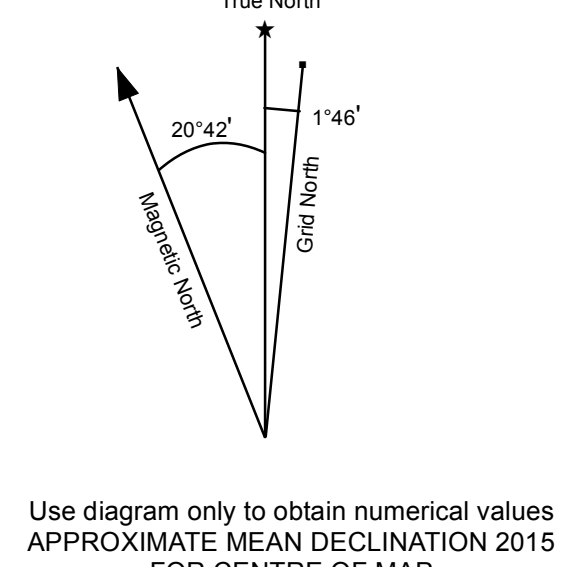
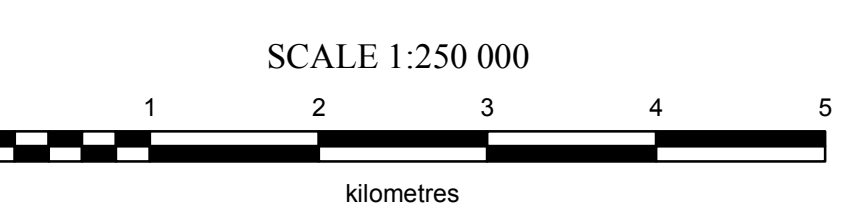


**Porphyry Cu-Au deposits
Weighted sums model
(Principal Component Residuals)
Sheet 12 of 15**



1150	115P	105M
STEWART RIVER	MCQUESTEN	MAYO
115J	115I	105L
STEVENSON RIDGE	THIS MAP	GLENLYON
115G	115H	105E
KUJANE LAKE	AISHRIK LAKE	LAKE LABERGE

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 1151) 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, Ti, Mo and As. Respectively, these element groupings form spatial patterns matching distribution of Carmacks 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 subtle 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 related 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 sheet the two approaches produce WSMs that are quite similar.

The effectiveness of historical sampling coverage has been assessed empirically using graphs of WSMs plotted against catchment surface area to determine the ideal maximum catchment size (14 km²). Catchments that cover larger areas (shown on the map with bold outlines) are interpreted to have been under-sampled and thus require further sampling to properly evaluate the area for geochemical anomalism. Given the likelihood that a mineralization 'signal' would be progressively diluted with increase in catchment size,

Table 2: Importance rankings for weighted sums models using residuals on principal components.

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

^aPolymetallic Ag-Pb-Zn type includes vein and manto styles; SEDEX = sedimentary exhalative; VMS = volcanic-hosted/associated massive sulphide deposits; Hydrothermal Anomaly = principal component 6
^bFor heavily censored elements and those not strongly controlled by geology as interpreted from principal component analysis, raw data are used following a log₁₀ transformation.

LEGEND

Weighted sums model (PC residuals)
Porphyry Cu-Au deposits

- incomplete element suite
- 0-50th percentile
- 50-75th percentile
- 75-90th percentile
- 90-95th percentile
- 95-98th percentile
- 98-100th percentile

■ Town
▲ Mineral Occurrence
— Road
— Contour
~ River
— Water Body
— Wetland
• Sample Location
 Catchment > 14km²
 Catchment

REFERENCES

Geological Survey of Canada, 1986. Regional stream sediment and water geochemical reconnaissance data, southern Yukon (NTS 1151). Geological Survey of Canada, Open File 1220.
 Jackaman, W., 2015. Regional stream sediment geochemical data, Carmacks area, southern Yukon (NTS 1151). Yukon Geological Survey, Open File 2015-14.
 Mackie, R., Arne, D. and Brown, O., 2015. Enhanced interpretation of regional stream sediment (RGS) geochemical data from Yukon: catchment basin analysis and weighted sums modeling. Yukon Geological Survey, Open File Report 2015-10.
 Yukon MINFILE, 2015. Yukon MINFILE – A database of mineral occurrences. Yukon Geological Survey, www.data.geology.gov.yk.ca, accessed May 2015.

Table 1: List of Mineral Occurrences for NTS map sheet 1151 (Yukon MINFILE, 2015)

Number	Name	Type	Status	Commodities
1151068	COMBE	Vein Au-Quartz	Drilled Prospect	Gold, Silver
1151069	SCHST	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Anomaly	Asbestos, Copper, Nickel
1151070	MALONEY	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum, Gold, Silver, Tungsten
1151071	CHART	Unknown	Anomaly	Copper
1151074	COMANCHE	Porphyry Cu-Mo-Au	Drilled Prospect	Copper
1151075	NORTHSTAR	Unknown	Anomaly	Copper
1151076	TUF	Porphyry Cu-Mo-Au	Showing	Copper
1151077	CROSSING	Vein Cu-Ag-Quartz	Showing	Copper
1151079	GRU	Porphyry Cu-Mo-Au	Anomaly	Copper, Gold
1151080	RICO	Unknown	Anomaly	Copper, Lead, Zinc, Gold
1151081	KERR	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum
1151083	MEYERS	Unknown	Unknown	Coal
1151084	LONELY	Vein Au-Quartz	Showing	Copper, Silver, Gold
1151085	CAR	Vein & Disseminations Siltstone	Prospect	Gold, Arsenic
1151086	WILKINSON	Vein & Disseminations Siltstone	Showing	Antimony, Mercury, Silver, Arsenic, Gold
1151087	KOOK	Porphyry Cu-Mo-Au	Anomaly	Copper, Molybdenum
1151088	BATH	Porphyry Alkaline Cu-Au	Anomaly	Antimony, Copper
1151092	RINK	Coal	Anomaly	Coal
1151093	GOLTLER	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Gold, Lead, Molybdenum, Zinc, Silver
1151095	BLUFF	Vein Cu-Ag-Quartz	Showing	Copper, Silver, Gold
1151096	RUSK	Vein Polymetallic Ag-Pb-Zn-Au	Drilled Prospect	Copper, Lead, Silver, Molybdenum, Gold
1151098	HLAVAY	Coal	Drilled Prospect	Coal
1151100	PITTS	Epithermal Au-Ag-Cu: High Sulphidation	Showing	Antimony, Mercury, Arsenic, Gold
1151102	LIMNEY	Porphyry Cu-Mo-Au	Anomaly	Copper, Molybdenum
1151105	MERIDIAN	Vein Polymetallic Ag-Pb-Zn-Au	Drilled Prospect	Lead, Silver, Zinc
1151106	HAPPY	Vein Au-Quartz	Showing	Gold, Lead, Zinc
1151107	NUCLEUS	Porphyry Cu-Mo-Au	Deposit	Gold, Silver, Copper, Tungsten, Molybdenum
1151108	TOOT	Porphyry Cu-Mo-Au	Showing	Coal
1151110	ROW	Unknown	Anomaly	Copper, Silver, Zinc, Lead
1151111	ANDROMAK	Porphyry Subvolcanic Cu-Au-Ag (As-Sb)	Deposit	Gold, Silver, Copper
1151112	WHALE	Vein Au-Quartz	Drilled Prospect	Gold, Silver
1151113	FIELD	Unknown	Anomaly	Gold
1151115	TDAST	Unknown	Anomaly	Gold
1151117	DIC	Vein Polymetallic Ag-Pb-Zn-Au	Showing	Antimony, Gold, Copper, Lead, Silver, Zinc
1151119	DOWS	Epithermal Au-Ag-Cu: High Sulphidation	Drilled Prospect	Gold
1151120	ELEPHANT	Unknown	Anomaly	Copper, Lead, Zinc, Silver, Gold
1151121	STODDART	Unknown	Showing	Antimony, Gold, Copper, Lead, Silver, Zinc
1151122	GRZLY	Vein Au-Quartz	Showing	Gold, Silver, Tungsten
1151123	ANG	Unknown	Showing	Coal
1151001	SOUTH TANTALUS	Porphyry Cu-Mo-Au	Deposit	Coal
1151002	TANTALUS MINE	Coal	Past Producer	Coal
1151003	TANTALUS BUTTE	Coal	Past Producer	Coal
1151004	FIVE FINGERS	Coal	Past Producer	Coal
1151008	RICKE	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Gold
1151008	CARMACKS COPPER	Porphyry Alkaline Cu-Au	Deposit	Copper, Gold, Copper - Oxide, Copper - Total, Copper - Sulphide, Silver
1151012	WALD	Unknown	Unknown	Coal
1151013	HOOCHKOD	Vein Cu-Ag-Quartz	Showing	Copper, Gold, Silver
1151017	TOWHATA	Coal	Anomaly	Coal
1151018	NEEDLEROCK	Coal	Showing	Coal
1151019	BRADENS CANYON	Vein Cu-Ag-Quartz	Prospect	Copper, Silver
1151020	COON	Vein Cu-Ag-Quartz	Drilled Prospect	Copper, Gold, Silver
1151021	MINIO	Porphyry Alkaline Cu-Au	Producer	Copper, Silver, Gold, Lead, Zinc
1151022	MINIO NORTH	Porphyry Alkaline Cu-Au	Deposit	Copper, Silver, Gold
1151023	PAL	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Gold, Silver
1151025	GRENER	Coal	Showing	Coal
1151028	PELLEY	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum
1151029	AMADEUS	Porphyry Cu-Mo-Au	Drilled Prospect	Antimony, Arsenic, Copper, Zinc, Lead, Silver, Gold
1151031	TADTORO	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Gold, Zinc, Molybdenum, Silver, Lead
1151032	PHELPS	Vein Polymetallic Ag-Pb-Zn-Au	Showing	Copper, Molybdenum, Gold
1151034	PROSPECTOR MOUNTAIN	Vein Polymetallic Ag-Pb-Zn-Au	Drilled Prospect	Copper, Silver, Zinc, Gold, Lead
1151035	STARBIRD	Porphyry Subvolcanic Cu-Au-Ag (As-Sb)	Showing	Copper, Molybdenum, Zinc, Silver, Gold, Antimony, Lead
1151037	CASH	Porphyry Cu-Mo-Au	Deposit	Lead
1151038	FLORIAN	Drilled Prospect	Copper, Gold, Silver, Molybdenum	
1151039	COM	Porphyry Cu-Mo-Au	Anomaly	Copper, Fluorite, Tungsten
1151042	REVENUE	Porphyry Cu-Mo-Au	Deposit	Copper, Gold, Silver, Molybdenum, Tungsten
1151043	COMBO	Vein Polymetallic Ag-Pb-Zn-Au	Showing	Gold, Tungsten, Zinc, Lead, Silver
1151045	NEWKIRK	Porphyry Cu-Mo-Au	Showing	Copper, Zinc, Molybdenum
1151046	LIL	Vein Au-Quartz	Showing	Gold
1151047	TRITOP	Porphyry Cu-Mo-Au (Low F-type)	Anomaly	Copper, Molybdenum, Gold
1151048	EDGAR	Porphyry Cu-Mo-Au	Anomaly	Copper, Molybdenum
1151049	CARIBOU CREEK	Vein Au-Quartz	Past Producer	Gold, Silver
1151050	GRABNER	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Silver, Molybdenum, Gold
1151051	CASTLE	Vein Cu-Ag-Quartz	Showing	Antimony, Gold, Copper, Lead, Zinc, Silver
1151052	RED FOX	Vein Polymetallic Ag-Pb-Zn-Au	Drilled Prospect	Gold, Lead, Zinc, Silver
1151053	GLUER	Skarn Au	Deposit	Silver, Gold
1151054	LIFORMA	Epithermal Au-Ag-Cu: High Sulphidation	Deposit	Silver, Gold, Lead, Zinc, Copper
1151055	EDMONS HILL	Epithermal Au-Ag-Cu: High Sulphidation	Drilled Prospect	Antimony, Mercury, Silver, Gold
1151058	TINTA HILL	Vein Polymetallic Ag-Pb-Zn-Au	Drilled Prospect	Copper, Gold, Zinc, Silver, Lead
1151060	WOLF	Unknown	Anomaly	Arsenic, Gold
1151062	FOSTER	Skarn Au	Showing	Gold
1151064	BROWN/MCDADE	Epithermal Au-Ag-Cu: High Sulphidation	Past Producer	Copper, Silver, Lead, Copper, Zinc, Antimony
1151065	MOUNT NANSEN	Epithermal Au-Ag-Cu: High Sulphidation	Past Producer	Silver, Gold
1151066	CYPRUS	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Gold, Molybdenum
1151005	CONGLOMERATE	Unknown	Anomaly	Unknown
1151011	STU	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Silver, Gold
1151017	KLAZA	Vein Polymetallic Ag-Pb-Zn-Au	Deposit	Copper, Gold, Zinc, Silver, Lead
1151099	RAND	Unknown	Unknown	Unknown
1151059	ZERO	Unknown	Unknown	Unknown
1151030	CHART	Unknown	Unknown	Unknown
1151028	MINNESOTA	Vein Au-Quartz	Unknown	Unknown
1151033	TERRA	Unknown	Unknown	Unknown
1151061	OPAL	Unknown	Unknown	Unknown
1151001	PANTHER	Epithermal Au-Ag-Cu: High Sulphidation	Anomaly	Arsenic, Gold
1151094	GIANT	Porphyry Cu-Mo-Au	Anomaly	Copper
1151124	TOE	Porphyry Cu-Mo-Au	Anomaly	Copper
1151125	PEPPER	Porphyry Cu-Mo-Au	Anomaly	Copper
1151014	VERLENE	Porphyry Cu-Mo-Au	Unknown	Copper, Silver, Gold
1151089	BEAVON	Unknown	Unknown	Copper
1151126	BUTTER	Porphyry Cu-Mo-Au	Anomaly	Copper, Gold
1151127	HOOCHIE	Porphyry Cu-Mo-Au	Anomaly	Copper, Gold
1151128	GRAN	Porphyry Cu-Mo-Au	Anomaly	Copper
1151010	BONAZZA CREEK	Vein Cu-Ag-Quartz	Prospect	Copper, Gold, Silver
1151007	MVS	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Silver, Gold
1151009	MERRICE	Vein Cu-Ag-Quartz	Showing	Copper, Silver, Gold
1151057	GRANITE MOUNTAIN	Vein Polymetallic Ag-Pb-Zn-Au	Drilled Prospect	Copper, Molybdenum, Gold
1151098	MORI	Unknown	Unknown	Unknown
1151072	PHOEBE	Unknown	Unknown	Unknown
1151044	EGG	Unknown	Unknown	Unknown
1151082	LESS	Unknown	Unknown	Unknown
1151091	MC CABE	Unknown	Unknown	Unknown
1151024	ADERA	Porphyry Cu-Mo-Au	Anomaly	Unknown
1151097	BOYLEN	Unknown	Anomaly	Unknown
1151114	TATLARAN	Unknown	Anomaly	Unknown
1151027	NIX	Unknown	Showing	Unknown
1151090	SAM	Unknown	Anomaly	Unknown
1151015	YDEN	Vein Au-Quartz	Showing	Unknown
1151040	SPOKANE	Skarn Cu	Anomaly	Unknown

RECOMMENDED CITATION

MACKIE, R., ARNE, D. AND PENNIMPEDE, C., 2016. Weighted sums model for Porphyry Cu-Au deposits using principal component residuals. In: Enhanced interpretation of stream sediment geochemical data for NTS map sheet 1151. Yukon Geological Survey, Open File 2016-14, scale 1:250 000, sheet 12 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. 867-687-3201, Email geology@gov.yk.ca.

A digital PDF (Portable Document File) file of this map may be downloaded free of charge from the Yukon Geological Survey website: <http://www.geology.gov.yk.ca>.

Yukon Geological Survey
Energy, Mines and Resources
Government of Yukon

Open File 2016-14

**Weighted sums model for Porphyry Cu-Au deposits
using principal component residuals (NTS 1151)
Sheet 12 of 15**

by
Rob Mackie, Dennis Arne,
and Chris Pennimpe