REGIONAL STREAM SEDIMENT AND WATER GEOCHEMICAL RECONNAISSANCE DATA,YUKON 1986,GSC-OF 1364,NGR 100-1986,NTS 115N(E1/2),115O

****
*
* OPEN FILE 1364
*
****

	PAGE
SURVEY NOTES	1
DATA LIST	12
SUMMARY STATISTICS	76

GEOLOGICAL SURVEY OF CANADA OPEN FILE 1364.
REGIONAL STREAM SEDIMENT AND WATER GEOCHEMICAL RECONNAISSANCE DATA,
WESTERN YUKON NTS 115N(E1/2),115O.

THE RECONNAISSANCE SURVEY WAS UNDERTAKEN BY THE GEOLOGICAL SURVEY OF CANADA IN CONJUNCTION WITH THE DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT, AND THE GOVERNMENT OF YUKON UNDER THE CANADA-YUKON MINERAL DEVELOPMENT AGREEMENT (1985-1989).

E.H.W. HORNBROOK DIRECTED THE SURVEY PROGRAM.

P.W.B. FRISKE COORDINATED THE OPERATIONAL ACTIVITIES OF THE CONTRACTING AND GEOLOGICAL SURVEY OF CANADA STAFF THROUGHOUT THE SURVEY.

CONTRACTS LET FOR COLLECTION, SAMPLE PREPARATION AND ANALYSIS WERE THE RESPONSIBILITY OF, AND WERE SUPERVISED AND/OR MONITORED BY THE STAFF OF THE EXPLORATION GEOCHEMISTRY SUBDIVISION AS FOLLOWS:

COLLECTION:
- MONAGHAN DELPH MILLER LTD., DON MILLS, ONTARIO
- E.H.W. HORNBROOK, P.W.B FRISKE

PREPARATION:
- GOLDER ASSOCIATES, OTTAWA, ONTARIO
- J.J. LYNCH

ANALYSIS:
- BONDAR - CLEGG AND COMPANY LTD., OTTAWA
- BARRINGER MAGENTA LABORATORIES (ALBERTA) LTD., CALGARY,ALBERTA (WATERS)
- CHEMEX LABS LTD.,NORTH VANCOUVER,B.C. (GOLD)
- J.J. LYNCH, D.J. ELLWOOD

H.R. SCHMITT COORDINATED OPEN FILE PRODUCTION.

A.C. GALLETTA MANAGED THE DIGITAL GEOCHEMICAL DATA AND PROVIDED COMPUTER PROCESSING SUPPORT.

D.J. ELLWOOD DEVELOPED SOFTWARE TO RASTER PLOT OPEN FILE VALUE,SYMBOL AND REGIONAL TREND MAPS. THE PLOTTING WAS DONE BY CANADA LANDS DATA SYSTEMS STAFF AT ENVIRONMENT CANADA, HULL QUEBEC.

M. MCCURDY AND S. COOK PROCESSED INCOMING AND OUTGOING MATERIALS,SUPPLIES AND SAMPLES.

COMPUTING,PLOTTING, AND OPEN FILE TEXT LASER PRINTING SERVICES, WERE PROVIDED BY THE COMPUTER SCIENCE CENTER, E.M.R.

J. YELLE AND F. WILLIAMS OF THE GEOLOGICAL INFORMATION DIVISION SUPERVISED THE PREPARATION OF OPEN FILE MAPS BY CARTOGRAPHY UNIT A-2.

HELICOPTER AND TRUCK SUPPORTED SAMPLE COLLECTION WAS CARRIED OUT DURING THE SUMMER OF 1986.
STREAM SEDIMENT AND WATER SAMPLES WERE COLLECTED AT AN AVERAGE DENSITY OF ONE SAMPLE PER 13 SQUARE KILOMETERS THROUGHOUT THE 16600 SQUARE KILOMETERS OF THE WESTERN YUKON SURVEY AREA.

SAMPLE SITE DUPLICATE SAMPLES WERE ROUTINELY COLLECTED IN EACH ANALYTICAL BLOCK OF TWENTY SAMPLES.

IN OTTAWA, FIELD DRIED SAMPLES WERE AIR-DRIED, SIEVED THROUGH AN 80 MESH SCREEN AND BALL MILLED. THE BALL MILLED FRACTION WAS USED FOR SUBSEQUENT ANALYSES.
AT THIS TIME, CONTROL REFERENCE AND BLIND DUPLICATE SAMPLES WERE INSERTED INTO EACH BLOCK OF TWENTY SEDIMENT SAMPLES. FOR THE WATER SAMPLES,ONLY CONTROL REFERENCE SAMPLES WERE INSERTED INTO THE BLOCK. THERE WERE NO BLIND DUPLICATE WATER SAMPLES.

ON RECEIPT, FIELD AND ANALYTICAL DATA WERE PROCESSED WITH THE AID OF COMPUTERS.
THE FIELD DATA WERE RECORDED BY THE FIELD CONTRACT STAFF ON STANDARD STREAM WATER AND SEDIMENT FIELD CARDS (REV. 74) USED BY THE GEOLOGICAL SURVEY OF CANADA (GARRETT, 1974).
THE SAMPLE SITE POSITIONS WERE MARKED ON APPROPRIATE 1/250,000 SCALE NTS MAPS IN THE FIELD.
THESE MAPS WERE DIGITIZED AT THE GEOLOGICAL SURVEY IN OTTAWA TO OBTAIN THE SAMPLE SITE UTM COORDINATES.

THE SAMPLE SITE COORDINATES WERE CHECKED AS FOLLOWS: A SAMPLE LOCATION MAP WAS PRODUCED ON A CALCOMP 1051 DRUM PLOTTER USING THE DIGITIZED COORDINATES; THE FIELD CONTRACTOR'S SAMPLE LOCATION MAP WAS THEN OVERLAYED WITH THE CALCOMP MAP; THE TWO SETS OF POINTS WERE CHECKED FOR COINCIDENCE.
THE DOMINANT ROCK TYPES IN THE STREAM CATCHMENT BASINS WERE IDENTIFIED ON APPROPRIATE GEOLOGICAL MAPS USED AS THE BEDROCK GEOLOGICAL BASE ON RGR MAPS.

THOROUGH INSPECTIONS OF THE FIELD AND ANALYTICAL DATA WERE MADE TO CHECK FOR ANY MISSING INFORMATION AND/OR GROSS ERRORS.

QUALITY CONTROL AND MONITORING OF THE GEOCHEMICAL DATA WAS UNDERTAKEN BY A STANDARD METHOD USED BY THE EXPLORATION GEOCHEMISTRY SUBDIVISION AT THE GEOLOGICAL SURVEY OF CANADA.

FOR THE DETERMINATION OF ZN, CU, PB, NI, CO, AG, MN, FE, CD, AND AS
A 1 GRAM SAMPLE WAS REACTED WITH 3 ML CONC. HNO3 IN A TEST TUBE OVERNIGHT AT ROOM TEMPERATURE.
AFTER DIGESTION, THE TEST TUBE WAS IMMERSED IN A HOT WATER BATH AT ROOM TEMPERATURE AND BROUGHT UP TO 90C AND HELD AT THIS TEMPERATURE FOR 30 MINUTES WITH PERIODIC SHAKING. 1 ML CONC. HCL WAS ADDED AND HEATING WAS CONTINUED FOR ANOTHER 90 MINUTES.
THE SAMPLE SOLUTION WAS THEN DILUTED TO 20 ML WITH METAL FREE WATER AND MIXED.
ZN, CU, PB, NI, CO, AG, MN, FE AND CD WERE DETERMINED BY ATOMIC ABSORPTION SPECTROSCOPY USING AN AIR-ACETYLENE FLAME.
BACKGROUND CORRECTIONS WERE MADE FOR PB, NI, CO, AG AND CD.

AS WAS DETERMINED BY ATOMIC ABSORPTION USING A HYDRIDE EVOLUTION METHOD WHEREIN THE HYDRIDE(ASH3) IS EVOLVED, PASSED THROUGH A HEATED QUARTZ TUBE IN THE LIGHT PATH OF AN ATOMIC ABSORPTION SPECTROPHOTOMETER.
THE METHOD IS DESCRIBED BY ASLIN (1976).

MOLYBDENUM AND VANADIUM WERE DETERMINED BY ATOMIC ABSORPTION SPECTROSCOPY USING A NITROUS OXIDE ACETYLENE FLAME.
A 0.5 GRAM SAMPLE WAS REACTED WITH 1.5 ML CONCENTRATED HN03 AT 90C FOR 30 MINUTES.
AT THIS POINT 0.5 ML CONCENTRATED HCL WAS ADDED AND THE DIGESTION WAS CONTINUED AT 90C FOR AN ADDITIONAL 90 MINUTES.
AFTER COOLING, 8 ML OF 1250 PPM AL SOLUTION WERE ADDED AND THE SAMPLE SOLUTION WAS DILUTED TO 10 ML BEFORE ASPIRATION.

MERCURY WAS DETERMINED BY THE HATCH AND OTT PROCEDURE WITH SOME MODIFICATIONS.
THE METHOD IS DESCRIBED BY JONASSON ET AL. (1973).
A 0.5 GRAM SAMPLE WAS REACTED WITH 20 ML CONCENTRATED HNO3 AND 1 ML CONCENTRATED HCL IN A TEST-TUBE FOR 10 MINUTES AT ROOM TEMPERATURE PRIOR TO 2 HOURS OF DIGESTION WITH MIXING AT 90C IN A HOT WATER BATH.
AFTER DIGESTION, THE SAMPLE SOLUTIONS WERE COOLED AND DILUTED TO 100 ML WITH METAL FREE WATER.
THE HG PRESENT WAS REDUCED TO THE ELEMENTAL STATE BY THE ADDITION OF 10 ML 10% W/V SNSO4 IN M H2SO4.
THE HG VAPOUR WAS THEN FLUSHED BY A STREAM OF AIR INTO AN ABSORPTION CELL MOUNTED IN THE LIGHT PATH OF AN ATOMIC ABSORPTION SPECTROPHOTOMETER.
ABSORPTION MEASUREMENTS WERE MADE AT 253.7 NM.

LOSS ON IGNITION WAS DETERMINED USING A 500 MG SAMPLE.
THE SAMPLE, WEIGHED INTO 30 ML BEAKER, WAS PLACED IN A COLD MUFFLE FURNACE AND BROUGHT UP TO 500C OVER A PERIOD OF 2-3 HOURS.
THE SAMPLE WAS LEFT AT THIS TEMPERATURE FOR 4 HOURS, THEN ALLOWED TO COOL TO ROOM TEMPERATURE FOR WEIGHING.

URANIUM WAS DETERMINED USING A NEUTRON ACTIVATION METHOD WITH DELAYED NEUTRON COUNTING.
A DETAILED DESCRIPTION OF THE METHOD IS PROVIDED BY BOULANGER ET AL(1975).
IN BRIEF, A 1 GRAM SAMPLE WAS WEIGHED INTO A 7 DRAM POLYETHYLENE VIAL, CAPPED AND SEALED.
THE IRRADIATION WAS PROVIDED BY THE SLOWPOKE REACTOR WITH AN OPERATING FLUX OF 5** 10 NEUTRONS/SQ.CM./SEC.
THE SAMPLES WERE PNEUMATICALLY TRANSFERRED FROM AN AUTOMATIC LOADER TO THE REACTOR, WHERE EACH SAMPLE WAS IRRADIATED FOR 20 SECONDS.
AFTER IRRADIATION, THE SAMPLE WAS AGAIN TRANSFERRED PNEUMATICALLY TO THE COUNTING FACILITY WHERE AFTER A 10 SECOND DELAY THE SAMPLE WAS COUNTED FOR 20 SECONDS WITH SIX HELIUM DETECTOR TUBES EMBEDDED IN PARAFFIN.
FOLLOWING COUNTING,THE SAMPLES WERE AUTOMATICALLY EJECTED INTO A SHIELDED STORAGE CONTAINER.
CALIBRATION WAS CARRIED OUT ONCE A DAY AS A MINUMUM, USING NATURAL MATERIALS OF KNOWN URANIUM CONCENTRATION.

FLUORINE WAS DETERMINED IN STREAM SEDIMENTS AS DESCRIBED BY FICKLIN (1970).
A 250 MG SAMPLE WAS SINTERED WITH 1 GRAM OF A FLUX CONSISTING OF TWO PARTS BY WEIGHT SODIUM CARBONATE AND 1 PART BY WEIGHT POTASSIUM NITRATE.
THE RESIDUE WAS THEN LEACHED WITH WATER, THE SODIUM CARBONATE WAS NEUTRALIZED WITH 10 ML 10% (W/V) CITRIC ACID AND THE RESULTING SOLUTION WAS DILUTED TO 100 ML WITH WATER.
THE PH OF THE RESULTING SOLUTION SHOULD BE FROM 5.5 TO 6.5.
THE FLUORIDE CONTENT OF THE TEST SOLUTION WAS THEN MEASURED USING A FLUORIDE ION ELECTRODE.
STANDARD SOLUTIONS CONTAIN SODIUM CARBONATE AND CITRIC ACID IN THE SAME QUANTITIES AS THE SAMPLE SOLUTION.
A DETECTION LIMIT OF 40 PPM WAS ACHIEVED.

GOLD WAS DETERMINED USUALLY ON A 10 GRAM STREAM SEDIMENT SAMPLE; DEPENDING ON THE AMOUNT OF SAMPLE AVAILABLE,LESSER WEIGHTS WERE SOMETIMES USED. THIS RESULTED IN A VARIABLE DETECTION LIMIT:1 PPB FOR A 10 GRAM SAMPLE,2 FOR A 5 GRAM SAMPLE... THE SAMPLE WAS FUSED TO PRODUCE A LEAD BUTTON, COLLECTING ANY GOLD IN THE SAMPLE, WHICH WAS CUPELLED IN A MUFFLE FURNACE TO PRODUCE A SILVER(DORE) BEAD. THE SILVER BEADS WERE IRRADIATED IN A NEUTRON FLUX FOR 1 HOUR,COOLED FOR 4 HOURS,AND COUNTED BY GAMMA RAY SPECTROMETRY.CALIBRATION WAS CARRIED OUT USING STANDARD AND BLANK BEADS.

TUNGSTEN WAS DETERMINED AS FOLLOWS: A 0.2 GRAM SAMPLE OF STREAM SEDIMENT WAS FUSED WITH 1 GRAM K2S2O7 IN A RIMLESS TEST TUBE AT 575C FOR 15 MINUTES IN A FURNACE. THE COOLED MELT WAS THEN LEACHED WITH 10 ML CONCENTRATED HCL IN A WATER BATH HEATED TO 85C. AFTER THE SOLUBLE MATERIAL HAD COMPLETELY DISSOLVED, THE INSOLUBLE MATERIAL WAS ALLOWED TO SETTLE AND AN ALIQUOT OF 5 ML WAS TRANSFERRED TO ANOTHER TEST TUBE. 5 ML OF 20% SNCL2 SOLUTION WERE THEN ADDED TO THE SAMPLE ALIQUOT,MIXED AND HEATED FOR 10 MINUTES AT 85C IN A HOT WATER BATH. A 1 ML ALIQUOT OF DITHIOL SOLUTION (1% DITHIOL IN ISO-AMYL ACETATE) WAS ADDED TO THE TEST SOLUTION AND THE TEST SOLUTION WAS THEN HEATED FOR 4-6 HOURS AT 80-85C IN A HOT WATER BATH. THE TEST SOLUTION WAS THEN REMOVED FROM THE HOT WATER BATH,COOLED AND 2.5 ML OF KEROSENE ADDED TO DISSOLVE THE GLOBULE.
THE COLOUR INTENSITY OF THE KEROSENE SOLUTION WAS MEASURED AT 630 NM USING A SPECTROPHOTOMETER.
THE METHOD IS DESCRIBED BY QUIN AND BROOKS (1972).

TIN IN STREAM SEDIMENTS WAS DETERMINED AS FOLLOWS:A 200 MG SAMPLE WAS HEATED WITH NH4I;THE SUBLINED SNI4 WAS DISSOLVED IN ACID AND THE TIN DETERMINED BY ATOMIC ABSORPTION SPECTROMETRY.

ANTIMONY WAS DETERMINED IN STREAM SEDIMENTS AS DESCRIBED BY (ASLIN,1976).
A 500 MG SAMPLE WAS PLACED IN A TEST TUBE; 3 ML CONCENTRATED HNO3 AND 9 ML CONCENTRATED HCL ARE ADDED AND THE MIXTURE WAS ALLOWED TO STAND OVERNIGHT AT ROOM TEMPERATURE.THE MIXTURE WAS HEATED SLOWLY TO 90C AND MAINTAINED AT THIS TEMPERATURE FOR AT LEAST 90 MINUTES.
THE SOLUTION WAS COOLED AND DILUTED TO 10 ML. A 400 MICRO L ALIQUOT OF THIS TEST SOLUTION WAS REMOVED AND DILUTED TO 10 ML WITH 1.8M HCL.THE ANTIMONY IN AN ALIQUOT OF THIS DILUTE SOLUTION WAS THEN DETERMINED BY HYDRIDE EVOLUTION-ATOMIC ABSORPTION SPECTROMETRY .

BARIUM WAS DETERMINED AS FOLLOWS: A 0.25 GRAM SAMPLE WAS HEATED WITH 5 ML CONC. HF, 5 ML CONC. HCLO4 AND 2 ML CONC. HNO3 TO FUMES OF HCLO4; 3 ML OF CONC. HCLO4 WERE ADDED AND HEATED TO LIGHT FUMES; 5 ML OF WATER WERE ADDED AND THE SOLUTION WAS TRANSFERRED TO A CALIBRATED TEST TUBE AND DILUTED TO 25 ML WITH WATER. BARIUM WAS DETERMINED BY ATOMIC ABSORPTION SPECTROSCOPY USING A NITROUS OXIDE ACETYLENE FLAME.

FLUORIDE IN STREAM WATER SAMPLES WAS DETERMINED USING A FLUORIDE ELECTRODE. PRIOR TO MEASUREMENT AN ALIQUOT OF THE SAMPLE WAS MIXED WITH AN EQUAL VOLUME OF TISAB II SOLUTION (TOTAL IONIC STRENGTH ADJUSTMENT BUFFER).
THE TISAB II BUFFER SOLUTION WAS PREPARED AS FOLLOWS: 58 GM NACL AND 5 GM CDTA (CYCLOHEXYLENE DINITRILO ACETIC ACID) WERE DISSOLVED IN A MIXTURE OF 50 ML METAL FREE WATER AND 57 ML GLACIAL ACETIC ACID. THE SOLUTION WAS COOLED TO ROOM TEMPERATURE AND THE PH ADJUSTED TO BETWEEN 5.0 AND 5.5 BY NTHE SLOW ADDITION OF 5M NAOH SOLUTION. THE SOLUTION WAS COOLED AND DILUTED TO 1 LITER IN A VOLUMETRIC FLASK.

HYDROGEN ION ACTIVITY (PH) WAS MEASURED WITH A COMBINATION GLASS-CALOMEL ELECTRODE AND A PH METER.

URANIUM IN WATERS WAS DETERMINED BY A LASER-INDUCED FLUOROMETRIC METHOD USING A SCINTREX UA-3 URANIUM ANALYSER.
A COMPLEXING AGENT, KNOWN COMMERCIALLY AS FLURAN AND COMPOSED OF SODIUM PYROPHOSPHATE AND SODIUM MONOPHOSPHATE, (HALL, G.E.M., 1979) WAS ADDED TO PRODUCE THE URANYL PYROPHOSPHATE SPECIES WHICH FLUORESCES WHEN EXPOSED TO THE LASER.
SINCE ORGANIC MATTER IN THE SAMPLE CAN CAUSE UNPREDICTABLE BEHAVIOUR, A STANDARD ADDITION METHOD WAS USED.
FURTHER, THERE HAVE BEEN INSTANCES AT THE G.S.C. WHERE THE REACTION OF URANIUM WITH FLURAN IS EITHER DELAYED OR SLUGGISH; FOR THIS REASON AN ARBITRARY 24 HOUR TIME DELAY BETWEEN THE ADDITION OF THE FLURAN AND THE ACTUAL READING WAS INCORPORATED INTO THIS METHOD.
IN PRACTICE,500 UL OF FLURAN SOLUTION WERE ADDED TO A 5 ML SAMPLE AND ALLOWED TO STAND FOR 24 HOURS. AT THE END OF THIS PERIOD FLUORESCENCE READINGS WERE MADE WITH THE ADDITION OF 0.0, 0.2 AND 0.4 PPB U.
FOR HIGH SAMPLES THE ADDITIONS WERE 0.0, 2.0 AND 4.0 (20 UL ALIQUOTS OF EITHER 55 OR 550 PPB U WERE USED).
ALL READINGS WERE TAKEN AGAINST A SAMPLE BLANK.

TABLE -1 DISPLAYS THE DATA RECORD FORMAT SPECIFICATIONS AND TABLE -2 THE DETECTION LIMITS OF THE ANALYTICAL METHODS.
THE SECOND FIGURE UNDER THE DETECTION LIMIT HEADING CORRESPONDS TO AN ARBITRARILY SET VALUE IF THE RESULTS FALL BELOW THE DETECTION LIMIT (USUALLY 1/2 THE DETECTION LIMIT) AND ARE USED IN SOME OF THE STATISTICAL CALCULATIONS.

TABLE -1

ELEMENT	CARD	COLUMNS FIELD
MAP	1	01-06
ID	1	07-12
UTM ZONE	1	13-14
UTM EAST (METER)	1	15-20
UTM NORTH (METER)	1	21-27
ROCK TYPE	1	28-31
SAMPLE MATERIAL	1	32
STREAM WIDTH (DECIMETER)	1	33-35
STREAM DEPTH (DECIMETER)	1	36-38
REPLICATE STATUS	1	39-40
CONTAMINATION	1	41
BANK TYPE	1	42
WATER COLOUR	1	43
FLOW RATE	1	44
SEDIMENT COLOUR	1	45
SAMPLE COMPOSITION	1	46-48
PRECIPITATE IN STREAM	1	49
DISTINCTIVE PRECIPITATE	1	50
GENERAL PHYSIOGRAPHY	1	55
DRAINAGE PATTERN	1	56
STREAM TYPE	1	57
STREAM CLASS	1	58
SOURCE OF WATER	1	59
AGE	1	70-71

TABLE -2

THE ANALYTICAL DATA WERE RECORDED AS FOLLOWS:

ELEMENT	UNITS	CARD	COLUMNS	DETECTION LIMIT
SEDIMENT				
ZN	PPM	2	16-20	<2=1
CU	PPM	2	21-25	<2=1
PB	PPM	2	26-30	<2=1
NI	PPM	2	31-35	<2=1
C0	PPM	2	36-40	<2=1
AG	PPM	2	41-47	VARIABLE
MN	PPM	2	48-52	<5=3
AS	PPM	2	54-60	<1=.5
MO	PPM	2	61-65	VARIABLE
FE	PCT	2	66-70	<0.02=0.01
HG	PPB	2	71-75	<10=5
LOI	PCT	2	76-80	<1.0=.5
U	PPM	3	16-22	<0.5=0.3
F	PPM	3	23-27	<40=20
V	PPM	3	28-32	<5=3
CD	PPM	3	33-39	VARIABLE
SB	PPM	3	40-46	VARIABLE
W	PPM	3	47-51	<2=1
BA	PPM	3	52-56	<40=20
SN	PPM	3	57-63	<1=.5
AU	PPB	4	31-35	VARIABLE
REPEAT AU	PPB	4	36-40	VARIABLE
AU WEIGHT	GRAMS	4	41-44	
REPEAT AU WEIGHT	GRAMS	4	45-48	
WATER				
F	PPB	4	26-30	<20=10
PH	LOG	4	31-35	
U	PPB	4	36-40	<0.05=0.03

PRESENTATION OF GOLD DATA AND COMMENTS REGARDING INTERPRETATION OF RESULTS

THE FOLLOWING DISCUSSION REVIEWS THE FORMAT USED TO PRESENT THE AU GEOCHEMICAL DATA AND OUTLINES SOME IMPORTANT POINTS TO CONSIDER WHEN INTERPRETING THIS DATA. THIS DISCUSSION IS INCLUDED IN RECOGNITION OF THE SPECIAL GEOCHEMICAL BEHAVIOUR AND MODE OF OCCURRENCE OF AU IN NATURE AND THE RESULTANT DIFFICULTIES IN OBTAINING AND ANALYZING SAMPLES WHICH REFLECT THE ACTUAL CONCENTRATION LEVEL AT A GIVEN SITE.

UNDERSTANDING AU GEOCHEMICAL DATA FROM REGIONAL STREAM SEDIMENT OR LAKE SEDIMENT SURVEYS REQUIRES AN APPRECIATION OF THE UNIQUE CHEMICAL AND PHYSICAL CHARACTERISTICS OF AU AND ITS MOBILITY IN THE SURFICIAL ENVIRONMENT. KEY PROPERTIES OF AU THAT DISTINGUISH ITS GEOCHEMICAL BEHAVIOUR FROM MOST OTHER ELEMENTS INCLUDE :

1) AU OCCURS MOST COMMONLY IN THE NATIVE FORM WHICH IS CHEMICALLY AND PHYSICALLY RESISTANT. A HIGH PROPORTION OF THE METAL IS DISPERSED IN MICRON-SIZED PARTICULATE FORM. GOLD'S HIGH SPECIFIC GRAVITY ENSURES HETEROGENEOUS DISTRIBUTION ESPECIALLY IN STREAM SEDIMENT AND CLASTIC-RICH (LOW LOI) LAKE SEDIMENT ENVIRONMENTS. AU DISTRIBUTION APPEARS TO BE MORE HOMOGENEOUS IN ORGANIC-RICH FLUVIATILE AND LAKE SEDIMENT ENVIRONMENTS.

2) AU TYPICALLY OCCURS AT LOW CONCENTRATIONS IN THE PPB RANGE. AU CONCENTRATIONS OF A FEW PPM MAY REPRESENT ECONOMIC DEPOSITS. BACKGROUND LEVELS ENCOUNTERED FOR STREAM AND CENTRE-LAKE SEDIMENTS SELDOM EXCEED 10 PPB,AND COMMONLY ARE NEAR THE DETECTION LIMIT OF 1 PPB.

THE MANY FOREGOING FACTORS CAN RESULT IN A PARTICLE SPARSITY EFFECT WHEREIN VERY LOW CONCENTRATIONS OF AU ARE HETEROGENEOUSLY DISTRIBUTED IN THE SURFICIAL ENVIRONMENT. HENCE, A MAJOR PROBLEM FACING THE GEOCHEMIST IS OBTAINING A REPRESENTATIVE SAMPLE. IN GENERAL THE LOWER THE ACTUAL CONCENTRATION OF AU, THE LARGER THE SAMPLE SIZE, OR THE SMALLER THE GRAIN SIZE REQUIRED TO REDUCE UNCERTAINTY OVER WHETHER SUBSAMPLE ANALYTICAL VALUES TRULY REPRESENT ACTUAL VALUES.CONVERSELY, AS ACTUAL AU CONCENTRATIONS INCREASE OR GRAIN SIZE DECREASES,THE NUMBER OF AU PARTICLES TO BE SHARED IN RANDOM SUBSAMPLES INCREASES AND THE VARIABILITY OF RESULTS DECREASES (CLIFTON ET AL., 1969; HARRIS, 1982). THE LIMITED AMOUNT OF MATERIAL COLLECTED DURING THE RAPID,RECONNAISSANCE-STYLE REGIONAL SURVEYS AND THE NEED TO ANALYZE FOR A BROAD SPECTRUM OF ELEMENTS, PRECLUDES THE USE OF A SIGNIFICANTLY LARGE SAMPLE WEIGHT FOR THE AU ANALYSES. THEREFORE, TO THE EXTENT THAT SAMPLE REPRESENTIVITY CAN BE INCREASED,SAMPLE GRAIN SIZE IS REDUCED BY SIEVING AND BALL MILLING OF ALL SAMPLES.
IF THE AU IS PRESENT IN A METALLIC STATE, BALL MILLING MAY NOT REDUCE IT'S PARTICLE SIZE SIGNIFICANTLY BECAUSE OF ITS MALLEABILITY.

GOLD DATA DISCUSSION CONTINUED

THE FOLLOWING CONTROL METHODS ARE CURRENTLY EMPLOYED TO EVALUATE AND MONITOR THE SAMPLING AND ANALYTICAL VARIABILITY WHICH ARE INHERENT IN THE ANALYSIS OF AU IN GEOCHEMICAL MEDIUMS :

1) FOR EACH BLOCK OF TWENTY SAMPLES:

   A) RANDOM INSERTION OF A STANDARD REFERENCE SAMPLE TO MONITOR AND CONTROL ANALYTICAL ACCURACY AND LONG-TERM PRECISION,

   B) COLLECTION OF A FIELD DUPLICATE (TWO SAMPLES SEPARATELY COLLECTED FROM ONE SITE) TO MONITOR SAMPLING VARIANCE,

   C) ANALYSIS OF A SECOND SUBSAMPLE (BLIND DUPLICATE) FROM ONE SAMPLE TO MONITOR AND CONTROL SHORT-TERM PRECISION;

2) FOR BOTH STREAM SEDIMENTS AND LAKE SEDIMENTS, REPEAT ANALYSES ON A SECOND SUBSAMPLE ARE PERFORMED FOR ALL SAMPLES HAVING VALUES THAT ARE STATISTICALLY ABOVE APPROXIMATELY THE 90TH PERCENTILE OF THE TOTAL DATA SET; WITHIN THE SURVEY AREA

3) FOR LAKE SEDIMENTS ONLY, REPEAT ANALYSIS ON A SECOND SUBSAMPLE WAS PERFORMED ON THOSE SAMPLES WITH LOI VALUES BELOW 10%, INDICATING A LARGE CLASTIC COMPONENT. ON-GOING STUDIES SUGGEST THAT THE AU DISTRIBUTION IN THESE SAMPLES IS MORE LIKELY TO BE HIGHLY VARIABLE THAN IN SAMPLES WITH A HIGHER LOI CONTENT.

AU DATA PRESENTATION, STATISTICAL TREATMENT AND THE VALUE MAP FORMAT ARE SOMEWHAT DIFFERENT THAN FOR OTHER ELEMENTS. AU DATA LISTED IN THIS OPEN FILE INCLUDES INITIAL ANALYTICAL RESULTS, VALUES DETERMINED FROM REPEAT ANALYSES, TOGETHER WITH SAMPLE WEIGHTS AND CORRESPONDING DETECTION LIMITS FOR ALL ANALYZED SAMPLES.
THE GOLD HISTOGRAM, STATISTICAL PARAMETERS, AND REGIONAL TREND MAP ARE DETERMINED USING THE FOLLOWING DATA POPULATION SELECTION CRITERIA:

1) ONLY THE FIRST VALUE OF A REPEAT ANALYSIS IS UTILIZED;

2) AU VALUES DETERMINED FROM SAMPLE WEIGHTS LESS THAN 10 G ARE EXCLUDED.

3) AU VALUES LESS THAN THE DETECTION LIMIT(<1PPB) FOR 10 G SAMPLES ARE SET TO 0.5 PPB.

GOLD DATA DISCUSSION CONTINUED

ON THE VALUE MAPS, REPEAT ANALYSIS VALUES(NOT FIELD DUPLICATES) ARE PLACED IN BRACKETS FOLLOWING THE INITIAL VALUE DETERMINATION. ALL VALUES DETERMINED ON A SAMPLE LESS THAN 10 G ARE DENOTED BY AN ASTERISK. ACTUAL SAMPLE WEIGHT USED CAN BE DETERMINED FROM THE TEXT. FOLLOWING ARE POSSIBLE VARIATIONS IN DATA PRESENTATION ON A VALUE MAP:

*	NO DATA
+27	SINGLE ANALYSIS,10 G SAMPLE WEIGHT
+27*	SINGLE ANALYSIS,<10 G SAMPLE WEIGHT
+27(14)	REPEAT ANALYSIS,BOTH SAMPLES 10 G
+27(14*)	REPEAT ANALYSIS,FIRST SAMPLE 10 G,REPEAT <10 G
+<1	SINGLE ANALYSIS,10 G SAMPLE,LESS THAN DETECTION LIMIT OF 1 PPB

IN SUMMARY,GEOCHEMICAL FOLLOW-UP INVESTIGATIONS FOR AU SHOULD BE BASED ON A CAREFUL CONSIDERATION OF ALL GEOLOGICAL AND GEOCHEMICAL INFORMATION, AND ESPECIALLY A CAREFUL APPRAISAL OF GOLD GEOCHEMICAL DATA AND ITS VARIABILITY. IN SOME INSTANCES, PROSPECTIVE FOLLOW-UP AREAS MAY BE INDIRECTLY IDENTIFIED BY PATHFINDER ELEMENT ASSOCIATIONS IN FAVOURABLE GEOLOGY, ALTHOUGH A COMPLEMENTARY AU RESPONSE DUE TO NATURAL VARIABILITY MAY BE LACKING. ONCE AN ANOMALOUS AREA HAS BEEN IDENTIFIED,FIELD INVESTIGATIONS SHOULD BE DESIGNED TO INCLUDE DETAILED GEOCHEMICAL FOLLOW-UP SURVEYS AND COLLECTION OF LARGE REPRESENTATIVE SAMPLES. SUBSEQUENT REPEAT SUBSAMPLE ANALYSES WILL INCREASE THE RELIABILITY OF RESULTS AND PERMIT A BETTER UNDERSTANDING OF NATURAL VARIABILITY WHICH CAN THEN BE USED TO IMPROVE SAMPLING METHODOLOGY AND INTERPRETATION.

REFERENCES

ASLIN, G.E.M. (1976) THE DETERMINATION OF ARSENIC AND ANTIMONY IN GEOLOGICAL MATERIALS BY FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETER JOURNAL OF GEOCHEMICAL EXPLORATION, VOL. 6,PP. 321-330.

BOULANGER, A., EVANS, D.J.R. AND RABY, B.F. (1975) URANIUM ANALYSIS BY NEUTRON ACTIVATION DELAYED NEUTRON COUNTING: PROC. OF THE 7TH ANNUAL SYMP. OF CANADIAN MINERAL ANALYSTS. THUNDER BAY, ONTARIO, SEPT. 22-23, 1975.

CLIFTON,H.E.,HUNTER,R.E.,SWANSON,F.J.AND PHILLIPS,R.L. (1969) SAMPLE SIZE AND MEANINGFUL GOLD ANALYSIS. U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 625-C.

FICKLIN, W.H. (1970) A RAPID METHOD FOR THE DETERMINATION OF FLUORIDE IN ROCKS AND SOILS, USING AN ION SELECTIVE ELECTRODE. U.S. GEOL. SURV. PAPER 700C PP. C186-188.

GARRETT, R.G. (1974) FIELD DATA AQUISITION METHODS FOR APPLIED GEOCHEMICAL SURVEYS AT THE GEOLOGICAL SURVEY OF CANADA: GEOL SURV. CAN. PAPER 74-52.

HALL, G.E.M. (1979) A STUDY OF THE STABILITY OF URANIUM IN WATERS COLLECTED FROM VARIOUS GEOLOGICAL ENVIRONMENTS IN CANADA; IN CURRENT RESEARCH, PART A, GEOL. SURV. CAN. PAPER 79-1A, P. 361-365.

HARRIS,J.F. (1982) SAMPLING AND ANALYTICAL REQUIREMENTS FOR EFFECTIVE USE OF GEOCHEMISTRY IN EXPLORATION FOR GOLD. IN LEVINSON,A.A.,EDITOR; PRECIOUS METALS IN THE NORTHERN CORDILLERA, PROCEEDINGS OF A SYMPOSIUM SPONSORED BY THE ASSOCIATION OF EXPLORATION GEOCHEMISTS AND THE CORDILLERAN SECTION OF THE GEOLOGICAL ASSOCIATION OF CANADA,PP.53-67.

JONASSON, I.R., LYNCH,J.J. AND TRIP, L.J. (1973) FIELD AND LABORATORY METHODS USED BY THE GEOLOGICAL SURVEY OF CANADA IN GEOCHEMICAL SURVEYS: NO. 12, MERCURY IN ORES, ROCKS,SOILS, SEDIMENTS AND WATER: GEOL. SURV. CAN. PAPER 73-21.

QUIN,B.F. AND BROOKS,R.R.(1972) THE RAPID DETERMINATION OF TUNGSTEN IN SOILS, STREAM SEDIMENTS, ROCKS AND VEGETATION. ANAL.CHIM. ACTA. 58 PP 301-309.

DATA LIST LEGEND

MAP-	NATIONAL TOPOGRAPHIC SYSTEM(NTS)- LETTERED QUADRANGLE (SCALE 1:250000). PART OF SAMPLE NUMBER
ID-	REMAINDER OF SAMPLE NUMBER- YEAR(2), FIELD CREW(1), SAMPLE SEQUENCE NUMBER(3)
UTM COORDINATS-	UNIVERSAL TRANSVERSE MERCATOR(UTM) COORDINATE SYSTEM- SAMPLE COORDINATES
ZN-	ZONE
EAST-	EASTING(METERS)
NORTH-	NORTHING(METERS)
ROCK TYPE-	MAJOR ROCK TYPE OF THE CATCHMENT AREA
AGE-	STRATIGRAPHIC AGE OF ROCK TYPE
WD-	WIDTH OF STREAM(DECIMETER) AT SAMPLE SITE
DT-	DEPTH OF STREAM SAMPLED TO NEAREST DECIMETER
SAMP-	TYPE OF MATERIAL SAMPLED
RP ST-	REPLICATE STATUS- RELATIONSHIP OF SAMPLE TO OTHERS WITHIN THE THE BLOCK OF 20
CONT-	CONTAMINATION
BANK-	BANK TYPE
WCOL-	WATER COLOUR AND SUSPENDED LOAD
RATE-	WATER FLOW RATE
SCOL-	PREDOMINANT SEDIMENT COLOUR
SMP CMP-	SAMPLE COMPOSITION- BULK MECHANICAL COMPOSITION OF SAND, FINES AND ORGANICS RESPECTIVELY
PPPS-	PRECIPITATE OR STAIN ON SEDIMENTS AT SAMPLE SITE
PRPB-	DISTINCTIVE PRECIPITATE,STAIN,WEATHERING,BLOOMS ON ROCKS IN IMMEDIATE CATCHMENT AREA
PHYS-	GENERAL PHYSIOGRAPHY
PATT-	DRAINAGE PATTERN
TYPE-	STREAM TYPE
CLSE-	STREAM CLASS
SRCE-	SOURCE OF WATER

ROCK TYPES:

QUATERNARY

RECENT
SELKIRK GROUP
(RS 64) - BASALT,ANDESITE FLOWS,BRECCIA,TUFF.

PLEISTOCENE AND RECENT
(QS 64) - GLACIAL AND SURFICIAL DEPOSITS.

TERTIARY

OLIGOCENE AND MIOCENE
(OMCV 61) - ANDESITE,BASALT,BRECCIA.
(OMD 61) - DONJEK:TUFF,BRECCIA.

OLIGOCENE
CARMACKS GROUP
(OCS 60) - CONGLOMERATE,SANDSTONE,SHALE.

LOWER TERTIARY
(ITS 58) - CONGLOMERATE,SANDSTONE,SHALE.
(TVR 58) - RHYOLITE,QUARTZ FELDSPAR PORPHYRY.

EARLY TERTIARY
(ETF 57) - GRANITE AND SYENITE PORPHYRY, RHYOLITE.

CRETACEOUS

(KY 52) - SYENITE,MONZONITE.
(KQM 52) - QUARTZ MONZONITE,GRANODIORITE;CASSIAR QUARTZ MONZONITE,ALASKITE.

TRIASSIC

(TGDN - 42) - FOLIATED HORNBLENDE GRANODIORITE, QUARTZ.

ROCK TYPES(CONTINUED):

PALEOZOIC AND MESOZOIC UNDIVIDED

(PMUB 40) - ULTRAMAFIC ROCKS

PALEOZOIC UNDIVIDED
(PN 09) - NASINA:GRAPHITIC QUARTZITE,SCHIST.
(PC 09) - LIMESTONE.
(PTV 09) - CHERT,VOLCANIC ROCKS,SLATE.
(PV 09) - GREENSTONE,AMPHIBOLITE.
(PQMN 09) - FOLIATED MUSCOVITE QUARTZ MONZONITE.
(PGDN 09) - PELLY GNEISS:FOLIATED TO GNEISSIC GRANODIORITE.

PERMIAN

SKOLAI GROUP
(PS 36) - ANDESITE,BASALT,ULTRAMAFICS,PYROCLASTICS, PHYLLITE,CHERT,LIMESTONE,CONGLOMERATE.

CARBONIFEROUS AND PERMIAN

(CPS 35) - QUARTZ-MUSCOVITE SCHIST.
(CPSN 35) - SCHIST,GNEISS,INCLUDES BIG SALMON METAMORPHIC COMPLEX.
(CPUB 35) - SERPENTITE,DIORITE,PYROXENITE, PERIDOTITE.

AGE:
- 64 - PLEISTOCENE TO RECENT
- 61 - OLIGOCENE AND MIOCENE
- 60 - OLIGOCENE
- 58 - LOWER TERTIARY
- 57 - EARLY TERTIARY
- 52 - CRETACEOUS
- 42 - TRIASSIC
- 40 - PALEOZOIC AND MESOZOIC UNDIVI
- 36 - PERMIAN
- 35 - CARBONIFEROUS AND PERMIAN
- 09 - PALEOZOIC UNDIVIDED

SAMP:
- 1 - STREAM BED SEDIMENT
- 2 - SPRING OR SEEP SEDIMENT
- 6 - SIMULTANEOUS STREAM WATER AND SEDIMENT

RP ST:
- 00 - ROUTINE REGIONAL SAMPLE
- 10 - FIRST OF FIELD DUPLICATE
- 20 - SECOND OF FIELD DUPLICATE

CONT:
- 0 - NONE
- 1 - POSSIBLE
- 2 - PROBABLE
- 3 - DEFINITE
- 4 - MINING ACTIVITY
- 9 - BURNED AREAS

BANK:
- 1 - ALLUVIAL
- 2 - COLLUVIAL
- 3 - GLACIAL TILL,TILLITE
- 4 - GLACIAL OUTWASH SEDIMENTS
- 6 - TALUS,SCREE
- 7 - ORGANIC PREDOMINANT

WCOL:
- 0 - CLEAR
- 1 - BROWN TRANSPARENT
- 2 - WHITE CLOUDY
- 3 - BROWN CLOUDY

RATE:
- 0 - ZERO
- 1 - SLOW
- 2 - MODERATE
- 3 - FAST
- 4 - TORRENTIAL

SCOL:
- 1 - RED,BROWN
- 3 - BLACK
- 6 - GREY,BLUE GREY
- 8 - BUFF TO BROWN
- 9 - BROWN

SMP CMP:
PORTION OF EACH COMPONENT IS INDICATED AS A FRACTION OF THE TOTAL OF ALL THREE COLUMNS.
EXAMPLES:
013-NO SAND,25% FINES,75% ORGANICS
122-20% SAND,40% FINES,40% ORGANICS
030-NO SAND,100% FINES,NO ORGANICS

PPPS:
- 0 - NONE
- 1 - RED,BROWN,BLACK
- 2 - WHITE OR BUFF
- 7 - PINK
- 8 - BUFF TO BROWN

PRPB:
- 0 - FEATURELESS
- 1 - RED,BROWN
- 2 - WHITE OR BUFF
- 3 - BLACK

PHYS:
- 0 - PLAIN
- 1 - MUSKEG,SWAMPLAND
- 2 - PENEPLAIN OR PLATEAU
- 3 - HILLY,UNDULATING
- 4 - MOUNTAINOUS,MATURE

PATT:
- 0 - POORLY DEFINED,HAPHAZARD
- 1 - DENDRITIC
- 2 - HERRINGBONE
- 5 - DISCONTINOUS SHIELD TYPE (CHAINS OF LAKES)

TYPE:
- 0 - UNDEFINED
- 1 - PERMANENT,CONTINUOUS
- 2 - INTERMITTENT,SEASONAL
- 3 - RE-EMERGENT,DISCONTINUOUS

CLSE:
- 0 - UNDEFINED
- 1 - PRIMARY
- 2 - SECONDARY
- 3 - TERTIARY
- 4 - QUATERNARY

SRCE:
- 0 - UNKNOWN
- 1 - GROUNDWATER
- 2 - SNOW MELT OR SPRING RUNOFF

ZN-	ZINC BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
CU-	COPPER BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
PB-	LEAD BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
NI-	NICKEL BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
CO-	COBALT BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
AG-	SILVER BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
MN-	MANGANESE BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
AS-	ARSENIC BY HYDRIDE EVOLUTION-ATOMIC ABSORPTION SPECTROSCOPY(PPM)
MO-	MOLYBDENUM BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
FE-	IRON BY ATOMIC ABSORPTION SPECTROSCOPY(%)
HG-	MERCURY BY FLAMELESS SPECTROSCOPY(PPB)
LOI-	LOSS ON IGNITION BY WEIGHT DIFFERENCE(%)
U-	URANIUM BY NEUTRON ACTIVATION - DELAYED NEUTRON COUNTING (PPM)
F-	FLUORINE BY SPECIFIC ION ELECTRODE(PPM)
V-	VANADIUM BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
CD-	CADMIUM BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
W-	TUNGSTEN BY COLORIMETRY USING DITHIOL(PPM)
SN-	TIN BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
SB-	ANTIMONY BY HYDRIDE EVOLUTION-ATOMIC ABSORPTION SPECTROSCOPY(PPM)
BA-	BARIUM BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)
AU-	GOLD BY FIRE ASSAY PRECONCENTRATION-NEUTRON ACTIVATION(PPB)
AU-R-	GOLD REPEAT ANALYSIS BY FIRE ASSAY PRECONCENTRATION-NEUTRON ACTIVATION(PPB)
AU WT1-	WEIGHT IN GRAMS OF ORIGINAL GOLD SAMPLE ANALYZED
AU WT2-	WEIGHT IN GRAMS OF REPEAT GOLD SAMPLE ANALYZED
DL1-	GOLD DETECTION LIMIT BASED ON ANALYSIS SAMPLE WEIGHT FOR INITIAL GOLD ANALYSIS
DL2-	GOLD DETECTION LIMIT BASED ON ANALYSIS SAMPLE WEIGHT FOR REPEAT GOLD ANALYSIS
F-W-	FLUORIDE IN WATERS BY SPECIFIC ION ELECTRODE(PPB)
PH-	PH BY COMBINATION GLASS-CALOMEL ELECTRODE
U-W-	URANIUM IN WATERS BY LASER INDUCED FLUORESCENCE(PPB)