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Geological Survey of Canada
Commission géologique du Canada
Resource Geophysics and Geochemistry Division



Province of
British Columbia Ministry of
Energy, Mines and
Petroleum Resources

Geological Branch
Mineral Resources Division

NATIONAL GEOCHEMICAL RECONNAISSANCE 1:250 000 MAP SERIES

PEMBERTON, BRITISH COLUMBIA
(NTS 92J)

GSC
Open File 867

MEMPR
BC RGS 9

1982

REGIONAL GEOCHEMICAL SURVEY, BRITISH COLUMBIA, 1981

NTS 92J, PEMBERTON

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AVAILABLE FOR SALE AT:

- BRITISH COLUMBIA MINISTRY OF ENERGY, MINES AND
PETROLEUM RESOURCES, VICTORIA, BRITISH COLUMBIA
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AVAILABLE FOR REFERENCE AT:

- ALL LIBRARIES OF THE GEOLOGICAL SURVEY OF CANADA
- BRITISH COLUMBIA MINISTRY OF ENERGY, MINES AND
PETROLEUM RESOURCES, VICTORIA, BRITISH COLUMBIA

REGIONAL GEOCHEMICAL SURVEYS 7, 8, AND 9 WERE MANAGED AND FUNDED BY
THE BRITISH COLUMBIA MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES;
DATA MANAGEMENT BY THE GEOLOGICAL SURVEY OF CANADA.

REGIONAL STREAM SEDIMENT AND WATER GEOCHEMICAL RECONNAISSANCE DATA, BRITISH COLUMBIA, 1981

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THE 1980 RECONNAISSANCE SURVEY WAS UNDERTAKEN BY THE BRITISH COLUMBIA MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES USING THE METHODS OF SAMPLE COLLECTION AND ANALYSES ESTABLISHED BY THE GEOLOGICAL SURVEY OF CANADA DURING THE FEDERAL -PROVINCIAL JOINT URANIUM RECONNAISSANCE PROGRAM.

CONTRACTS LET FOR SAMPLE COLLECTION, PREPARATION, AND ANALYSES WERE SUPERVISED AND/OR MONITORED BY STAFF OF THE MINISTRY AS FOLLOWS:

COLLECTION	- ROOI ENTERPRISES LTD., VICTORIA. QUASAR AVIATION.
SUPERVISION	- W.J. MCMILLAN, W.M. JOHNSON.
PREPARATION	- KAMLOOPS RESEARCH ASSAY AND LABORATORY LTD.
SUPERVISION	- W.M. JOHNSON.
ANALYTICAL	- CHEMEX LABS. LTD., NORTH VANCOUVER (STREAM SEDIMENTS). BONDAR-CLEGG & COMPANY LTD., NORTH VANCOUVER (STREAM WATERS). NOVATRACK ANALYSTS LIMITED, VANCOUVER (URANIUM IN STREAM SEDIMENTS).
SUPERVISION	- W.M. JOHNSON.

THE GEOLOGICAL SURVEY OF CANADA WAS RESPONSIBLE FOR DATA MANAGEMENT.

FEDERAL LIAISON WAS WITH E.H.W. HORN BROOK, G. LYNCH, AND S.B. BALLANTYNE, RESOURCE GEOCHEMISTRY SUBSECTION, GEOLOGICAL SURVEY OF CANADA.

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STREAM SEDIMENT AND WATER SAMPLES WERE COLLECTED AT AN AVERAGE DENSITY OF ONE SAMPLE PER 16.6 SQUARE KILOMETRES (6.4 SQUARE MILES) THROUGHOUT THE 30 000-SQUARE-KILOMETRE (11,600-SQUARE-MILE) SOUTH-CENTRAL BRITISH COLUMBIA SURVEY AREA. THE HELICOPTER AND 4-WHEEL-DRIVE TRUCK-SUPPORTED SAMPLE COLLECTION WAS CARRIED OUT DURING THE SUMMER OF 1981.

FIELD DRIED SAMPLES WERE AIR DRIED AND THE MINUS 80 MESH (177 MICRONS) FRACTION WAS OBTAINED FOR SUBSEQUENT ANALYSES.

ONE FIELD DUPLICATE SAMPLE WAS ROUTINELY COLLECTED IN EACH ANALYTICAL BLOCK OF 20 SAMPLES.

FOR CONTROL, A SAMPLE BLOCK OF 20 SILT SAMPLES INCLUDES THE FIELD DUPLICATE, ONE CONTROL REFERENCE AND ONE BLIND DUPLICATE SAMPLE. IN EACH ANALYTICAL BLOCK OF 20 WATER SAMPLES THE CONTROL REFERENCE AND BLIND DUPLICATE SAMPLE POSITIONS WERE FILLED WITH CONTROL REFERENCE WATER SAMPLES. THE SAMPLE PREPARATION LABORATORY IS RESPONSIBLE FOR INSERTION OF CONTROL SAMPLES.

THE DETERMINATION OF ZN, CU, PB, NI, CO, AG, MN, FE, MO, AS, W, SB, AND HG IN STREAM SEDIMENTS WAS CARRIED OUT BY CHEMEX LABS LTD.

THE DETERMINATION OF U IN STREAM SEDIMENTS WAS CARRIED OUT BY NOVATRACK ANALYSTS LIMITED.

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THE DETERMINATION OF U, F, AND pH IN STREAM WATERS WAS CARRIED OUT BY BONDAR-CLEGG & COMPANY LTD.

FOR THE DETERMINATION OF ZN, CU, PB, NI, CO, AG, MN, AND FE, A 1-GRAM SAMPLE WAS REACTED WITH 3 ML OF CONCENTRATED HN03 IN A TEST TUBE FOR 30 MINUTES AT 90° C. AT THIS POINT, 1 ML CONCENTRATED HCL WAS ADDED AND THE DIGESTION WAS CONTINUED AT 90° C FOR AN ADDITIONAL 90 MINUTES.

THE SAMPLE SOLUTION WAS THEN DILUTED TO 20 ML WITH METAL-FREE WATER AND MIXED. ZN, CU, PB, NI, CO, AG, MN, AND FE WERE DETERMINED BY ATOMIC ABSORPTION SPECTROSCOPY USING AN AIR-ACETYLENE FLAME.

BACKGROUND CORRECTIONS WERE MADE FOR PB, NI, CO, AND AG.

MOLYBDENUM WAS 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 90° C FOR 30 MINUTES.

AT THIS POINT 0.5 ML CONCENTRATED HCL WAS ADDED AND THE DIGESTION WAS CONTINUED AT 90° C FOR AN ADDITIONAL 90 MINUTES.

AFTER COOLING, 8 ML OF 1 250 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).

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A 0.5-GRAM SAMPLE WAS REACTED WITH 20 ML CONCENTRATED HNO_3 AND 1 ML CONCENTRATED HCL IN A TEST TUBE FOR 10 MINUTES AT ROOM TEMPERATURE PRIOR TO 2 HOURS OF DIGESTION WITH MIXING AT 90°C 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 W/V SnSO_4 IN M H_2SO_4 .

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.

ARSENIC WAS DETERMINED BY HYDRIDE GENERATION/ATOMIC ABSORPTION SPECTROSCOPY ON AN ALIQUOT TAKEN FROM THE SAMPLE PREPARED FOR THE BASE METAL ANALYSES.

ANTIMONY WAS DETERMINED AS FOLLOWS: A 2-GRAM SAMPLE WAS DIGESTED WITH CONCENTRATED HCL IN A HOT WATER BATH. THE IRON WAS REDUCED TO FE (II) AND THE Sb EXTRACTED WITH TRIOCTYL PHOSPHINE OXIDE MIBK AND MEASURED WITH ATOMIC ABSORPTION SPECTROSCOPY WITH BACKGROUND CORRECTION.

TUNGSTEN WAS DETERMINED COLOURIMETRICALLY SUBSEQUENT TO A PYROSULFATE FUSION AND A DITHIOLCARBONATE COMPLEXING FOR THE GENERATION OF THE COLOUR.

URANIUM WAS DETERMINED USING A NEUTRON ACTIVATION METHOD WITH DELAYED NEUTRON COUNTING.

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A DETAILED DESCRIPTION OF THE METHOD IS PROVIDED BY BOULANGER, ET AL. (1975). IN BRIEF, A 1-GRAM SAMPLE IS WEIGHED INTO A 7-DRAM POLYETHYLENE VIAL, CAPPED AND SEALED.

THE IRRADIATION IS PROVIDED BY THE TRIUMF CYCLOTRON WITH AN OPERATING FLUX OF 10^{11} NEUTRONS PER SQUARE CENTIMETRE PER SECOND.

THE SAMPLES ARE PNEUMATICALLY TRANSFERRED FROM AN AUTOMATIC LOADER TO THE REACTOR, WHERE EACH SAMPLE IS IRRADIATED FOR 60 SECONDS.

AFTER IRRADIATION, THE SAMPLE IS AGAIN TRANSFERRED PNEUMATICALLY TO THE COUNTING FACILITY WHERE AFTER A 20-SECOND DELAY THE SAMPLE IS COUNTED FOR 60 SECONDS WITH SIX BF₃ DETECTOR TUBES EMBEDDED IN PARAFFIN.

FOLLOWING COUNTING, THE SAMPLES ARE AUTOMATICALLY EJECTED INTO A SHIELDED STORAGE CONTAINER.

CALIBRATION IS CARRIED OUT EVERY 40 SAMPLES AS A MINIMUM USING NATURAL MATERIALS OF KNOWN URANIUM CONCENTRATION.

URANIUM WAS DETERMINED IN THE WATER SAMPLES BY A FLUOROMETRIC METHOD. THE URANIUM WAS INITIALLY PRECONCENTRATED BY EVAPORATION. THE RESIDUE AFTER EVAPORATION WAS FUSED WITH A MIXTURE OF Na₂CO₃, K₂CO₃, AND NAF IN A PLATINUM DISH. AFTER COOLING THE FLUORESCENCE OF THE FUSED PELLET WAS MEASURED USING A TURNER FLUOROMETER MODEL 111.

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FLUORIDE IN STREAM WATER SAMPLES WAS DETERMINED USING A SPECIFIC ION ELECTRODE. AN ALIQUOT OF THE SAMPLE WAS MIXED WITH AN EQUAL VOLUME OF A TISAB SOLUTION (TOTAL IONIC STRENGTH ADJUSTMENT BUFFER). THE FLUORIDE WAS MEASURED USING A CORNING 101 ELECTROMETER WITH AN ORION FLUORIDE ELECTRODE.

FOR THE DETERMINATION OF pH AN ALIQUOT OF THE WATER SAMPLE WAS TRANSFERRED TO A CLEAN DRY BEAKER. THE pH WAS MEASURED USING A FISHER ACCUMET pH METER.

ON RECEIPT, FIELD AND ANALYTICAL DATA WERE PUNCHED ONTO 80-COLUMN CARDS AND ALL SUBSEQUENT PROCESSING WAS CARRIED OUT WITH THE AID OF COMPUTERS. THE FIELD DATA WERE RECORDED BY THE FIELD CONTRACT STAFF ONTO STANDARD GEOCHEMICAL STREAM WATER AND SEDIMENT SAMPLE FIELD CARDS BASED ON FORM REV. 77 USED BY THE GEOLOGICAL SURVEY OF CANADA.

THE SAMPLE SITE POSITIONS WERE SELECTED ON 1:50 000 BASE MAPS AND TRANSFERRED TO 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 DOMINANT ROCK TYPES IN THE STREAM CATCHMENT BASINS WERE IDENTIFIED BY J. BRISTOW ON A GEOLOGICAL MAP WITH A MODIFIED LEGEND AND GEOLOGICAL SOURCES ARE GIVEN IN THE REFERENCES.

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THE ANALYTICAL DATA WERE RECORDED AS FOLLOWS (SEE GARRETT, 1974, FOR DETAILS) AND ALSO FOR CONVENIENCE THE DETECTION LIMITS OF THE ANALYTICAL METHODS USED ARE GIVEN:

	ELEMENT*	DETECTION LIMIT (D.L.)	VALUE REPORTED IF LESS THAN D.L.
SEDIMENT			
	ZN	2	1
	CU	2	1
	PB	2	1
	NI	2	1
	CO	2	1
	AG	0.2	0.1
	MN	5	2
	FE	0.02	0.01
	AS	1.0	0.5
	MO	2	1
	W	2	1
	HG PPB	10	5
	U	0.2	0.1
	SB	0.2	0.1
WATER			
	U PPB	0.05	0.02
	F PPB	20	10

* UNLESS OTHERWISE NOTED THE UNITS OF MEASUREMENT FOR THE ANALYSES ARE PPM. THE FIGURES TO WHICH VALUES WERE SET IF THEY FELL BELOW THE DETECTION LIMIT WERE CHOSEN ARBITRARILY.

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

THE SAMPLE SITE COORDINATES WERE CHECKED BY PLOTTING SAMPLING LOCATION MAPS ON A FLAT BED PLOTTER FROM THE DIGITIZED COORDINATES AND THEN OVERLYING THESE OVER THE FIELD CONTRACTOR'S SAMPLE LOCATION BASE MAPS.

QUALITY CONTROL AND MONITORING OF THE ANALYTICAL DATA WAS BASED ON CONTROL REFERENCE AND BLIND DUPLICATE SAMPLES AND CRITERIA STIPULATED IN THE ANALYTICAL CONTRACTS.

REFERENCES

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- GARRETT, ROBERT G. (1974): FIELD DATA ACQUISITION METHODS FOR APPLIED GEOCHEMISTRY SURVEYS AT THE GEOLOGICAL SURVEY OF CANADA, GEOL. SURV., CANADA, PAPER 74-52.
- 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., CANADA, PAPER 73-21.
- RODDICK, J.A. AND HUTCHINSON, W.W. (1973): PEMBERTON (EAST-HALF), B.C., GEOL. SURV., CANADA, PAPER 73-17, (MAP 13-1973) 21PP.
- WOODSWORTH, G.J. (1977): GEOLOGY OF PEMBERTON MAP-AREA, GEOL. SURV., CANADA, OPEN-FILE 482.

DATA LIST LEGEND

MAP-	NATIONAL TOPOGRAPHIC SYSTEM (NTS) - LETTERED SIXTEENTH (SCALE 1:500000). PART OF SAMPLE NUMBER
SAMPLE-	REMAINDER OF SAMPLE NUMBER - YEAR (2), FIELD CREW (1), SAMPLE SEQUENCE NUMBER (3)
UTM COORDINATES-	UNIVERSAL TRANSVERSE MERCATOR (UTM) COORDINATE SYSTEM - SAMPLE COORDINATES
ZN-	ZONE
EAST-	EASTING (METERS)
NORTH-	NORTHING (METERS)
ROCK TYPE-	MAJOR ROCK TYPE OF CATCHMENT AREA
AGE-	STRATIGRAPHIC AGE OF ROCK TYPE
WD-	WIDTH OF STREAM (DECIMETER) AT THE SAMPLE SITE
DT-	DEPTH OF STREAM SAMPLED TO NEAREST DECIMETER
SAMP-	TYPE OF MATERIAL SAMPLED
RP ST-	REPLICATE STATUS - RELATIONSHIP OF SAMPLE WITH RESPECT TO OTHERS WITHIN THE SURVEY
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, ORGANICS RESPECTIVELY
PPPS-	PRECIPITATE OR STAIN ON SEDIMENTS AT SAMPLE SITE
PRPB-	DISTINCTIVE PRECIPITATE, STAIN, WEATHERING, BLOOMS ON ROCKS IN THE IMMEDIATE CATCHMENT AREA
PHYS-	GENERAL PHYSIOGRAPHY
PATT-	DRAINAGE PATTERN
TYPE-	STREAM TYPE
CLSE-	STREAM CLASS
SRCE-	SOURCE OF WATER

DATA LIST LEGEND

ROCK TYPE:	TILL- TILL		
	GRNT- GRANITE		
	GRCK- GRAYWACKE	RATE:	1- SLOW
	ARGL- ARGILLITE		2- MODERATE
	SPRN- SERPENTENITE		3- FAST
	ANDS- ANDESITE		4- TORRENTIAL
	GRNS- GREENSTONE	SCOL:	1- RED, BROWN
	RDCT- RHYODACITE		2- WHITE, BUFF
	SHLE- SHALE		3- BLACK
	MSDM- META - SEDIMENT		6- GREY, BLUE-GREY
AGE:	10- PALEOZOIC UNDIVIDED	SMP CMP:	0- ABSENT
	32- TRIASSIC		1- MINOR <33%
	35- JURASSIC - CRETACEOUS		2- MEDIUM 33-67%
	36- CRETACEOUS		3- MAJOR >67%
	41- MESOZOIC - CENOZOIC	PPPS:	0- NONE
	42- TERTIARY		1- RED, BROWN
	43- TERTIARY - QUATERNARY		2- WHITE, BUFF
	44- QUATERNARY	PRPB:	0- FEATURELESS
SAMP:	1- STREAM BED SEDIMENT		1- RED, BROWN
	6- SIMULTANEOUS STREAM WATER AND SEDIMENT	PHYS:	5- MOUNTAINOUS YOUTHFUL
RP ST:	00- ROUTINE REGIONAL SAMPLE	PATT:	1- DENDRITIC
	10- FIRST OF FIELD DUPLICATE	TYPE:	1- PERMANENT, CONTINUOUS
	20- SECOND OF FIELD DUPLICATE		2- INTERMITTENT, SEASONAL
CONT:	0- NONE		3- RE-EMERGENT, DISCONTINUOUS
	1- POSSIBLE	CLSE:	1- PRIMARY
	2- PROBABLE		2- SECONDARY
	3- DEFINITE		3- TERTIARY
	4- MINING ACTIVITY INCLUDING PITTING, TRENCHING		4- QUATERNARY
	6- AGRICULTURAL	SRCE:	1- GROUNDWATER
	8- FORESTRY ACTIVITY		4- ICE-CAP OR GLACIER MELT WATER
BANK:	1- ALLUVIAL		
	5- BARE ROCK		
WCOL:	0- CLEAR		
	1- BROWN TRANSPARENT		
	2- WHITE CLOUDY		
	3- BROWN CLOUDY		

DATA LIST LEGEND (CONT'D)

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)
FE- IRON BY ATOMIC ABSORPTION SPECTROSCOPY (PCT)
AS- ARSENIC BY FLAMELESS ATOMIC ABSORPTION SPECTROSCOPY (PPM)
MO- MOLYBDENUM BY ATOMIC ABSORPTION SPECTROSCOPY (PPM)
W- TUNGSTEN BY COLORIMETRY USING DITHIOL (PPM)
HG- MERCURY BY FLAMELESS ATOMIC ABSORPTION SPECTROSCOPY (PPB)
U- URANIUM BY DELAYED NEUTRON ACTIVATION (PPM)
SB- ANTIMONY MIBK SOLVENT EXTRACTION ATOMIC ABSORPTION SPECTROSCOPY (PPM)
U-W- URANIUM IN WATERS FLUORMETRICALLY (PPB)
F-W- FLUORINE IN WATERS BY SPECIFIC ION ELECTRODE (PPB)
PH- PH BY COMBINATION GLASS - CALOMEL ELECTRODE