METALLOGENIC MAP

WHITEHORSE MAP AREA, YUKON

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DEPT. INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

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INTRODUCTION

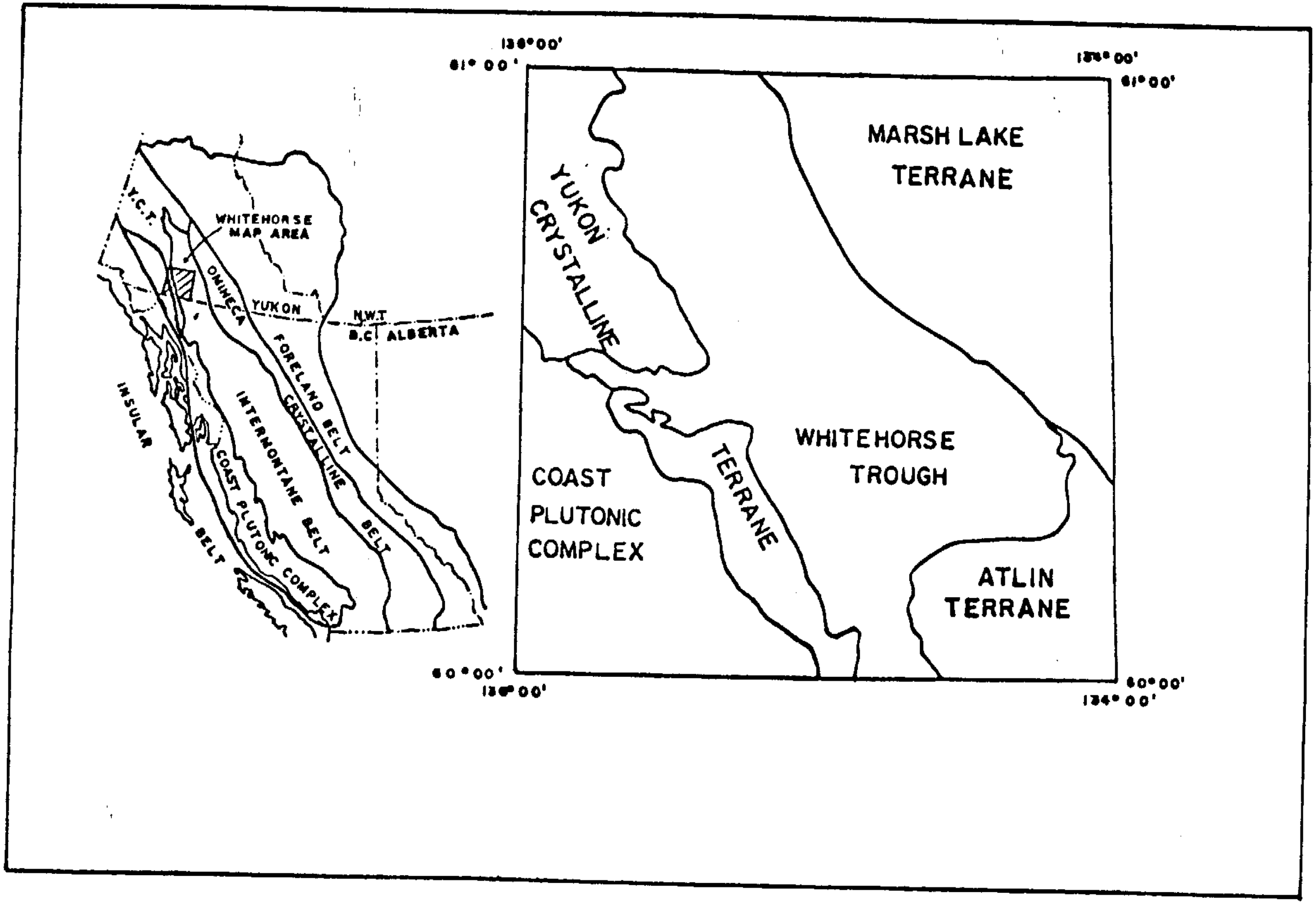
This report is essentially an update of an earlier paper (Morrison, 1976) on the distribution of intrusion related and other mineral occurrences in the Whitehorse map-area, Yukon. Mineral occurrences recorded in the Archer, Cathro and Associates, Ltd., Northern Cordillera Mineral Inventory have been classified according to deposit type and principal commodities then plotted on a lithologic map which is in part an updated version of the Geological Survey of Canada four mile map for the Whitehorse map-area (Wheeler, 1961). New information added to the map includes: geology and geochronology of the Bennett Lake cauldron subsidence complex (Lambert, 1974); geology of the Atlin Terrane (Monger, 1975); reinterpreted geology of the adjacent Laberge map-area (Tempelman-Kluit, 1978) and part of the Bennett and Atlin map-areas (Bultman, 1979); a reclassification of geologic units in southern Yukon (Geological Survey of Canada, 1976); reconnaissance mapping, classification and geochronology of granitic rocks in the Whitehorse map-area (Morrison, Godwin and Armstrong, in prep.); and detailed stratigraphy of the Upper Triassic Lewes River Group with special emphasis on the Whitehorse Copper Belt and the associated Cu-Fe skarn deposits (Morrison, thesis in preparation). The latter two projects include field and laboratory studies carried out by the author in 1975, 1976 and 1977.

Geological Setting

The Whitehorse map-area in southwestern Yukon covers latitudes 60 to 61 degrees north and longitudes 134 to 136 degrees west; it extends northward from the British Columbia border and includes the city of Whitehorse and the segment of the Yukon River between Bennett Lake and Lake Laberge.

Tectonically, Whitehorse map-area straddles the Coast Plutonic Complex, Yukon Crystalline Terrane, and the Intermontane Belt which has been further subdivided into three terranes. (Fig. 1).

The Coast Plutonic complex is represented by the soutern extension of the Ruby Range granodiorite which has been dated as mid-Cretaceous in Whitehorse map-area (Morrison _et al_, in prep.) but may be as old as


WHITEHORSE MAP AREA
Y.C.T.
OMINECA
YUKON
N.W.T.
B.C.
ALBERTA
FORELAND BELT
CRYSTALLINE BELT
INTERMONTANE BELT
COAST PLUTONIC COMPLEX
INSULAR BELT
136°00'
61°00'
134°00'
61°00'
60°00'
136°00'
60°00'
134°00'
MARSH LAKE TERRANE
YUKON CRYSTALLINE TERRANE
WHITEHORSE TROUGH
COAST PLUTONIC COMPLEX
ATLIN TERRANE

Triassic (Tempelman-Kluit, 1976). It is intruded by Eocene granite-quartz monzonite and rhyolite porphyry and contains remnants of Proterozoic to Paleozoic biotite schist and marble which are comparable to the metamorphic rocks in the southern part of the Yukon Crystalline Terrane. (Tempelman-Kluit, 1976).

The Yukon Crystalline Terrane in Whitehorse map-area contains the southern extension of the Triassic (?) Aishihik Batholith of quartz diorite to quartz monzonite composition which is intruded by Eocene granite-quartz monzonite and rhyolite porphyry and includes erosional remnants of Mesozoic to Quaternary volcanic and sedimentary rocks and Proterozoic to Paleozoic matamorphic rocks.

In Whitehorse map-area the Intermontane Belt has been subdivided into three terranes each containing a distinctive lithologic assemblage (Fig. 1). The Whitehorse Trough (Wheeler, 1961) consists of an Upper Triassic island arc assemblage of mafic volcanic and volcano-sedimentary rocks overlain by Jurassic and Cretaceous conglomerate, greywacke, pelite and coal measures deposited in a successor basin. The Atlin Terrane (Monger, 1975) consists of Pennsylvanian and Permian ultramafic rocks, mafic volcanic rocks, chert, pelite and limestone of oceanic affinity in fault contact with the Jurassic sedimentary rocks of the Whitehorse Trough. Marsh Lake Terrane, is a poorly understood area of Permo-Triassic (?) mafic to intermediate volcanic rocks, ultramafic rocks, chert, pelite and limestone in fault contact with Jurassic and Upper Triassic sedimentary rocks of the Whitehorse Trough. The volcanic rocks in the Marsh Lake Terrane are distinguished from Upper Triassic volcanic rocks in the Whitehorse Trough by the presence of numerous serpentinite bodies and remnants of ultramafic rocks that result in a strong linear magnetic anomaly at the western margin of the Marsh Lake Terrane. Although the volcanic rocks are normally in fault contact with Upper Triassic sedimentary rocks within the terrane, locally they underlie Upper Triassic pelite and limestone. The presence of Upper Triassic sedimentary rocks in the Marsh Lake Terrane may be a Permo-Triassic oceanic assemblage thrust over the sedimentary rocks of the Whitehorse Trough. All three terranes in the Intermontane Belt are intruded by mid-Cretaceous, Late Cretaceous and Eocene plutonic suites.

Mineral Occurrences

Mineral occurrences in the Whitehorse map-area have been classified into four major groups; vein, skarn, porphyry and other. The vein deposits (Sb-Ag, Au-Ag, Ag-Pb and ploymetallic Au-Ag-Pb-Zn-Cu types), porphyry deposits (Cu and/or Mo) and the Pb-Zn skarn and replacement deposits are all spatially associated with subvolcanic phases (stocks, plugs and dyke swarms) of the Eocene and Late Cretaceous plutonic suites, particularly where these intrude Cretaceous and older volcanic and sedimentary rocks at the western margin of the Whitehorse Trough and in the Yukon Crystalline Terrane. These types of occurrences, and their metal and alteration zoning described in an earlier report (Morrison, 1976; Fig. 5), are directly comparable to mineralization associated with Tertiary caldera complexes in the southwestern United States and Mexico. However, there are two types of mineral occurrence normally associated with caldera complexes that have to date not been found in Whitehorse map-area. At Buena Esperanza, Chile (Sillitoe, 1977) manto-type copper deposits consisting of chalcocite, bornite, chalcopyrite with tennantite occur as disseminations and fracture and vesicle fillings in flow tops, in the matrix of volcanic breccia, and in organic-rich limestones in a sequence of intercalated andesitic flows, breccias and sediments in a Jurassic subaerial volcanic complex. Within the McDermitt caldera, Nevada-Oregon (Rytuba and Glanzman, 1978), mercury, uranium and lithium occurrences are associated with "moat-fill" volcaniclastic rocks and lucustrine sediments. Uranium also occurs in veins in rhyolite domes in the ring fracture of the caldera complex. In Whitehorse map-area there are at least three Eocene caldera complexes (Bennett Lake, Mt. Skukum, Mt. Byng) that have andesitic bases (eTvb on map) and rhyolitic caldera facies (eTva) with rhyolitic and feldspar porphyry domes and plugs (Trp) and granitic stocks (Tgqm). The caldera complexes have potential for manto-type copper mineralization in their andesitic base and for uranium mineralization in the rhyolitic caldera facies as well as for vein, skarn and porphyry mineralization.

Cu-Fe and Cu skarn deposits, typified by the Whitehorse Copper Belt, are in Upper Triassic dolomite, limestone and volcaniclastic rocks in contact with unaltered and unmineralized diorite and quartz diorite of the mid-Cretaceous plutonic suite (Kgd). Several other Cu-Fe skarns occur in the same host rocks but associated with younger plutons. It has been suggested that the volcaniclastic rocks are the principal source of metals in these deposits and that within a given contact aureole facies boundaries within Upper Triassic carbonate reef complexes control the distribution of skarn ore (Morrison and Hodder, 1977). A knowledge of the stratigraphy of the Upper Triassic Lewes River Group is essential to exploration for copper belt-type skarn deposits.

Minor occurrences of Cu, Cr, Ni, asbestos, coal and fluorite have also been reported from Whitehorse map-area.

Description of Mineral Occurrence Types

Mineral occurrences listed in Archer, Cathro and Associates Ltd., Northern Cordillera Mineral Inventory have been classified according to deposit type and principal commodities. The following groups have been recognized:

1) Vein Deposits: Generally spatially associated with stocks, plugs and dykes of quartz and feldspar porphyry (Trp) in shear zones in leucocratic granite-quartz monzonite (Tgqm) and other older plutonic, volcanic and sedimentary rocks.

a) Sb-Ag: Stibnite associated with Pb, Zn and Cu sulfides and Ag-bearing sulfosalts in quartz, calcite, barite veins. e.g. Opulence, Mount Reid, Morning, Goddell, Porter, Yukon Antimony (Becker-Cochran).

b) Au-Ag: Native Au and Au-Ag tellurides with pyrite, arsenopyrite and galena in quartz veins and occassionally shear or breccia zones. e.g. Lulu, Buffalo Hump, Ridge, Mascot, Sheep, Gold Hill, Gold Reef, Tally-Ho, Combs, Cutoff.

c) Ploymetallic Au-Pb-Zn-Cu: Polymetallic veins with silver and gold in sulfosalts of Pb and Fe associated with galena, sphalerite and chalcopyrite in silicified shear zones and as quartz lenses and veins. e.g. Venus, Jean, Arctic, Mt. Stevens, Mt. Anderson, Ingram, Ace, Abi.

d) Ag-Pb: Ag probably in sulfosalts associated with galena and sometimes sphalerite and chalcopyrite in quartz veins and silicified shear zones. Probably just an Au-poor equivalent of c). e.g. Idaho Hill, Donkey, Mineral Hill, Mt. Wheaton, Cromwell, Milhaven.

2) Skarn Deposits

a) Pb-Zn: galena and sphalerite in garnet-diopside skarn and replacements in limestone (PPc) adjacent to quartz feldspar porphyry stocks (Trp). e.g. Primrose, Ram.

b) Cu: Chalcopyrite with pyrite and occasionally molybdenite in diopside garnet-epidote skarn in bioclastic limestone (uTrc) adjacent to biotite-hornblende granodiorite (Kgd) or other plutons (Tgqm, LKgm). e.g. Gronk, Nip, Pow, silicate skarns in Whitehorse Copper Belt.

c) Cu-Fe: Chalcopyirte, bornite and valleriite with magnetite and occasionally specularite occur in serpentine, actinolite, epidote skarns in dolomite or dolomitic limestone (uTrc) adjacent to biotite hornblende granodiorite (Kgd) or other plutons (Tgqm). e.g. Grouse, magnetite skarns in Whitehorse Copper Belt.

3) Porphyry Deposits

Cu and/or Mo: Chalcopyrite and/or molybdenite in quartz veins or fractures in hydrothermally altered granitic rocks. The host rocks may be breccias in the ring fracture of Tertiary cauldron subsidence complexes (e.g. Latreille, Skukum; older granitic rocks intruded by swarms of porphyry dykes (Trp) (e.g. Alligator, Ark, Keeweenaw); quartz monzonite stocks (LKgm) (e.g. Lime, Bear Molybdenum); or granodiorite stocks (LKgd) (e.g. Red Ridge, Imp).

4) Other Deposits

a) Cu: Native copper, chalcocite, bornite and chalcopyrite occur in sheared volcanic rocks (Cvb, PTrv, uTrvb) and occasionally in greywacke (uTrwp) or limestone (uTrc) where no intrusive rocks are evident. e.g. Millett, Knob Hill, McClintock, College Green, Finger, Mud, Midgett, Gee.

b) asb, Cr, Ni: Asbestos, Ni sulfides and chromite-magnetite lenses occur in serpentinized peridotite and dunite (PTrub, Cvb) e.g. Marsh, Lavalee, Michi, Effie.

c) Coal: A few low grade coal seams occur in the Tantalus Formation (JKcm) e.g. Mt. Bush, Whitehorse Coal, Ptarmigan, Coal Ridge, Beresford, Fish Lake, Luscar.

d) fl: Fluorite is common in miarolitic cavities of the leucocratic granite-quartz monzonite (Tgqm). e.g. Boudette.

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METALLOGENIC MAP : WHITEHORSE, YUKON

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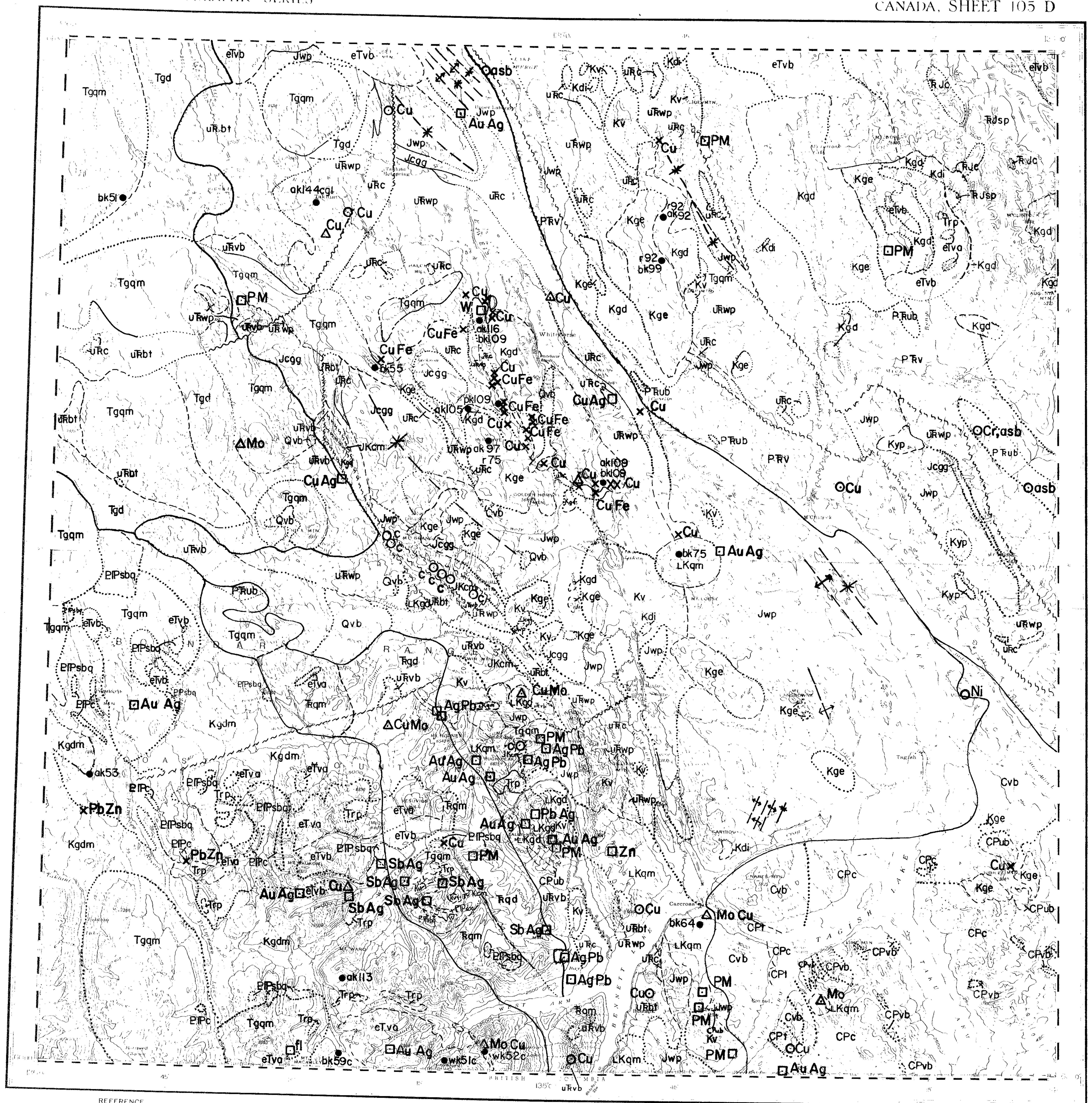


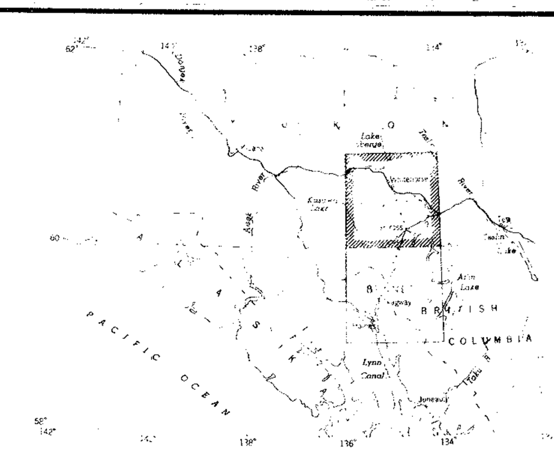
REFERENCE

MAP 953A

WHITEHORSE
YUKON TERRITORY
(FIRST EDITION)

Scale: 1/250,000 or Approximately 4 Miles to 1 Inch

Copies may be obtained from the Map Distribution Office, Department of Energy, Mines and Resources, Ottawa.



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Whitehorse, Yukon Territory

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LEGEND : METALLOGENIC MAP-WHITEHORSE, YUKON

COAST PLUTONIC COMPLEX	YUKON CRYSTALLINE TERRANE	INTERMONTANE BELT		
		WHITEHORSE TROUGH	MARSH LAKE TERRANE	ATLIN TERRANE

QUATERNARY
MILES CANYON BASALT

Qvb Basalt flows, minor pyroclastic rocks

TERTIARY
EOCENE (50±5 my)

Trp Stocks, plugs and dikes of quartz and feldspar porphyry with aphanitic rhyolitic matrix. Some granite porphyry; some intermediate plugs and dikes.

SKUKUM GROUP

eTva Rhyolite and trachyte breccias tuffs and flows; some felsic plugs and dikes (Trp).

eTvb Andesite and basalt tuffs, flows and breccias; minor greywacke at base.

Tgqm Leucocratic granite-quartz monzonite with miarolitic cavities; minor biotite granite. May include some felsic stocks, plugs and dikes (Trp).

Tgd Inhomogeneous, locally gneissic and porphyritic grano-diorite and quartz monzonite with abundant dioritic and meta-sedimentary inclusions; Marginal phase of Tgqm; Includes TRqd, TRqm locally in Aishihik Batholith.

CRETACEOUS (?)
RUBY RANGE BATHOLITH

Kgdm Coarse grained equigranular biotite hornblende grano-diorite-quartz monzonite. Includes undifferentiated Trp and Tgqm

LATE CRETACEOUS (70±10 my)

LKgd Stocks, plugs and dikes of mafic-rich, biotite and hornblende grano-diorite and syenodiorite; plagioclase porphyry locally.

LKqm Biotite rich, locally feldspar porphyritic quartz monzonite; granodioritic marginal phase.

CRETACEOUS (100±10 my)

Kyp Plugs of feldspar porphyritic, locally pegmatitic syenite;

Kdi Stocks, plugs and dikes of plagioclase porphyritic hornblende diorite

Kge Hornblende-bearing, feldspar porphyritic, pink quartz monzonite; granophyric matrix common.

Kgd Homogeneous biotite hornblende granodiorite-quartz diorite.

CRETACEOUS
HUTSHI GROUP (IN PART)

Kv Mostly intermediate flows, flow-breccia and pyroclastic rocks; basalt and rhyolite flows and pyroclastic rocks locally; minor greywacke, argillite and conglomerate.

UPPER JURASSIC AND LOWER CRETACEOUS
TANTALUS FORMATION

JKcm Coal measures: quartzite-bearing and chert-bearing conglomerate, sandstone, shale and coal.

LOWER AND MIDDLE JURASSIC
LABERGE GROUP

Jwp Greywacke, arkose, quartzite, siltstone and argillite; minor conglomerate; lithologically in-distinguishable from uTRwp, but stratigraphically higher than uTRc.

Jcgg Granitoid-bearing conglomerate, greywacke matrix.

TRIASSIC (?)
AISHIHIK BATHOLITH

TRqm Altered, gneissic, porphyritic (K-feldspar) quartz monzonite-granodiorite.

TRqd Altered, gneissic, porphyritic (plagioclase) quartz diorite-granodiorite.

UPPER TRIASSIC
LEWES RIVER GROUP

uTRc Reefoid and clastic limestone; dolomite.

uTRwp Greywacke, siltstone, argillite, minor conglomerate; lithologically indistinguishable from Jwp but stratigraphically lower than uTRc.

uTRbt Volcanic breccia, conglomerate, lapilli tuff and tuff; minor greywacke.

uTRvb Basalt and basaltic andesite flows and flow breccias; augite and/or feldspar porphyritic locally

TRIASSIC AND JURASSIC (?)

TRJc Reefoid and clastic limestone

TRJsp Siltstone and argillite; minor greywacke.

PERMIAN (?) AND TRIASSIC (?)

PTRv Andesite and basalt flows; local chert and tuff.

PTRub Variably serpentinised dunite, peridotite and pyroxenite; minor gabbro.

CARBONIFEROUS AND PERMIAN
CACHE CREEK GROUP

CPt Kedahda Formation: bedded chert, cherty pelite and pelite, minor carbonate breccia.

CPc Horsefeed Formation: limestone and minor chert; locally interbedded basalt, tuff and diabase (CPvb).

CPub Variably serpentinised peridotite and dunite; locally associated gabbro, pyroxenite, pyroxene diorite.

CARBONIFEROUS

Cvb Nakina Formation: altered basic volcanic rocks; minor chert, carbonate, serpentinite.

PROTEROZOIC AND PALEOZOIC

PPc Marble, crystalline limestone; minor graphitic limestone, skarn.

PPsbq Quartz-mica, quartz-chlorite schist and quartzite; minor amphibolite, feldspathic gneiss.

SYMBOLS

Geological Boundary (defined, approximate, assumed)
Fault (defined, approximate, assumed)
Major Folds (syncline, anticline)
Tectono-stratigraphic Boundary
Isotopic Age Determinations .... ●
sample analysed: amphibole, biotite, phlogopite, whole rock .... a, b, p, w
isotopes determined: potassium-argon, rubidium-strontium .... k, r
ages in millions of years
laboratory: University of British Columbia (no designation)
Carleton University (c)

Mineral Occurrences

Deposit type:	vein	□	porphyry	△
	skarn	×	other	○
Minerals:	Antimony	Sb	Gold	Au
	Asbestos	asb	Lead	Pb
	Coal	c	Molybdenum	Mo
	Copper	Cu	Nickel	Ni
	Chromite	cr	Polymetallic (AuAgPbZnCu)	PM
	Fluorite	fl	Zinc	Zn

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