G021.DOC

Geochemical studies, Bathurst-Jacquet River District, New Brunswick

R.W. Boyle et al.

Project 570022 Operation Bathurst

The components are geochemistry of Pb, Zn, Cu, As, Sb, Mo, Sn, W, Ag, Ni, Co, Cr, Ba and Mn in waters and stream sediments. Minor and trace element distribution in heavy minerals of streams.

The principal investigator was R.W. Boyle. Other investigators were: waters and stream sediments - W.M. Tupper, J. Lynch, G. Friedrich, M. Ziauddin, M. Shafiqullah, M. Carter and K. Bygrave; heavy minerals - M. Shafiqullah, C.C. Durham, W.M. Tupper, G. Friedrich, M. Ziauddin, M. Carter and K. Bygrave.

The project was done during the 1965 field season.

Data for waters and stream sediments were published (Boyle et al., 1966) as a summary report, 13 geochemical data maps and 1 geological compilation map, all on a 1-mile scale. Heavy mineral results were published (Boyle et al., 1968) in a summary report accompanied by 2 data maps on a 1-mile scale. Geological Survey of Canada Open File 27 (Sept. 3, 1970) gives the analytical data on which the maps of Boyle et al., 1966 are based. These data are for stream sediment samples only.

The project was part of a geochemical and geological study of the Bathurst base metal district. The objective was to geochemically inventorize stream waters and sediments in order to assess the correlation of drainage geochemistry with bedrock geology and with known mineral deposits.

The work showed that most known sulphide deposits in the area are reflected by: (1) higher than average heavy metal content (mainly zinc) of nearby streams; and .(2) higher than average cold-extractable heavy metal content of nearby spring and stream sediments. Numerous other anomalies (waters and sediments) were recorded for which further investigation was recommended. Variations in heavy mineral element content generally correlate with bedrock type of the drainage area and element distribution also reflects the presence of known sulphide deposits. Heavy mineral results generally substantiate anomalies shown by stream sediments and water analyses.

The project area covers about 800 sq. mi. (2080 km^2) in north-eastern New Brunswick, from N 47°30′ to Chaleur Bay and from W 65°30′ to W 66°15′. The area includes NTS sheets 21P/13, 21P/12, 21O/9 E1/2, and 21O/16 E1/2.

The southern part of the area is underlain chiefly by folded and sheared metavolcanic and metasedimentary rocks of the Ordovician Tetagouche Group, cut in the south-east by the Bathurst Granite (Devonian).

The central and northern parts are underlain by younger sedimentary and volcanic rocks ranging from Ordovician (Elm Tree Group) through Silurian and Devonian (including Chaleur Bay Group and Dalhousie Formation) to Carboniferous in part possibly Triassic (Bathurst, Bonaventure Formations). Pre-Carboniferous strata are cut by basic intrusions of Devonian and Silurian (?) age and by Devonian granitic rocks.

The area is mantled by glacial till, sand, and gravel and locally in near-shore areas by recent post-glacial sands and clay.

Several massive Cu-Pb-Zn-(Ag) deposits occur in Tetagouche group schists in the south-western part of the area (Anaconda, Tetagouche explorations). Lesser deposits occur elsewhere in Tetagouche rocks or in or associated with the Bathurst Granite. Included are the Austin Brook magnetite deposit, quartz-

manganese occurrences on Tetagouche River and Po-Py-Sp-Ga veins in the Nigadoo River-Millstream area. Ordovician (?) Elmtree group rocks host a number of smaller sulphide deposits, principal of which is the past-producing Keymet Mine (Cu-Zn-Pb-Ag). Silurian rocks of the Chaleur Bay Group contain a number of magnetite deposits, sulphide veins, and molybdenum occurrences, chief of which are the Beresford Cu deposit, the Millstream iron deposit, and the Nigadoo sulphide (Cu, Zn, Pb, Ag) lenses and veins. Devonian, Carboniferous, and Triassic (?) rocks contain only subordinate or minor mineralization.

See also:

Gilbert (1964)
Lavergne (1963)
Lynch and Mihailov (1963)
North (1956)

References

Boyle, R.W., Tupper, W.M., Lynch, J.J., Friedrich, G., Ziauddin, M., Shafiqullah, M., Carter, M., and Bygrave, K. (1966). Geochemistry of Pb, Zn, Cu, As, Sb, Mo, Sn, W, Ag, Ni, Co, Cr, Ba and Mn in the waters and stream sediments of the Bathurst-Jacquet River District, New Brunswick. Geological Survey of Canada Paper 65-42.

Boyle, R.W., Shafiqullah, M., Durham, C.C., Tupper, W.M., Friedrich, G., Ziauddin, M., Carter, M. and Bygrave, K. (1968) Minor and trace element distribution in the heavy minerals of the rivers and streams of the Bathurst-Jacquet River District, New Brunswick. Geological Survey of Canada Paer 67-45.

Boyle, R.W., Illsley, C.T. and Green, R.N. (1965). Geochemical investigations of the heavy metal content of stream and spring waters in the Keno Hill-Galena Hill area, Yukon Territory. Geological Survey of Canada Bulletin 32.

Gilbert, M.A. (1964). Field and laboratory methods used by the Geological Survey of Canada. **In** Geochemical Surveys, No. 1. Laboratory methods for determining copper, zinc and lead. Geological Survey of Canada Paper 59-3.

Lavergne, P.J. (1965). Field and laboratory methods etc. .., No. 8. Preparation of geological materials for chemical and spectrographic analysis. Geological Survey of Canada Paper 65-18.

Lynch, J.J. and Mihailov, G. (1963). Field and laboratory methods etc., No. 3. Method for determining arsenic. Geological Survey of Canada Paper 63-8.

North, A.A. (1956). Geochemical field methods for the determination of tungsten and molybdenum in soils. Analyst, **81**: 660-668.

Smith, A.Y. (1964). Field and laboratory methods etc., No. 5. Cold-extractable heavy metal in soil and alluvium. Geological Survey of Canada Paper 63-49.

Stanton, R.E. and MacDonald, A.J. (1962) Field determination of antimony in soil and sediment samples. Trans. Inst. Mining Met., London, **71**: 517-522.

The project has three components: stream sediments, waters, and heavy mineral studies. Sampling was done by two-man ground traversing teams at 1500-foot station intervals. Stream sediments and waters were field-tested for total cold-extractable metals by the methods of Smith, 1964 (sediments) and Boyle, Illsley and Green, 1965 (waters). At each station a sediment sample for laboratory analysis was collected and, where possible, samples of water and heavy mineral concentrates were collected for each river, stream, or major tributary.

The project is divided into the following three files:
File 021 - complete text and stream sediment data
File 022 - stream water data
File 023 - heavy mineral data

File 021 - Operation Bathurst stream sediment data

sample data were recorded on field computer cards as follows:

Column No.

1- 6 sample number.
col. 3-6 is a four-digit number; col. 2 is zero; col. 1 is the field party number

7- 9 stream width in feet

10-12 stream depth in feet

13 flow rate.
0=not flowing 1=slow 2=moderate 3=fast

14 water level
0=dry 1=low 2=average 3=high

15 colour of turbid material in water or water colour (1)
1=clear 2=red 3=brown 4=grey 5=black
6=white 7=orange 8=yellow.

16 colour of precipitate or stain on boulders of stream bottom. Code is as col. 15 except for 1=green

17 environment of sediment sample
0=dry stream bed 1=active, below water level
2=active, at water level 3=active, above water level
4=bank

18 sample location in stream profile
1=right bank 2=mid stream 3=left bank

19 colour of sediment. Codes same as col. 16

20-24 sediment size analysis, estimated from 1 to 9 for each component category of gravel, sand, silt, clay and organic material. Totals to 10.

example	Component	Percent	Code
	gravel	10	1
	sand	20	2
	silt	50	5
	clay	10	1
	organic	10	1

25-28 rock type of local drainage area. See mnemonic code FF

29-32 eh of water given in range -600 to +600 millivolts

33-34 pH of water given as 0 to 9.9

35-36 temperature of water in degrees C.

37 sample map reference number, coded as follows:
2 = 21 P/13
3 = 21 O/16
4 = 21 O/9
5 = 21 P/12

38-40 total cold-extractable metal in ppm. Samples titrated to 20 ppm. only. For values greater than titration limit (20 ppm) the notation -20 is used.

41-42 U.T.M. zone

43-56 U.T.M. co-ordinates. Cols. 43-49 is easting, cols. 50-56 is northing.

57-58 materials classification
00=igneous rock 10=metamorphic rock
20=sedimentary rock 30=mineral
50=unconsolidated material
59=combined stream water and sediment
60=water 90=unclassified

59-60 sample type identified more specifically than cols. 57-58.
1=water and sediment 2=water only 3=sediment only

4=spring water and sediment 5=spring water sample
6=spring sediment
7=heavy mineral, water, and sediment sample.
61-62 stratigraphic age. all coded 44 (Quaternary)
63-73 Geological Survey of Canada sample number
74-80 total metal-zinc equivalent in water, in ppm

Rock Type (mnemonic) code (cols. 25-28) follows:

ALLUV	alluvia	MDSN	mudstone
ANDS	andesite	PCSC	pelitic schist
ARGL	argillite	PHLT	phyllite
BRCC	breccia	QRTZ	quartzite
BSLT	basalt	RYLT	rhyolite
CGLM	conglomerate	SCST	schist
DIBS	diabase	SHLE	shale
DIRT (DORT)	diorite	SLSN	siltstone
GBBR	gabbro	SLTE	slate
GRNT	granite	SNDS	sandstone
GRSC	greenschist	TRCT	trachyte
IRFM	iron formation	TUFF	tuff
LMSN	limestone	WCKE	wacke

Analytical details follow:

Stream Sediments

A total of 3500 stream sediments was analyzed on site for cold-extractable heavy metals by the procedure given by Smith (1964).

A total of 3550 stream sediment samples was collected for laboratory analysis of Cu, Pb, Zn, Mn, Ba, Co, Ni, Cr, As, Sb, Mo, W, Sn and Ag. Note however, that this file contains complete analytical data for 3481 samples and partial data for 33 samples, giving a total of 3514 samples. The other 36 samples were repeats done to check high values.

Note that in all cases values for Sn are omitted. This is because Sn was below detection limits in most cases. For other information on Sn see Boyle et al, (1968).

Stream sediment samples were oven-dried at 65 degrees C. For 48 hours, sieved to -80 mesh and then ground to -150 mesh according to the method of Lavergne (1965). The minus 150 mesh material was analyzed in a mobile field spectrographic laboratory and a colorimetric laboratory established in a local school as follows:

colorimetric	Pb, Zn, Cu, As, Sb, Mo, W
spectrograph	Sn, Ag, Ni, Co, Cr, Ba and Mn

Methods of analysis follow:

Colorimetric -

Zn, Pb, Cu dithizone (Gilbert, 1964). The Zn method was modified by the addition of sodium fluoride to the acetate buffer.
As by Gutzeit method (Lynch and Mihailov, 1963). For modifications to the method see Boyle et al, 1966, p 19.
Sb brilliant green used as a reagent (Stanton and Mac Donald, 1962).
Mo, W by zinc dithiol method (North, 1956).

Spectrographic -

Total energy DC arc semi-quantitative method using a 1.5 meter grating spectrograph. For procedure details see Boyle

et al, 1966, p. 19.

The analytical card coding follows:

Col.	Item
1- 6	sample number
7	blank
8-11	contains *STSD* meaning stream sediment
12-14	contains *607* meaning that the material analyzed was the minus 80 mesh fraction ground to 150 mesh.
15	blank
16-80	nine fields of F5.0 containing results for: Cu, Pb, Zn, Mn, Ba, Co, Ni, Cr, As. Four fields of F5.1 containing the results for: Sb, Mo, W. Ag.

Note that in Open File 27 (Geological Survey of Canada, Sept. 3, 1970) the analytical data printout merges coding from the field card and the analytical card as follows:

Col.	ITEM
1- 6	sample number
7- 8	blank
9-10	UTM zone
11	blank
12-17	UTM easting
18	blank
19-25	UTM northing
26-28	blank
29-31	width of stream, feet
32-34	blank
35-37	depth of stream, feet

followed by values in ppm for Cu, Pb, Zn, Mn, Ba, Cc, Ni, Cr, As, Sb, Mo, W, Ag.

Detection limits and convention used for values below detection limits follow:

Element	Detection Limit ppm	Convention ppm
Cu	4	2
Pb	5	2
Zn	5	NA.
Mn	30	NA.
Ba	70	35
Co	10	5
Ni	2	1
Cr	10	5
As	2	1
Sb	1.0	0.5
Mo	1.0	0.5
W	5.0	2.0
Ag	0.5	0.2
Sn	10	NA.

Note that some samples gave Mn and As over 1% (10,000 ppm) and in such cases a value of 2% (20,000 ppm) has been assigned. Some Cu values exceeded 4,000 ppm and they have been recorded as 8,000 ppm.

Precision and accuracy data are not applicable for spectrographic analyses, since they are semi-quantitative only.

Some precision and accuracy information for colorimetric methods used in the stream sediment analyses follow:

Element	Method	Reference	Precision or Accuracy
Cu, Pb, Zn	Dithizone	Gilbert (1964)	precision of + or - 20% over range of 10 to 200

			ppm
As	Gutzeit	Lynch and Mihailov (1963)	precision of + or - 25% limiting ranges unknown
Sb		Stanton and MacDonald (1962)	precision of + or - 25% at 95% conf. Over 0.1 to 55 ppm
W	Zn Dithiol	North (1956)	accuracy over range 33 to 408 ppm is from + or - 6 TO 30% (mean + OR - 15%) precision at 95% conf. Over same range is + or - 10% to 30% (mean + or - 18%)

GAS file header records:

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21    2  318 3514   39    0
 WIDTH DEPTHRAFLOWWATLEVTURBID PPTE   ENVIRSAMLOCCOLOURSICOMPROKTYP   EH      PH
TEMWAT   MAP    CXM   UTMZ   UTME   UTMN   CLASSTYPSAM   AGE GSCSAM   TMZ STREAM MESH
CU     PB     ZN     MN     BA     CO     NI     CR     AS     SB     MO      W     AG
(A6,F3.0,F3.1,7F1.0,F5.0,A4,F4.0,2F2.1,F1.0,F3.0,F2.0,2F7.0,3F2.0,A11,F7.0/7X,
A4,F3.0,1X,9F5.0,4F5.1)
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Digital Data:

file location:	w:\adcock\archives\gas
file name:	g021.gas
file type:	80 character fixed record length, ASCII
file size:	588,160 bytes