Yukon Geological Survey

CSA Global
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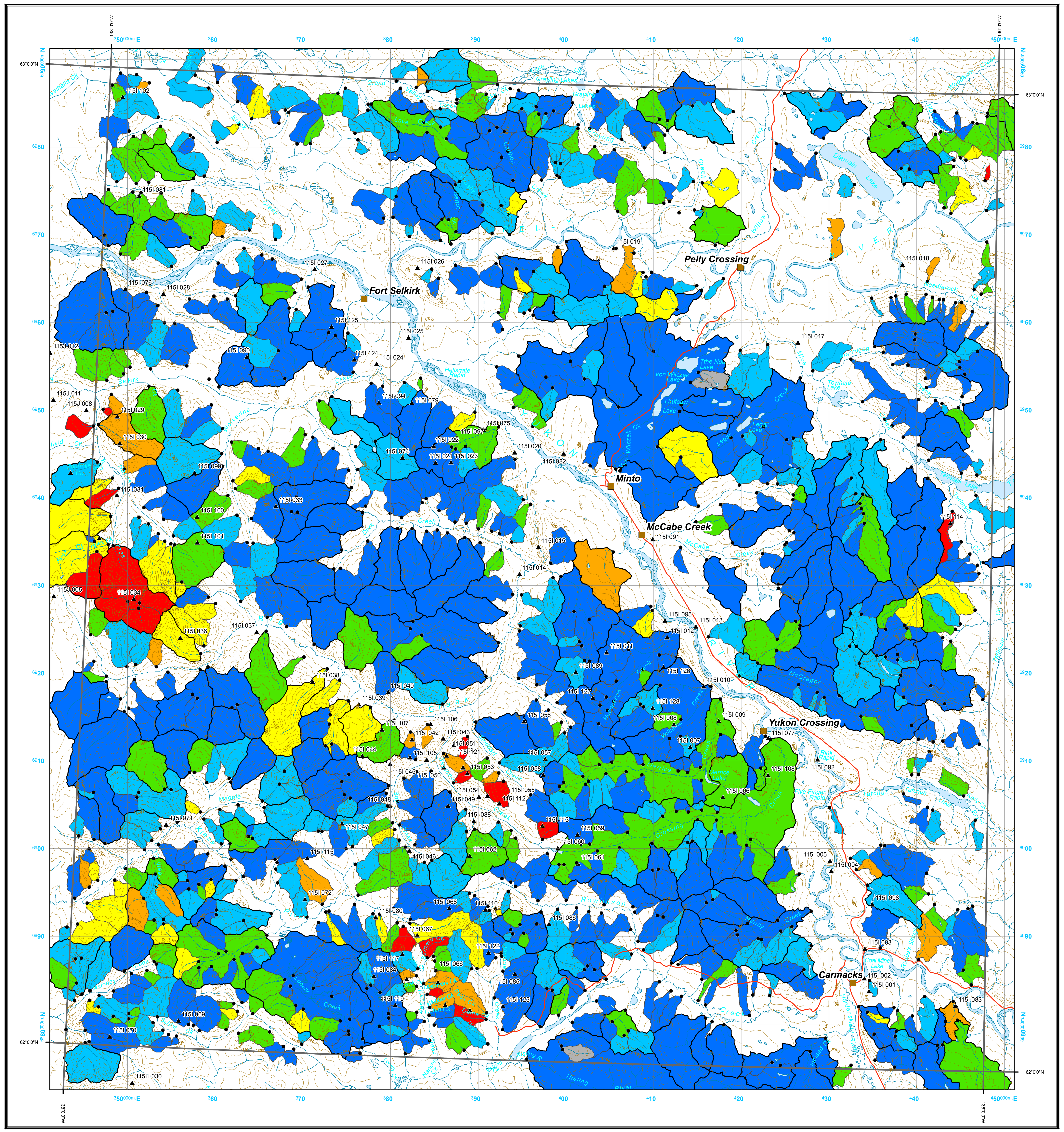
Yukon
Energy, Mines and Resources



INTRODUCTION

New geochemical data from re-analysis of archived stream sediment samples have been assessed using weighted sums modeling and catchment basin analysis as described in the methodology report that accompanies this map (Mackie *et al.,* 2015). Both commodity and pathfinder element abundances are evaluated to highlight areas that show geochemical responses consistent with a variety of base and precious-metal mineral deposit types. The results of modeling, completed using two approaches, are presented as a series of catchment maps and associated data files. This release is part of a regional assessment of stream sediment geochemistry that covers a large part of Yukon.

SAMPLING AND ANALYSIS PROGRAMS

Stream sediment and water samples from the Carmacks area (NTS 115I) were collected at a reconnaissance scale in 1985 under the direction of the Geological Survey of Canada (GSC) in conjunction with the Department of Indian Affairs and Northern Development and the government of Yukon (Geological Survey of Canada, 1986). Geochemical data for 951 sample sites were first released in GSC Open File 1220 (Geological Survey of Canada, 1986). As part of an ongoing database upgrade project by the Yukon Geological Survey (YGS), archived sample material has been re-analyzed by inductively coupled plasma mass spectrometry following an aqua-regia digestion as described in YGS Open File 2015-14 (Jackaman, 2015). The reader is referred to these reports for detailed descriptions of sampling techniques, analytical procedures and quality control measures.

MINERAL OCCURRENCES

The Carmacks area contains several significant base and precious-metal deposits of various types (Table 1). These include the Minto Cu-Au-Ag mine, past producing Mt. Nansen epithermal Au-Ag and Caribou Creek Au mines, Klaza and Tintina polymetallic Ag-Au-Pb-Zn deposits and the Nucleus and Revenue Cu-Mo-Au porphyry deposits. The Casino Cu-Mo porphyry deposit occurs in the adjacent map area to the west supporting the prospectivity of the region for this deposit type.

WEIGHTED SUMS MODELING

As described in the methodology report (Mackie *et al*., 2015), two approaches have been used to subdue the influence of background lithological variation on the composition of stream sediments. One uses data levelled by the dominant geology mapped within each catchment, while the other uses residuals calculated from regression against principal components interpreted to represent geologic horizons that exhibit strong influence on the distribution of commodity and pathfinder elements of interest.

Weighted sums models (WSM) have been generated using the processed data. The importance rankings used in WSMs are summarized in Table 2 for a variety of deposit types. Each model is optimized for a target deposit type however other deposit types may be represented in a given model due to similarities in elemental abundances and associations.

Exploratory data analysis of both raw element data and principal components shows that the much of the variability can be related to mineralization and the influence of lithological variation is of lesser importance for certain elements. This differs from some of the other map areas evaluated in this project where the lithological control was of particular importance. The first principal component, accounting for ~28% of the total variation, shows high positive loadings for Mg, Co, Cr and Sc; and high negative loadings for Ag, Cd, Sb, Pb, Bi, Tl, Mo and As. Respectfully, these element groupings form spatial patterns matching distribution of Carmacks group mafic-intermediate volcanic rocks and occurrences of Cu porphyry and Ag-Pb-Zn vein/manto-style mineralization. The second principal component shows high negative loadings for Cu, loss-on-ignition and Cd, and is interpreted to reflect scavenging by organic material. This interpretation is supported by the fact that most inverse PC2 responses correspond to samples collected in areas of subdue topography adjacent to rivers and lakes. Principal components 5 and 6, with high loadings of Al, LOI, Mn, Fe, As, Zn, Pb and Co, are also relatable to possible scavenging by clay minerals and Fe-Mn oxides/hydroxides. Regression analysis using the relevant principal component(s) effectively filters these effects resulting in enhanced responses related to known mineral occurrences. Levelling by dominant mapped geology has a more subdued effect on filtering the interpreted lithological control however given the strong mineralization signal on the map

Table 2: Importance rankings for weighted sums models using data levelled by dominant mapped geology.

Target Deposit Type[a]	Other Deposit Types[a]	Mn	Fe	Co	Ni	Cu	Mo	Zn	Pb	Ag[1]	Au[1]	As[1]	Ba	Cd	Sn	Sb	Te[1]	Hg[1]	Tl	Bi	W
Polymetallic Ag-Pb-Zn	VMS (Zn-rich); SEDEX; Pb-Zn skarn							2	3	4		1				1					
Porphyry Cu-Mo	Cu skarn; Porphyry Mo; VMS (Cu-rich)					5	3		-2	2	2	1					1				
Porphyry Cu-Au	Cu skarn; Porphyry Mo; VMS (Cu-rich)					5			-2	1	1						2				
Epithermal Au-Ag	Intrusion-related and orogenic Au; Polymetallic Ag-Pb-Zn									3	3	1				2	1				
VMS (Zn-rich)	Polymetallic Ag-Pb-Zn; SEDEX; Pb-Zn skarn					1		5	3	1			1	1					1		
Orogenic Au	Intrusion-related Au; Epithermal Au-Ag					-2					3	3				1				1	
Hydromorphic Anomaly		4	4	2								2									

[a]Polymetallic Ag-Pb-Zn type includes vein and manto styles; SEDEX = sedimentary exhalative; VMS = volcanic-hosted/associated massive sulphide deposits

[1] For heavily censored elements and those not strongly controled by geology, raw data are used following a $\log_{10}$ transformation.

Table 1: List of Mineral Occurrences for NTS map sheet 115I (Yukon MINFILE, 2015)

Number	Name	Type	Status	Commodities
115I 068	DIVIDE	Vein Au-Quartz	Drilled Prospect	Gold, Silver
115I 069	SCHIST	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Anomaly	Asbestos, Copper, Nickel
115I 070	MALONEY	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum, Gold, Silver, Tungsten
115I 071	CHART	Unknown	Anomaly	Copper
115I 074	COMANCHE	Porphyry Cu-Mo-Au	Drilled Prospect	Copper
115I 075	NORTHAIR	Unknown	Anomaly	Copper
115I 076	TUF	Porphyry Cu-Mo-Au	Showing	Copper
115I 077	CROSSING	Vein Cu+/-Ag Quartz	Showing	Copper
115I 079	ORI	Porphyry Cu-Mo-Au	Anomaly	Copper, Gold
115I 080	RICO	Unknown	Anomaly	Copper, Lead, Zinc, Gold
115I 081	KERR	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum
115I 083	MEYERS	Unknown	Unknown	Coal
115I 084	LONELY	Vein Au-Quartz	Showing	Copper, Silver, Gold
115I 085	CAR	Vein & Disseminations Stibnite	Prospect	Antimony, Copper, Tungsten, Silver, Mercury, Lead, Gold, Arsenic
115I 086	ROWLINSON	Vein & Disseminations Stibnite	Showing	Antimony, Mercury, Silver, Arsenic, Gold
115I 087	KOOK	Porphyry Cu-Mo-Au	Anomaly	Copper, Molybdenum
115I 088	BATH	Porphyry Alkalic Cu-Au	Anomaly	Antimony, Copper
115I 092	RINK	Coal	Anomaly	Coal
115I 093	GOULTER	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Gold, Lead, Molybdenum, Zinc, Silver
115I 095	BLUFF	Vein Cu+/-Ag Quartz	Showing	Copper, Silver, Gold
115I 096	RUSK	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	Copper, Lead, Silver, Molybdenum, Gold
115I 098	HLAVAY	Coal	Drilled Prospect	Coal
115I 100	PITTS	Epithermal Au-Ag-Cu: High Sulphidation	Showing	Antimony, Mercury, Arsenic, Gold
115I 102	LUMBY	Porphyry Cu-Mo-Au	Anomaly	Copper, Molybdenum
115I 105	MERIDIAN	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	Lead, Silver, Zinc
115I 106	HAPPY	Vein Au-Quartz	Showing	Gold, Lead, Zinc
115I 107	NUCLEUS	Porphyry Cu-Mo-Au	Deposit	Gold, Silver, Copper, Tungsten, Molybdenum
115I 108	TOOT	Porphyry Cu-Mo-Au	Showing	Copper
115I 110	ROW	Unknown	Anomaly	Copper, Silver, Zinc, Lead
115I 111	ANTONIUK	Porphyry Subvolcanic Cu-Au-Ag (As-Sb)	Deposit	Gold, Silver, Copper
115I 112	WHALE	Vein Au-Quartz	Drilled Prospect	Gold, Silver
115I 113	FIELD	Unknown	Anomaly	Gold
115I 115	TOAST	Unknown	Anomaly	Gold
115I 117	DIC	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Antimony, Gold, Copper, Lead, Silver, Zinc
115I 119	DOWS	Epithermal Au-Ag-Cu: High Sulphidation	Drilled Prospect	Gold
115I 120	ELEPHANT	Unknown	Anomaly	Copper, Lead, Zinc, Silver, Gold
115I 121	STODDART	Vein Au-Quartz	Showing	Antimony, Gold, Copper, Lead, Silver, Zinc
115I 122	GRIZZLY	Vein Au-Quartz	Showing	Gold, Silver, Tungsten
115I 123	ANG	Unknown	Showing	Gold
115I 001	SOUTH TANTALUS	Coal	Deposit	Coal
115I 002	TANTALUS MINE	Coal	Past Producer	Coal
115I 003	TANTALUS BUTTE	Coal	Past Producer	Coal
115I 004	FIVE FINGERS	Coal	Past Producer	Coal
115I 006	BCICE	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Gold
115I 008	CARMACKS COPPER	Porphyry Alkalic Cu-Au	Deposit	Copper, Gold, Copper - Oxide, Copper - Total, Copper - Sulphide, Silver
115I 012	MAUD	Unknown	Unknown	Copper
115I 013	HOOCHEKOO	Vein Cu+/-Ag Quartz	Showing	Copper, Gold, Silver
115I 017	TOWHATA	Coal	Anomaly	Coal
115I 018	NEEDLEROCK	Coal	Showing	Coal
115I 019	BRADENS CANYON	Vein Cu+/-Ag Quartz	Prospect	Copper, Silver
115I 020	COIN	Vein Cu+/-Ag Quartz	Drilled Prospect	Copper, Gold, Silver
115I 021	MINTO	Porphyry Alkalic Cu-Au	Producer	Copper, Silver, Gold, Lead, Zinc
115I 022	MINTO NORTH	Porphyry Alkalic Cu-Au	Deposit	Copper, Silver, Gold
115I 023	PAL	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Gold, Silver
115I 025	GRENIER	Coal	Showing	Coal
115I 026	PELLY	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum
115I 029	AMADEUS	Porphyry Cu-Mo-Au	Drilled Prospect	Antimony, Arsenic, Copper, Zinc, Lead, Silver, Gold
115I 031	TAD/TORO	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Gold, Zinc, Molybdenum, Silver, Lead
115I 032	PHELPS	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Copper, Molybdenum, Gold
115I 034	PROSPECTOR MOUNTAIN	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	Copper, Silver, Zinc, Gold, Lead
115I 036	STARBIRD	Porphyry Subvolcanic Cu-Au-Ag (As-Sb)	Showing	Copper, Zinc, Silver
115I 037	CASH	Porphyry Cu-Mo-Au	Deposit	Copper, Molybdenum, Zinc, Silver, Gold, Antimony, Lead
115I 038	KLAZAN	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Gold, Silver, Molybdenum
115I 039	COM	Porphyry Cu-Mo-Au	Anomaly	Copper, Fluorite, Tungsten
115I 042	REVENUE	Porphyry Cu-Mo-Au	Deposit	Copper, Gold, Silver, Molybdenum, Tungsten
115I 043	COMBO	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Gold, Tungsten, Zinc, Lead, Silver
115I 045	NEWKIRK	Porphyry Cu-Mo-Au	Showing	Copper, Zinc, Molybdenum
115I 046	LIL	Vein Au-Quartz	Showing	Gold
115I 047	TRITOP	Porphyry Mo (Low F-Type)	Anomaly	Copper, Molybdenum, Gold
115I 048	EDGAR	Porphyry Cu-Mo-Au	Anomaly	Copper, Molybdenum
115I 049	CARIBOU CREEK	Vein Au-Quartz	Past Producer	Gold, Silver
115I 050	GRANGER	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Silver, Molybdenum, Gold
115I 051	CASTLE	Vein Cu+/-Ag Quartz	Showing	Antimony, Gold, Copper, Lead, Zinc, Silver
115I 052	RED FOX	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	Gold, Lead, Zinc, Silver
115I 053	GUDER	Skarn Au	Deposit	Silver, Gold
115I 054	LAFORMA	Epithermal Au-Ag-Cu: High Sulphidation	Deposit	Silver, Gold, Lead, Zinc, Copper
115I 055	EMMONS HILL	Epithermal Au-Ag-Cu: High Sulphidation	Drilled Prospect	Antimony, Mercury, Silver, Gold
115I 058	TINTA HILL	Vein Polymetallic Ag-Pb-Zn+/-Au	Deposit	Copper, Gold, Zinc, Silver, Lead
115I 060	WOLF	Unknown	Anomaly	Arsenic, Gold
115I 062	FOSTER	Skarn Au	Showing	Gold
115I 064	BROWN-MCDADE	Epithermal Au-Ag-Cu: High Sulphidation	Past Producer	Gold, Silver, Lead, Copper, Zinc, Antimony
115I 065	MOUNT NANSEN	Epithermal Au-Ag-Cu: High Sulphidation	Past Producer	Silver, Gold
115I 066	CYPRUS	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Gold, Molybdenum
115I 005	CONGLOMERATE	Unknown	Anomaly	
115I 011	STU	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Silver, Gold
115I 067	KLAZA	Vein Polymetallic Ag-Pb-Zn+/-Au	Deposit	Copper, Gold, Zinc, Silver, Lead
115I 099	RAND	Unknown	Unknown	
115I 059	ZERO	Unknown	Unknown	
115I 030	CHAT	Unknown	Unknown	
115I 028	MINNESOTA	Vein Au-Quartz	Unknown	
115I 033	TERRA	Unknown	Anomaly	
115I 061	OPAL	Unknown	Unknown	
115I 101	PANTHER	Epithermal Au-Ag-Cu: High Sulphidation	Anomaly	Arsenic, Gold
115I 094	GIANT	Porphyry Cu-Mo-Au	Anomaly	Copper
115I 124	TOE	Porphyry Cu-Mo-Au	Anomaly	Copper
115I 125	PEPPER	Porphyry Cu-Mo-Au	Anomaly	Copper
115I 014	VERLENE	Porphyry Cu-Mo-Au	Unknown	Copper, Silver, Gold
115I 089	BEAVON	Unknown	Unknown	Copper
115I 126	BUTTER	Porphyry Cu-Mo-Au	Anomaly	Copper, Gold
115I 127	HOOCHE	Porphyry Cu-Mo-Au	Anomaly	Copper, Gold
115I 128	GRAN	Porphyry Cu-Mo-Au	Anomaly	Copper
115I 010	BONANZA CREEK	Vein Cu+/-Ag Quartz	Prospect	Copper, Gold, Silver
115I 007	WS	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Silver, Gold
115I 009	MERRICE	Vein Cu+/-Ag Quartz	Showing	Copper, Silver, Gold
115I 057	GRANITE MOUNTAIN	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	Copper, Molybdenum, Gold
115I 056	MORI	Unknown	Unknown	
115I 072	PHEOBE	Unknown	Unknown	
115I 044	EGG	Unknown	Unknown	
115I 082	LEIS	Unknown	Anomaly	
115I 091	MCCABE	Unknown	Drilled Prospect	
115I 024	ADERA	Porphyry Cu-Mo-Au	Anomaly	
115I 097	BOYLEN	Unknown	Anomaly	
115I 114	TATLMAIN	Unknown	Anomaly	
115I 027	NIX	Unknown	Showing	
115I 090	SAM	Unknown	Anomaly	
115I 015	LYDEN	Vein Au-Quartz	Showing	
115I 040	SPOKANE	Skarn Cu	Anomaly	

LEGEND

Town

Mineral Occurrence

Road

Contour

River

NTS map sheet

Water Body

Wetland

Sample Location

Catchment > 14km²

Catchment

Weighted sums model (Geology Levelled)

Epithermal Au-Ag deposits

incomplete element suite

0-50th percentile

50-75th percentile

75-90th percentile

90-95th percentile

95-98th percentile

98-100th percentile

RECOMMENDED CITATION

MACKIE, R., ARNE, D. AND PENNIMPEDE, C., 2016. Weighted sums model for Epithermal Au-Ag deposits levelled by geology. In: Enhanced interpretation of stream sediment geochemical data for NTS map sheet 115I. Yukon Geological Survey, Open File 2016-14, scale 1:250 000, sheet 1 of 15.

Catchment basin polygons generated by the Yukon Geological Survey (J. O. Bruce).

Any revisions or additional geological information known to the user would be welcomed by the Yukon Geological Survey.

Paper copies of this map and the accompanying report may be obtained from the Yukon Geological Survey, Energy, Mines and Resources, Government of Yukon, Room 102-300 Main St., Whitehorse, Yukon, Y1A 2B5. Ph. 867-667-3201, Email geology@gov.yk.ca.

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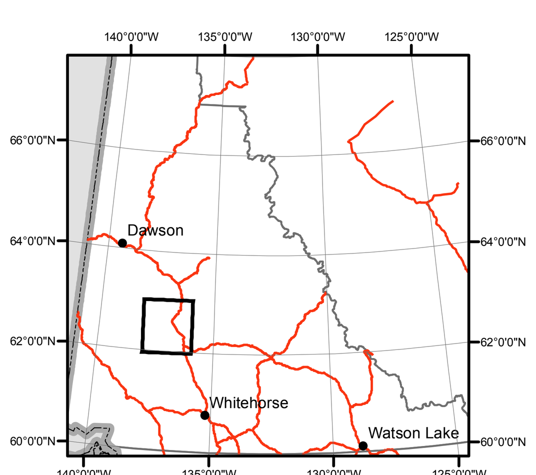


1:250 000-scale topographic base data produced by
CENTRE FOR TOPOGRAPHIC INFORMATION, NATURAL RESOURCES CANADA

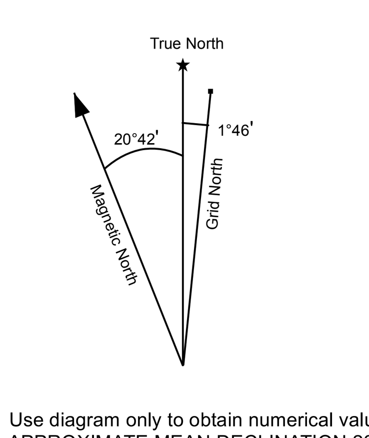
ONE THOUSAND METRE GRID
Universal Transverse Mercator Projection
North American Datum 1983
Zone 8

CONTOUR INTERVAL 100 FEET
Elevations in metres above Mean Sea Level

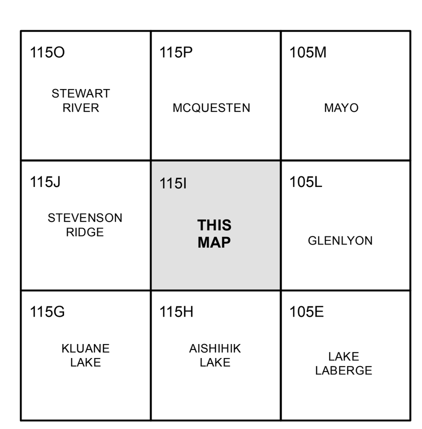
Epithermal Au-Ag deposits
Weighted sums model (Geology Levelled)
Sheet 1 of 15

SCALE 1:250 000

0 1 2 3 4 5
kilometres



Use diagram only to obtain numerical values
APPROXIMATE MEAN DECLINATION 2015
FOR CENTRE OF MAP



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Energy, Mines and Resources
Government of Yukon

Open File 2016-14

Weighted sums model for Epithermal Au-Ag deposits levelled by mapped geology (NTS 115I)
Sheet 1 of 15

by

Rob Mackie, Dennis Arne,
and Chris Pennimpede