Cu±Ag QUARTZ VEINS I06

by David V. Lefebure[1]
Modified for Yukon by A. Fonseca
Refer to preface for general references and formatting significance.
May 30, 2005

IDENTIFICATION

SYNONYMS: Churchill-type vein copper, vein copper

COMMODITY (*BYPRODUCTS*): Cu (Ag, rarely Au).

EXAMPLES: (British Columbia - *Canada/International*): Davis-Keays (094K012, 050), Churchill Copper (Magnum, 094K003), Bull River (082GNW002), Copper Road (092K060), Copper Star (092HNE036), Copper Standard (092HNE079), Rainbow (093L044); *Bruce Mines and Crownbridge (Ontario, Canada), Blue Wing and Seaboard (North Carolina, USA), Matahambre (Cuba), Inyati (Zimbabwe), Copper Hills (Western Australia), Tocopilla area (Chile), Burgas district (Bulgaria), Butte (Montana, USA), Rosario (Chile).*

GEOLOGICAL CHARACTERISTICS

CAPSULE DESCRIPTION: Quartz-carbonate veins containing patches and disseminations of chalcopyrite with bornite, tetrahedrite, covellite and pyrite. These veins typically crosscut clastic sedimentary or volcanic sequences, however, there are also Cu quartz veins related to porphyry Cu systems and associated with felsic to intermediate intrusions.

TECTONIC SETTINGS: A diversity of tectonic settings reflecting the wide variety of hostrocks including extensional sedimentary basins (often Proterozoic) and volcanic sequences associated with rifting or subduction-related continental and island arc settings.

DEPOSITIONAL ENVIRONMENT / GEOLOGICAL SETTING: Veins emplaced along faults; they commonly postdate major deformation and metamorphism. The veins related to felsic intrusions form adjacent to, and are contemporaneous with, mesozonal stocks.

AGE OF MINERALIZATION: Any age; can be much younger than host rocks. **In Yukon, most prospects are associated with Mesozoic intrusions.**

HOST/ASSOCIATED ROCK TYPES: Cu±Ag quartz veins occur in virtually any rocks although the most common hosts are clastic metasediments and mafic volcanic sequences. Mafic dykes and sills are commonly spatially associated with metasediment-hosted veins. These veins are also found within and adjacent to felsic to intermediate intrusions.

DEPOSIT FORM: The deposits form simple to complicated veins and vein sets which typically follow high-angle faults which may be associated with major fold sets. Single veins vary in thickness from centimetres up to tens of metres. Major vein systems extend hundreds of metres along strike and down dip. In some exceptional cases the veins extend more than a kilometre along the maximum dimension.

[1] British Columbia Geological Survey, Victoria, B.C., Canada

TEXTURE/STRUCTURE: Sulphide minerals are irregularly distributed as patches and disseminations. Vein breccias and stockworks are associated with some deposits.

ORE MINERALOGY (Principal and *subordinate*):

- Metasedimentary and volcanic-hosted: Chalcopyrite, pyrite, chalcocite*; bornite, tetrahedrite, argentite, pyrrhotite, covellite, galena.*
- Intrusion-related: Chalcopyrite, bornite, chalcocite, pyrite, pyrrhotite; *enargite, tetrahedrite-tennantite, bismuthinite, molybdenite, sphalerite, native gold and electrum*.

GANGUE MINERALOGY (Principal and *subordinate)*: Quartz and carbonate (calcite, dolomite, ankerite or siderite); *hematite, specularite, barite*.

ALTERATION MINERALOGY: Wallrocks are typically altered for distances of centimetres to tens of metres outwards from the veins.

- Metasediment and volcanic-hosted: The metasedimentary rocks display carbonatization and silicification. At the Churchill and Davis-Keays deposits, decalcification of limy rocks and zones of disseminated pyrite in roughly stratabound zones are reported. The volcanic hostrocks exhibit abundant epidote with associated calcite and chlorite.
- Intrusion-related: Sericitization, in places with clay alteration and chloritization.

WEATHERING: Malachite or azurite staining; silicified linear "ridges".

ORE CONTROLS: Veins and associated dykes follow faults. Ore shoots commonly localized along dilational bends within veins. Sulphide minerals may occur preferentially in parts of veins which crosscut carbonate or other favourable lithologies. Intersections of veins are an important locus for ore.

GENETIC MODEL: The metasediment and volcanic-hosted veins are associated with major faults related to crustal extension which control the ascent of hydrothermal fluids to suitable sites for deposition of metals. The fluids are believed to be derived from mafic intrusions which are also the source for compositionally similar dikes and sills associated with the veins. Intrusion-related veins, like Butte in Montana and Rosario in Chile, are clearly associated with high-level felsic to intermediate intrusions hosting porphyry Cu deposits or prospects.

ASSOCIATED DEPOSIT TYPES:

- Metasediment and volcanic-hosted: Possibly related to sediment-hosted Cu (E04) and basaltic Cu (D03).
- Intrusion-related: High sulphidation (H04), copper skarns (K01), porphyries (L01?, L03, L04) and polymetallic veins (I05).

COMMENTS: Cu±Ag quartz veins are common in copper metallogenetic provinces; they commonly are more important as indicators of the presence of other types of copper deposits. **Yukon has no known Cu+/-Ag quartz vein type deposits, but this type of mineralization occurs associated with other deposit types.**

EXPLORATION GUIDES

GEOCHEMICAL SIGNATURE: High Cu and Ag in regional silt samples. The Churchill-type deposits appear to have very limited wallrock dispersion of pathfinder elements; however, alteration halos of silica and carbonate addition or depletion might prove useful. Porphyry-related veins exhibit many of the geochemical signatures of porphyry copper systems.

GEOPHYSICAL SIGNATURE: Large veins with conductive massive sulphides may show up as electromagnetic conductors, particularly on ground surveys. Associated structures may be defined by ground magnetic, very low frequency or electromagnetic surveys. Airborne surveys may identify prospective major structures.

OTHER EXPLORATION GUIDES: Commonly camp-scale or regional structural controls define a dominant orientation for veins.

ECONOMIC FACTORS

GRADE AND TONNAGE: Typically range from 10 000 to 100 0000 t with grades of 1 to 4% Cu, nil to 300 g/t Ag. The Churchill deposit has reserves of 90 000 t of 3 % Cu and produced 501 019 t grading 3% Cu and the Davis-Keays deposit has reserves of 1 119 089 t grading 3.43 % Cu. The Big Bull deposit has reserves of 732 000 t grading 1.94% Cu. The intrusion-related veins range up to millions of tonnes with grades of up to 6% Cu. The Butte veins in Montana have produced several hundred million tonnes of ore with much of this production from open-pit operations.

ECONOMIC LIMITATIONS: Currently only the large and/or high-grade veins (usually associated with porphyry deposits) are economically attractive.

IMPORTANCE: From pre-historic times until the early 1900s, high-grade copper veins were an important source of this metal. With hand sorting and labour-intensive mining they represented very attractive deposits.

ACKNOWLEDGEMENTS

This deposit profile represents the results of a literature review. It benefited from comments by David Sinclair and Vic Preto.

SELECTED BIBLIOGRPAHY

Benes, K. and Hanus, V., 1967. Structural Control and History of Origin of Hydrothermal Metallogeny in Western Cuba*; Mineralium Deposita*, Volume 2, pages 318-333.

Carr, J.M. (1971): Geology of the Churchill Copper Deposit; *The Canadian Institute of Mining and Metallurgy*, Bulletin, Volume 64, pages 50-54.

Hammer, D.F. and Peterson, D.W, 1968. Geology of the Magma Mine Arizona; *in* Ore Deposits of the United States 1933-1967, Ridge, J.D., Editor, *American Institute of Mining Engineers*, New York, pages 1282-1310.

Kirkham, R.D., 1984. Vein Copper; *in* Canadian Mineral Deposit Types: A Geological Synopsis, Eckstrand, O.R., Editor, *Geological Survey of Canada*, Economic Geology Report 36, page 65.

Kirkham, R.D. and Sinclair, W.D., in press. Vein Copper; *in* Geology of Canadian Mineral Deposit Types, Eckstrand, O.R., Sinclair, W.D. and Thorpe, R.I., (Editors*), Geological Survey of Canada*, Geology of Canada, No. 8, pages 383-392.

Kish, S.A. (1989): Post-Acadian Metasomatic Origin for Copper-bearing Vein Deposits of the Virgilina District, North Carolina and Virginia; *Economic Geology*, Volume 84, pages 1903-1920.

Laznicka, P., 1986. Empirical Metallogeny, Depositional Environments, Lithologic Associations and Metallic Ores, Volume 1, Phanerozoic Environments, Associations and Deposits; *Elsevier*, New York, 1758 pages.

Nockleberg, W.J., Bundtzen, T.K., Berg, H.C., Brew, D.A., Grybeck, D., Robinson, M.S., Smith, T.E. and Yeend, W., 1987. Significant Metalliferous Lode Deposits and Placer Districts of Alaska, U.S. Geological Survey, Bulletin 1786, 104 pages.

Pearson, W.N. (1979. Copper Metallogeny, North Shore of Lake Huron, Ontario; *in* Current Research, Part A, *Geological Survey of Canada*, Paper 79-1A, pages 289-304.

Pearson, W.N., Bretzlaff, R.E. and Carrière, J.J., 1985. Copper Deposits and Occurrences in the North Shore Region of Lake Huron, Ontario; *Geological Survey of Canada*, Paper 83-28, 34 pages.

Preto, V.A., 1972. Lode Copper Deposits of the Racing River - Gataga River Area; *in* Geology, Exploration and Mining in British Columbia 1971, B. C. Ministry of Energy, Mines *and Petroleum Resources*, pages 75-107.

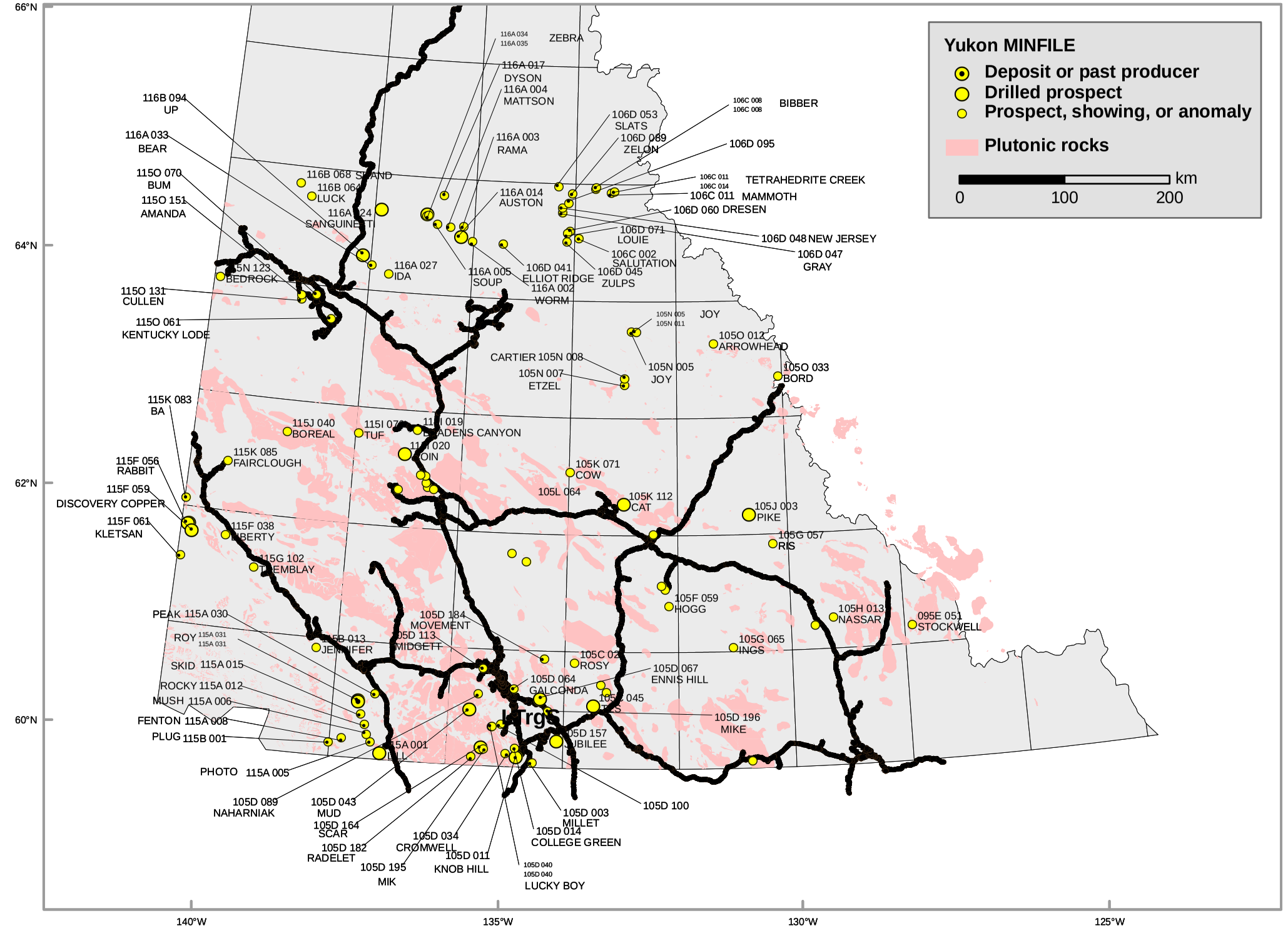
Roberts, A.E., 1973. The Geological Setting of Copper Orebodies at Inyati Mine, Headlans District, Rhodesia; *Geological Society of South Africa*, Special Publication 3, , pages 189-196.

I06 - Cu+/-Ag quartz veins - BC deposits

Deposit	Country	tonnes	Au (g/t)	Ag (g/t)	Cu	Pb	Zn
Dusty Macs	CNBC	93 392	6.49	112.99	0.00	0.00	0.00
Baker	CNBC	120 449	17.87	269.67	0.00	0.00	0.00
Mets	CNBC	144 000	11.30	0.00	0.00	0.00	0.00
Vault	CNBC	152 000	14.00	0.00	0.00	0.00	0.00
Gold Wedge	CNBC	329 000	24.90	201.20	0.00	0.00	0.00
Black Dome	CNBC	368 343	21.48	78.86	0.00	0.00	0.00
Golden Stranger	CNBC	500 000	2.70	0.00	0.00	0.00	0.00
Lawyer	CNBC	528 337	8.42	168.29	0.00	0.00	0.00
New Moon	CNBC	609 900	0.99	15.43	0.00	0.00	0.00
Shasta	CNBC	1 071 033	4.09	217.50	0.00	0.00	0.00
Sulphur	CNBC	1 437 000	11.50	783.60	0.00	0.00	0.00
Silba	CNBC	7 065 528	9.03	188.92	0.03	0.40	0.14
Cinola	CNBC	23 800 000	2.47	3.10	0.00	0.00	0.00

Yukon MINFILE

MINFILE	NAMES	STATUS
115A 031	JOHOBO, JAC, MOOSE, ROY, JEAN	OPEN PIT PAST PRODUCER
105J 003	PIKE	DEPOSIT
105C 045	TES	DRILLED PROSPECT
105D 011	KNOB HILL	DRILLED PROSPECT
105D 067	MCCLINTOCK, ENNIS HILL	DRILLED PROSPECT
105K 112	STARLIGHT	DRILLED PROSPECT
115A 001	JACKPOT, PET, KEM, KAY, ALDER HILL, TATS, LILL	DRILLED PROSPECT
115F 056	RABBIT	DRILLED PROSPECT
115I 020	COIN	DRILLED PROSPECT
116A 014	AUSTON	DRILLED PROSPECT
116B 094	O'BRIEN, AJ	DRILLED PROSPECT
105D 064	GALCONDA	PROSPECT
105F 018	KOPINEC	PROSPECT
105F 067	FURY	PROSPECT
106D 045	ZULPS	PROSPECT
115A 006	MUSH	PROSPECT
115B 013	JENNIFER	PROSPECT
115I 010	BONANZA CREEK, WILLIAMS & MERRICE CREEKS	PROSPECT
115I 019	BRADENS CANYON	PROSPECT
115O 070	BUM	PROSPECT
116A 027	IDA	PROSPECT
095E 051	STOCKWELL	SHOWING
105C 018	MT. GRANT	SHOWING
105C 024	ROSY	SHOWING
105D 003	MILLET	SHOWING
105D 014	COLLEGE GREEN	SHOWING
105D 034	CROMWELL	SHOWING
105D 089	NAHARNIAK	SHOWING
105D 113	MIDGETT	SHOWING
105D 182	RADELET	SHOWING
105D 195	MIK	SHOWING
105D 196	MIKE	SHOWING
105E 014	SEMENOF	SHOWING
105E 016	CASSIER BAR	SHOWING
105F 059	HOGG	SHOWING
105G 057	RIS	SHOWING
105G 065	INGS	SHOWING
105H 013	FRANCES, MINK, LUCKY, SU, NIPRO, JOE	SHOWING
105H 015	DOUG, EVA	SHOWING
105K 003	RAGS, KO	SHOWING
105L 065	GLAD	SHOWING
105N 007	ETZEL	SHOWING
105N 008	CARTIER	SHOWING
105N 011	AUREOLE	SHOWING
106C 002	SALUTATION	SHOWING
106C 008	BIBBER	SHOWING
106C 011	MAMMOTH	SHOWING
106C 094	CAROL	SHOWING
106D 041	ELLIOT RIDGE	SHOWING
106D 047	GRAY	SHOWING
106D 048	NEW JERSEY	SHOWING
106D 053	SLATS	SHOWING
106D 060	DRESEN	SHOWING
106D 071	LOUIE	SHOWING
106D 089	ZELON	SHOWING
115A 005	PHOTO	SHOWING
115A 008	FENTON	SHOWING
115A 015	BELOUD, ELLEN, DORTHY ANN, SKID, EARLY	SHOWING
115F 038	LIBERTY	SHOWING
115F 061	KLETSAN	SHOWING
115I 009	MERRICE, HOMESTAKE	SHOWING
115I 013	HOOCHEKOO	SHOWING
115I 051	CASTLE	SHOWING
115I 077	CROSSING	SHOWING
115I 095	BLUFF	SHOWING
115K 083	RIP, ELDORADO, BEAVER, BA	SHOWING
115K 085	FAIRCLOUGH	SHOWING
115O 151	AMANDA	SHOWING
116A 002	WORM	SHOWING
116A 003	RAMA	SHOWING
116A 004	MATTSON	SHOWING
116A 005	SOUP	SHOWING
116A 034	HAWLEY	SHOWING
116A 035	BRIDEN	SHOWING
116B 064	FIFTEEN MILE, JOE, LUCK, CHAMOX, GEM, MOVIE	SHOWING
116B 068	SHAND, SHAND LODE	SHOWING
105L 066	FRENCHMAN	ANOMALY
105N 005	JOY	ANOMALY
115B 001	PLUG	ANOMALY
105C 042	THOM	UNKNOWN
105K 071	COWARD, TAY, COW	UNKNOWN
115G 102	TREMBLAY	UNKNOWN



Map of Yukon showing Cu-Ag vein occurrences and the distribution of plutonic rocks