columbia Department of Mines and Petroleum Resources who were mapping similar terrane on the Tutshi map sheet (104/M15) south of the British Columbia-Yukon border were most helpful in sharing their data.

Grant Abbott, acting chief geologist of Exploration and Geological Services Division, D.I.A.N.D. contributed his time and advise throughout the project and his efforts are sincerely acknowledged.

TECTONIC SETTING

Two tectonic elements, the Whitehorse Trough and the Nisling Terrane are present in the map area (Figure 1). The Whitehorse Trough is part of the Intermontane Belt, while the Nisling Terrane is composed of rocks of the Yukon Crystalline Terrane and the Coast Plutonic Complex (Wheeler and McFeely 1987).

Whitehorse Trough forms an elongate feature extending from Carcross to Minto, bounded on the east by the Teslin Suture and on the west by the Nisling Terrane. In early Mesozoic time, the trough existed as a fore-arc basin. Sedimentary and volcanic rocks of the Triassic Lewes River volcanic arc were deposited, on and near the edge of Stikinia (Tempelman-Kluit 1981). Conglomerate, sandstone and shale of the Jurassic Laberge Group were derived from the uplifted core of the arc.

Triassic plutons were emplaced in Stikinia as part of the Lewes River Arc and are now exposed as the oldest plutons of the Coast Plutonic Complex . Cretaceous plutons form the greater part of the Coast Plutonic Complex. Plutonic activity essentially ceased between 90 and 60 Ma.

During Late Jurassic and Early Cretaceous time, easterly derived chert pebble conglomerate and other terrestrial sediments of the Tantalus Formation were deposited in a successor basin that developed over both the Yukon Crystalline Terrane and Whitehorse Trough.

Early Eocene high level alaskite bodies and related bi-modal calc-alkaline felsic to intermediate volcanic rocks were emplaced, primarily along the eastern margin of the Coast Plutonic Complex, probably in response to regional crustal extension.

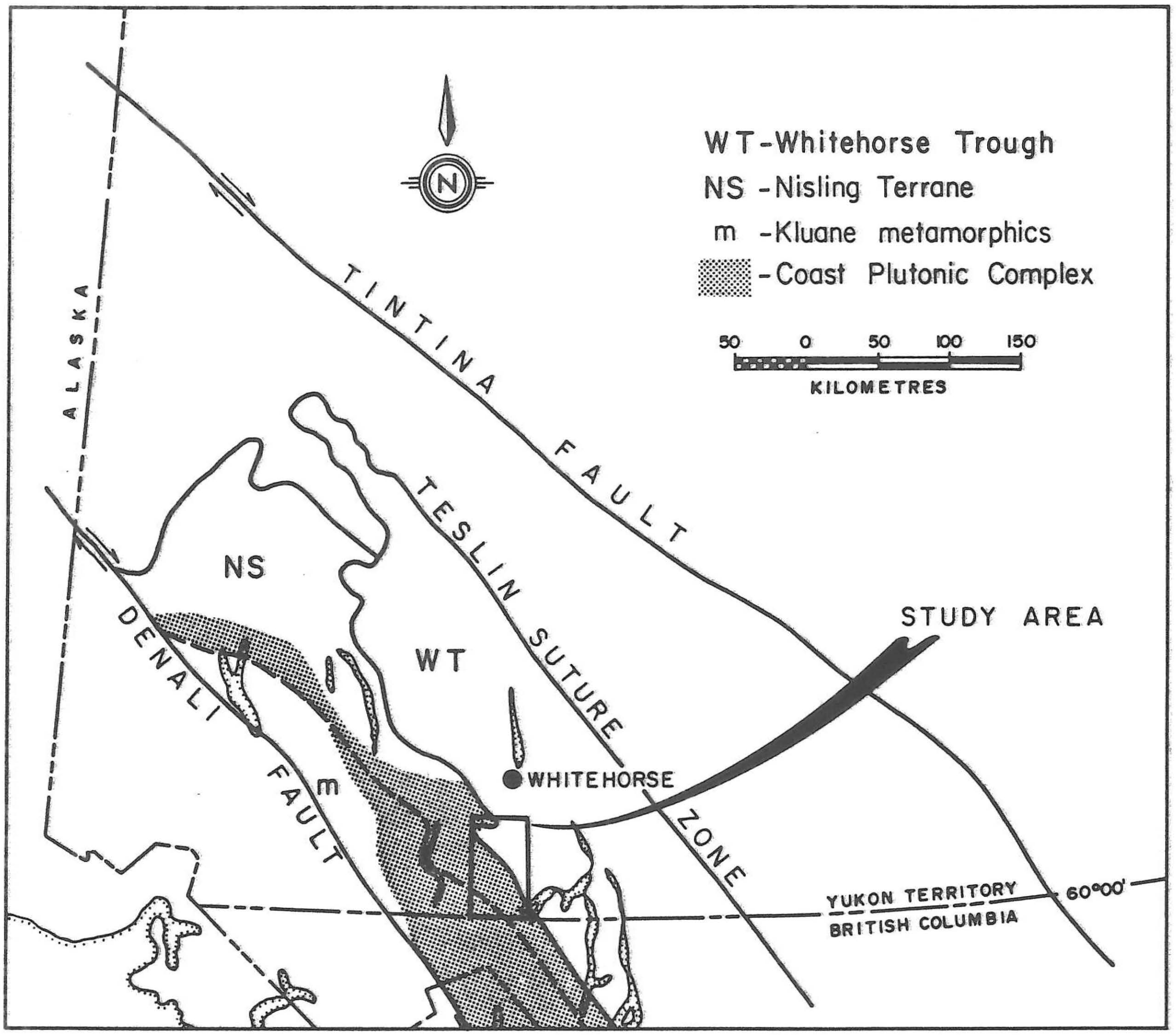

Figure 1 . **Regional tectonic setting of the study area.**

GENERAL GEOLOGY

Yukon Crystalline Terrane and the Coast Plutonic Complex in the south and west, and the Whitehorse Trough in the north and northeast, are the important geological elements in the map area.

Schists and gneisses of Proterozoic to Permian age (TABLE 1), of the Yukon Crystalline Terrane are the oldest rocks in the area (Tempelman-Kluit 1976).

Coast Plutonic Complex includes three distinct intrusive suites ranging from Triassic to Tertiary in age. The older intrusive rocks form northwest-trending granodiorite batholiths containing pendants of the Yukon Crystalline Terrane. This package is intruded by a suite of mid-Cretaceous granodiorite and quartz-monzonite bodies. Small, high-level Tertiary plutons form discordant bodies along the eastern margin of the Coast Plutonic Complex.

Rocks of the Whitehorse Trough include: 1) Mesozoic volcanic rocks; 2) Lewes River Group volcanic, clastic and carbonate rocks; 3) Laberge Group conglomerate and wacke; and 4) Tantalus chert pebble conglomerate, grit and coal.

In the map-area, the Whitehorse Trough rocks form three northwest-trending belts: the Corwin Belt, the Dugdale Belt, and the "Tally-Ho Shear Zone" (Figure 2). The Corwin Belt extends northward on both sides of the Corwin Valley to Mt. Folle and Red Ridge. The Dugdale Belt continues from south of Goat Mountain to Coal Ridge and beyond the northern and western map boundaries. This belt forms the limit of the southwestern limb of the Fish Lake Syncline. The "Tally Ho Shear Zone" forms a 1-4 km wide belt from the southeastern corner of the map-area to Alligator Lake.

Sheared and foliated greenstones and mylonites of the "Tally Ho Shear Zone" form the contact between the Coast Plutonic Complex and the Whitehorse Trough. The suturing of these two geologic elements is presumed to have taken place in the Late Jurassic, when regional deformation resulted in the folding and backthrusting of Whitehorse Trough strata.

Middle and Late Cretaceous volcanic and sub-volcanic rocks of the Mt. Nansen and Carmacks Groups overlie and intrude both tectonic provinces.

Mt. Skukum and Bennett Lake Volcanic Complexes are two significant Eocene volcanic centers. Each complex represents several eruptive cycles of primarily felsic and intermediate flows and pyroclastic rocks, followed by varying degrees of subsidence. Eocene volcanism was triggered by crustal extension which allowed the emplacement of small felsic intrusions and dyke swarms throughout southwestern Yukon.

Recent Miles Canyon Basalt extruded from several vents south and west of Whitehorse, are the youngest rocks in the region.

Table of Formations

ERA	PERIOD or EPOCH	FORMATION	LITHOLOGY
CENOZOIC	Pleistocene and Recent		Glacial drift, alluvium, volcanic ash
		Miles Canyon	Basalt, minor sediments and pyroclastics
	Unconformity		
	Eocene	Skukum and Bennett Lake Intrusives	Quartz feldspar granite porphyry
			Smokey quartz eye granite
			Rhyolite feldspar porphyry
			Ryolite dykes
		Intrusive Contact	
		Skukum and Bennett Lake Volcanic Complexes	Felsic pyroclastics, tuff, lithic tuff, welded tuff, flow banded rhyolite, epiclastic sediments, andesite flows and breccias, dacite flows, conglomerate and basalt
	Unconformity		
	Tertiary		Ibex alaskite
			Pink quartz monzonite
			Alaskite granite with mafic border phase
			Leucogranite
Intrusive Contact			
MESOZOIC	Cretaceous	Mt. Nansen Gp.	Rhyolite to andesite flows and lithic tuff
		Unconformity	
		Coast Plutonic Complex	Folle Mountain biotite granite
			Hornblende granodiorite
			Mt. Anderson granite-granodiorite
			Boudette Creek quartz monzonite
			Wheaton Valley hornblende granodiorite
			Fenwick Creek diorite
	Intrusive Contact		
	Uppermost Jurassic/ Lower Cretaceous	Tantalus Formation	Chert pebble conglomerate, grit, sandstone, shale and coal
	Lower and Middle Jurassic	Laberge Group	Granite cobble conglomerate, greywacke, arkose, siltstone and andesite
	Disconformity		
	Late Triassic		Friday Creek diorite
			Pyroxenite, leucogabbro
			Megacrystic granite-granodiorite
			Intrusion breccia
		Intrusive Contact	
		Lewes River Group	Andesite flows, breccias, tuff, augite and feldspar porphyry, chlorite schist, agglomerate, arkose, conglomerate, marble, limestone, greywacke and argillite
		Relations Uncertain	
			Andesite flows, breccia and tuff
Unconformity			
PALEOZOIC -?-?-?-?- Precambrian			Hornblende granodiorite gniess
	Intrusive Contact		
	Paleozoic and Older	Yukon Crystalline Terrane	Biotite muscovite quartz feldspar gneiss, chlorite biotite feldspar gneiss, muscovite quartz schist, marble, quartzite, amphibolite

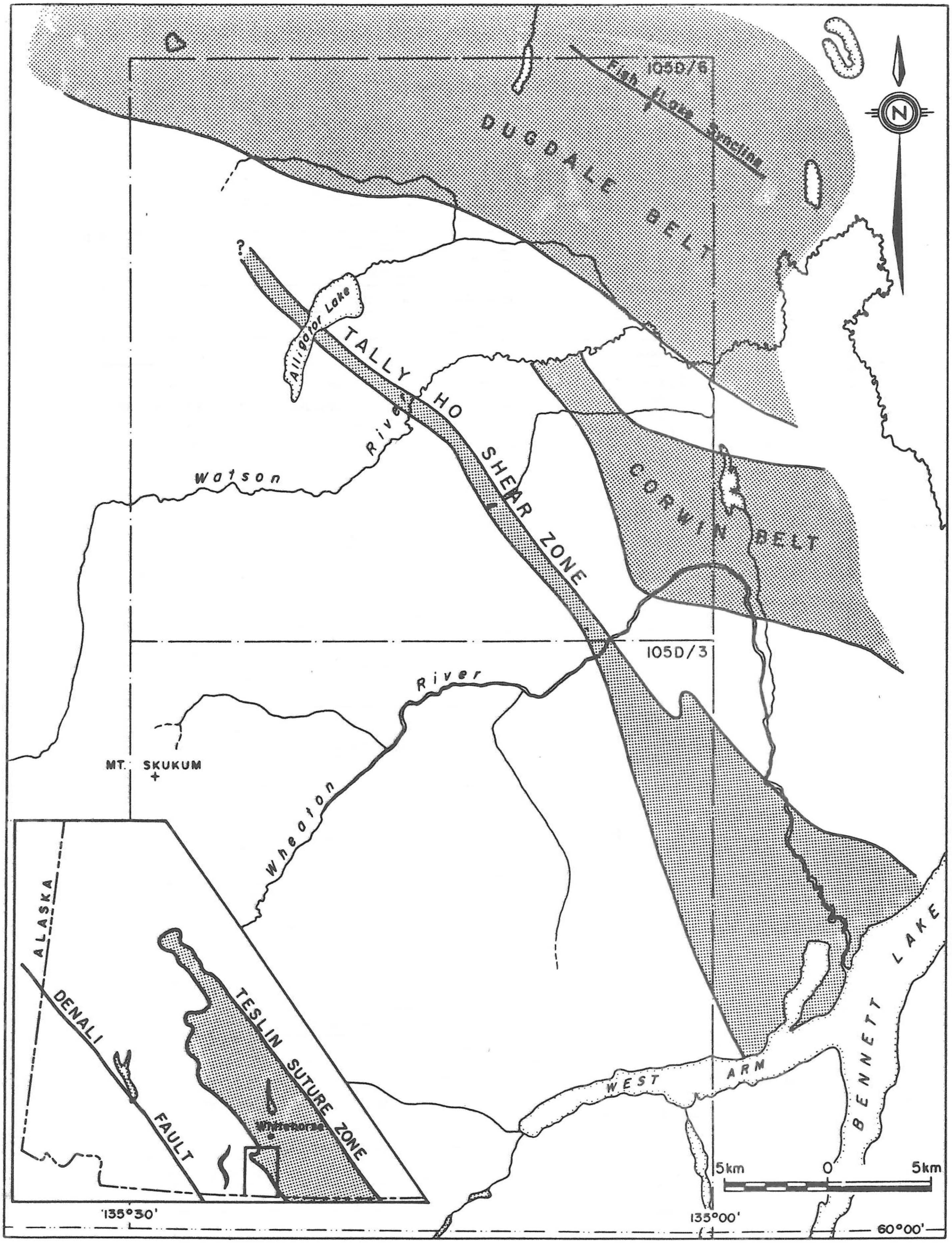

Figure 2. Northwest-trending belts of Whitehorse Trough rocks in the study area.

YUKON CRYSTALLINE TERRANE (HCsn)

Metamorphic rocks are preserved as down-faulted blocks or pendants ranging in size from <1km^2 to several tens of km^2. The larger exposures occur under Eocene volcanic strata which may account for their preservation. All are west of the "Tally-Ho Shear Zone" with notable exposures on Mt. Anderson, Mt. Bell, western Bennett Lake Complex and southwestern Skukum Complex.

The original thickness of this unit is unknown but is greater than 2,500' (800 m) (Wheeler 1961).

Outcrops are rusty-brown weathering and form steep cliff faces. Lithologies include feldspar-hornblende (chlorite) gneisses, quartzite, quartz-biotite schist and marble with lesser amounts of amphibolite and muscovite-quartz schist. Foliation parallels bedding and generally trends northwest. Lithologies are variable as documented in a section 4 km northwest of Mt. Skukum (Wheeler 1961).

Discontinuous lenses of white and grey, massive to thick bedded crystalline marble and sheared marble (Hc) between 5m and 50m thick are exposed in the map-area, 4 km southwest of Stony Mountain, on Mt. Bell, Mt. Anderson and Mt. Reid. Outside the map-area large recumbent folds are visible in cliff exposures on the west side of the Watson River.

Age and Interpretation

These rocks belong to the Yukon Crystalline Terrane and represent the lower biotite schist assemblage described by Tempelman-Kluit (1976, 1981). The protolith is assumed to be Proterozoic to Paleozoic, quartz-rich, shelf and flysch style lithologies. They were deformed in the Paleozoic(?), before they were intruded by Late Triassic plutonic rocks (Tempelman-Kluit 1976).

Whole-rock Rb-Sr analysis on HCsn biotite-quartz schist (Watson et al. 1981) from the Primrose Lake area, 15 km west of the study area, gave an isochron indicating an age of 1200 Ma. Similar Precambrian Rb/Sr ages have been obtained in schists by L. Werner (Watson et al, 1981) west of Atlin Lake, and Wasserburg et al (1963) in the Yukon-Tanana uplands of Alaska.

Wheeler (1961) included these rocks in the "Yukon Group" as first described by Cairnes (1914). Recently they were included in the Nisling Terrane, a displaced continental margin (Wheeler and McFeely 1987). They are not considered equivalent to the "Boundary Ranges metamorphics" as described by Mihelynuk and Rouse (1988).

MESOZOIC VOLCANICS (Mv)

Mesozoic mafic volcanic flows and breccias occur in a wide belt between Mt. Perkins and Alligator Mountain, mainly east of the "Tally-Ho Shear Zone". They were described as "Volcanics of Uncertain Age" by Wheeler (1961), and the "Perkins Group" by Cairnes (1912). Similar rocks have been described by Mulligan (1963), Christie (1957) and Tempelman-Kluit (1974) in nearby map-areas. Conodonts obtained from thin limestone beds in the volcanics yielded a Carnian age (M. Orchard pers. comm.) which indicates that these metavolcanics form the lowermost Lewes River Group. (This age was obtained after the maps accompanying this report were released preventing the authors from changing the unit names.) A significant unconformity probably separates the Mesozoic volcanics in and about the Tally-Ho Shear Zone from the Lewes River Group rocks to the east.

Mesozoic volcanics form massive, recessive, black to light green, fine grained, non-magnetic andesitic flows and breccias with lesser amounts of porphyry, tuff, felsic flows and associated epiclastic sediments. Metamorphic grade is lower greenschist facies and saussuritization is pervasive. Few primary minerals are preserved and secondary epidote and chlorite are significant rock-forming constituents. Iron and carbonate alteration form small local gossans and nets of albite and carbonate veins are common. Bedding is obscured by alteration but if flat lying, this unit is approximately 800 m thick.

Minor conglomerate, greywacke, and thin faulted and disharmonically folded limestone beds were observed on Twin Mountain. Massive, clast supported volcanic conglomerate forms a single 20 m wide bed . Clasts of light green fine grained volcanics with occasional feldspar and hornblende phenocrysts are sub-angular to sub-rounded, and average 3-10 cm in size. Unusual fragments include dark, magnetic feldspar-phyric basalt and sheared augite porphyry similar to rocks seen in the "Tally-Ho Shear Zone".

West of Perkins Peak this volcanic unit appears to grade upwards to fresh well-bedded epiclastic and pyroclastic rocks and porphyritic flows. However, a fault is presumed to downdrop fresh, younger volcanics on the east, against the older Mesozoic volcanics.

LEWES RIVER GROUP (uTrL)

Excluding the Mesozoic volcanics, the Lewes River Group has been subdivided into four map units; basaltic andesite, augite flows and breccias (TLv), overlain by a variable thickness of carbonate and laterally equivalent clastic rocks and tuff (uTLc), a mixed sedimentary and volcanic unit (uTLvs) and volcanically derived coarse clastic rocks and debris flows (uTLs). The first two units outcrop primarily within or about the "Tally-Ho Shear Zone" whereas the latter two are found to the east.

These are the westernmost exposures of rocks of the Whitehorse Trough. Previously this group of rocks was mapped as "Porphyrites" (McConnell 1909), the "Mt. Stevens Group" (Cairnes 1912), "Older Volcanics" and Laberge Series (Cockfield and Bell 1926). They have been described by Cairnes (1910), Lees (1934), Bostock and Lees (1938), Fyles (1950), Tozer (1958), Wheeler (1961), Tempelman-Kluit (1985) and Reid and Tempelman-Kluit (1987).

The internal stratigraphy of the Lewes River Group, although well documented elsewhere, is not well understood in the Wheaton District. Greater than 3500'(1035 m) of section forming five units have been measured by Wheeler (1961) 30 km north of the study-area, near Jackson Creek. The maximum thickness in the map-area is 1000 m.

VOLCANICS (TLv)

Lewes River Group volcanic rocks outcrop in the "Tally-Ho Shear Zone" and on the Friday Creek Plateau. They are massive, dark weathering, dark green, aphanitic, basaltic andesite flows with lesser amounts of breccia and tuff. Locally the volcanics are porphyrytic with small feldspar or hornblende phenocrysts. Distinctive coarse-grained, euhedral augite porphyry is well-exposed in the "Tally-Ho Shear Zone". Attitudes of the volcanic rocks are rarely apparent; flow contacts are either irregular or masked by alteration.

Volcanic rocks show evidence of low temperature alteration. Secondary chlorite and epidote are common and calcite, dolomite and ankerite (?) form veins and irregular patches throughout.

In the "Tally-Ho Shear Zone" the andesitic flows and breccias are intensely foliated, sheared and altered to sheared greenstone and chlorite schist, with lesser talc and sericite schist. Sheared augite porphyry phenocrysts are smeared out along mylonitic foliation planes.

On Mt. Hodnett, Tally-Ho and Alligator Mountains, alternating light and dark-coloured bands parallel to foliation are common in the greenstone schists. Locally, unfoliated epidote and garnet overprint the original banding

Lewes River Group volcanics are equivalent to Division A of Wheeler (1961) which has a minimum measured thickness of 200' (61 m). This unit also resembles the Povoas Formation as described by Tempelman-Kluit (1985), in the Laberge map-sheet.

CARBONATE UNIT (uTLc)

A 25 m thick Carbonate unit overlies TLv volcanics along the western side of the"Tally-Ho Shear Zone", between the Wheaton and Watson Rivers. The largest exposures on the north face of Tally-Ho Mountain, are approximately 100 m thick. The limestone may have been tectonically thickened in the shear zone.

This unit is massive to thick-bedded, white to buff weathering, white to light grey crystalline limestone, sheared limestone, coarse-grained marble and foliated marble. On Tally-Ho Mountain, a thin package of finely laminated, fine-grained, siliceous, non-limey sediments envelope the massive limestone. Resistant weathering siliceous beds in the marble consistently trend northwest and dip 40° to 70° west. Relic fossils are suspected but are obscured by shearing.

This carbonate unit is not stratigraphically equivalent to the younger carbonate unit seen on Grey Mountain near Whitehorse. It occurs lower in the stratigraphy and does not contain reefs.

VOLCANICALLY-DERIVED SEDIMENTARY ROCKS (uTLvs)

Overlying the volcanic and carbonate rocks are coarse clastic sedimentary rocks derived from flows, breccias and porphyries in the Lewes River Group. Debris flows, agglomerate and conglomerate, arkose, greywacke and mudstone dominate; pyroclastic flows and tuffs form occasional interbeds.

Debris flows, agglomerate and conglomerate are typically massive, clast supported, accumulations of purple and green amygdaloidal and porphyritic andesite volcanic clasts. Clasts are poorly sorted and angular, commonly greater than one meter but average between 5 to 20 cm across. Andesite flows and breccias with similar characteristics to the fragments form thin discontinuous interbeds. Notable exposures of this unit occur on the west slope of Goat Mountain, and elsewhere in the Dugdale Belt, and on Needle Mountain.

Thin beds of poorly indurated, friable, green, red and purple mudstone are common in the coarser clastic rocks.

Pink and pale grey limestone and limestone breccia forms several discontinuous lenses and a 2-4 m bed in the coarse volcano-clastic rocks between Two Horse Creek and Double Mountain, and on the west slope of Needle Mountain above Annie Lake.

The thickness of the volcano-clastic unit is not precisely known. It resembles Units D, C, and the upper portion of B as described by Wheeler (1961) who estimated a thickness of 3000'(915 m). The Mandanna Member of the Aksala Formation as described by Tempelman-Kluit (1985) is probably equivalent.

CLASTIC ROCKS (uTLs)

Dark-grey and black, poorly bedded, resistant, well-indurated, coarse lithic greywacke, gritstone, arkose, argillite and limey argillite outcrops along the western margin of the Dugdale Belt, easternmost Red Ridge, on the eastern portion of Beresford Hills, and the lower 5 km of Two Horse Creek.

Similarity of this unit with greywacke in the Laberge Group is well documented by Wheeler (1961). Outcrops on Two Horse Creek and at the end of Red Ridge may belong to the Laberge Group, however other Laberge Group exposures near intrusions are rusty weathering, while these are not.

Wheeler (1961) considered the Two Horse Creek exposures to be down-dropped blocks of Tantalus Formation. However, the authors feel that their abundant lithic fragments, the dark colouring, induration and lack of siliceous fragments typical of the Tantalus Formation, suggest they are more like rocks of the Lewes River Group. In addition, this evaluation requires a less complicated structural interpretation.

Age and Interpretation

Tozer (1958) and Wheeler (1961) obtained upper Triassic fossils from the Lewes River Group. More recently Tempelman-Kluit (1985) and Reid and Tempelman-Kluit (1987) have assigned Carnian to Sinemurian (Late Triassic to Early Jurassic) ages to Lewes River strata. From oldest to youngest, the Povoas Formation is Carnian (and Older?), and is overlain by the Carnian to Norian, Casca and Hancock Members and the Norian to Sinemurian Mandanna Member, all members of the Aksala Formation (Figure 3). Most ages were obtained from conodont data.

Lewes River Group is part of an extensive belt of upper Triassic volcanic rocks which extend into southern B.C. as the Stuhini, Nicola, and Takla Groups,(see Kerr 1948; Bultman 1979; Mihalynuk and Rouse 1988; and Thorkelson 1988). Nicola Group volcanics are intruded by and considered to be coeval with calc-alkaline granodiorite to diorite plutons which yield late Triassic to Early Jurassic isotopic dates between 190 and 220 Ma (Mortimer 1987).

Modern augite-porphyry lavas are found in both island-arc and intraplate settings. The abundance of fragmental volcanic rocks, marine clastics, carbonate reefs and regional tectonic relationships indicate that the Lewes River Group represent a Late Triassic volcanic arc that formed west of a subduction-accretion zone. Calc-alkaline differentiation trends, common to arc style volcanics (i.e., Nicola Group, Preto 1979; Mortimer 1987), have not been identified in the Lewes River Group.

Andesite flows, autoclastic submarine flow breccias, pyroclastic flows and tuffs were deposited on the arc during catastrophic events. Overlying limestone and marine clastics were deposited during quiescent intervals in shallow marine environments around the eroding volcanic centers.

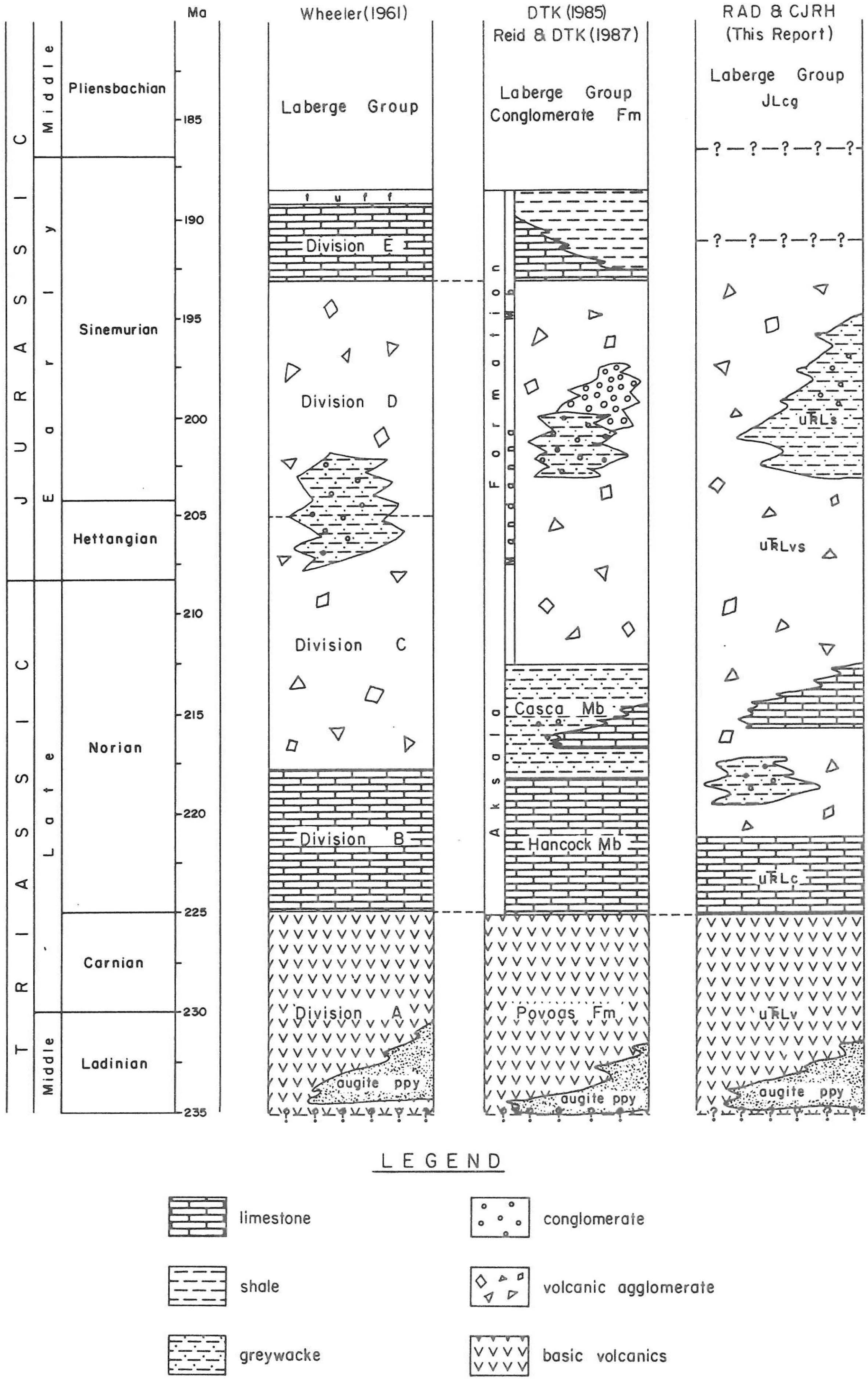

Figure 3. Approximate stratigraphic correlation between generalized sections of the Lewes River Group.

LABERGE GROUP (JL)

Jurassic Laberge Group is restricted to the eastern Corwin Belt and the northern Dugdale Belt. Small pendants (<1km^3) are found 1 km northwest of Pugh Peak and directly across the Watson River from Mineral Hill. Small erosional remnants, overlying the Lewes River Group, were mapped north of Friday Creek.

Laberge Group comprises greywacke, shale and conglomerate with lesser amounts of sandstone, arkose, andesite, andesite breccia and limestone. The aggregate thickness in the Wheaton River District is estimated at greater than 1300 metres. Cairnes (1912) suggested a maximum aggregate thickness of at least 5000 feet (1525 m) while Wheeler (1961) measured a 4000' (1220 m) section on Gray Ridge and a >8000' (2440 m) section north of Coal Ridge.

Since exposures of the Laberge Group in the Wheaton District are either fault bounded or isolated by granitic intrusions, stratigraphic correlations are incomplete. On Gray Ridge, conglomerate is overlain by a much thicker package of shale and greywacke. In the Dugdale Belt, conglomerate dominates with lesser shale, sandstone and greywacke.

CONGLOMERATE (JLcg)

Typical conglomerate is well-indurated and resistant, forming steep-walled hummocky terrane. The distinctive orange-brown weathering surface makes identification easy. Beds are very thick to massive, poorly sorted, clast- and matrix-supported. Clasts are typically sub- to well-rounded pebbles, boulders, and cobbles of hornblende granodiorite, foliated hornblende granodiorite, leucogranite, quartz diorite, fine-grained andesite, feldspar porphyry, biotite-feldspar gneiss, quartzite, quartz, limestone, siltstone and rare jasper.

Massive and foliated granitic clasts are most abundant, occasionally totalling 70%. Volcanic fragments dominate in places. Wheeler (1961) suggested that green volcanic clasts are most abundant in Whitehorse map-sheet. The authors noted abundant Yukon Crystalline Terrane metamorphic fragments (15%) in a section west of Coal Lake and an anomalous percentage of limestone and siltstone clasts near Caribou Mountain, east of the study area.

SEDIMENTARY ROCKS (JLs)

Fine-grained sedimentary rocks of the Laberge Group include well-bedded shale and siltstone with poorly bedded greywacke, sandstone, arkose and rare volcaniclastic rocks. These are typically orange-brown weathering, recessive, dark-grey, moderately- to well-bedded and contain ammonites. Where exposed in the Corwin Belt, they are hornfelsed.

Poorly indurated, immature greywacke and argillite are interbedded with chloritic and hematitic volcanic agglomerate on the west slope of Coal Ridge. Although like the Lewes River Group, this exposure is bounded on all sides by the Laberge Group. Similar rocks are interbedded with Laberge lithologies on Idaho Hill and "3 miles southeast of Watson" (Wheeler 1961). These rocks might belong to the uppermost Laberge Group. Tempelman-Kluit (1985) describes "red weathering, dacite to andesite flows beneath Tantalus strata."

PORPHYRITIC ANDESITE (JLan)

Porphyritic andesite flows and dykes are rare in the Laberge Group, but were seen on the east side of Folle mountain, on the extreme east side of Goat Mountain and above the Ibex River. The andesites are very competent massive dark green plagioclase porphyry flows, commonly with glomeroporphyritic textures. Single phenocrysts are equant and up to 5 mm across, acicular hornblende phenocrysts are common. On the east side of Goat Mountain, andesite flows are concordant with bedding.

Age

Fossils from limestone near the top of the Lewes River Group suggest a Carnian and Norian age, (Reid and Tempelman-Kluit 1987). Allowing some time for uplift and erosion the lower Laberge conglomerates should be lower Jurassic in age. Reid and Tempelman-Kluit (1987) assign the Laberge Group Sinemurian to Aaleneian (Early Jurassic) ages. These dates correlate well with Pliensbachian to early Middle Jurassic ammonoids collected by Wheeler (1961). Bultman (1979) collected Inklin Formation ammonites which indicated an Early to Middle Jurassic age.

Summary and Interpretation

Stratigraphy in the Laberge Group is not well understood. Shale dominates in the Corwin Belt and conglomerate in the Dugdale Belt may represent either a facies change or the preferential preservation of the higher stratigraphy in the Corwin Belt.

Faulting obscures relationships with other units. Lower contacts of the Laberge Group elsewhere in the Whitehorse map-sheet show great thicknesses of massive conglomerate overlying Lewes River Group limestone and volcanic breccia. The presence of Lewes River fragments as clasts in the conglomerate confirm an unconformable relationship.

Upper contacts with the Tantalus Formation may be unconformable while that with the Mt. Nansen Group (Kv) is unconformable.

Fragments derived from both the Coast Plutonic Complex and Yukon Crystalline Terrane in Laberge strata suggest that the dominant source area was from the west and south. Paleoflow indicators measured by Bultman (1979) imply that transportation of Laberge Group sediments in northern B.C. were predominantly toward the northeast.

Laberge Group rocks are approximately equivalent to Inklin Formation rocks of northwestern British Columbia.

TANTALUS FORMATION (JKt)

Upper Jurassic(?) to Lower Cretaceous Tantalus Formation sediments were deposited over both the Coast Plutonic Complex and the Whitehorse Trough. East of the "Tally-Ho Shear Zone", the Tantalus Formation consists of chert-pebble conglomerate, gritty sandstone, quartz sandstone, siliceous shale, carbonaceous argillite and coal. The Tantalus Formation is exposed as fault-bounded blocks within the Dugdale Belt and as a thin fault slice in the Corwin Belt. West of the "Tally-Ho Shear Zone" these rocks occur as erosional remnants within a 5 km radius of Carbon Hill. Exposures can be seen on Mount Bell, easternmost Mount Reid and about Carbon Hill.

On Mt. Bush, in the Corwin Belt, the Tantalus Formation is estimated to be at least 600 m thick while in the Dugdale Belt it may be as thick as 1800 m. This section "is possibly repeated by folding or faulting." (Wheeler 1961).

COAL MEASURES (JKtcm)

Coal measures occur at three locations: on the south side of Mount Granger (Whitehorse Coal and Ptarmigan, YEX Nos. 41 and 83); on Coal Ridge, (YEX No. 83); northeast of Beresford Hill (YEX No. 84); and on Mount Bush (YEX No. 38). All coals are of high ash anthracite or meta-anthracite grade, are broken by faults, contain beds of hydrated clays (bentonite?), and are altered by numerous cross-cutting dikes. Maximum thickness of the coal beds is 4 m, but average about 2 m.

CHERT PEBBLE CONGLOMERATE (JKtcg)

Chert-pebble conglomerate comprises, well-rounded, 1-4 cm pebbles of grey, white, pale blue and black chert and cherty quartzite. Exposures weather dark grey, are well-indurated, resistant and are thought to occur near the base of the Formation (Wheeler 1961).

Clasts in the sandstone and gritty sandstone are less well-rounded and only moderately well sorted. They form tawny coloured, poorly-indurated, friable, recessive outcrops. Chert clasts are dominate with lesser but variable amounts of feldspar and siltstone .

Grey-blue siliceous shale with vivid orange and red weathering surfaces and excellent slaty cleavage, outcrop in moderately resistant beds 20 m or less thick on Mt. Bush west of the coal measures. The shales are interbedded with the aforementioned sandstones. Thin (3-5 m), fissile, carbonaceous black shale interbeds contain woody plant fragments and rare trace fossils.

Exposures, where intruded by later granites on Mt. Bell and Carbon Hill have well developed dark red and orange gossans indicating the presence of either allogenic or authigenic iron, probably as pyrite.

Tempelman-Kluit (1985) reports "red weathering, dacite to andesite flows beneath (typical) Tantalus strata." Sediments derived from rocks such as these might include red shale and greywacke similar to that seen in the Mandanna Formation. Such lithologies are interbedded with chert-pebble conglomerate north of a small hill between Lakeview Mountain and Beresford Hill and are thus considered to be part of the Tantalus Formation.

Age and Interpretation

Jurassic and Lower Cretaceous fossils have been collected and identified from the Mt. Bush coal locality, (Wilson 1916; Cockfield and Bell 1944; Bell 1956; Wheeler 1961). A "Jura-Cretaceous" age had been assigned to this unit by Cairnes (1912). More recently, Lowey (1983) considered Albian siliciclastic rocks near the Indian River in west-central Yukon, to be coeval with the upper part of the Tantalus Formation.

Internal stratigraphy of the Tantalus Formation in the Wheaton District is not well known. A section measured by J.G. Fyles in the Dugdale Belt (Wheeler 1961), suggests that thick conglomerate is at or near the base of the stratigraphy while another, thinner conglomerate occurs higher up.

A lower contact of the Tantalus Formation with Laberge Group is exposed near Mt. Bush, where a conformable relationship is presumed, as reported in the Carmacks map-area by Bostock (1936). Wheeler (1961) notes that the contact appears to be either faulted or unconformable.

At Mt. Bell, Tantalus conglomerate unconformably overlies schist of the Yukon Crystalline Terrane. Tantalus rocks in a small exposure on easternmost Mt. Reid are faulted against skarnified marbles. A thin coal seam within quartz pebble conglomerate is overlain by Skukum Group Volcanics west of Chieftain Hill. An upper contact of Tantalus Formation was found on western Carbon Hill where Cretaceous fragmental volcanic rocks (Kv) of either Mt. Nansen or Carmacks affiliation overlie and cross-cut conglomerate.

Paleoflow indicators have suggested multiple source areas for the Tantalus Formation (Lowey pers. comm. 1987). Wheeler and McFeely (1987) indicate a source from the east.

Maturity and high percentage of chert clasts suggest a tectonically stable source area and a drastic change in provenance from that of the Laberge Group. The source changed from igneous to chert or silicious metasediments during the early Late Jurassic. Allochthonous, overthrusted siliciclastic rocks of the Cache Creek Group in the Atlin Terrane to the east were exposed, eroded (Monger

1975), and probably acted as the source for post early Late Jurassic deposition of the Tantalus Formation.

CRETACEOUS VOLCANICS (Kv)

Felsic and intermediate volcanic rocks of late Cretaceous age occur throughout the map-area. These volcanics are considered to be equivalent to the Mount Nansen Group, but the volcanic stratigraphy does not correlate well from one area to another suggesting multiple volcanic episodes.

Outcrops are preserved as downfaulted blocks in the Coast Plutonic Complex and unconformably overlying Laberge and Lewes River Groups. The best exposures occur west of the Ibex River at latitude 60° 25', on Lakeview Mountain and Goat Mountain, and between Perkins Peak and Pugh Peak, all in Alligator Lake (105D/6) map-area. Small outliers occur at Carbon Hill, Upper Fenwick Creek and north of Mount McAuley within Fenwick Creek (105D/3) map-area.

A 1000 foot section on the west side of the Ibex River consists of interlayered andesites porphyry flows and fragmental units and dark grey siliceous rhyolite lithic tuff. Both the felsic and intermediate lithic tuffs contain volcanic and granitic fragments. Lithic fragments average 5 cm across.

Map unit (Eva) on the north side of the Mount Skukum Volcanic Complex resembles the volcanic rocks west of the Ibex River and may be correlative.

On Lakeview Mountain and Goat Mountain the Cretaceous volcanic rocks consist of mixed volcanic and sedimentary rocks. On the east side of Lakeview Mountain, immature dark grey greywacke and siltstone interbedded with andesite porphyry and immature matrix supported heterolithic conglomerate. Outcrops are generally poor and the stratigraphy is complex and disrupted by faulting. At the centre of Lakeview Mountain, thick 2-5 m massive light pink rhyolite porphyry flows outcrop over a 100 to 200 m vertical interval on the west side of a steep north-south trending valley. The rhyolites are overlain by conglomerate containing large 50 cm boulders of porphyritic andesite and leucogranite interbedded with thin rhyolite flows and crosscut by numerous thin flaggy rhyolite dykes.

Between Perkins Peak and Pugh Peak andesite and felsic fragmental rocks are interbedded with minor bedded sedimentary rocks.

Outcrops on Carbon Hill are primarily rhyolite lithic and lapilli tuff and porphyritic andesite.

TERTIARY VOLCANIC ROCKS (Esk)

Early Tertiary Skukum Group is part of the Sloko Volcanic province of northern British Columbia and Southern Yukon (Souther 1977). In southwestern Yukon, the Skukum Group consist of the Bennett Lake Cauldron Subsidence Complex (Lambert 1974) and the Mount Skukum Volcanic Complex (Pride 1985a, 1985b). The reader is referred to these authors for detailed descriptions of each complex. The Skukum Group was first described by Cairnes (1912) who called them the Wheaton River Volcanics, later named the Skukum Group by Wheeler (1961).

This report briefly reviews the geology of the Bennett and Skukum Complexes and presents significant new data or interpretations.

BENNETT LAKE CAULDRON SUBSIDENCE COMPLEX

Bennett Lake Complex is an Eocene, 30 by 19 km volcanic complex composed of two cauldrons. The first is nested as a fault bounded block within the second which is defined by a series of arcuate step faults. Concentric and radial fracture systems, a central dome and a ring dyke system are well-developed.

Eruptive centers were located along ring fractures of both cauldrons and contributed to the bulk of cauldron fill. Each cauldron represents a resurgent cycle of cataclysmic eruption of pyroclastic materials. A change from acid to mafic volcanism during each eruptive cycle represents the tapping of a vertically zoned magma chamber (Lambert 1974).

Rhyolite to dacite ash-flow tuffs and breccias with lesser rhyolite, dacite, and andesite flows comprise the bulk of caldera fill. Epiclastic wacke and siltstone form interbeds. Avalanching debris from cauldron walls form granite boulder conglomerate which is intercalated with the volcanics and sediments.

Lambert (1974) defined seven formations and two informal units. Six of these formations are fill for the larger cauldron.

MOUNT SKUKUM VOLCANIC COMPLEX

Stratigraphy of the Mount Skukum Volcanic Complex has been reinterpreted and is divided into seven volcanic cycles (Figure 4), following that described by Pride (1985a) with the some important revisions. Cycle 1, Map unit Eva consists of felsic lithic tuffs and flows located on the north side of the Complex. The felsic flows and tuffs commonly contain rounded to angular volcanic and granitic fragments and are lithologically similar to map unit Kv west of the Ibex River. The felsic volcanics (Eva) are unconformably overlain by epiclastics of Formation 1 of Pride (1985a), and represent an earlier felsic volcanic cycle. Cycles 5 and 6 are a thick pile of altered felsic lithic and lapilli tuffs and breccias which filled a depression on the northeast side of the complex and are considered the youngest volcanic event. These felsic units are the only rocks not cut extensively by the late rhyolite dikes, and are younger than Formation 5 (Pride 1985a) which is cut by many rhyolite dykes.

Four interpreted vent areas are shown on (Figure 4). These are: 1. The southeast corner of the main cirque at Mount Skukum, a interpreted source area of map units Erf and Ewt, rhyolite flows and welded tuff; 2. Rhyolite Creek, where a number of vertical dyke breccias crosscuts and disrupts volcanic Cycles 2 and 3, and is an interpreted linear vent associated with map unit Elt, Vents 1 and 2 are the interpreted source of the felsic units on the northeast side of the complex; 3. Summit Pass area is a third possible vent, recognized by disrupted bedding attitudes, and shattered and brecciated granodiorite; 4. Mount Skukum is the inferred vent area for unit Eab, andesite monolithic breccia.

Strong northeast structural trends in the Skukum Complex are probably caused by doming related to the emplacement of plutons that fed large ash flow eruptions and subsequent collapse of the volcanic edifice. The doming and collapse has resulted in the development of an apical graben structure with a strong northeast trend. Emplacement of the central plug (Cycle 7) caused doming and disruption of the surrounding volcanic stratigraphy.

Age and Interpretation

Rhyolite dykes and plugs cross-cut the volcanic rocks of both the Skukum and Bennett Lake complexes. They are considered to be the latest phase of the Eocene volcanism.

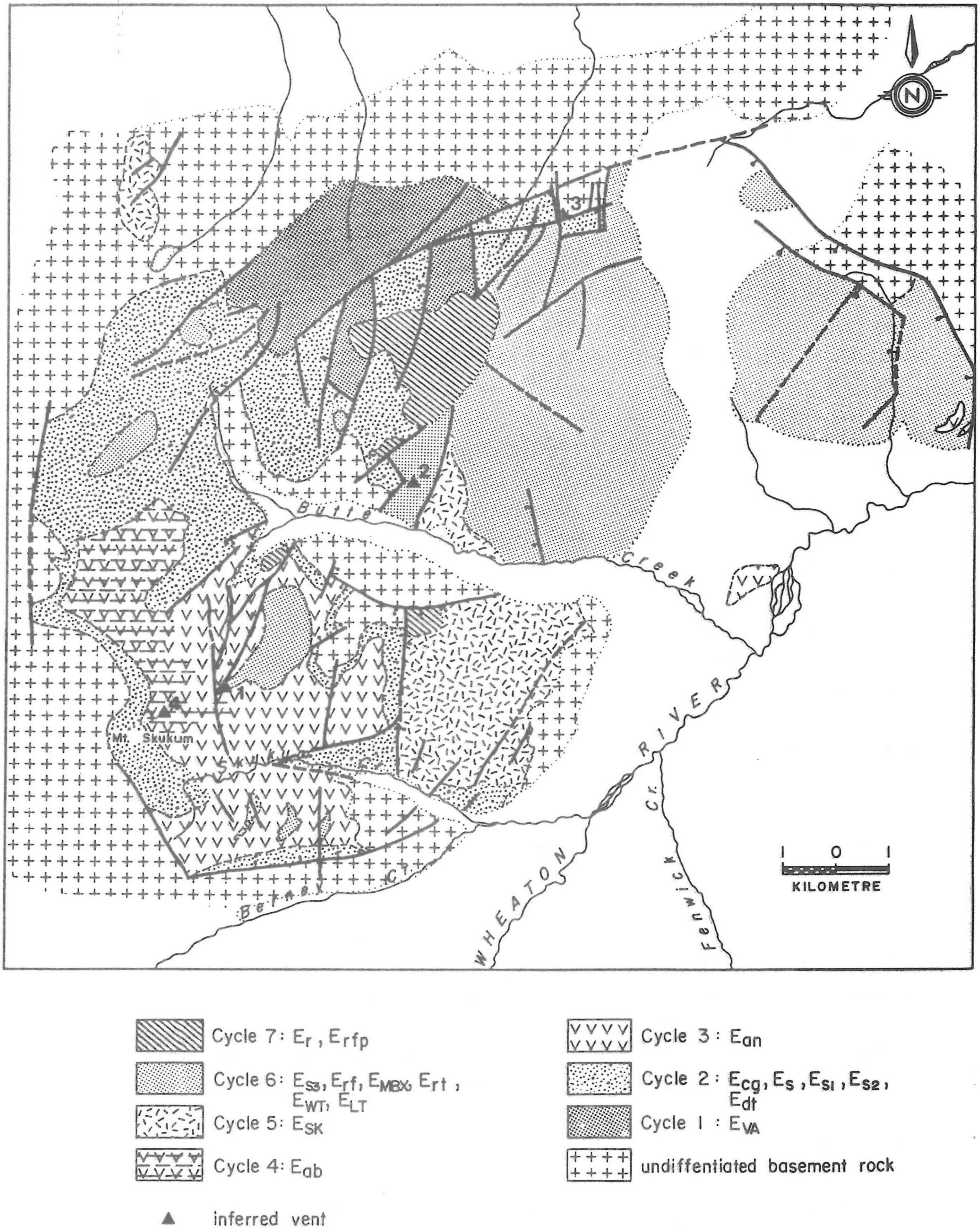

Figure 4 **Simplified geology of the Mount Skukum Complex, showing major volcanic cycles, structure, and inferred vent areas.**

An Rb/Sr date of 53.3+/-1.1 Ma (Pride and Clark 1985) on high level rhyolite plugs is considered to be the best date available and represents both the dykes and the plugs. It also represents the oldest date available, and suggests that younger K-Ar dates from the Eocene complexes (e.g. 50-51+/-3 Ma, Lambert 1974) may represent either a low closure temperature or argon loss and isotopic resetting.

Dykes and plugs were emplaced at high levels along either fractures in the volcanic edifice or along fissures or weaknesses created by regional tectonic forces. Rhyolite plugs sampled by Smith (1982) represent a highly differentiated magma which was emplaced by resurgent pressure related to cauldron subsidence of the Bennett and Skukum complexes.

Bennett Lake Cauldron Subsidence Complex has a well developed concentric ring dyke system; has relatively more flat lying volcanic units; is structurally less disrupted, contains a much greater volume of avalanche debris material and a high volume of non volcanic fragments, and has virtually no andesite flows.

Mount Skukum Volcanic Complex has a thick (> 750 m) andesitic pile, is strongly dissected by northeast trending faults and overall has much stronger gossans developed throughout. A system of satellite rhyolite porphyry plugs and a radial dyke system are developed instead of a ring dyke system.

A paucity of mineral occurrences in the Bennett Complex compared with the Skukum Complex may be related to the level of exploration activity, or to the erosional level of the Bennett Complex.

RHYOLITE DYKES AND PLUGS (Er, Erfp)

Rhyolite dykes, swarms, laccoliths, domes or plugs related to Skukum-age volcanism (Smith 1982; Pride and Clark 1985) intrude most rocks in the map-area. Northeast-trends (20-40^{o}) are predominant.

Felsic dykes and plugs are pale to buff, orange, rusty-orange, white-orange, mauve or tan, aphanitic to fine-grained, and occasionally contain sparse feldspar phenocrysts. Distinct weathering patterns include, flaggy partings parallel to the flow layering and concentric rusty liesegang bands.

Near Hodnett Lakes and east of Johnson Hill swarms of parallel dykes up to 5 km long, cut the granitic country rock. They are contained along faults or local fractures and have brecciated margins. This is common in dykes of the Skukum Complex.

Siliceous, saccharoidal textured, rusty-orange weathering dykes were mapped on Mt Reid adjacent to the Berney Creek Fault, and on Mt. Stevens. Trachytic to dacitic mauve to tan coloured dykes, containing 2-10% feldspar phenocrysts, rare granitic clasts, and vugs lined with flourite are common on Johnson Hill and near the Skukum Creek deposit. They resemble dykes near Jones Creek described by Lambert (1974). McDonald (1986) considers them younger than the Skukum rhyolite dykes. A number of dykes in the map are are composite with dark andesitic margins up to 1 m thick grading into thick central rhyolite porphyry.

Excluding the Bennett Lake Complex, approximately eight irregularly-shaped felsic plugs between 1 and 6 km^2 outcrop in the map-area (Figure 5). Two plugs west of Alligator Lake and a third near Fenwick Creek were previously unmapped. The remaining five have been examined by Smith (1982).

Rhyolite plugs and domes, like the dykes, have steep sided contacts with flow banded or autobrecciated margins. Textures vary from glassy, aphanitic, fine-grained to porphyritic. Phenocrysts include plagioclase or potassium feldspar up to 8 mm across with occasional smaller quartz-eyes and lesser biotite or hornblende. The presence of euhedral quartz-eyes, flow banding, miarolitic cavities, fluorite and spherulites suggests emplacement at high levels.

Towards the centre of some plugs, phenocrysts become crowded and quartz percentage increases. Quartz, calcite,and fluorite stockworks are found in the Folle, Carbon and Central plugs.

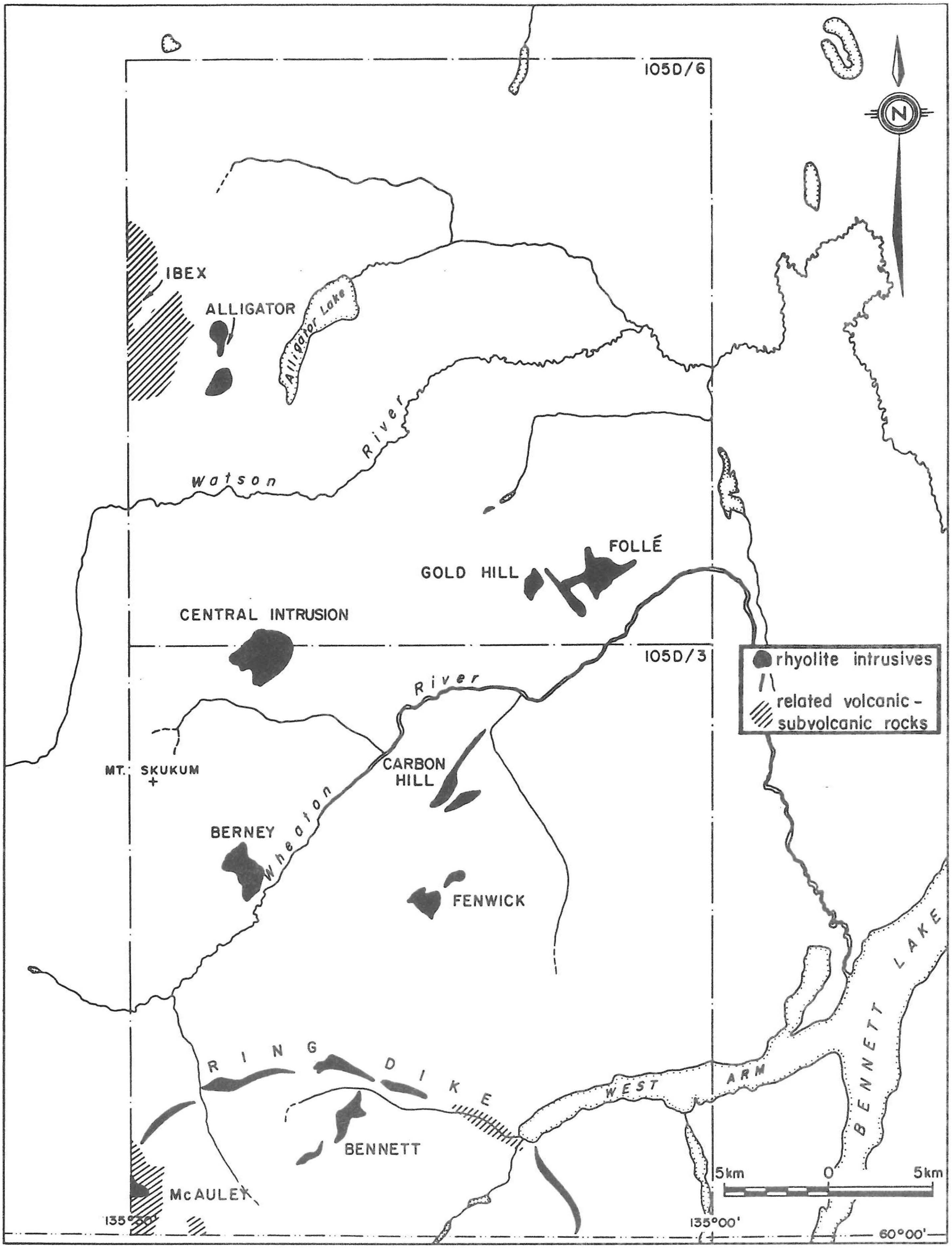

Figure 5. Location of major Eocene rhyolite intrusions and associated sub-volcanic rocks.

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PETROCHEMISTRY OF RHYOLITES

Whole-rock geochemical analyses of rhyolite dykes and plugs in the Wheaton and Bennett Lake areas are found in Lambert (1974), Smith (1982) and McDonald (1986). Geochemical classification produces a single cluster in the rhyolite field (Figure 6) with a few samples in the trachyte field. Most samples are saturated or oversaturated in silica.

Major and minor element oxide Harker diagrams for Skukum and Bennett Lake intrusions compiled from the fore mentioned works show two elliptical clusters (A+B) with negative linear trends (Figure 7). Al_2O_3, CaO, Fe_2O_3 and TiO_2 decreases with increases in SiO_2 content while plots against Na_2O and K_2O show some scatter. Smith (1982) suggests this represents a highly differentiated magma expected with a cogenetic suite of igneous rocks.

Most samples from the Skukum rhyolite plugs, Bennett Lake associated dykes and Skukum Main Cirque rhyolite dykes plot in Cluster A. All four Skukum Ore Zone rhyolite dyke samples along with two Skukum rhyolite plug samples have higher minor element oxide percentages in Cluster B. The Bennett Ring Dyke rocks generally plot between the two clusters. The Bennett Lake associated dykes form their own cluster within Cluster A.

Two chemically distinct suites of rhyolite are defined. Cluster A is high silica rhyolite; Cluster B comprises low silica rhyolite that crosses into the Trachyte field .

Low silica chemistry of the Ore Zone dykes begs the suggestion that their unique chemistry may have some relationship to the formation of gold ore. If so, the two Skukum rhyolite plugs (or their associated dykes) which are chemically similar to the Ore Zone dykes would provide excellent exploration targets. Further, whole-rock geochemistry of rhyolite dykes and plugs could prove to be a useful exploration tool.

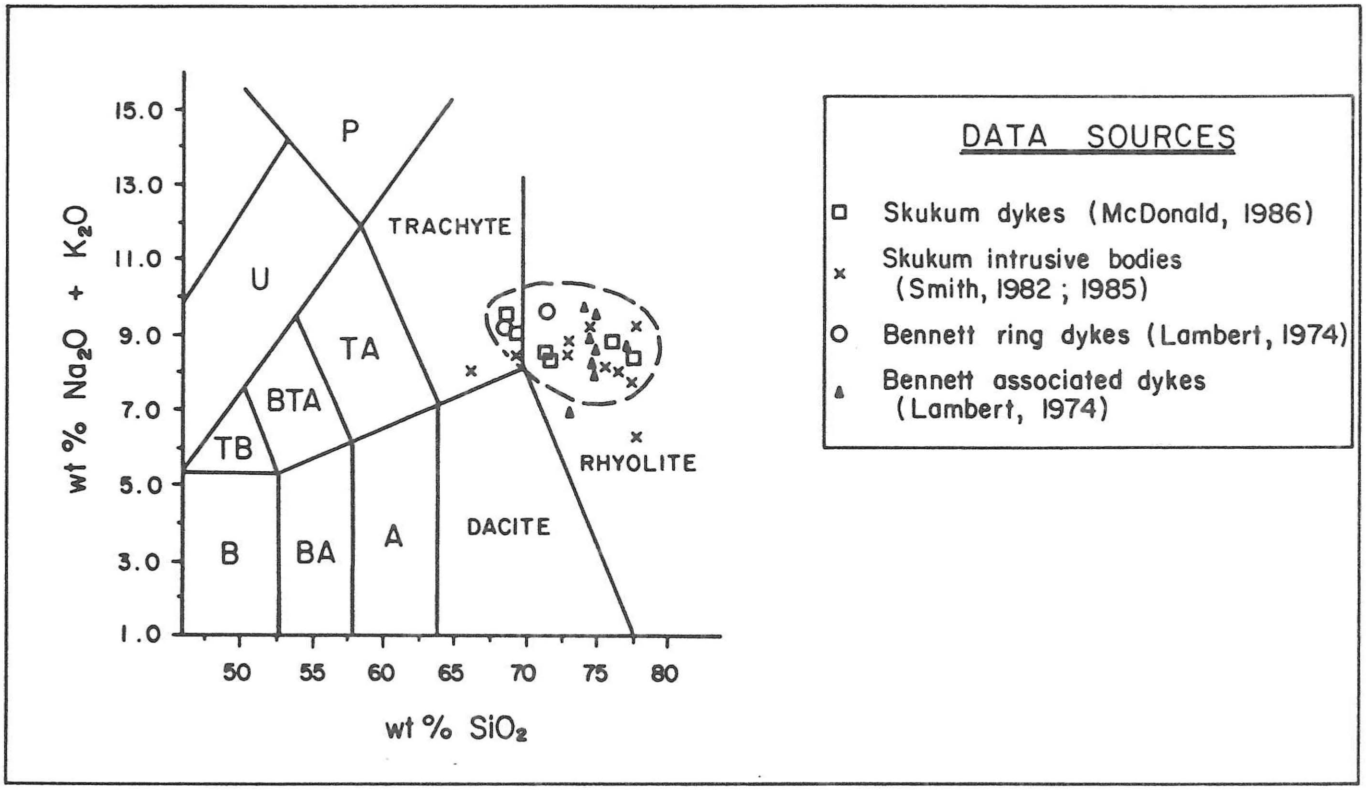

Figure 6. Plot of $Na_2O + K_2O$ versus SiO_2 after LeBas (1986), for Skukum and Bennett Lake dykes and plugs.

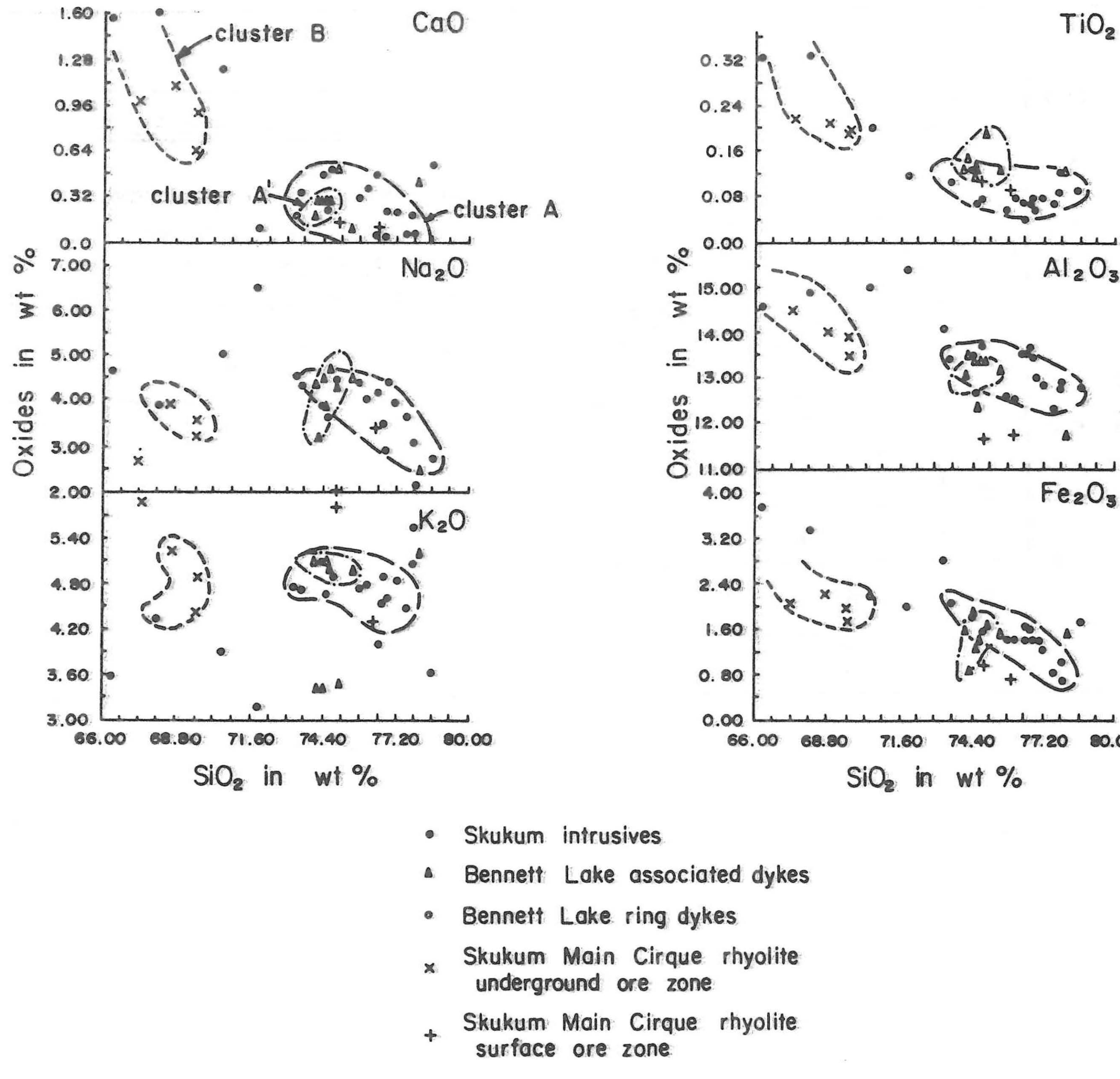

Figure 7 Major and minor element oxide Harker diagrams for rhyolite samples from Skukum and Bennett Lake Complexes

FOLIATED GRANODIORITE (Pgdn)

Foliated Granodiorite is found as fault bounded blocks or pendants in younger intrusions at Alligator Lake, Summit Creek Pass, south-east of Johnson Hill, and west of Boudette Creek. These are the oldest intrusive rocks in the map-area and are presumed, on the basis of field descriptions, to be equivalent to the Triassic Klotassin Granodiorite suite (Tempelman-Kluit 1976).

Massive, dark-grey, blocky outcrops are associated with Yukon Crystalline Terrane metamorphic rocks. They are medium- to coarse-grained, equigranular, well-foliated, hornblende, or hornblende-biotite granodiorite, quartz diorite and hornblende-feldspar gneiss. Foliation generally strikes northerly and dip steeply.

Age and Interpretation

This unit has not been dated and cannot be assigned to the Klotassin suite with confidence. If cross-cutting dykes in the foliated granodiorite (Pgdn) originated from the Late Triassic Megacrystic Granite (Trgd), (220+/- 5 ma, See Appendix D), then the Foliated Granodiorite must have been intruded and foliated before 220 Ma.

MEGACRYSTIC FELDSPAR GRANITE-GRANODIORITE (Trgd)

This unit, the most extensive intrusion in the map-area, forms a large batholith up to 15 km wide, extending from the West Arm of Bennett Lake, northwest to for 50 km past Alligator Lake.

The western contact is the Mt. McNeil Granite which may represent a transitional border phase. The eastern contact is the "Tally-Ho Shear Zone." In the southern portion of the map-area, and elsewhere unit mKgd has an unknown relationship.

This unit forms dark-grey to black, lichen covered, blocky outcrops, and is easily recognized by the presence of large, tabular, pink, potash feldspar phenocrysts up to 3 cm in length. They vary from a creamy white to pale pink to a fleshy brown colour and contain plagioclase or hornblende poikiloblasts. The rock is composed of approximately 33% potassium feldspar, 32% plagioclase feldspar, 24% quartz and 11% lath shaped euhedral hornblende with minor biotite, chlorite and zircon.

Most outcrops are fresh and massive, but megacrysts tend to be roughly oriented to suggest foliation. Exposures west of Alligator Lake are foliated, if not sheared.

Thin bifurcating dykes of pink, coarse-grained, orthoclase crystals and quartz, probably derived from the Megacrystic Granite (Trgd), cut Foliated Granodiorite 4 km south of Mt. Bell. East west trending mafic dyke swarms are common in this unit.

Age and Interpretation

A U/Pb analysis of two populations of zircons by H. Baadsgaard of the University of Alberta yielded a Late Triassic date of 220+/-5 Ma, (See, Appendix D). A third population of highly contaminated zircons provided a 207Pb/206Pb date of approximately 905 Ma which suggests contamination or derivation from Precambrian material. Initial 87Sr/86Sr ratios between 0.7060 and 0.7071 (LeCouteur and Tempelman-Kluit 1976) combined with Precambrian zircon contamination, suggests that Triassic plutons were emplacement through Precambrian continental crust.

ULTRAMAFIC ROCKS (Trub, Trb)

Ultramafic rocks form elongate masses and as sheared and faulted bodies with poorly defined contacts in the "Tally-Ho Shear Zone" between Tally-Ho Mountain and Stony Mountain. Pyroxenite and sheared equivalents; coarse grained gabbro; and enstatite-bearing peridotite(?) have been identified.

Pyroxenite outcrops on the centre and south side of Tally-Ho Mountain. It is slightly resistant, black, dark-grey to brown weathering, medium-grained masses of fresh, dark grey-green, magnetite and diopside bearing pyroxenite. Locally the pyroxenite has been sheared, serpentinized, and silicified. In several areas, bands of chrysotile fibres are found in the altered ultramafic.

Coarse-grained, foliated, hornblende-plagioclase leuco-gabbro is on the top and southern slope of Dickson Hill with smaller exposures on southwestern Tally-Ho Mountain. Hornblende and plagioclase crystals are up to 3 cm in length. Outcrops contain light and dark phases reflecting variations in the hornblende:plagioclase ratio. More mafic phases contain minor chalcopyrite. Foliation is moderate.

Age and Interpretation

The age of these ultramafic rocks is unknown. They were mapped as upper Paleozoic by Cairnes (1912), Cretaceous by Wheeler (1961) and Carboniferous-Permian by Morrison (1979). Fyles (1950) observed similar ultramafic rocks west of Upper Laberge intruding Laberge Group arkose, suggesting that the ultramafic bodies are younger than Middle Jurassic.

Ultramafic rocks occur only in Lewes River volcanic rocks along the "Tally-Ho Shear Zone," and are probably Triassic or younger. A close temporal and spatial relationship between upper Triassic volcanics and ultramafic intrusions has been documented in the Stuhinni, Takla (Souther 1977) and Nicola (Mortimer 1987) volcanics of B.C.

A 30 kg sample of the coarse-grained leuco-gabbro yielded insufficient zircons for U/Pb isotopic age dating.

INTRUSION BRECCIA (Trbx ?)

A long resistant ridge of highly siliceous fragmental rocks occurs southeast of Alligator Lake. The map unit appears to trend obliquely northeast toward the "Tally-Ho Shear Zone". Fragments contained in this unit are commonly rounded to sub-angular, and include rare granitic lithologies and what appears to be white fine grained saccharoidal aplite material. The matrix is very siliceous.

FRIDAY CREEK DIORITE (Jdi)

Grey to very light grey diorite to Quartz diorite containing acicular hornblende intrudes mafic volcanics on the Friday Creek plateau. In recessive gullies, outcrops are commonly very crumbly weathering. This unit may be equivalent to JKgd.

FENWICK CREEK GRANODIORITE (JKdi)

Dark-grey, blocky weathering, fine- to medium-grained, fresh, unfoliated, acicular hornblende diorite and quartz diorite form a large pluton in the southern part of the map-area. Lambert (1974) mapped this as Unit 2A and also recognized a biotite-rich granodioritic phase west of Boudette Creek. This unit is easily recognized by the needle-like hornblende which rarely exceeds 4 mm in length.

Notable are large volumes of finer-grained blocky xenoliths contained in this unit. Several phases of small (<0.5 m) granitic dikes cross-cut the xenoliths.

Several bodies of Leucocratic Granite (LKlg) up to 1 km^2 are fully contained in the diorite. Relationships between the two units are uncertain. Faulted or intrusive contacts were not recognized. (This unit is described later in this report.)

Age and Interpretation

This unit is intruded by the Cretaceous-Tertiary(?) Mt. McNeil granite and is probably mid-Cretaceous or older. The fresh and unfoliated nature of the rock, combined with its affiliation with the leucocratic granite (LKlg), support this age. Lambert (1974) felt that this was the oldest granite in the Bennett Lake area.

Morrison et al. (1979) obtained a hornblende K/Ar date of 113+/-4 Ma from foliated hornblende granodiorite south of Mount Ward which has been mapped as JKdi. Unfortunately an Rb-Sr isochron could not be achieved for three specimens from the same body and the above age is considered to have been reset.

WHEATON VALLEY GRANODIORITE (JKgd)

Wheaton Valley Granodiorite, is the largest intrusion east of the "Tally-Ho Shear Zone", and is elongated parallel to it.

Granodiorite is light to dark grey weathering and forms steep, blocky exposures and flat, felsenmeer-covered plateaus. Compositions vary between granodiorite and quartz diorite with hornblende as the primary mafic constituent. The hornblende varies between small, fresh, acicular crystals and large, lath-like crystals altered to chlorite. In places this unit resembles unit JKdi or when altered, unit mKgd. Most exposures show some degree of saussuritization.

Unit JKgd intrudes Laberge Group on Idaho Hill, Perkins Peak and Red Ridge. Unit KTal is assumed to be latest Cretaceous in age and intrudes Jkgd west of Bush Mountain. Unit JKgd is therefore younger than Middle Jurassic, and older than latest Cretaceous.

BOUDETTE CREEK QUARTZ MONZONITE (Kqm)

Exposed in the southeast corner of the map-area at the headwaters of Boudette Creek and into British Columbia, the rocks are dark grey weathering, massive, medium- to coarse-grained, hornblende-biotite quartz monzonite grading to granodiorite. Brecciation and shearing was observed near Mt. McAuley, possibly as a result of Bennett Lake Complex volcanic activity.

It contains 28% potassium feldspar, 32% plagioclase feldspar, 30% quartz and 10% hornblende (+/- biotite). Samples collected during the program contain 5-15 % chlorite with some alteration of feldspars. Most samples collected by Lambert (1974) plot in the quartz monzonite field.

Age and Interpretation

Dikes of the ring dike and smokey quartz-eye granite (Tgr) cross-cut this unit. A biotite K/Ar age of 57 +/- 3 Ma was reported by Lambert (1974) and recalculated as 59 +/-3 Ma by Morrison et al. (1979). Lowdon et al. (1963) reported 65 to 68 Ma ages from similar rocks 15 km south of the Bennett Lake Complex.

MT. ANDERSON GRANODIORITE (mKgr)

Mt. Anderson Granodiorite includes two batholiths west of the "Tally-Ho Shear Zone". One is on the south side of Mt. Anderson and covers most of the drainage of upper Becker Creek, while the other extends from near Gold Hill to north of Alligator Lake. This unit intrudes the Megacrystic granite (Trgd) and is faulted against the "Tally-Ho Shear Zone" north of the Wheaton River.

Outcrops are white to light-grey, massive, blocky weathering and form flat, overburden-covered upland plateaus. This unit is a medium- to coarse-grained, hornblende- or biotite-phyric granodiorite. Hornblende crystals are up to 2 cm long and biotite forms excellent black to silver hexagonal books. Plagioclase crystals up to 1 cm across form 40% of the rock, hornblende and biotite up to 25%, interstitial quartz from 20 to 30%, and potassium feldspar up to 30%.

Typically the rock is fresh, although some samples have a weak foliation and mafic minerals are locally altered to chlorite. Local shearing and alteration gives outcrops a dark green hue that resembles mafic volcanic rocks from a distance.

This unit is like unaltered outcrops of the Wheaton Valley Granodiorite and is often indistinguishable.

Age and Interpretation

Mt. Anderson Granodiorite intrudes Megacrystic Granite (Trgd). Three samples of the Mt. Anderson pluton yielded a zircon U/Pb age of 119+/-5 Ma, (See, Appendix D). This date is similar to, although slightly older than, a cluster of mid-Cretaceous K/Ar dates ranging between 105 and 116 Ma from the Whitehorse pluton (Morrison et al. 1979).

GRANODIORITE (Kgd)

Located primarily along the southern margin of the Skukum Complex, Unit Kgd forms steep, resistant cliffs and large blocky scree slopes. It contains large pendants of Yukon Crystalline Terrane metamorphic rocks and is cut by many faults associated with of the Skukum Volcanic Complex. Fresh exposures are easily identified by the abundance of euhedral hornblende phenocrysts which often reach 1.5 cm in length and compose up to 20% of the rock. Where the hornblende is less abundant, this unit resembles unit JKdi and the Wheaton Valley granodiorite (JKgd).

Composition ranges between granodiorite, quartz-diorite and gabbro depending on the hornblende content.

Age and Interpretation

Small isolated intrusions of this unit have been seen in unit JKdi. Therefore Kgd is younger than the arbitrary Jurassic-Cretaceous age assigned to unit JKdi.

FOLLE MOUNTAIN GRANITE (Kgr)

Folle Mountain Granite forms a small plug on the south-facing slope of Folle Mountain below 4500' (1480 m) and in a roadcut at the base of the mountain.

Pale pink weathering granite is , medium- to coarse-grained and quartz-rich. Equal parts of quartz and orthoclase feldspar with 8% biotite form subhedral crystals up to 15 mm in length. Finer-grained phases contain significantly less quartz.

Age of the Folle Mountain Granite is unknown but is presumed to be Late Cretaceous and related to either the Mt. McNeil granite (KTgr) or the pink quartz monzonite (KTqm). It is intruded by Eocene Skukum rhyolite and quartz feldspar porphyry dykes.

LEUCOCRATIC GRANITE (LKlg)

Four bodies of Leucocratic Granite form a belt extending from the West Arm of Bennett Lake to the headwaters of Berney Creek. Each body intrudes Unit JKdi on its southern and western contact. Other contacts are either faulted or intrusive.

Exposures are distinctively white to buff weathering and are resistant and blocky. The rock is a white, medium-grained, saccharoidal textured, quartz-rich granite, containing 50% clear to pale blue interstitial quartz, 45% combined plagioclase and white orthoclase feldspars and not more than 5% light amber coloured biotite.

It is spatially associated with Unit JKdi and forms small undefined bodies up to 1 km^2 in it. Contacts with Unit JKdi are undefined.

Age and Interpretation

Leucocratic Granite appears to intrude JKdi and the Mt. McNeil Granite, but is intruded by the Pink Quartz Monzonite (KTqm). No precise ages are known for any of these rock units and a Late Cretaceous or Early Tertiary age is assumed.

MOUNT MCNEIL GRANITE (KTgr)

Mt. McNeil Granite is a 25 km long, cigar-shaped batholith extending from Munroe Lake at the B.C.-Yukon border to Berney Creek. A fault bounded block occurs on the western flank of Carbon Hill. Light rusty-orange weathering, massive, medium-grained, biotite granite is easily recognized in hand specimen by the distinctive aggregates of pink potassium feldspar. It is composed of 33%

quartz, 40% potassium feldspar, 22% plagioclase feldspar and 5% combined mafic minerals.

Most of the southwestern contact of the intrusion is faulted against Unit JKdi and the Leucocratic Granite. This relationship is well exposed in a gully on Mt. McNeil where several mafic dikes parallel the fault. Prominent air photo linears also defined the fault.

Age and Interpretation

Relationships with other units give few indications of a relative age, although the Mt. McNiel granite appears to intrude units Kgdmx, JKdi, and possibly LKlg.

The batholith forms the southwestern margin of the Megacrystic Granite which is a potassium feldspar porphyry granite. The Mt. McNeil Granite may be a finer-grained biotite-rich marginal phase of the Megacrystic Granite. If so it would be Late Triassic .

PERKINS PEAK PLUG (KTal)

Perkins Peak Plug is a small alaskite body intruding into Cretaceous Volcanics and the Wheaton Valley Hornblende Granodiorite. It was called the Klusha Intrusions by Cairnes (1912), and he considered it one of the youngest intrusions in the area.

The plug has a coarse grained equigranular texture and is composed of approximately equal amounts of quartz and feldspars with only minor mafic minerals. Potassium feldspar is more abundant than plagioclase. The Perkins Peak Plug has a hornblende and biotite rich border phase. Mafic minerals increase from less than 1% to approximately 10%, quartz decreases and plagioclase is the major feldspar.

Age and Interpretation

Perkins Peak Plug cuts Cretaceous Volcanics and is considered to be of Late Cretaceous to Tertiary age.

PINK QUARTZ MONZONITE (KTqm)

Pink Quartz Monzonite forms two bodies in the southern portion of map-sheet 105 D/3. A small plug (3 km^2) at the headwaters of Fenwick Creek appears to intrude the Leucocratic Granite (LKlg) and JKdi although its northern contact is probably a fault. The other plug is near the head of the West Arm of Bennett Lake between Unit JKdi and Bennett Lake Complex volcanic rocks.

Both plugs consist of light orange weathering, recessive, well-jointed, non-foliated, medium-grained, miarolitic pink quartz monzonite, containing approximately 50% pale pink potassium feldspar, 20% plagioclase feldspar, 25% smokey grey quartz and 5% fine-grained hornblende. Fluorite is a minor constituent. The pink orthoclase may result from preferential potassium metasomatism of the larger, tabular plagioclase feldspars. Quartz forms subhedral eyes of varying size.

Age and Interpretation

Field relationships suggest that the Pink Quartz Monzonite is younger than the Leucocratic Granite, older than the Bennett Lake Complex and therefore Late Cretaceous or Paleocene in age.

This Pink Quartz Monzonite is not equivalent to the pink quartz monzonite described by Tempelman-Kluit (1974) and dated at 165 Ma by Tempelman-Kluit and Wanless (1975). It is equivalent to pink granophyric quartz monzonite described by Wheeler (1961) and biotite quartz monzonite mapped by Morrison (1979). Wheeler suggested it was Tertiary or older. Morrison et al. (1979) obtained biotite K/Ar ages of 75.3 +/- 2.8 Ma and 64.3+/- 2.2 Ma from the Mt. Lorne and Carcross plutons respectively.

Subhedral quartz eyes, miarolitic cavities and fluorite suggest that the pluton was emplaced at a high-level.

IBEX ALASKITE (Tal)

Ibex Alaskite is a high level discordant pluton of yet unknown dimensions that outcrops on the western border of the map-sheet 5 km west of Alligator Lake at the head of the Ibex River. The intrusion is light tan to buff, blocky-weathering, massive, fine- to medium-grained, miarolitic, biotite alaskite. It contains approximately 35% smokey dipyramidal quartz phenocrysts up to 4 mm long, 35% tabular euhedral plagioclase, 25% fine-grained light coloured matrix and 5% combined black biotite and thin acicular, chloritized hornblende crystals. Miarolitic cavities up to 0.5 cm across are common, tourmaline was noted in some miarolitic cavities.

Its granular texture has the appearance of a crowded, medium-grained porphyry. Dark rusty-brown spots on weathered surfaces indicate that disseminated iron minerals were present.

Unit Eqfp (quartz-eye feldspar porphyry) is a border phase of the Ibex Alaskite, and forms apophysis into adjacent felsic volcanics (Kv) thought to be of late Cretaceous or early Tertiary age.

Age and Interpretation

Ibex Alaskite has been dated radiometrically using zircon U-Pb data and returned a maximum age of 58+/-1 Ma, latest Paleocene-Early Eocene, (See, Appendix D).

This unit is therefore part of the regionally important suite of high level Eocene intrusions which occur along the eastern margin of the Coast Plutonic Complex. They are known as the Nisling Range Alaskite (Tempelman-Kluit 1974) and have been dated previously at 54 Ma (Tempelman-Kluit and Wanless 1975).

Originally thought to be coeval with explosive volcanism of the Mt. Nansen Group (Tempelman-Kluit 1976), the Nisling Range Alaskite has consistently yielded Eocene K-Ar ages between 50 and 60 Ma. A temporal relationship with the volcanic rocks of the Skukum and Sloko Groups is indicated and not the Mt. Nansen or Carmacks Groups as has previously been proposed.

SMOKEY QUARTZ-EYE GRANITE (Tgr)

Two bodies of Smokey Quartz-eye Granite occur near the Bennett Lake Complex ring dyke. At the head of the West Arm of Bennett Lake, a large 5 km long, dyke-like intrusion mimics the ring dyke fracture system, and intrudes JKdi along its northern contact but has a steep northerly dipping fault along its southern contact. Another body, west of Boudette Creek, has a complex series of faults along its eastern contact with HCsn, JKdi and Kqm, and several small dykes intruding Unit Kqm.

Smokey Quartz-eye Granite is easily recognized in the field by its distinctive orange-brown weathering surfaces and widely spaced joint sets. The rock is composed of 50% large, smokey subhedral quartz, 40% friable, pale potassium feldspar and 10% biotite (vermiculite?). The coarse grain size and the large percentage of quartz and large biotite crystals allow it to disintegrate easily into a coarse grit. Lambert (1974) mentions miarolitic cavities lined with crystals of quartz and fluorite.

Age and Interpretation

Dykes of Smokey Quartz-eye Granite intrude Kqm and are intruded by dykes homotaxial with the ring dyke. Therefore it is older than the 51 Ma ring dike but younger than the 59 Ma(?) Kqm.

Smokey quartz-eyes and miarolitic cavities also suggests a genetic affiliation with the finer-grained Ibex Alaskite.

SMOKEY QUARTZ FELDSPAR PORPHYRY (Eqfp)

South of the headwaters of the Ibex River on the western side of the map-area is a body of Smokey Quartz Feldspar Porphyry which probably represents a border phase of the Ibex Alaskite.

Outcrops are buff to orange weathering and are easily identified in the field. The rock is a coarse, quartz-feldspar, granite porphyry and contains up to 60% phenocrysts. Quartz forms smokey dark-grey, euhedral to subhedral, dipyramidal eyes up to 7 mm long which occupy approximately 15% of the rock. Well-developed, tabular, euhedral pale orange to white, sanadine and plagioclase phenocrysts are typically slightly larger than the quartz phenocrysts and compose an additional 35% of the rock volume. Small hornblende phenocrysts typically altered to chlorite and biotite is a rare constituent. The matrix is tan-orange weathering, light green to grey, aphanitic to fine-grained.

Smokey Quartz Feldspar Porphyry forms the ring dyke around the Bennett Lake Complex and discontinuous dykes which are described earlier in this report.

Age and Interpretation

Association with the Ibex Alaskite and the Bennett Lake Complex suggest that the Smokey Quartz Feldspar Porphyry is Eocene age and was emplaced as a result of resurgent volcanic activity. Tempelman-Kluit (1974) recognized an association between a similar unit (Tfp) and the Nisling Range Alaskite.

MILES CANYON BASALT (R_{MC})

Flows of Miles Canyon basalt and associated rocks are exposed in the northwest portion of the map-area, between Alligator Lake and the Ibex River. They are the youngest rocks in the area and belong to a province of alkaline volcanism which incorporates the Stikine volcanic belt (Souther 1977) active during late Tertiary to Quaternary time. These rocks have been described by Fyles (1950), Wheeler (1961) and Eiche (1985).

Alligator Lake volcanic complex (Eiche 1985), covers approximately 50 km^2 and consists of a basaltic shield capped by two pyroclastic cones. Outliers, located primarily around Friday Creek, are small (<1 km^2) erosional remnants of individual flows on alpine plateaus. Total extrusive volume is less than 0.5 km^3 (Eiche 1985). Five basaltic units were identified by Eiche (1985), (Figure 8).

Basalts are dark red to brown weathering, columnar-jointed, grey or black, amygdaloidal and vesicular and subaerial flows. They are aphanitic with local trachytic alignment of feldspar laths, and contain phenocrysts of olivine and augite. Spinel-lherzolite xenoliths up to 30 cm in diameter are present in units 2 and 3 as described by Eiche (1985).

Fine-grained siliceous sediments with slatey cleavage form interbeds on some isolated exposures on the Friday Creek Plateau. They rarely exceed 2 m in thickness.

Individual northeast-trending brown spheroidal weathering diabase dykes up to 5 m wide intrude granite on Carbon Hill and north of West Arm, Eocene volcanic rocks 2 km east of Mt. Skukum. These dikes are considered to be intrusive equivalents of the Miles Canyon basalts.

Age and Interpretation

Alligator Lake volcanic complex unconformably overlies Eocene Skukum rhyolite and Cretaceous granitic rocks. Miles Canyon basalt is cut by glacial meltwater channels, is eroded by cirques and is overlain by glacial erratics. This indicates that volcanic activity is post-Eocene, yet had ceased before at least the last phase of Pleistocene glaciation.

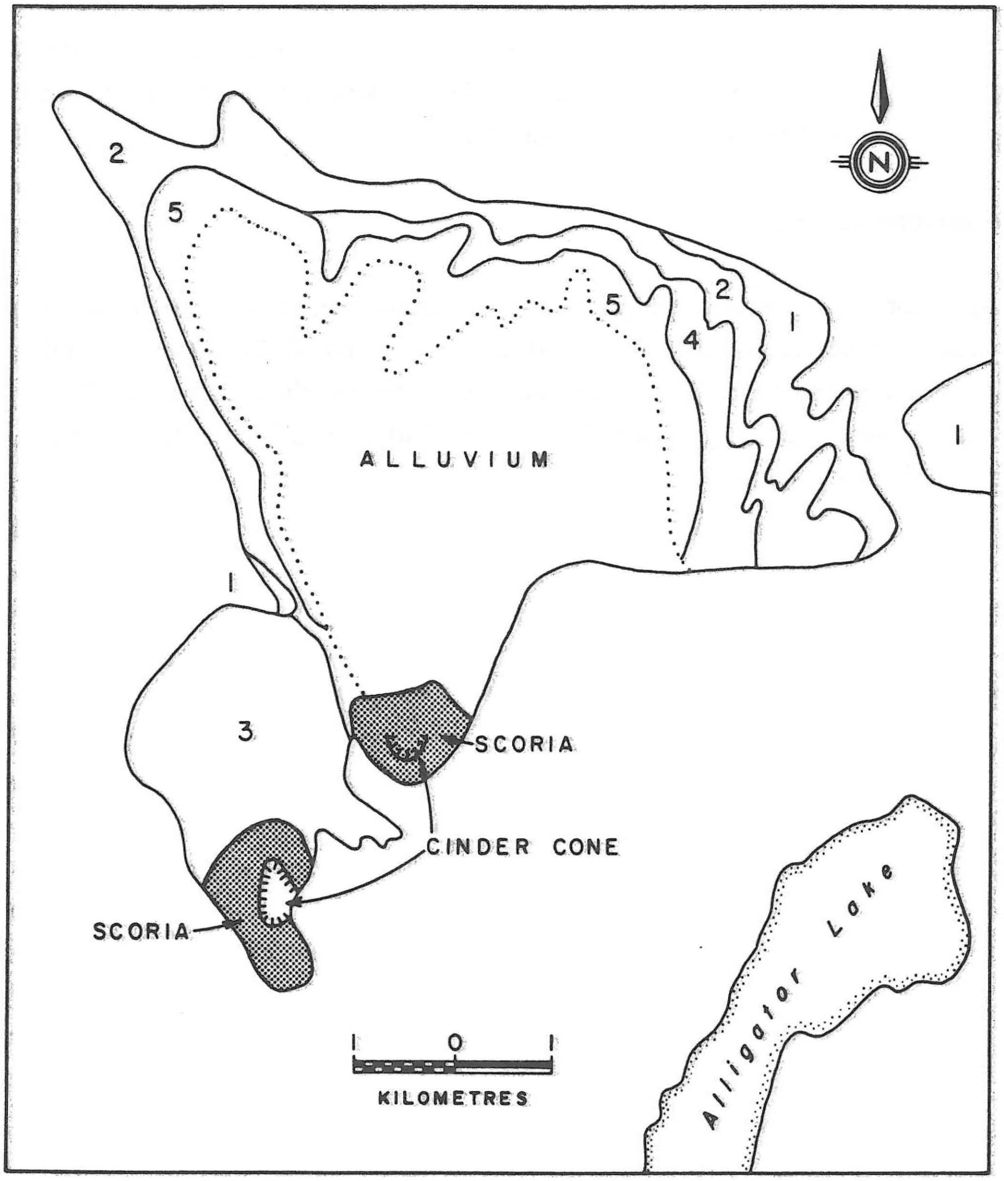

Figure 8. Map of the Alligator Lake Volcanic Complex, showing the locations of the vents and the five flow units. (after Eiche 1986).

STRUCTURAL GEOLOGY

The "Tally-Ho Shear Zone" separates the Intermontane Belt and Nisling Terrane. The structural style in each Terrane is distinct and reflects differences in rock types and tectonic history.

INTERMONTANE BELT

Northwest-trending normal faults are the main structures in the Intermontane Belt. Some are traceable for 30 km beyond the limits of mapping where they form the western contact of the Fish Lake Syncline along the Ibex River Valley. These faults juxtapose Tantalus Formation against Lewes River Group volcanic rocks and movement must therefore be at least as great as the thickness of the Laberge Group (1500 m). In the Corwin Belt, similar faults juxtapose Mesozoic volcanics and Laberge Group rocks against Mesozoic intrusive rocks.

Faults commonly strike at 150^{o} with dips near vertical or inclined to the southwest. In the northern portion of the map-area the orientation changes to 125^{o}. Faults at 125^{o} probably occur along the Friday Creek valley and may repeat units in the Dugdale Belt.

Normal faulting commenced in the Late Jurassic and continued (intermittently?) into the Late Cretaceous. Late Cretaceous reactivation was probably associated with plutonism and volcanism responsible for the deposition of mid-Cretaceous age volcanic rocks. Souther (1977) suggested that this volcanism was associated with block faulting, which preserved many of these deposits in grabens. These structures probably remained active until Tertiary time, possibly as a result of dextral motion associated with the Denali or Tintina Faults.

NISLING TERRANE

Most structures in the Nisling Terrane are related to the emplacement of various age plutons. Younger structures are related to Tertiary volcanic and plutonic activity. The few faults which trend northwest are south of Mt. Bell and north of the Bennett Lake Complex. The sense of movement along them is unknown. Similar faults may exist in the valleys of Partridge, Becker, Fenwick and Summit Creeks.

East-trending normal faults on Carbon Hill, Mt. Reid, Mt. Anderson, near Mt. Bell and elsewhere probably postdate the northwest trending faults. The faults cut Late Cretaceous volcanic rocks on Carbon Hill. The large fault on Mt. Reid, known as the Berney Creek Fracture, truncates a series of rhyolite dykes that are believed to be pre-Tertiary in origin and was reactivated by post-eruptive subsidence related to the Skukum Volcanic Complex, and moformed the southern bounding fault of the Skukum Volcanic Complex.

East-trending faults host antimony-silver-lead-zinc and gold-bearing veins. The most prominent are the Carbon Hill and Chieftain Hill mineral showings.

"TALLY HO SHEAR ZONE"

The "Tally-Ho Shear Zone" is 1-4 km wide, 40 km long, strikes at 145^{o} and dips 40^{o}-75^{o} southwest. Mafic volcanic and volcaniclastic rocks, augite porphyry, marble, and ultramafic intrusions are variably metamorphosed to upper greenschist facies and contain a penetrative fabric, indicative of semi-ductile to brittle deformation. Fabrics are parallel or sub-parallel to the main trend but occasionally exhibit oblique second order shear bands (Figure 9 ; Coward 1982; McClay 1984)

A marble horizon on the western margin of the shear zone is nearly continuous for 15 km. On Tally-Ho Mountain tectonic shortening has distorted the marble into steep, northerly plunging, tight, disharmonic buckle and boudined folds. Contacts with adjoining units are faulted or sheared. The degree of deformation varies greatly in the shear zone and rock types include siliceous mylonite, talc-sericite schist and fresh augite porphyry. These variations occur across a few metres.

Most faults in the "Tally-Ho Shear Zone" are too small to be mapped. One exception is the fault on the south side of Tally-Ho Mountain which cuts and dextrally offsets a (Latest Triassic (?)) pyroxenite intrusion. Such faults may develop as brittle R_1 fractures (Figure 9).

Quartz veins are common in the "Tally-Ho Shear Zone" as sub-parallel open space fracture fillings which generally cut the shear zone foliation. Many of the fractures within the shear zone result from R_1 fractures created during later stage brittle deformation.

Movement on the "Tally-Ho Shear Zone" is complex and indefinite. Kinematic indicators were not measured in the field. Evidence of semi-ductile shearing is indicated in sheared ultramafic rocks, Lewes River Group greenstones, and granodiorite (Trgd). Younger intrusives and Middle Jurassic Laberge Group rocks do not occur within the shear zone suggesting that the deformation is pre upper-middle Jurassic. Semi-ductile deformation had probably ceased before the deposition of the Laberge Group and may in fact have resulted in the uplift of source rocks for the Laberge Group. Metamorphic quartz sweats in shear zone are fractured suggesting a change from semi-ductile to brittle shear.

Middle Cretaceous granodiorite (mKgd) near the contacts of the "Tally-Ho Shear Zone" is often strongly shattered while shear zone contacts with Eocene intrusions are unfractured.

Brittle reactivation of the shear zone probably occurred in the Late Cretaceous or Early Tertiary. Since the Tintina and Denali Fault systems were active during this time, similar dextral transcurrent motion may have been concentrated along the ""Tally-Ho Shear Zone"".

Shear zone properties compiled by Ramsay (1980) suggest a change in shear zone characteristics from semi-ductile to brittle infers an uplift from a crustal depth of 5-10 km to 0-5 km.

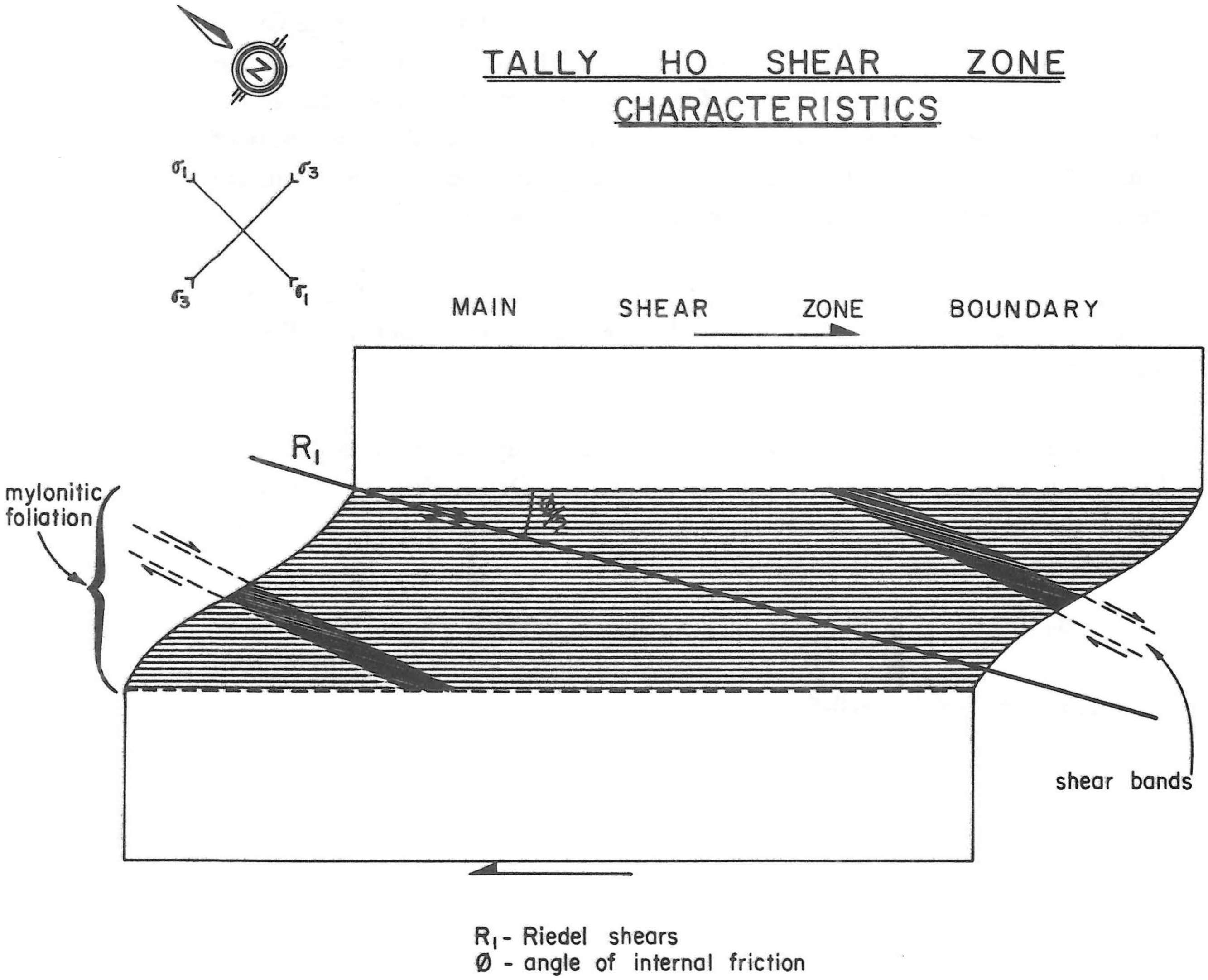

Figure 9. **Characteristics of the "Tally-Ho Shear Zone" showing the allignment of second order shear bands and R_1 Riedel shears.**

YOUNGER STRUCTURES

East-northeast-trending faults are common throughout the northern portion of the study area. The faults are sub-parallel, spaced approximately 2-3 km apart and trend between 50° and 75° with steep dips. The most prominent of these are on the Alligator Lake plateau and between Mt. Hodnett and the Said/The (YEX No. 228) property. Other faults are in the valley bottoms of both forks of Dugdale Creek, Two Horse Creek, Hodnett Lakes and portions of the Wheaton and Watson Rivers.

Eocene rhyolite dykes were emplaced along these faults, suggesting pre-Eocene formation. The motion on the faults is sinistral with maximum displacements of less than 2.0 km. This displacement is well documented by the offset of the "Tally-Ho Shear Zone". This series of faults is similar to R_2-Riedel shears subsidiary to the Denali Fault.

REMOTE SENSING

Remote sensing imagery outlined prominent lineations in the area. Most are young structures such as the east-northeast-trending sinistral faults and faults associated with Eocene volcanic centers.

"Wheaton Lineament", the most prominent lineation detected with the help of imagery, extends for 40 km southwest from the Hodnett Lakes area through Mt. Vesuvius, across Summit Creek, through Chieftain Hill and Mt. McNeil to the southern end of Primrose Lake (Figure 10). The lineation is hosted primarily in Mesozoic plutonic rocks but is also seen through Eocene volcanic strata. No apparent displacement or excessive fracturing was observed onthis feature. However disruptions of units on the eastern side of Chieftain Hill may be related to this structure. The "Wheaton Lineament" probably represents a deep seated structure which was active during pre-Tertiary time and reactivated during post-Eocene time. Deep-seated structures such as these provide intriguing exploration targets.

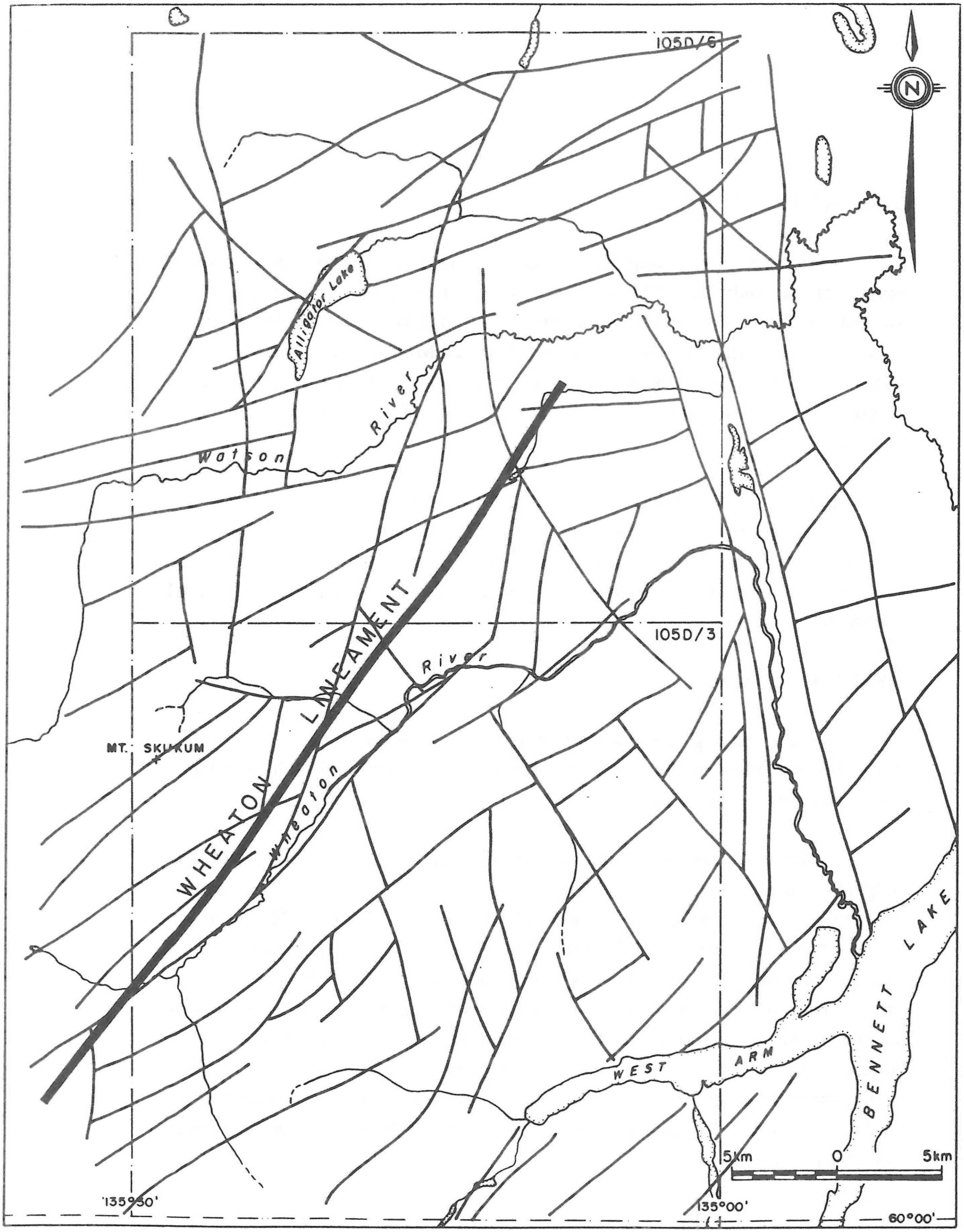

Figure 10. **Lineations derived from satellite imagery showing numerous ENE lineaments. The "Wheaton Lineament," probably represents a long lived deep seated crustal structure.**

ECONOMIC GEOLOGY

Introduction

Mineral exploration in the Wheaton River - Bennett Lake area began in the late 1800's. The first prospectors in the area were Frank Corwin and Thomas Rickman who staked claims on Carbon Hill, Chieftain Hill and Idaho Hill and returned to Juneau with high grade gold bearing quartz samples that assayed $1200 per ton, (Cairnes 1912). Unfortunately both prospectors died before disclosing the location of their claims.

In 1906, quartz veins containing free gold and gold-silver tellurides were discovered on Gold Hill and over 500 quartz claims recorded in the valley that summer,(Cairnes 1912). Cairnes reported veins carrying gold and tellurides on Mount Stevens, Tally-Ho Mountain, Wheaton Mountain, Gold Hill, Mineral Hill, and Mule Hill; antimony-silver veins on Becker Creek, Carbon Hill and Chieftain Hill; and massive argentiferous galena in quartz veins on Mount Anderson.

In his Memoir on the Wheaton District, Cairnes 1912 states;

"..this undeveloped field promises to become one of the more important mining districts of southern Yukon."

In the early 1980's, the Wheaton River-Bennett Lake area, specifically the Tertiary volcanic complexes, were targeted for gold exploration by numerous mining companies. The discovery of the Mount Skukum bonanza gold-silver deposit by AGIP Canada Ltd. during the 1980-1984 field seasons caused a major staking rush in the area and exploration activity has continued to the present.

Classification of Vein Systems

Based on the known occurrences, Cairnes (1912) classified the mineralization in the Wheaton River district as follows:

1. Gold-silver quartz veins.
2. Antimony-silver veins
3. Silver-lead veins
4. Contact-metamorphic ore-deposits

Apart from recently discovered epithermal deposits, our classification does not depart significantly from the classification outlined by Cairnes (1912). Three types of veins are recognized.

1. Epithermal gold-silver veins associated with northeast trending normal faults hosted within bi-modal calc-alkaline andesitic volcanics of the Skukum Group and associated with Eocene rhyolite porphyry dykes outside the volcanic complex.

2. Antimony-silver veins with silver in argentiferous galena and with or without sphalerite, jamesonite, gold, arsenopyrite and pyrite. The veins are in important east-west trending normal faults cutting Late Triassic and younger granitic rocks.

3. Gold-silver,and telluride-bearing quartz veins spatially related to the "Tally-Ho Shear Zone", sheared and chloritized mafic volcanics rocks and nearby sheared or unsheared granitic rocks and Jurassic Laberge Group arkosic sedimentary rocks..

At Chieftain Hill, Becker-Cochran, Mount Anderson and Wheaton Mountain, mineral occurrences have characteristics of both Type 1 and Type 2 veins. The Type 2 antimony-silver veins commonly strike at 115^{o} and dip steeply to the south. Northeast trending structures that controll the emplacement of rhyolite dykes crosscut the Type 2 veins and often host quartz-chalcedony stockworks with typical Type 1 epithermal characteristics. At the Godell occurrence (YEX No. 24), silver-antimony veins crosscut saccaroidal textured (older?) rhyolite dykes but do not cut typical Skukum rhyolite dykes (Ian Coster, pers. comm.). At the Mount Skukum deposit (Yex No. 115) and elsewhere in the area the Type 1 epithermal mineralization is invariably associated with Skukum Group rhyolite dykes.

Mineralization can be classified based on mineralogical, geochemical, structural and age criteria. Table 2 summarizes the characteristics of the three types of vein systems.

Fluid inclusion data from mineral occurrences in the area have been determined by McDonald (1986) for the Skukum deposit, Rucker (1987) on a number of the antimony-silver veins and gold-silver-telluride veins in the Wheaton district and by Walton (1987) on the Venus deposit at Montana Mountain southeast of the Wheaton District. The data obtained in these studies supports the classification proposed in this report and is summarized in Table 2. A tabulated summary of all mineral occurrences is found in Appendix A, and geochemical results for vein samples is presented in Appendix B.

	AGE EXAMPLE	HOST ROCK	ORE MINERALOGY	GANGUE MINERALOGY	ALTERATION ASSEMBLAGE	GEO-CHEMISTRY	VEIN TEXTURES	STRUCTURE	FLUID INCLUSION
TYPE I	EOCENE Gold-Silver Epithermal Veins Mt. Skukum	Esk; Skukum Gp Andesite flows & tuff; Rhyl dykes & dyke bx; pebble dykes; overlying HCsn, Kgd	native gold electrum minor proustite Py, Sph, Gn at depth; low sulphide	Qtz + Cal lamellar & bladed texture; fluorite rhodochrosite adularia	Silicification Propylitic Phyllic Argillic	Au, Ag (+/-)As, Mn Distal Hg, Ba	lamellar cockade comb breccia stockwork ft wall & hg wall gouge	Steep normal faults ft. wall & hg. wall gouge 035° trending	T 190-313°C 0.7 wt% NaCl $\delta^{18}O$ ‰ CO_2 [1]
TYPE II	K - T CRETACEOUS to TERTIARY Antimony - Silver Veins Morning Goddell Porter Becker- Cochran	Trgd, Kgd Localized near downfaulted blocks of Kv, JKTcg HCsn; some post mineralization Eocene dykes	Stibnite, galena, sphalerite, jamesonite arsenopyrite; jarosite & realgar at surface	Quartz, bladed barite, calcite fluorite	Strong phyllic, Fe-Carbonate	Sb, Ag, Pb, Zn, Cu, Ba, Hg, (+/-) Au, Au increases at depth ?	Massive qtz & stibnite, bladed barite. Some crustiform textures, fluorite casts	Steep normal faults 115°/85S	T 213 °C 4.9 wt% NaCl $\delta^{18}O$ ‰ +5.8 CO_2 [2]
TYPE III	Tr - K Gold-Silver Tellurides Dail Gold Reef Tally-Ho	uTrLv augite porp. sheared mafic volcanics; sheared grdr	native gold tellurides galena pyrite; minor Cu as malachite	Quartz, ribboned qtz, massive finely crystalline quartz	weak phyllic Fe-carbonate	Au-Ag-Te As, Bi, Pb, Zn, Cu	massive ribboned saccharoidal	Regionally extensive shear zone	T 298 °C 4.7 wt% NaCl $\delta^{18}O$ ‰ [2]

TABLE 2: Characteristics of Vein Deposits; ([1] McDonald, 1986; [2] Rucker, 1987).

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APPENDIX A

CHARACTERISTICS OF MINERAL OCCURRENCES

<u>Abbrevations</u>

Ag	silver	Gnt	garnet
Au	gold	Hem	hematite
Aspy	arsenopyrite	Jms	jamesonite
Azrt	azurite	Mal	malachite
Bn	bornite	Mo	molybdenum
Bx	breccia	opt	oz per ton
Ca	calcite	Pb	lead
Carb	carbonate	Po	pyrrhotite
Cc	chalchocite	Qtz	quartz
Chl	chlorite	Sb	antimony
Cu	copper	Ser	sericite
DDH	diamond drilling	Sil	silicification
Fe	iron	Sph	sphalerite
Fl	fluorite	Te	telluride
Ept	epidote	Zn	zinc
Gn	galena	UG	underground work

YEX No. Refers to the occurrence number in the Yukon Exploration Summaries. The occurrence locations are plotted sample numbers and is also plotted on the accompanying geology maps.

YEX No. NTS	NAME	HOST LITHOLOGY	ALTERATION ASSEMBLAGE	MINERALIZATION VEIN(S) DESCRIPTION	MINERALOGY OF VEIN
35 105D/6	DAIL (GOLDHILL)	GRANODIORITE (JKgd)	PY,SER	Qtz FISSURE VIEN	Diss. Gn, Te
36 105D/6	GOLDREEF	GREENSTONES (TrLv)	Qtz-Ca VEINING	MASSIVE Qtz TRACED 305m	Py,Gn,Au,Ag,Te,Cu
37 105D/6	IDAHO HILL (UNION MINE)	LABERGE GREYWACKE (JLs)	MINOR BLEACHING SER,PY	>12 TABULAR Qtz-SULPHIDE VEINS UP TO 100m, MANY RICH PODS 1.5-6.0m LONG	DISS & MASS Gn,Aspy Sph,Py,Cp WITH Qtz
38	MT. BUSH	TANTALUS CONGLOMERATE (JKTcg)	MINOR ACID LEACHING	3 SEAMS UP TO 1km LONG	HIGH ASH COAL
39 105D/6	LEGAL TENDER	GRANODIORITE (mKgd)		Qtz FISSURE VEIN	Gn,Cp,Py
40 105D6	ALLIGATOR	GRANODIORITE (mKgd)		PORPHYRY Cu,Mo	
41 105D/6	WHITHORSE COAL	TANTALUS CONGLOMERATE (JKTcg)		THREE MAIN LONG LENSOID BEDS	META-ANTHRACITE COAL
78 105D/6	INCO	GRANODIORITE (JKgd)		PORPHYRY Cu	
82 105D/6	PTARMIGAN	TANTALUS CONGLOMERATE		PART OF WHSE COAL	COAL
83 105D/6	COAL RIDGE	TANTALUS CONGLOMERATE			SANDY COAL
84 105D/6	BERESFORD	TANTALUS CONGLOMERATE		POSS. 2 BEDS	COAL
116 105D/6	DAYIR	CARBONATE AND MARBLE (uTrL)	PY, CHL	SKARN & DISS. SULPHIDES	Zn,Cu,Fe,Mo
117 105D/6	EVIEW	VOLCANICS (Kv) & SHALE (JLs) CUT BY DYKES	GOSSAN	VEINS	Qtz,Py,Aspy,Gn,Sph
145 105D/6	BEAR CUB (VESUVIUS)	FELSIC TUFF & BRECCIA (Esk)	MINOR ARGILLIC & PROPYLITIC		Qtz,Ca,Py,Ag

YEX No. NTS	VEIN ATTITUDE	VEIN WIDTH	EXPLORATION/ DEVELOPMENT	PRODUCTION AND/ OR RESERVES	REFERENCES
35 105D/6	098/80S	2.4 - 6.1m		1916: 3 SAMPLES AU opt : AG opt 0.25 0.75/14" 0.11 1.99/20" 1.51 15.74/GRAB	DIAND 1987, p.163-164 WHEELER 1961, p. 124 CAIRNES 1916, p. 43
36 105D/6	125/60SW	1.2 - 1.5m	1909: >100m of SHAFTS DRIFTS & CROSSCUTS 1987: TRENCHING	< 1 TON ORE GRABS SAMPLES UP TO 23g/T Au, 1330 g/T Ag	DIAND 1987, p. 167-168 DIAND 1986, p. 78 COCKFIELD AND BELL 1926
37 105D/6	115/?	0.1 - 1.2m	PRE-1961: 41m X-CUT, TRENCHES	REPORTED VALUES OF 50 TO 127 opt Ag 49% Pb, 6% Zn	DIAND 1986, p. 165 WHEELER 1961, p. 135
38 105D/6	170/70W	UP TO 3m	HAND TRENCHES		WHEELER 1961, p.143 CAIRNES 1916, p. 145-147
39 105D/6	135/70	0.9 - 3.2m	PRIOR 1909: 30.5m DRIFT	1908:REPORTED $40 Au+Ag	DIAND 1987, p. 163-164 WHEELER 1961, p. 121
40 105D6					DIAND 1985, p. 157 CRAIG AND MILNER 1972, p.
41 105D/6	130/40NE	UP TO 4m	TRENCHING AND STOCKPILING		DIAND 1986, p. 72 WHEELER 1961, p. 143
78 105D/6					DIAND 1985, p. 158
82 105D/6			TRENCHING		CAIRNES 1908, p. 20-21
83 105D/6	110/40N	APPROX. 2m			
84 105D/6	130/65N				CAIRNES 1908, p. 20-21
116 105D/6					DIAND 1983, p. 116
117 105D/6	360	APPROX. 2m			DIAND 1987, p. 176 DIAND 1983, p. 117
145 105D/6			DDH		DIAND 1987, p. 183 DIAND 1986, p. 76 DIAND 1985, p. 165

YEX No. NTS	NAME	HOST LITHOLOGY	ALTERATION ASSEMBLAGE	MINERALIZATION VEIN(S) DESCRIPTION	MINERALOGY OF VEIN
224 105D/6	RED RIDGE	LABERGE SEDS (JLs) CUT BY DYKES OF JKgd AND Er	HORNFELSED SEDS PY, SER	MANY Qtz VEINS	Qtz,Cp,Cc,Bn,Mal Ag, Au
228 105D/6	SAID/THE	LITHIC & FELSIC TUFFS & FLOWS (Esk)	CLAY GOUGE PHYLLIC	Qtz-CHALCEDONY-Fl VEINS	Qtz,Fl,Au,Ag
259 105D/6	LUCKY BOY MINERAL HILL	GREENSTONES (TrLv)	PY,FE-CARB	Qtz VEIN	Cp, Cc, Mal
15 105D/3	LATREILLE	FELSIC TUFF (Epl) RHYOLITE DYKES (Er)		MINERALIZED BRECCIAS AND STRINGERS PORPHYRY Cu	Qtz,Cp,Bn,Mo,Py
19 105D/3	CHARLESTON (MASCOT GP)	GRANODIORITE (Kgd) AND YUKON GROUP (HCsn)	1.5m EITHER SIDE OF VEIN IS SAUSSURITIZED	2 VEINS: 61m Qtz AND 30m Qtz-Ca VEIN	Py,Po,Aspy,Cp,Gn,Au Gn
21 105D/3	MT REID	GRANODIORITE (Kgd) CUT BY RHY. & ANDS. DYKES	Qtz VEIN GOUGE BETW.VEIN & WALLROCK SER,PY	2 Qtz VEINS,N&S 30.5-91.5m APART S.VEIN TRACED 305m VERT. 198M	N.VEIN;Qtz S.VEIN;Qtz,Py,Aspy, Gn,Sph,Sb
22 105D/3	RACA	GRANODIORITE (Kgd)& SKUKUM RHY. TUFF (Esk)	ALTD. GRDR & VOLC BRECCIA, Ept, Chl	400m x 600m BX ZONE	Qtz,Mal,Py,Mo
23 105D/3	MORNING & EVENING (CHIEFTAIN HILL)	ALTERED ANDESITE (Mv)	OXIDIZED VEIN MATERIAL SER	Qtz VEIN WITH GOUGE IN 12.2m WIDE FRACTURE ZONE	Qtz,Sb,Sph
24 105D/3	GODDELL	GRANODIORITE (Trgd)	PHYLLIC SER,PY	2 SUB. PARALLEL VEINS IN 15.6m WIDE SHEAR ZONE	Qtz,Sb,Jms,Aspy
25 105D/3	PORTER (FLEMING, EMPIRE & EXCELSIOR)	GRANODIORITE (Trgd) CUT BY RHY. & AND DYKES	PHYLLIC SER, PY FE-CARB	#VEINS EXPOSED WITH 3 MAIN Qtz VEINS; 61m ON SURFACE	Qtz,Sb,Jms,Gn, Barite
26 105D/3	BECKER-COCHRAN (POP CLAIMS)	GRANITE (Trgd) CUT BY RHY. & ANDS. DYKES	SER,CLAY,CARB, (Qtz-SIL) ALBITE, EPIDOTE	LENSES OF MASSIVE STIBNITE IN Qtz,Py, & GOUGE IN SHEAR ZONE	Qtz,Sb,Py,IN GOUGE

YEX No. NTS	VEIN ATTITUDE	VEIN WIDTH	EXPLORATION/ DEVELOPMENT	PRODUCTION AND/ OR RESERVES	REFERENCES
224 105D/6	160/90		SOIL AND ROCK SAMPLING		
228 105D/6	070/70S	3500m	DDH 9-899m	VALUES TO 19 g/t	
259 105D/6	135/?		TRENCHING		WHEELER 1961, p. 124 CAIRNES 1909, 1906
15 105D/3					DIAND 1981, p. 165
19 105D/3	145/45NE	0.5 - 1.3m	PRE-1922: 61m DRIFT 1984: TRENCHES 1987: 3 DDH	0.39 opt Au, 1.0% Sb 1984: 13 TRENCHES OVER 650m AVG.	DIAND 1987, p. 155 DIAND 1985, p. 165 DIAND 1983, p. 114
21 105D/3	080/80S	0.6 - 7.6m	1937:S.VEIN 48m DRIFT 1986-87: DDH & UG WORK, BULK SAMPLING	821,000 TONS OF 0.41 opt Au EQUIV.	DIAND 1987, p. 156 DIAND 1982, p. 114 SINCLAIR ET AL 1975, p. 14 WHEELER 1961, p. 125 BOSTOCK 1938, p. 12
22 105D/3			1967:2 DDH TOT.277m	0.43% Cu GRAB 20m CHIP, 4.45 g/t Au 21.9 g/t Ag	DIAND 1987, p. 157 CRAIG & MILNER 1975, p. 55
23 105D/3	090/90	MAX. 1.5m	TRENCHES	HIGH GRADE OF 49.9% Sb	DIAND 1983, p. 117 WHEELER 1961, p. 135 BOSTOCK 1941, p. 36-37
24 105D/3	097/90	0.08 - 1.2m	TRENCHES,UNDERGR WORK.??	VALUES REPORTED: 14.19% Sb 0.09 opt Au 0.28 opt Ag	DIAND 1987, p. 158 DIAND 1986, p. 75 MORIN ET AL 1977, p. 50 WHEELER 1961, p. 134
25 105D/3	130/75SW	2.01m	PRIOR 1916:835m WORK. PRIOR 1961:102m ADIT WITH X-CUTS,2 TUNNELS: AT 58.5m & 115.5m	APPROX AVG 5 opt Ag HIGH GRADE AVG 15-30 opt Au,20-25% Sb AVG APPROX 0.04 opt Au	DIAND 1986, p. 71 WHEELER 1961, p. 133 BOSTOCK 1941, p. 36-37 CAIRNES 1919, p. 47-48
26 105D/3	130/60-75SW	2.5m	PRIOR 1912:MINOR UG WORK, TRENCHING. 1965:112.8m ADIT, 40m DRIFT 1966:312m UG, DDH 475m 1976:DDH 1225.5m 1985:2 LEVELS OF ACCESS. UG TOTAL 549m	1974:POSSIBLE 140,000 TONS OF 4% Sb, TRACE Au, Ag	DIAND 1987, p. 159 DIAND 1986, p. 75-77 DIAND 1985, p. 160 MIR 1977, p. 60 GREEN 1965, p. 42 GREEN 1967, p. 52 WHEELER 1961, p. 132 CAIRNES 1916

YEX No. NTS	NAME	HOST LITHOLOGY	ALTERATION ASSEMBLAGE	MINERALIZATION VEIN(S) DESCRIPTION	MINERALOGY OF VEIN
27 105D/3	FLEMING	GN, SCH & MARBLE (HCsn) & GRANODIORITE (Trgd)	SKARNIFICATION, Ept, Act, Gnt	# INDIVIDUAL SKARN BODIES	Qtz,Mag,Hem,Cp,Bn, Py
28 105D/3	MT ANDERSON (WHIRLWIND & SHEEP CREEK)	GRANODIORITE (Trgd) CUT BY RHY. DYKES (Er)	PY,SER	2 Qtz VEINS, TRACED FOR 650m. BASALT DYKE WITH VEINING & GOUGE	Gn,Py
29 105D/3	TALLY-HO	GRANODIORITE (JKgd) CUT BY RHY. DYKE	ALTERED RHY. AND GRANODIORITE	RHY. ASSOC. WITH Qtz VEINS,GOUGE & BRECCIA ZONES FAULT ZONE IN GRDR	Qtz,Gn
30 105D/3	MT. WHEATON CLAIMS (GOPHER,MCDONALD & SILVER QUEEN)	MCDONALD & S. QUEEN, GRANODIORITE (JKgd) GOPHER: GREENSTONE (TrLv)	PY,SER FE-CARB	MASSIVE & COCKSCOMB Qtz LENSES	MCDONALD BANDED Gn GOPHER DISS Gn S.QUEEN Gn,Py
31 105D/3	BUFFALO HUMP (GOLDEN SLIPPER, SUNRISE, WHEATON CLMS, MT.STEVENS)	GRANODIORITE (JKgd)	PY, SER FE-CARB	Qtz FISSURE VEIN EXPOSED 15.3m	Qtz,DISS Gn,Py,Au, Ag
72 105D/3	SHAW (GOAT & RIDGE CLS.)	FELSIC ASH FLOW TUFFS (Emc)	ARGILLIC BLEACHING BESIDE VEIN	SWARM OF VEINS 0.1-5.0m WIDE	Qtz,Gn,Sb,Cp,Au Mal,Azrt,Py,Po Aspy,Scorodite, Jarosite
74 105D/3	OPULENCE	GREENSTONES (TrLv) & GRANODIORITE (mKgr, Trgd)		IRREG. VEINS WITH Sb	Qtz,Sb,Sph
85 105D/3	BOUDETTE	SMOKEY Qtz-EYE GRANITE (Tgr)	VERMICULITE	CUBES & OCTAHEDRA OF Fl OCCUR IN 0.6-0.9m VUGS WITH PYRAMIDAL Qtz CRYSTALS	Fl
90 105D/3	WEST	GRANODIORITE (Trgd)		URANIUM TARGET	U-RICH WATER

YEX No. NTS	VEIN ATTITUDE	VEIN WIDTH	EXPLORATION/ DEVELOPMENT	PRODUCTION AND/ OR RESERVES	REFERENCES
27 105D/3		LARGEST SKARN 9.1m LENSES 0.9 - 3.0m	TRENCHES	<0.07 OPT Au	MORIN ET AL 1977, p. 150 WHEELER 1961, p. 142
28 105D/3	090/90 120/80NE	1.0 - 1.2m 0.1 - 0.8m	UP.1915: 23m DRIFT 11m X-CUT L. 1915: 2 DRIFTS 46m APART TOT.159m, 52.5m X-CUT	1915: VEIN AVG. L.$5-18/T Au,Ag,Pb 1981: REPORTED VALUES ,58.8 g/t Au 1678.5 g/t Ag	DIAND 1987, p. 160 DIAND 1986, p. 76 DIAND 1981, p. 166 COCKFIELD AND BELL 1926 CAIRNES 1916
29 105D/3	135/60-70NE	VEIN: 0.2 - 0.6m BX: 1.2 - 3.6m	PRIOR 1909:88m DRIFT, 12m RAISE, 4.5m X-CUT PRIOR 1926: 2 ADITS, 213.4 & 152.4m X-CUTTING & DRIFTING 1966: 16 DDH: 457m	1912: $20.00 Au+Ag 1920'S: APPROX. 20,000 TONS HIGH GRADE AT >20PT Au	DIAND 1987, p. 162 DIAND 1985, p. 160 WHEELER 1961, p. 23 COCKFIELD AND BELL 1926 CAIRNES 1909
30 105D/3	133/80NW	0.9 - 2.1m	MCDONALD 1910 6.0m SHAFT		DIAND 1987, p. 163 DIAND 1985, p. 165 WHEELER 1961, p. 122
31 105D/3	135/20-35NE	0.6 - 0.9m MAX. 2.1m	PRIOR TO 1908: GOLDEN SLIPPER: 25m DRIFT,6m X-CUT		DIAND 1987, p. 165 DIAND 1986, P. 67 DIAND 1985, P. 165 DIAND 1982, p. 117
72 105D/3		0.1 - 5.0m		REPORTED VALUES: 2.2%Cu,1.7%Pb,.44%Zn 654.9g/T Ag, Tr. Au OVER 3.0m; 1.54%Cu, 7.23%Pb,1.48%Zn, 5.45 g/T Au, 573.4g/T AG OVER 1.2m	DIAND 1982, p. 116-117 FINDLAY 1968, p. 56-57 SINCLAIR AND GILBERT 1975 LAMBERT 1974, p. 140
74 105D/3				UP TO 473 g/t Sb	DIAND 1987, p. 164 DIAND 1986, p. 76 DIAND 1985, p. 165
85 105D/3					DIAND 1985, p. 158 LAMBERT 1974, p. WHEELER 1961, p.
90 105D/3					DIAND 1981, p. 166

YEX No. NTS	NAME	HOST LITHOLOGY	ALTERATION ASSEMBLAGE	MINERALIZATION VEIN(S) DESCRIPTION	MINERALOGY OF VEIN
91 105D/3	PART	TUFFS (Epl) AT CONTACT WITH Qtz. MONZ. (KTqm) AND RING DYKES (Eqfp)	ALTERED VOLC RX	Gn & NATIVE Ag,Au ALTERED VOLC RX	Qtz,Gn,Ag,Au
112 105D/3	ODD	LEWES R. GRP. VOLCS (TrLv)		Qtz VEINING, 5m IN LENGTH	Qtz,Cp,Py,
114 105D/3	NAIAD	GRANODIORITE TO Qtz-MONZONITE (Kqm) CUT BY RHY. DYKES (Er & Eqfp)		Mal	MINOR Qtz VEINING Tr. Gn
115 105D/3	MT SKUKUM	TERTIARY ANDESITE TO RHY. FLOWS, TUFF & BRECCIA; CUT BY RHY. DYKES (Er)	PROPYLITIC, ARGILLIC,SILICIC, PHYLLIC	5 MAJ. Qtz-Ca VEINS 3 MOST SIGN, ARE: MAIN ZONE:TRACED 1KM WITH A 225x75x105 m ORE SHOOT LAKE ZONE:TRACED 700m	MAIN ZONE&LAKE ZONE MICRON SIZED Au BRANDY ZONE:TRACE VG & MICRON SIZED Au
129 105D/3	GLENLIVET	TUFF & BRECCIA CUT BY RHY. INTRUSIVES (Er)	PROPYLITIC POSS. PHYLLIC	1.GOSSANOUS RHYOLITE, 2. Qtz-Ca VEINING 3. Qtz-Ca STOCKWORK	1. Qtz, Py 2. Qtz,Ca,Gn,Py 3. Qtz,Ca,Fl
142 105D/3	TYCON	GRANODIORITE (mKgd)	ARGILLIC	CHALCEDONIC Qtz VEINS	Qtz,Au,Ag,Py,Gn
153 105D/3	SCAR	FELSIC PLUG (Erfp) IN GRANITE	PHYLLIC ARGILLIC	STRINGERS	Qtz,Sph,Py,Bn,Ag
155 105D/3	ROB	GRANODIORITE (Trgd) CUT BY RHY. & ANDS. DYKES	ARGILLIC		
173 105D/3	WAL	GRANODIORITE (Trgd) CUT BY RHY. & ANDS. DYKES	CLAY	VEINS	Qtz,Hem,Py,Gn,Cpy, Au,Ag
229 105D/3	EARL	GN. & SCH. (HCsn)	PY, SER	VEINS	Qtz,Py,Mag,Au,Ag
258 105D/3	CRAIG	GRANODIORITE (mKgd)	ARGILLIC,	6 PARALLEL VEINS & ALTERED GRANITE	Qtz,Gn,Sph,Mo Py

YEX No. NTS	VEIN ATTITUDE	VEIN WIDTH	EXPLORATION/ DEVELOPMENT	PRODUCTION AND/ OR RESERVES	REFERENCES
91 105D/3			SURFACE WORK	chip sample (40 cm) assayed 57.94 g/t Au 3583 g/t Ag	DIAND 1987, p. 171 DIAND 1981, p. 167
112 105D/3	135/?	2.0m	SURFACE EXPL.		DIAND 1987, p. 173 DIAND 1985, P. 165
114 105D/3			RX & SOIL SAMPLING	50 ppm Ag, 1% Pb	DIAND 1985, p. 159 DIAND 1983, p. 112, 116
115 105D/3	MAIN ZONE: 035/65S LAKE ZONE 015/75W BRANDY 010/80W	1.5 - 9.1m	1984:640m MAIN HAULAGE ADIT,DDH ON MAIN&LAKE ZONE	MAIN ZONE:240,000 T PROVEN WITH 0.73 opt Au;210,000 TONS PROB & POSS LAKE ZONE:4 DDH 3.2-63.92g/T Au	McDONALD 1987 DIAND 1987, p.175 McDONALD and STEWART 1986 McDONALD and GODWIN 1986 DIAND 1986, p. 71 DIAND 1985, p. 162-164
129 105D/3	170/90	APPROX. 3.0m	SURFACE WORK		DIAND 1985, p. 161
142 105D/3			TRENCHING 6 DDH 359m	UP TO 111.6 g/t Au, 9.6 g/t Ag	DIAND 1987, p. 180 DIAND 1986, p. 72 DIAND 1985, p. 165
153 105D/3					DIAND 1987, p. 186 DIAND 1986, p. 76
155 105D/3					DIAND 1987, p. 187 DIAND 1986, p. 76
173 105D/3					DIAND 1987, p. 195 DIAND 1986, p. 78
229 105D/3					
258 105D/3	010/20W	0.1 - 0.3m			NEW SHOWING

APPENDIX B

GEOCHEMICAL ANALYSES OF VEIN SAMPLES

Types 1, 2, and 3, refer to vein characteristics described in Table 2. Sample locations are plotted on the accompanying geology maps.

METALS ANALYSES TYPE 1 RELATED TO EOCENE VOLCANICS

SAMPLE NUMBER	AU PPB	AG PPM	SB PPM	AS PPM	PB PPM	ZN PPM	CU PPM	BI PPM	BA PPM	HG PPB	MN PPM
A100	10000	50	3	76	100	190	24	140	15	5	536
A53-3	420	2.8	5	334	125	31	7	17	895	5	62
A34-4	5	2.1	1040	58	159	32	18	2	1800	490	47
A26-5	2400	5.6	3	66	574	168	16	39	15	5	1575
MIN	5	50	3	58	100	31	7	2	15	5	47
MAX	10000	2.1	1040	334	574	190	24	140	1800	490	1575
AVG	3206.25	15.125	262.75	133.5	239.5	105.25	16.25	49.5	681.25	126.25	555

METALS ANALYSES TYPE 2 ANTIMONY SILVER VEINS

SAMPLE NUMBER	AU PPB	AG PPM	SB PPM	AS PPM	PB PPM	ZN PPM	CU PPM	BI PPM	BA PPM	HG PPB	MN PPM
A15-1	860	50	69	2000	10000	773	589	2	110	255	40
A22-3	30	10.5	2000	153	56	1476	72	2	20000	5000	21
CH87-13-1	140	50	119	716	10000	20000	7103	508	159	515	371
CH50-9	45	6.7	15	212	1181	131	38	16	600	225	419
CH50-10	20	4.2	18	260	881	106	51	198	2800	110	115
CH50-11	20	50	2000	667	10000	20000	7561	12	9500	5000	34
CH50-12	10	50	1913	296	10000	20000	2561	18	20000	5000	198
CH50-13	30	50	1091	302	2950	1347	20000	2	730	5000	114
CH70-1	8800	50	158	2000	10000	20000	829	10	116	265	1452
CH71	460	50	20000	242	293	2480	297	2	15	5000	86
MIN	10	4.2	15	153	56	106	38	2	15	110	21
MAX	8800	50	20000	2000	10000	20000	20000	508	20000	5000	1452
AVG	1041.5	37.14	2738.3	684.8	5536.1	8631.3	3910.1	77	5403	2637	285

METALS ANALYSES TYPE 3 GOLD-TELLURIDE VEINS

SAMPLE NUMBER	AU PPB	AG PPM	SB PPM	AS PPM	PB PPM	ZN PPM	CU PPM	BI PPM	BA PPM	HG PPB	MN PPM
A1	2880	50	1	510	1527	54	45	4146	15	5	44
A6-2	860	50	1003	2000	10000	20000	352	12	200	490	314
A10-3	1250	19.2	16	2000	4557	777	3657	2	90	70	700
A31-10	120	36.5	1609	139	2260	571	1151	163	2100	1350	44
A31-11	480	50	1	100	919	33	61	128	15	5	72
A56-6	10000	50	56	107	10000	276	51	454	20	180	90
J11-20	1200	26	33	40	1028	207	28	19	110	40	99
CH87-1-11	750	37	1	124	104	56	3418	351	467	15	228
CH87-3-4B	510	50	129	242	7965	1458	187	2	99	180	1847
CH87-4-3	9050	50	205	2000	10000	777	125	290	15	110	47
CH87-4-5	1150	50	112	2000	10000	2355	62	114	47	40	51

METALS ANALYSES TYPE 3 GOLD-TELLURIDE VEINS

SAMPLE NUMBER	AU PPB	AG PPM	SB PPM	AS PPM	PB PPM	ZN PPM	CU PPM	BI PPM	BA PPM	HG PPB	MN PPM
CH87-7-2	320	50	23	2000	1921	290	3743	219	15	65	73
CH87-8-11	110	50	17	2000	2423	479	7583	50	1639	45	67
CH87-8-12	190	50	466	739	10000	5191	508	2	15	1100	172
CH87-17-7	35	16.2	1	370	866	918	5173	11	651	65	1216
CH87-17-8	110	49	7	966	1821	926	555	1	72	240	2870
CH87-17-9	40	7.2	40	121	345	297	255	5	53	700	1838
CH87-20-2	2700	50	581	2000	10000	20000	605	2	15	95	2200
CH87-20-5	3100	50	518	2000	10000	14600	383	157	15	365	374
CH87-40-A	180	2.2	1	62	486	100	473	2	642	5	479
CH87-40-B	5	0.5	1	50	103	19	33	2	76	15	117
CH87-67	5	0.5	1	8	12	35	379	2	974	5	393
MIN	0	0.5	0	0	0	0	0	0	0	0	0
MAX	10000	50	1609	2000	10000	20000	7583	4146	2100	1350	2870
AVG	1464.375	31.77	200.88	815.75	4014.04	2892.50	1201.13	255.58	306.04	216.04	555.21

METALS ANALYSES UNRELATED TO TYPES 1,2 or 3

SAMPLE NUMBER	AU PPB	AG PPM	SB PPM	AS PPM	PB PPM	ZN PPM	CU PPM	BI PPM	BA PPM	HG PPB	MN PPM
CH87-31	40	35.0	1	128	10000	1748	7412	9	415	265	435
J-40	300	5.6	1	19	25	16	1275	26	2737	5	55
JM-9-3	240	2.6	1	40	140	8	43	15	15	5	18
A44-5	5	0.8	97	75	151	79	10	3	1000	120	694
A49-2	100	29.5	68	182	364	20000	20000	87	450	385	634
A49-2A	25	4.9	38	206	689	9210	1157	9	410	140	1301
J66-2	460	7.2	38	40	287	151	24	3	840	40	29
CH87-42-2	75	2.1	23	14	73	86	35	6	1500	35	224
CH60-1	15	1.7	5	24	340	235	126	2	260	700	231
CH60-2	5	4.6	25	76	207	143	1921	2	70	435	178
CH49-2	30	0.7	14	7	40	256	3	2	390	40	1782
CH49-3	30	1.0	9	20	50	177	17	2	20	40	1502
CH49-6	55	5.7	13	63	353	316	66	3	1400	45	756
CH50-3	10	0.6	12	5	38	34	2	2	2400	25	357
CH55-1	65	50.0	42	97	10000	20000	18601	2	550	2400	2474
CH55-2	10	4.1	54	53	527	536	285	2	1000	5000	54

APPENDIX C

WHOLE ROCK GEOCHEMICAL ANALYSES

Sample locations are plotted on the accompanying geology maps.

SAMPLE NUMBER	SiO2 WT %	TiO2 WT%	Al2O3 WT%	CaO WT%	Fe2O3 WT%	K2O WT%	MgO WT%	MnO WT%	Na2O WT%	P2O5 WT%	LOI WT%	TOTAL WT%
CH2-3	65.37	0.56	16.13	3.61	3.61	2.87	1.91	0.08	4.63	0.08	0.90	99.75
CH2-5	72.52	0.20	14.13	0.62	2.36	4.46	0.18	0.07	4.25	0.03	0.70	99.49
CH2-8	65.22	0.53	16.54	2.80	3.32	3.48	1.13	0.07	4.87	0.14	1.40	99.50
CH4-1	50.77	0.09	13.50	8.95	11.54	1.33	6.50	0.24	3.19	0.36	2.00	99.28
CH5-1	54.70	1.18	17.80	7.37	8.26	0.97	3.76	0.16	4.43	0.42	1.30	100.35
CH5-10	61.90	0.75	17.60	4.11	5.71	2.43	1.98	0.11	2.93	0.03	0.90	98.42
CH6-2	70.68	0.30	14.43	1.71	2.35	4.53	0.66	0.05	3.95	0.03	0.50	99.16
CH8A	52.39	0.30	2.63	18.53	7.21	0.07	16.93	0.13	0.24	0.03	1.40	99.83
CH8S	41.59	0.06	0.67	3.81	12.57	0.03	32.72	0.15	0.10	0.03	7.40	99.07
CH16-1	65.47	0.43	15.83	4.12	4.14	2.98	2.25	0.08	3.20	0.03	1.40	99.90
CH42-4	53.96	0.75	11.81	11.65	7.17	0.73	9.54	0.16	2.30	0.03	1.30	99.37
CH49	76.89	0.07	12.37	0.52	1.05	4.74	0.21	0.01	3.69	0.03	0.40	99.95
CH49-3	78.10	0.07	12.50	0.39	1.37	4.64	0.18	0.02	3.42	0.03	0.80	101.49
CH51	74.50	0.09	13.27	0.65	1.46	4.51	0.21	0.04	4.18	0.03	0.60	99.51
CH51-1	76.72	0.10	11.85	0.49	0.75	4.10	0.22	0.03	3.69	0.03	0.40	98.35
CH51-2	56.38	1.12	17.80	7.25	7.69	1.42	3.28	0.10	3.79	0.21	0.70	99.74
CH52-2	67.12	0.19	15.76	3.52	3.52	3.44	1.22	0.10	4.00	0.03	0.60	99.50
CH54-1	56.54	0.93	16.73	6.51	6.74	2.08	4.55	0.13	3.20	0.10	2.00	99.51
CHT43	66.34	0.57	15.65	3.44	4.50	3.49	0.63	0.11	4.14	0.05	1.00	99.92
CHT45	42.24	0.22	4.52	22.47	7.09	0.47	13.30	0.14	0.52	0.03	7.70	98.70
CHT56	62.78	0.84	14.92	4.38	6.20	3.14	1.63	0.15	3.57	0.26	2.50	100.37
50-4	72.37	0.25	13.40	1.72	1.74	3.99	0.72	0.05	3.47	0.29	0.70	98.70
A7-8	75.33	0.10	12.90	0.40	1.53	4.54	0.13	0.04	3.43	0.23	0.80	99.43
A7-10	69.55	0.33	14.62	2.03	3.32	4.06	0.59	0.08	3.69	0.27	0.80	99.34
A9-2	54.82	1.67	17.79	5.72	8.66	2.80	1.91	0.16	4.46	0.92	0.70	99.61
A10-2	49.62	0.65	10.75	9.66	10.37	1.74	12.15	0.19	0.87	0.52	2.80	99.32
A10-8	60.32	0.68	15.26	3.99	4.30	2.50	1.37	0.11	3.33	0.59	6.10	98.55
A16-1	76.48	0.13	12.69	0.63	0.97	3.97	0.27	0.03	3.89	0.29	0.60	99.89
A16-3	61.07	0.60	17.55	4.38	5.19	1.91	1.95	0.15	4.59	0.35	1.20	98.94
A19-1	48.06	0.74	17.38	15.07	10.00	0.72	4.94	0.26	1.82	0.39	0.50	99.88
A22-1	70.52	0.34	14.94	2.23	2.29	3.44	1.00	0.06	3.87	0.18	0.90	99.77
A26-1	76.18	0.13	13.03	0.63	0.89	4.04	0.22	0.03	3.89	0.15	0.80	99.99
A31-9	50.09	0.80	16.69	7.99	8.90	1.07	8.45	0.15	3.34	0.34	1.90	99.72
A31-10	49.10	0.86	18.30	9.14	8.52	0.96	6.56	0.17	3.14	0.03	1.60	98.35
A38-6	62.50	0.77	15.00	3.64	6.44	3.72	1.32	0.09	3.16	0.68	0.80	98.12
A38-7	67.49	0.54	15.10	2.42	3.68	3.71	0.81	0.08	3.99	0.22	1.20	99.24
A39-8	62.90	0.54	18.20	4.62	4.67	1.45	2.85	0.10	4.48	0.50	1.70	102.01
A43-2	77.48	0.09	13.02	0.62	0.95	4.14	0.12	0.02	3.38	0.30	0.01	100.12
A43-3	76.60	0.07	12.30	0.42	1.18	4.38	0.09	0.03	3.70	0.03	0.30	99.07
A45-2	51.21	0.67	17.29	6.27	8.01	1.38	7.74	0.16	2.46	0.58	2.70	98.47
A56-2	65.55	0.49	15.75	2.45	3.20	3.31	0.72	0.10	3.12	0.42	3.30	98.41
A-MID	73.40	0.14	14.40	0.80	1.98	5.49	0.14	0.06	3.57	0.18	0.50	100.66
J-L	58.30	0.64	16.81	4.37	5.81	3.26	3.24	0.11	3.41	0.28	3.10	99.33
J55-1	73.11	0.14	14.36	0.81	1.90	4.48	0.18	0.05	4.06	0.31	0.70	100.10
J57	76.60	0.06	14.00	0.45	1.18	4.32	0.10	0.03	4.07	0.74	0.30	101.85
W11-7	76.80	0.08	13.50	0.72	1.18	3.81	0.09	0.03	4.40	0.22	0.80	101.63
1-1	77.10	0.10	12.90	0.66	1.24	4.52	0.08	0.02	4.06	0.03	0.60	101.28
1-2	77.80	0.08	13.60	0.27	1.29	4.36	0.07	0.03	3.88	0.29	0.60	102.27
1-3	76.88	0.08	12.90	0.35	1.45	4.46	0.10	0.03	3.39	0.30	0.40	100.34
2-2	70.80	0.21	17.60	1.60	1.80	5.09	0.86	0.05	1.55	0.37	1.90	101.83
2-3	71.60	0.16	15.80	2.79	1.85	3.35	0.64	0.06	4.47	0.03	0.60	101.32
3-1	68.38	0.34	16.77	3.36	2.79	2.03	1.32	0.07	3.92	0.49	1.10	100.57
3-2	67.80	0.42	17.00	4.30	3.68	2.44	1.81	0.09	3.52	0.27	1.00	102.33
3-3	67.50	0.41	17.30	3.97	3.72	2.57	1.70	0.09	3.60	0.42	0.90	102.18
A35-3	49.40	1.32	17.10	8.07	9.13	2.24	4.90	0.18	3.04	0.54	2.00	97.92
CH2-4	54.37	0.82	19.45	6.87	6.69	3.29	1.91	0.12	3.63	0.50	1.00	98.65
CH5-12	52.63	1.51	19.59	6.16	9.83	2.29	2.32	0.19	4.34	0.52	0.70	100.08
CH6-1	73.75	0.22	14.10	0.57	2.33	4.39	0.30	0.06	4.17	0.04	0.52	100.45
CH6-8	52.20	1.46	20.01	2.89	9.33	2.43	4.81	0.19	1.37	0.69	3.70	99.08
CH7-4	42.85	0.69	13.91	10.16	12.57	1.62	11.54	0.25	0.79	0.39	5.30	100.07
CH33-6	58.14	1.38	16.74	4.60	6.90	2.28	2.27	0.09	3.53	0.54	2.90	99.37
EVA	60.98	1.04	15.55	4.31	8.23	3.06	1.44	0.14	3.87	0.60	3.06	99.82

APPENDIX D

U-PB ANALYSIS OF ZIRCONS FROM THE 1987 Zr 1, Zr 2 and Zr 3 SAMPLE SETS COLLECTED BY AURUM GEOLOGICAL CONSULTANTS

H. Baadsgaard
Dept. of Geology
University of Alberta
Edmonton, Alberta
T6G 2E3

The U-Pb analysis of zircons from three sets of samples was carried out after crushing and mineral separation. A gabbroic rock submitted for possible analysis proved to have insufficient zircon for analysis. Total population zircon analyses were made with attention to problems of contamination and metamorphism.

The analytical results are given in the data table and plotted on a concordia diagram in the figure. The concordia plot shows three coherent sets of data points which correspond to the selected sample sets. A lone exception is sample Zr 2-2. This sample is different from the other members of its set, and the zircons from it give much older dates. The 207Pb/206Pb date is ~950 Ma, and it is possible Zr 2-2 contains Precambrian material. Excluding sample Zr 2-2, the sets of zircon data give regression intercept ages (see the regression computer outputs) of 58 Ma (set Zr 1), 119 Ma (set Zr 3) and 220 Ma (set Zr 2).

It must be pointed out, however, that the lower intercept of each regression line gives negative or indeterminate data. This is most likely the result of contamination by older material in the zircon samples. When the zircons are examined under the polarizing microscope (see: NOTES ON THE AURUM ZIRCONS) there is found evidence of probable contamination by older materials in the Zr 1 and Zr 3 sets. Set Zr 2 zircons show little direct evidence of contamination, except for the Zr 2-2 sample which is the most highly-contaminated zircon sample. Zircon sample Zr 2-2 contains numerous grains with cores and the zircons generally have abundant inclusions.

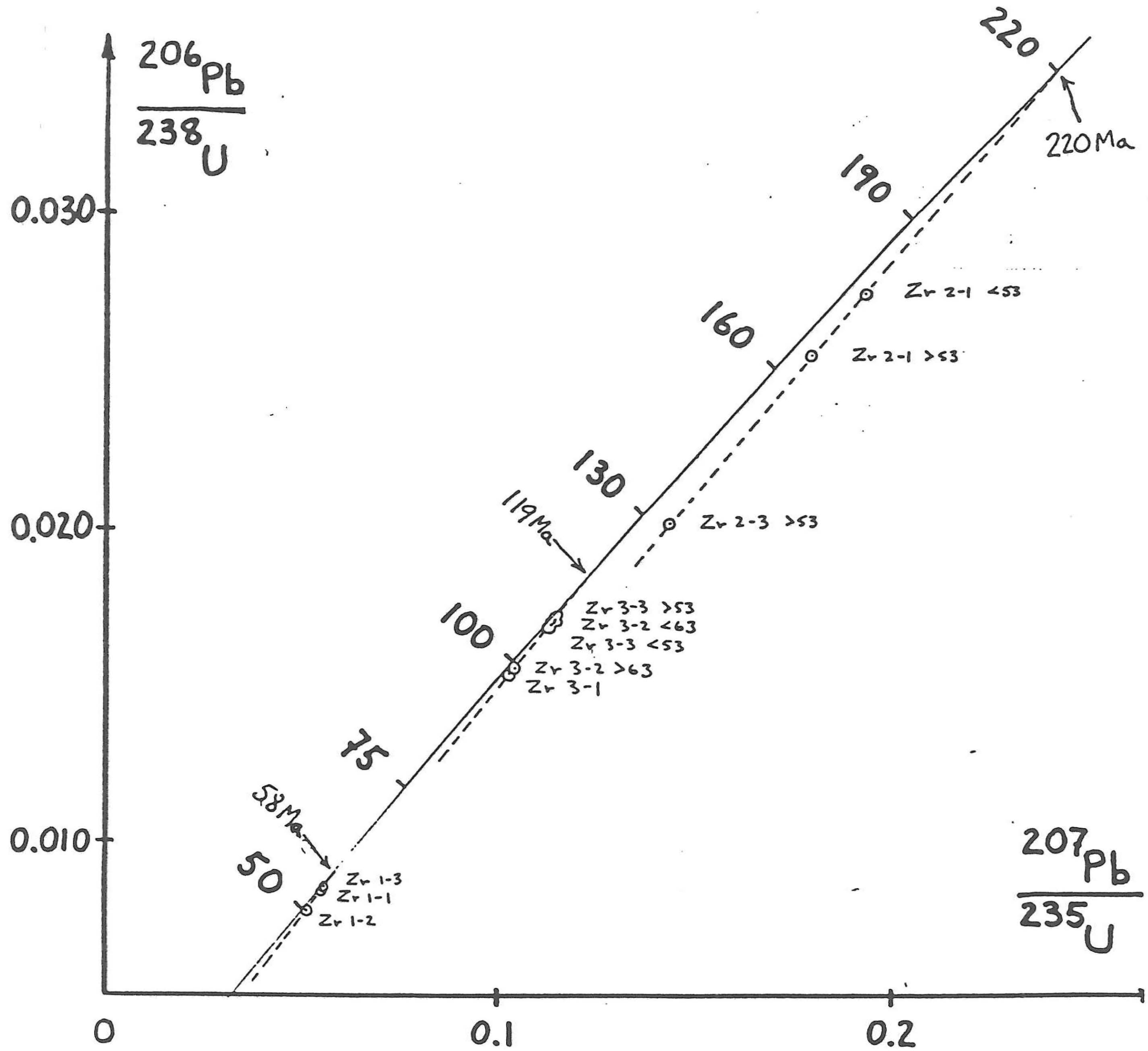
Except for sample Zr 2-2, the extent of contamination is not large, and the discordia-intercept ages should not be too severely biased. Since the contamination results in intercept ages that are too old, the three intercept ages should be considered maximum ages of crystallisation of the zircons. If one carries out selective zircon analyses (clear, uncontaminated grains only) on specially-purified grains, these ages may be refined somewhat. However, a lack of visible contamination is not necessarily a guarantee of isotopic purity for such minerals.

Submitted Feb. 1988,

H. Baadsgaard

Table. Analytical Data for Aurum Zircons, 1987

Sample No.	Pb isotope ratios, meas. 206/204	207/206	208/206	^{238}U ppm	^{206}Pb ppm	$\frac{^{206}Pb}{^{238}U}$	$\frac{^{207}Pb}{^{235}U}$
Zr 1-1	812±5	0.06581±1	0.21514±2	1277	9.36	0.00847	0.0558
Zr 1-2	813±13	0.06627±3	0.18932±3	1616	10.85	0.00776	0.0516
Zr 1-3	621±8	0.07122±1	0.19625±5	1756	13.04	0.00858	0.0561
Zr 2-1 >53 mu	2062±43	0.05826±1	0.11553±1	632	13.98	0.02556	0.1798
Zr 2-1 <53mu	4049±82	0.05465±1	0.11062±3	826	19.71	0.02756	0.1938
Zr 2-2	4566±63	0.07372±3	0.07009±2	1079	34.58	0.03702 (234Ma)	0.3609 (313 Ma)
Zr 2-3 <53mu	2179±57	0.05820±2	0.10404±3	1135	19.82	0.02017	0.1437
Zr 3-1	2410±75	0.05464±1	0.14467±1	1189	15.75	0.01531	0.1026
Zr 3-2 <63mu	1421±8	0.05923±2	0.16805±5	1105	16.29	0.01704	0.1145
Zr 3-2 >63mu	962±4	0.06393±2	0.24451±6	865	11.56	0.01543	0.1042
Zr 3-3 <53mu	1377±9	0.05926±1	0.20608±3	1491	21.85	0.01693	0.1133
Zr 3-3 >53mu	1377±6	0.05934±1	0.19997±2	1005	14.88	0.01710	0.1143



206Pb / 238U
0.030
0.020
0.010
207Pb / 235U
0
0.1
0.2
220
190
160
130
100
75
50
220Ma
119Ma
58Ma
Zr 2-1 <53
Zr 2-1 >53
Zr 2-3 >53
Zr 3-3 >53
Zr 3-2 <63
Zr 3-3 <53
Zr 3-2 >63
Zr 3-1
Zr 1-3
Zr 1-1
Zr 1-2

NOTES ON THE AURUM ZIRCONS

Sample	Shape	Inclusions	older cores	overgrowth	metamict
Zr 1-1	euhedral	many	few, <1%	none seen	no
Zr 1-2	(essentially the same as 1-1)				
Zr 1-3	(same as 1-1 , but coarser, some metamict grains)				
Zr 2-1 <53mu	euhedral	few	none	none	no, clear
Zr 2-1 >53mu	(same as 1-1 <53 but with a few metamict grains)				
Zr 2-2*	euhedral to sub-rounded	many	many,~30%	none seen	many
Zr 2-3 >53mu	(same as 2-1 except for grain size)				
Zr 3-1	euhedral	many	few, <5%	none seen	some,<10%
Zr 3-2 <63mu	euhedral to subrounded	some	small cores? single inclusions	none seen	few, <3%
Zr 3-3 >63mu	(same as 3-3 <63 except for size)				
Zr 3-3 <53mu	(same as 3-2)				
Zr 3-3 >53mu	(same as 3-2)				

* This zircon quite different from other Zr 2 zircons

```
      X←.0558,.0516,.0561
      Y←.00847,.00776,.00858
      SIGMAX←6
      SIGMAY←10
      SIGMAY←6
      BB3←.001
      R
0.95
      UPBREGR
THE NECESSARY INPUT IS X, Y, SIGMAX, SIGMAY, BB3, AND R
SLOPE , BB = 0.1776634603 +OR- 0.005213597663
Y=ZERO INTERCEPT, AA = ¯0.001412401619 +OR- 0.0002836227434
SUM OF SQUARED RESIDUALS = 4.380245503
NUMBER OF DEGREES OF FREEDOM =  1
MEAN SQUARE WEIGHTED DEVIATES =  4.380245503

PLUS ERROR : LOWER INTERCEPT =  59.34MYR  }
LOWER CONCORDIA INTERCEPT =     58.22MYR  } indeterminate
MINUS ERROR : LOWER INTERCEPT = 57.43MYR  }

PLUS ERROR : UPPER INTERCEPT =   59 MYR
UPPER CONCORDIA INTERCEPT    =   58 MYR
MINUS ERROR : UPPER INTERCEPT =  57 MYR

CENTROID : XBAR =  0.05436010092  YBAR =  0.008245402013
    207PB/235U       206PB/238U            X-RESIDUALS          Y-RESIDUALS

  5.580000000E¯2   8.470000000E¯3   ¯3.103319502E¯4   ¯2.391575425E¯5
  5.160000000E¯2   7.760000000E¯3    5.059619959E¯5    4.022122561E¯6
  5.610000000E¯2   8.580000000E¯3    2.478083009E¯4    1.854544223E¯5
      ' ZR 1 ZIRCONS AURUM'
 ZR 1 ZIRCONS AURUM
```

```
       X←.1798,.1938,.1437
       Y←.02556,.02756,.02017
       SIGMAX
6
       SIGMAY
6
       BB3←.001
       R
0.95
       UPBREGR
THE NECESSARY INPUT IS X, Y, SIGMAX, SIGMAY, BB3, AND R
SLOPE , BB = 0.1480234334 +OR- 0.00123468134
Y=ZERO INTERCEPT, AA = ¯0.001093966354 +OR- 0.0002077128163
SUM OF SQUARED RESIDUALS = 1.029070226
NUMBER OF DEGREES OF FREEDOM =  1
MEAN SQUARE WEIGHTED DEVIATES =  1.029070226

PLUS ERROR : LOWER INTERCEPT =  ¯62.56MYR
LOWER CONCORDIA INTERCEPT =     ¯78.67MYR
MINUS ERROR : LOWER INTERCEPT = ¯95.19MYR

PLUS ERROR : UPPER INTERCEPT =   225 MYR
UPPER CONCORDIA INTERCEPT    =   220 MYR
MINUS ERROR : UPPER INTERCEPT =  215 MYR

CENTROID : XBAR =  0.1668103023  YBAR =  0.02359786733
    207PB/235U       206PB/238U            X-RESIDUALS            Y-RESIDUALS

  1.798000000E¯1   2.556000000E¯2   2.387214648E¯4   ¯4.017108494E¯6
  1.938000000E¯1   2.756000000E¯2  ¯1.992770728E¯4    3.477739820E¯6
  1.437000000E¯1   2.017000000E¯2  ¯4.810652996E¯5   ¯1.197767862E¯7
```

!! (contaminated)

Zr 2 Zircons, Aurum

DIAND-YUKON REGION INFORMATION CENTRE

```
      X←.1026,.1145,.1042,.1133,.1143
      Y←.01531,.01704,.01543,.01693,.01710
      SIGMAX←8
      SIGMAY←6
      BB3←.02
      R
0.95
      UPBREGR
THE NECESSARY INPUT IS X, Y, SIGMAX, SIGMAY, BB3, AND R
SLOPE , BB = 0.1556688828 +OR- 0.00444495162
Y=ZERO INTERCEPT, AA = ¯0.0007263412958 +OR- 0.0004863410438
SUM OF SQUARED RESIDUALS = 4.87106922
NUMBER OF DEGREES OF FREEDOM =  3
MEAN SQUARE WEIGHTED DEVIATES =  1.62368974

PLUS ERROR : LOWER INTERCEPT =  ¯29.98MYR
LOWER CONCORDIA INTERCEPT =     ¯95.11MYR
MINUS ERROR : LOWER INTERCEPT = 115.27MYR
```

!! (contaminated)

```
PLUS ERROR : UPPER INTERCEPT =   126 MYR
UPPER CONCORDIA INTERCEPT    =   119 MYR
MINUS ERROR : UPPER INTERCEPT =  115 MYR

CENTROID : XBAR =  0.1092842123  YBAR =  0.01628580995
    207PB/235U      206PB/238U              X-RESIDUALS              Y-RESIDUALS

  0.1026            0.01531              0.0008733687044   0.00007124391348
  0.1145            0.01704             ¯0.0007792105388  ¯0.00006355438806
  0.1042            0.01543             ¯0.0008680621845  ¯0.00007077547028
  0.1133            0.01693              0.0002572037251   0.0000209821858
  0.1143            0.0171               0.0004506442057   0.00003676406484
      ' ZR 3 ZIRCONS AURUM'
 ZR 3 ZIRCONS AURUM
```