

MOUNTAINS

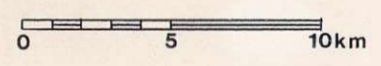
1. SPRUCE HILL
2. MOUNT MCNAMARA
3. TUFF PEAK
4. METSANTAN MOUNTAIN
5. CASTLE MOUNTAIN
6. TIGER NOTCH PASS
7. MOUNT GRAVES
8. THE PILLAR
9. DRYBROUGH PEAK
10. SERRATED PEAK

LAKES

- A. MOOSEHORN LAKE
- B. METSANTAN LAKE
- C. TOODOGGONE LAKE
- D. BLACK LAKE
- E. THUTADE LAKE
- F. NOROD LAKE

EPITHERMAL OCCURRENCES

- Adularia-Sericite Type – veins and stockworks
- x mine, major occurrence, prospect
- Acid-Sulphate Type – replacements and breccia
- major occurrence, prospect
- ◆ PORPHYRY OCCURRENCES
- ★ SKARN OCCURRENCES
- ✕ PLACER OCCURRENCES
- ^{178Ma} Numeric age of secondary alteration mineral



889926

STRATIGRAPHY

K/T

6

**UPPER
VOLCANIC
CYCLE**

5

INTERCYCLE SEDIMENTS

4

**LOWER
VOLCANIC
CYCLE**

3

2

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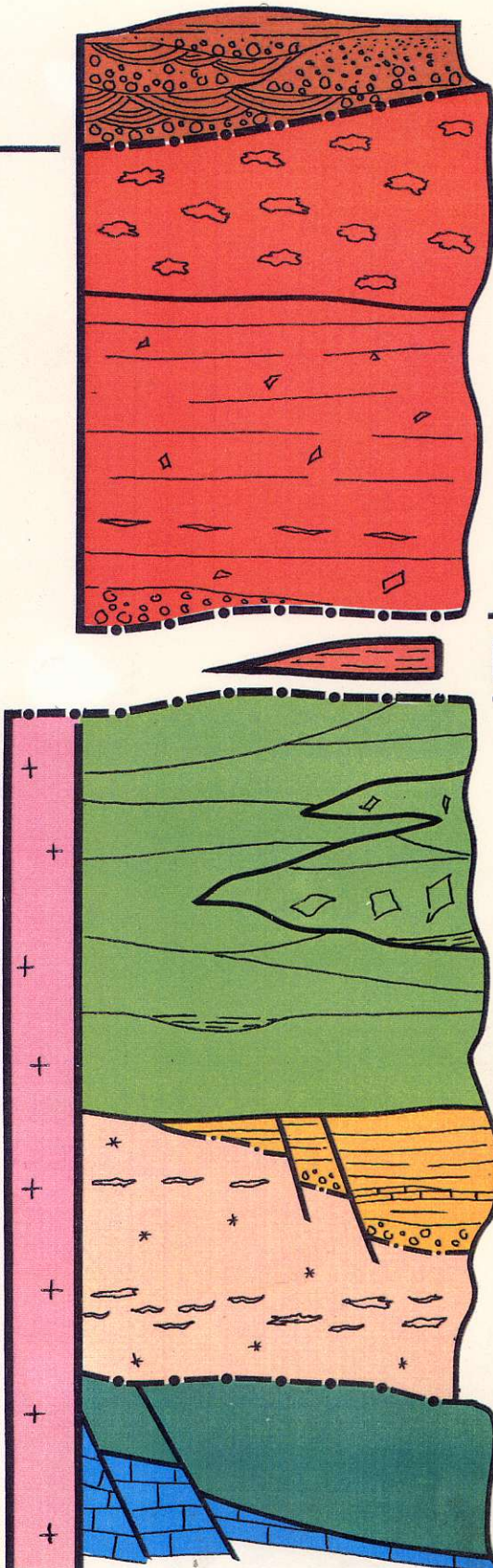
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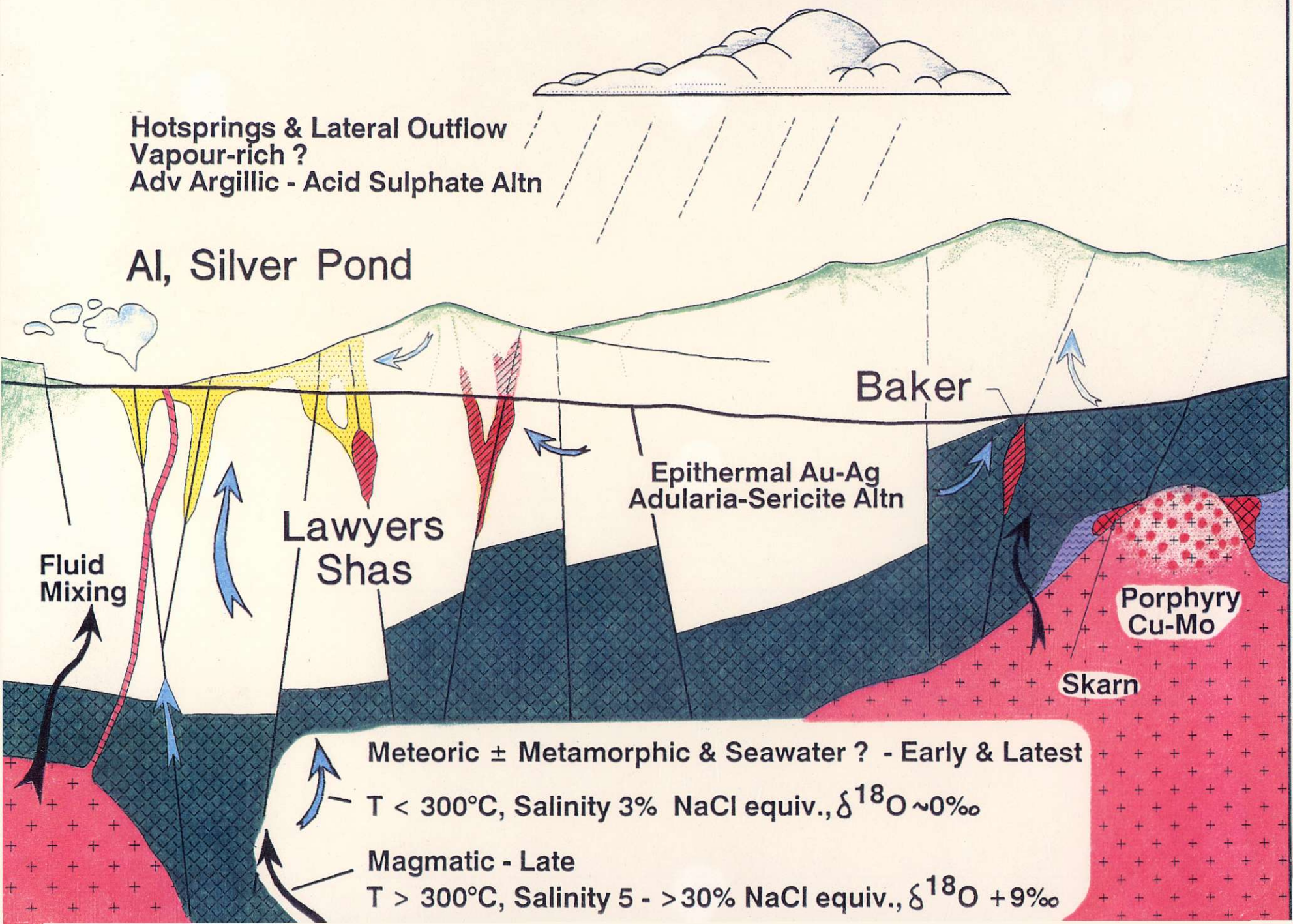
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TOODOGGONE - E. JURASSIC HYDROTHERMAL SYSTEMS



Epithermal Precious Metal Deposits In Toodoggone River Area, British Columbia Implications For Deposits In Mesozoic And Older Volcanic Terranes

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The Canadian Cordillera has long been known as a region of numerous small gold deposits. Much current exploration is directed toward gold-silver deposits of the epithermal type; these are generally small, high-grade vein or breccia-related precious metal deposits formed in subaerial volcanic terranes and regions with subvolcanic plutons. Some large, low-grade deposits that are amenable to open pit mining occur in both volcanic and sedimentary rocks. Many British Columbia epithermal occurrences closely resemble the so-called 'Tertiary-type, or bonanza deposits', which are precious metal deposits of volcanic association, or fossil hot spring deposits of the southwestern United States.

In the early 1970's explorationists discovered electrum and argentite-bearing quartz veins and amethyst breccia zones in Toodoggone River area of north-central British Columbia; subsequently these volcanic hosted epithermal deposits were determined to be of Jurassic age, not Tertiary. Exploration in Toodoggone area resulted in production from the small Baker mine during the early 1980's, and discovery of several promising properties. One, the Lawyers deposit, contains reserves of at least 1 million tonnes containing 7.2 g/t gold and 254 g/t silver. Although the area is remote, and all mining and exploration is done on a fly-in basis, the Toodoggone River area is now recognized as a major new gold 'camp' in the Canadian Cordillera.

The deposits occur along the central axis of a belt that is 20 kilometres wide and 100 kilometres long that consists of early Jurassic rocks called the 'Toodoggone volcanics' (Carter, 1972). The volcanics unconformably overlie late Triassic subaqueous basaltic volcanic rocks. The Toodoggone volcanics are potassium-rich andesitic subaerial pyroclastic rocks, and form a distinctive region within the upper part of the extensive Mesozoic island arc — back arc complex of the Intermontane tectonic zone. The volcanic belt is extensively block faulted; otherwise, there is little tectonic disruption of stratigraphy and little metamorphism above zeolite grade. No caldera development has been recognized despite detailed regional mapping but regional subsidence occurred during volcanism and local grabens developed. Northwesterly trending faults with strike lengths exceeding 20 kilometres have been outlined in the region. On a property scale these faults have been traced more than 1.5 kilometres; contrary to most Cordilleran trends, some faults show left lateral movement.

Hydrothermal fluids focussed along the major faults, particularly where they are intersected by local northeasterly trending structures. Hydrothermal alteration produced extensive propylitic zones with more restricted internal areas of clay alteration and local zones of silicification. Gold and silver are found within quartz and amethystine quartz veins, stockworks and pervasive silica replacement zones. Precious metal values are derived from electrum, argentite, native gold and silver, and silver sulphosalts. Pyrite and base metal sulphides are present and locally abundant. Barite, gypsum, alunite, hematite, adularia, calcite, and fluorite occur in parts of some deposits.

Following the initial discovery successful exploration in the area relied heavily on traditional prospecting. More recent soil, silt, rock geochemical and resistivity geophysical surveys, integrated with geological mapping and careful large-volume sampling are proving effective. The method involves extensive back-hoe trenching, blasting, and large diameter diamond drilling. Future discoveries will probably result from the application of depth-zoning geological models.

Ministry studies in the Toodoggone precious metal district have produced geological maps at 1:50 000 scale and several reports describing the geology, alteration, and mineralization. We have summarized our geological knowledge in a depth zoning model that compares Toodoggone deposits with similar epithermal and hot spring deposits in the U.S.A. and elsewhere.

HISTORY

1824 - Samuel Black noted in his diary the unusual and many gossanous colours in the headwaters of the Finlay River.

1925 - Discovery of gold by Charles McClair who mined placer deposits reportedly valued at \$17,500.

1927 - McClair and partner went missing.

1929 - First reconnaissance of the area by Cominco who staked several base metal skarn showings.

1933 - Efforts to relocate McClair's workings resulted in the formation of Two Brothers Valley Gold Mines Ltd., in which the legendary Grant McConachie (first president of CP Air) played an active role.

1940's - 1950's - Occasional horse-supported prospecting parties.

~1953 dit helicopter rescue of area
Late 1960's - Northward expansion of porphyry copper exploration.

1967-1968 - Kennco Explorations (Western) Ltd. conducted program of gossan sampling and detailed stream silt sampling.

1969 - Kennco prospector (the late) Gordon Davies and geologist Bob Stevenson checked out a copper silt anomaly and a gold anomaly in soils from a grid on the Chappelle claims. Subsequent analyses of several selected siliceous felsenmeer floats yielded one assay which ran 274.3 g Au/t (8 oz. Au/ton) and 2400 g Ag/t (70 oz. Ag/ton). Subsequent trenching exposed the source of the float in a 4 metre (13 feet) wide vein of high grade gold-silver mineralization.

1969-1974 - Realization that Toadoggone district had precious metal potential.
- Discovery of several Au-Ag occurrences on the Chappelle and Lawyers properties.
- Black Lake airstrip used as staging point.

1971-1975 - Regional mapping (1:250,000) by GSC.

1973 - Conwest optioned Chappelle property and explored underground by an adit.
- Kennco discovered the AGB Zone on Lawyers property during routine follow-up of geochemical anomalies.

1974 - Du Pont of Canada Exploration Ltd. optioned the Chappelle claims.

1974-1975 - Trenching and drilling in 10 holes on the Lawyers property yielded an intersection of 0.19 oz. Au/ton (6.5 g Au/t) and 3.15 oz. Ag/ton (108 g Ag/t) over 90 feet (27.5 m).

1978 - Kennco optioned Lawyers property to Semco Mining Corp. Serem (now Cheni Gold) examined Lawyers property.
- Asarco optioned the Shasta property from International Shast Res., but later returned the property.

1979 - Serem obtained an assignment of agreement from Semco for the Lawyers property and commenced a small exploration program on the AGB Zone.
- Energex acquired the Al, Moose and JD properties.

1980 - Du Pont of Canada Exploration and Provincial Government built Sturdee airstrip.

- First staking rush (2000 new units) and work by Serem, Du Pont, Texasgulf (now Kidd Creek Mines Ltd.), Lacana, Great Western Petroleum (now Cassidy Res.), and Taiga (now Golden Rule Res.).

1980-1983 - Baker Mine (ex-Chappelle) put into production at a rate of 100 tpd. Milled 87,740 tons of ore yielding 37,558 ounces (1,287,675 g) gold and 752,198 ounces (25,789,108 g) silver.

- Initial ore reserves estimated at 100,000 tons grading 1 oz. Au/ton and 20 oz. Ag/ton.
- Serem established Cliff Creek and Dukes' Ridge zones on Lawyers property.
- Regional mapping (1:50,000) by B.C. Ministry of Mines.

1981 - Kidd Creek Mines optioned Al, Moose, and JD properties from Energex and conducted trenching and drilling programs until late Fall 1984 when they returned the properties to Energex.
- Staking 'rush' continued.

1982 - Drilling programs by Kidd Creek (JD, Al, Porphyry Pearl), Serem (Lawyers), Lacana (Metsantan), and Du Pont (Baker).
- Newmont explore Golden Lion property.

1983 - Drilling on JD, Al, Lawyers, Shasta, and Golden Lion.

1984 - Newmont conducted drill programs on the Shasta (under option) and Golden Lion properties. Geologic reserves outlined on Shasta.
- Drilling also on Lawyers, JD, and Al properties.
- St. Joe Canada optioned the Silver Pond property and began exploration.
- Estimated \$3 million spent on exploration.

1985 - Major underground program at Lawyers property led to feasibility studies.
- Large program by Energex on Al and Moose properties.
- Multinational makes deal on Chappelle property and discovers significant potential of B Vein.
- Estimated \$6 million spent on exploration.

1986 - Feasibility study completed on Lawyers property with decision to proceed with indicated reserves of 1 million tons grading nearly 0.35 oz. Au equivalent /ton.
- Multinational establish possible new ore reserves in B Vein of 50,000 tons grading 0.36 oz. Au/ton.
- Energex outlines ore reserves in Thesis III, BV, and Bonanza-Ridge Zones and processes approximately 260 tons of ore with heads averaging 1.4 oz. Au/ton (48 g Au/t) through a 7 ton-per-day test plant. Heap leaching study conducted.
- Manson Creek/Golden Rule identify by drilling an orebody on 'A' Zone, Mets property.
- Cyprus Gold (Canada) Inc. optioned Moosehorn property and initiate drilling.
- Approximately \$4 million spent on exploration.

1987 - See 'Highlights'.
- Construction of Omineca Resource Road into Toadoggone.

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TOODOGGONE GOLD CAMP

PROPERTY NAME	OPERATOR	YEAR OF DISCOVERY (New Discovery)	DIMENSIONS (Drill Tested)			ORE	MINERALOGY GANGUE	RESERVES (tonnes @ g/tonne)
			Length (m)	Width (m)	Depth (Min.) (m)			
BAKER (ex-Chapelle)	Multinational Resources Inc. (ex-DuPont of Canada Exploration Ltd.)	1969 (1986)	435 x 0.5 to 9 x 150			Electrum, argentite, with minor chalcopyrite, sphalerite, pyrite, galena, bornite, polybasite, stromeyerite	Quartz, chlorite, calcite and trace flourite	—Produced 1 168 175 g Au (34 072 oz.) and 23 084 969 g Ag (673,326 oz.) from 77 500 tonnes (85,500 tons), 1980-1983 —Active exploration on 'B' Vein incl. 7m @ 21.6 Au + 61.4 Ag
LAWYERS AGB Zone Cliff Creek Zone Duke's Ridge Zone	Serem Inc.	1973	500 x 60 to 75 x 150 660 x 9 x 250 480 x 5 x 100			Native gold, native silver, electrum, argentite, with minor pyrite, chalcopyrite, sphalerite, galena and chalcocite	Chalcedony, quartz, amethyst, calcite, with minor adularia, hematite, barite, kaolinite, illite, montmorillonite	Total = 941 000 @ 7.2 Au (0.21 oz./ton) and 260 Ag (7.61 oz./ton or ~ 0.36 oz./ton gold-equivalent AGB ~ 50%; Cliff Creek ~ 45%; Duke's Ridge ~ 5% Note: 20% of known surface strike-lengths drilled
AL Thesis III Zone BV Zone Bonanza-Ridge Zone	Energex Minerals Ltd.	1981	200 x 5 to 30 x 75 500 x 5 x 50 300 x 3 to 5 x 35			Native gold with minor pyrite, tetrahedrite, electrum, argentite, chalcopyrite, galena and sphalerite	Quartz, barite, calcite with minor alunite, illite, hematite, sericite	Thesis III 121 624 @ 8.49 Au BV 117 926 @ 8.54 Au Total 239 550 @ 8.51 Au (open pitable) 1986: Pilot mill @ 6 tpd.
SHAS Creek Zone	International Shasta Resources Inc.	1982	370 x 2 to 23 x 100			Native silver, electrum, argentite, with minor native gold, galena, chalcopyrite, and sphalerite	Chalcedony, quartz with minor barite	2 176 800 @ 2.7 Au (0.079 oz./ton) incl. 471 640 @ 5.9 Au (0.172 oz./ton)
METS	Manson Creek Resources Ltd.	1981	125 x 5 to 9 x 60			Native gold, pyrite	Quartz, barite, hematite	OPEN, includes 13m @ 18 Au
SILVER POND West Zone Cloud Creek Zone	St. Joe Canada Inc.	1985				Electrum, pyrite, argentite, with minor chalcopyrite and tetrahedrite	Quartz, kaolinite, alunite	OPEN, includes values to 17.1 Au
JD Vein Zone Gasp Zone Gumbo Zone	Energex Minerals Ltd.	1981	600 x 1 to 4.6 x 50 150 x 20 x ? 400 x 10 x ?			Native gold, native silver, with minor galena, sphalerite, chalcopyrite and pyrite	Quartz, calcite, with minor hematite, barite, and various clays	OPEN, includes 27 210 @ 5.5 Au — Gumbo Zone (open pitable)
METSANTAN — Several Zones	Lacana Mining Corp.	1981	550 x 4 to 7 x 100 (Ridge Zone)			Chalcopyrite, galena, pyrite, sphalerite and trace polybasite	Quartz, amethyst, sericite, kaolinite, barite	OPEN, includes 4m @ 7.54 Au and 20m @ 6.3 Au
MOOSEHORN	Cyprus Metals (Canada) Ltd.	1981	670 x 1 to 5 x ?			Pyrite + argentite(?)	Amethyst, quartz, calcite	OPEN, includes assays to 16.1 Au
GOLDEN LION	Newmont Exploration of Canada Ltd.	1981	200 x 2 to 10 x 20			Galena, sphalerite, with minor pyrite, chalcopyrite, acanthite and linarite	Quartz, barite, calcite, hematite	OPEN, includes assays to 35 Au and 7 540 Ag
GOLDEN NEIGHBOUR	Lacana Mining Corp.	1980	460 x 3 to 130 x ? (geochemical anomaly)			Pyrite, argentite, sphalerite, galena, molybdenite	Quartz, kaolinite	OPEN
GOLDEN STRANGER	Western Horizons Resources Ltd.	1983	460 x 3 to 45 x ? (trenched)			Pyrite, chalcopyrite, galena, sphalerite	Amethyst, quartz	OPEN, includes 4m @ 11.7 Au (trench)

21A DEPOSIT MINERALOGY

Minerals identified by R.L. Barnett,
The University of Western Ontario

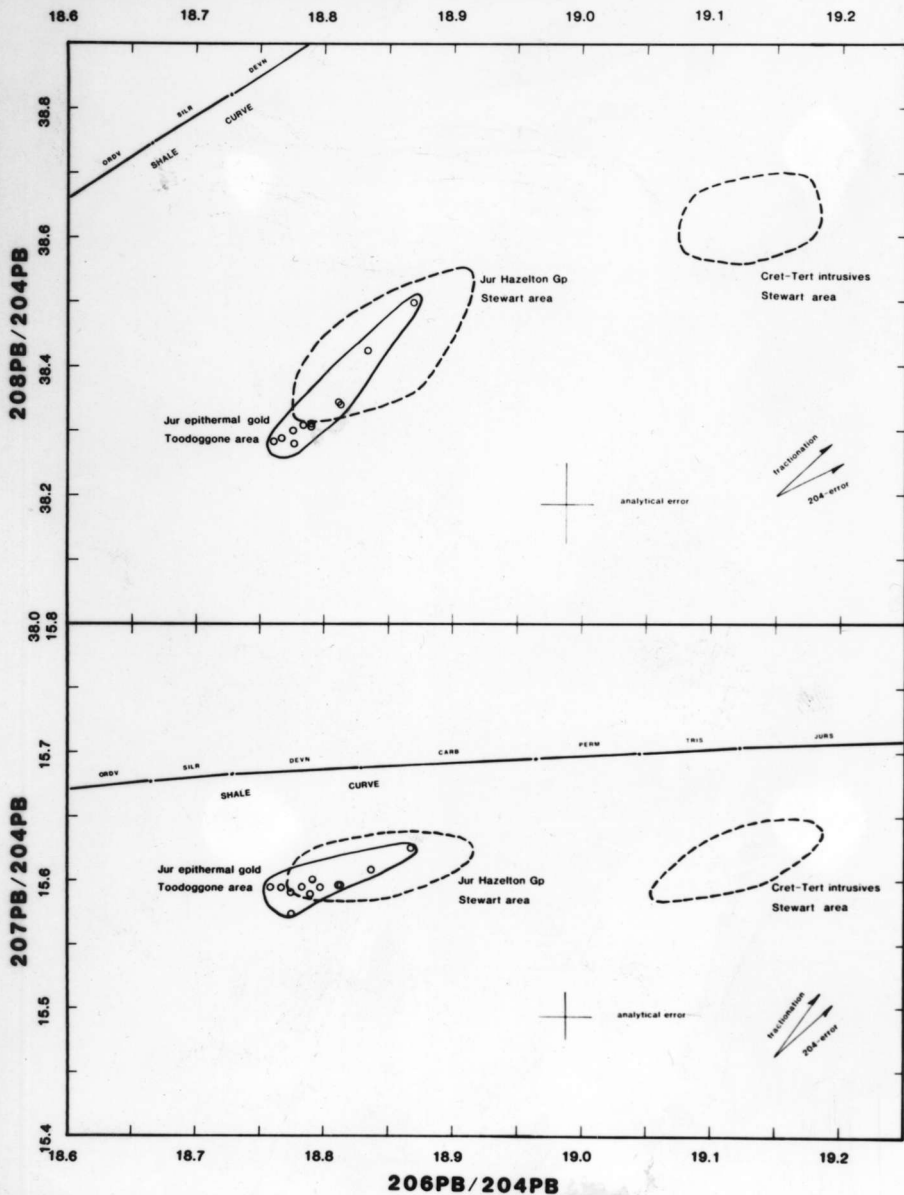
Metallic minerals

Stibnite	Sb₂S₃	Realgar	AsS
Gold	Au	Amalgam	Hg-Ag-(Au)
Aktashite	Cu₆Hg₃As₅S₁₂	Pyrite	FeS₂
Arsenic	As	Orpiment	As₂S₃
Hg-Wurtzite	(Hg,Zn)₂S	Sphalerite	ZnS
Cinnabar	HgS	Galena	PbS
Arsenopyrite	FeAsS		
Tetrahedrite	(Cu,Ag,Fe)₁₂ (Sb,As)₄ S₁₃		
Freibergite	(Cu,Fe,Zn,Ag)₁₂ (Sb,As)₄ S₁₃		

Alteration minerals

Mg-chlorite	Barite	Ba-muscovite	Calcite	Quartz
Carbon	Gypsum			

**GALENA LEAD ISOTOPES FROM JURASSIC EPITHERMAL
GOLD MINERALIZATION TOODOGGONE AREA
NORTH-CENTRAL BRITISH COLUMBIA**

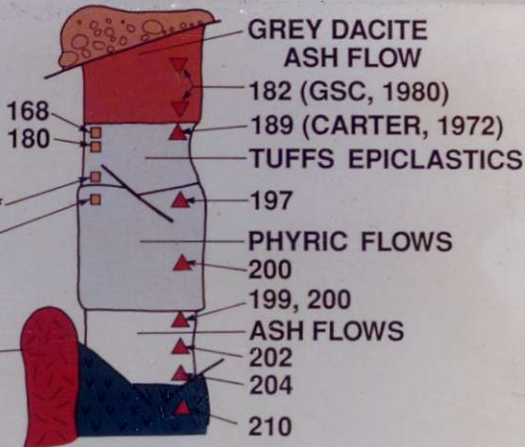


CRETACEOUS
SUSTUT GROUP

JURASSIC
TOODOGGONE
VOLCANICS

LATE TRIASSIC
TAKLA GROUP

STOCKS
180-207
Ma



RADIOMETRIC DATES, TOODOGGONE MAP-AREA, IN Ma

HOST ROCKS

(▲ -K/Ar; ▼ -Rb/Sr) ▲

HYDROTHERMAL MINERALS

(adularia: ■ - alunitic) ■



Hydrothermally altered Toodoggone andesitic crystal tuffs.

L - Kaolin Pyrophyllite C - Amorphous Clay, Kaolin
(Plag. Xls destroyed) (Plag. Xls - orange)

R - Kaolin (Relict Plag. Xls)



Toodoggone Crystal, Lithic, Lapilli Tuffs
L - orange lapilli are vitrophyre
C - chlorite alt'n of biotite
R - clay alt'd pumiceous lapilli



10 Toodoggone 'Volcanics' - Epiclastic 'Sandstones'



Toodoggone Andesitic Tuffs

L - Crystal Ash Tuff R - Lithic Ash Tuff



Typical Toodoggone 'Grey Dacite' Unit.