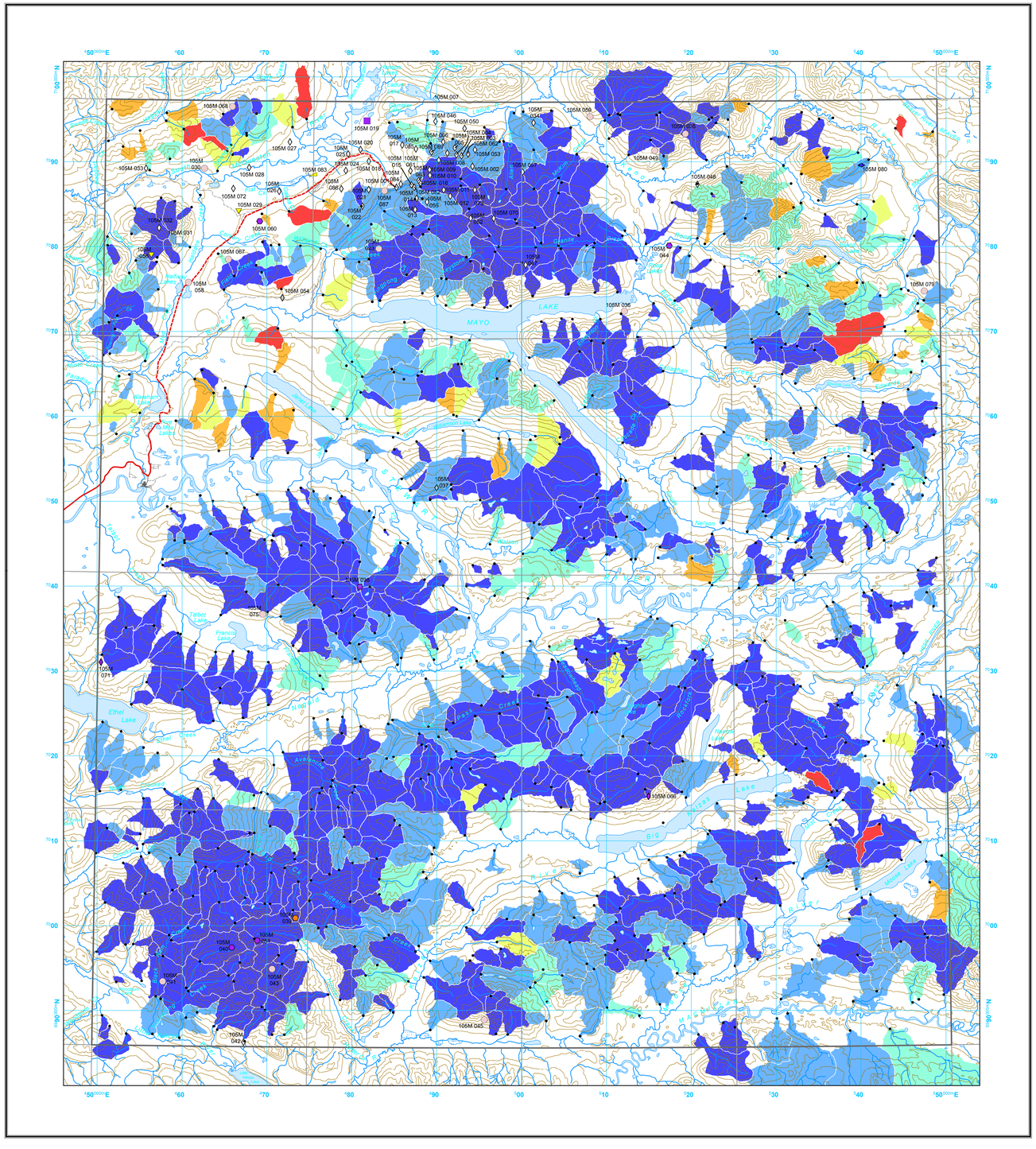


1:250 000-scale topographic base data produced by CENTRE FOR TOPOGRAPHIC INFORMATION, NATURAL RESOURCES CANADA

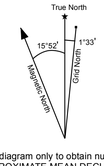
ONE THOUSAND METRE GRID
Universal Transverse Mercator Projection
North American Datum 1983
Zone 8

CONTOUR INTERVAL 100 FEET
Elevations in metres above Mean Sea Level

WEIGHTED SUMS MODEL
STREAM pH
YUKON

SCALE 1:250 000

0 1 2 3 4 5
kilometres



Use diagram only to obtain numerical values
APPROXIMATE MEAN DECLINATION 2013
FOR CENTRE OF MAP

116A LARSEN CREEK	106D NASH CREEK	106C NADALEEN RIVER
115P MCQUESTEN	105M **THIS MAP**	105N LANSING RANGE
115I CARMACKS	105L GLENLYON	105K TAY RIVER

Weighted Sums Modelling

The application of Weighted Sums Modelling (WSM) to exploration geochemistry was described by Garrett and Grunsky (2001) as a means to model multi-element data using a priori knowledge of the mineralogy and element composition of the sought after mineral deposit (Kane, 1977; Garrett et al., 1980). In this procedure weights or relative importances are assigned to each variable, or a subset of variables, according to some geochemical or mineralogical model of the target mineral deposit type or geological process. Weighted sums (WS) are new variables calculated from the multi-element geochemical results. Like Principal Components Analysis (PCA) or Factor Analysis scores, WS scores have the form of normal or standardized scores with a mean of zero and a standard deviation of one. The main difference between WSM and traditional multivariate statistical methods is that the user assigns the variable weightings rather than determining them with a covariance/correlation matrix for the dataset, as is done in PCA. Furthermore WSM is a robust statistical technique that is not influenced by the presence of outliers (Beckman & Cook, 1983).

The reader is referred to Garrett and Grunsky (2001) for a description of the WS calculation. In summary, relative importance is assigned for each variable. A weighting of 3, for example, means that that particular element is three times more important than an element with a weighting of one. Weighting can be positive or negative. Positive weightings mean that the target model is associated with elevated concentrations of an element. Negative weightings indicate that low concentrations or depletions of an element are important.

Individual relative importance is converted into weights that sum to one by dividing each importance by the sum of the absolute values of importance (i.e., ignoring the negative signs). A requirement of the method is that the sums of the squares of the final weights also equal one. This is achieved by dividing each weight by the square root of the sum of the squares of the weights.

The next step involves calculation of the normal scores for the variables included in the model for each individual sample. To do this, robust estimates of the mean and standard deviation are used. The median (or 50th percentile) is used as a robust estimate of the mean and the inter-quartile range (IQR) multiplied by 0.7413 is used as a robust estimate of the standard deviation. IQR is the difference between the 75th and 25th percentiles of the data distribution and therefore covers a band of data 25% wide (or 0.67449 standard deviation units) on either side of the mean. The constant 0.7413 is used to convert the IQR, which covers a range of 1.3490 standard deviation units to an equivalent standard deviation[1]. Weighted sums are then calculated by multiplying the normal scores for each element by the element's corresponding weight and summing for each sample. The high resistance of the median and IQR to outliers mean that it is not usually necessary to trim outlier and far outliers from the dataset before calculation.

[1] For a normal distribution the standard deviation is equal to 0.7413*IQR, where 0.7413 is the reciprocal of 1.349.

Models and Weightings

Six mineral deposit types (SEDEX, Porphyry Cu, W-Skarn, IRCG, Polymetallic veins, and Carlin) that are either known or believed to occur in the map sheet areas and one geochemical process (hydromorphic dispersion) are modeled using the WS method. Included elements and their relative importance are presented in Table 1.

Data Presentation

Results of each WS model are attached to the corresponding catchment basin polygons using a spatial join in ArcGIS. This process allows for the entire polygon to be assigned a colour based on its WS score. Colours are assigned on the basis of the following percentile breaks:

0-50%	Dark blue
50-75%	Pale blue
75-90%	Pale green
90-95%	Yellow
95-98%	Orange
98-100%	Red

With this scheme, catchment basins with the hotter colours represent samples with geochemical characteristics consistent with the mineralization style being modelled.

Table 1: Table of Relative Importances used to calculate weighted sums models

Deposit Type	Ag	Au	As	Ba	Bi	Cd	Co	Cu	Cs	Fe	Hg	K	Mn	Mo	Ni	Pb	S	Sb	Tl	W	Zn
Polymetallic Veins	4	4	3			4	1	2		1	1		1	1	1	5		3			5
W-Skarn			3		3					1		3		3					5	1	
Porphyry Cu	2	2			1			5	3					3			2				
Intrusive Related Cu-Au	1	2	5		5			2		1	5		1	2		1		1		2	
SEDEX				5		3									1	5		1	5		5
Carlin	2	1	5	2							4							5			
Hydromorphic Dispersion	2		1			4	5	2		5			5	2	4	2		1			3

LEGEND

- Regional Geochemistry Sample (RGS) location
- National Topographic System grid (1:250 000 scale)
- National Topographic System grid (1:50 000 scale)
- highway, paved
- highway, unpaved
- local road, paved
- local road, unpaved
- contour
- watercourse
- waterbody
- wetland

Stream pH

WSM Percentiles: WSM Score, Number of RGS Samples

- 0 - 50%: 0.000000 - 7.300000, 477 samples
- 50 - 75%: 7.300001 - 7.600000, 228 samples
- 75 - 90%: 7.600001 - 7.800000, 87 samples
- 90 - 95%: 7.800001 - 7.900000, 19 samples
- 95 - 98%: 7.900001 - 8.000000, 26 samples
- 98 - 100%: 8.000001 - 8.400000, 10 samples

Table 2: List of Mineral Occurrences for NTS map sheets 105O and part of 105P

OCCURRENCE #	OCCURRENCE NAME	ALIAS(ES)	DEPOSIT TYPE	STATUS	ECONOMIC COMMODITIES	OTHER COMMODITIES
105M001	KENO HILL		Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag, Zn	Cd, Au, Sn
105M002	FAITH		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Au, Pb, Ag, Zn
105M003	DUNCAN		Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag	
105M004	GOLDEN QUEEN		Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		Sb, Pb, Ag
105M005	SILVER BASIN		Polymetallic Veins Ag-Pb-Zn+/-Au	Prospect	Ag	Au, Pb
105M006	NABOB	LAURASIA, RUM TUM	Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Au, Pb, Ag
105M007	MONUMENT		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Pb, Ag
105M008	COMSTOCK	PORCUPINE VEIN	Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag, Zn	
105M009	APEX		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Pb, Ag, Zn
105M010	VANGUARD		Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag	
105M011	HOMESTAKE		Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		Au, Pb, Ag, Zn
105M012	CHRISTINE		Polymetallic Veins Ag-Pb-Zn+/-Au	Prospect		Pb, Ag
105M013	MO		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Au, Pb, Ag
105M014	MAYBRUN		Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Ag, Pb	
105M015	HOGAN		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Pb, Ag
105M016	RUNER	MT. KENO	Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag	Au, Zn
105M017	WERNECKE	RAILROAD	Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		Au, Pb, Ag, Zn
105M018	FORMO	YUKENO	Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag, Zn	
105M019	NOMAD		Porphyry W	Anomaly		
105M020	PADDY		Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag, Zn	Au
105M021	EAGLE		Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		Pb, Ag, Zn
105M022	FISHER		Polymetallic Veins Ag-Pb-Zn+/-Au	Anomaly		Au, Pb, Ag, Zn
105M023	PARENT		Unknown	Anomaly		
105M024	CREAM AND JEAN		Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag	Cu, Zn
105M025	NORD		Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		As, Au, Pb, Ag, Zn
105M026	GERLITZKI		Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		Pb, Zn, Ag
105M027	TITAN		Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		Pb, Ag, Zn
105M028	SHANGHAI	NORTH LIMB	Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		Cu, Pb, Ag, Zn
105M029	MCQUESTEN	WAYNE	Plutonic Related Au	Past Producer	Au, Pb, Ag, Zn	Bi
105M030	ARGENT		Unknown	Anomaly		Zn
105M031	STREICHUK	JOLUBIRA	Porphyry Sn	Prospect		As, Cu, Pb, Ag, Sn, W, Zn
105M032	MT HALDANE	LOOKOUT	Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag	As, Au, Zn
105M033	LAYSIER		Polymetallic Veins Ag-Pb-Zn+/-Au	Anomaly		Pb, Ag, Zn
105M034	COBALT		Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag	Sb, Cu, Zn
105M035	PATTERSON		Unknown	Anomaly		As, Cu, Au, Pb, Ag, Zn
105M036	ETTA		Unknown	Anomaly		
105M037	GORDON		Stibnite Veins & Disseminations	Prospect		Sb, As, Bi, Au, Hg, Ag
105M038	TWO BUTTES		W Skarn	Drilled Prospect		W
105M039	SIDE SLIP		Cu Skarn	Showing		Cu
105M040	GREAT HORN		W Skarn	Prospect		Cu, W, Zn
105M041	RAM		Unknown	Unknown		
105M042	HOTSPRING		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Pb, Ag
105M043	LOST WERNECKE COPPER		Unknown	Unknown		Cu
105M044	ROOP		W Skarn	Showing		
105M045	ABLE		Unknown	Anomaly		
105M046	MOON		Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		Au, Pb, Ag, Zn
105M047	MT. ALBERT		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Pb, Ag
105M048	MCKIM		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Ag
105M049	VACA		Unknown	Anomaly		
105M050	NERO		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Pb, Ag
105M051	FRIESEN		W Skarn	Prospect		Cu, Au, Pb, Mo, Ag, W
105M052	MT HINTON		Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		Au, Ag
105M053	AVENUE		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		
105M054	CHANCE		Stibnite Veins & Disseminations	Showing		Sb
105M055	YONO		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Pb, Ag
105M056	SUNDOWN		Plutonic Related Au	Showing		As, Bi, Au, Pb, Ag, Sn, W
105M057	GUSTAVUS		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Pb, Ag
105M058	HALFWAY	SINISTER	Unknown	Drilled Prospect		Au, Hg, W
105M059	RANKIN		Unknown	Anomaly		
105M060	NEWRY	AUREX	W Skarn	Drilled Prospect		As, Bi, Cu, Au, Pb, W, Zn
105M061	CHRISTAL	DOROTHY	Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Pb, Ag, Zn
105M062	SEGSWORTH	CARIBOU HILL	Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag	
105M063	IRON CLAD		Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		
105M066	KALZAS	FLO	W Veins	Drilled Prospect		Be, Pb, Mo, Ag, Sn, W
105M067	CORVERY		Unknown	Unknown		
105M068	WEASEL		Unknown	Unknown		
105M069	GAMBLER		Polymetallic Veins Ag-Pb-Zn+/-Au	Past Producer	Pb, Ag	Zn
105M070	HAVRENAK		Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		Au, Pb, Ag
105M071	DRILL		W Veins	Showing		W
105M072	BELLY		Polymetallic Veins Ag-Pb-Zn+/-Au	Drilled Prospect		Pb, Ag, Zn
105M073	BEMA		Polymetallic Veins Ag-Pb-Zn+/-Au	Showing		Au, Ag
105M075	WHITEMAN		Unknown	Unknown		
105M079	TINY ISLAND		Unknown	Prospect		
105M080	GORDEY		Sediment-Hosted Barite	Prospect		barite
105M082	BELLEKENO		Polymetallic Veins Ag-Pb-Zn+/-Au	Producer	Pb, Ag, Zn, Au	Cd, Sn
105M083	ELSA TAILINGS		Tailings Reprocessing	Deposit	Au, Pb, Ag, Zn	
105M084	ONIX		Polymetallic Veins Ag-Pb-Zn+/-Au	Deposit	Ag, Pb, Au, Zn	In
105M085	LUCKY QUEEN		Polymetallic Veins Ag-Pb-Zn+/-Au	Deposit	Ag, Pb, Zn, Au	
105M086	BERMINGHAM		Polymetallic Veins Ag-Pb-Zn+/-Au	Deposit	Pb, Zn, Ag, Au	
105M087	FLAME & MOTH		Unknown	Deposit	Au, Ag, Pb, Zn	

Mineral Occurrence Deposit Type (Total on map)

- Cu Skarn (1)
- Plutonic Related Au (2)
- Polymetallic Veins Ag-Pb-Zn+/-Au (49)
- Porphyry Sn (1)
- Porphyry W (1)
- Sediment-Hosted Barite (1)
- Stibnite Veins & Disseminations (2)
- Tailings Reprocessing (1)
- Unknown (15)
- W Skarn (5)
- W Veins (2)

REFERENCES

Beckman, R.J. and Cook, R.D.,1983. "Outliers," Technometrics, vol. 25, no. 2, p. 119-149.

Garrett R.G. and Grunsky, E.C., 2001. Weighted sums – knowledge based empirical indices for use in exploration geochemistry. Geochemistry: Exploration, Environment, Analysis, vol. 1 2001, p. 135–141.

Garrett, R.G., Kane, V.E. & Zeigler, R.K., 1980. The management and analysis of regional geochemical data. Journal of Geochemical Exploration, vol. 13, no 2.3, p. 115-152.

Jackaman, W., 2011. Regional stream sediment geochemical data Mayo area, central Yukon (105M). Yukon Geological Survey Open File 2012-8.

Kane, V.E., 1977. Geostatistics Symposium on Hydrogeochemical and Stream-Sediment Reconnaissance for Uranium in the United States. United States Department of Energy Report, GJBX-77(77), p. 203–222.

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

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Yukon Geological Survey
Energy, Mines and Resources
Government of Yukon

Open File 2013-16

Yukon Geochemistry Weighted Sums Model for NTS 105M: Stream pH (1:250 000 scale)

by

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