GEOCHEMISTRY

27. GEOCHEMICAL FEASIBILITY STUDY IN THE COPPERMINE AREA, DISTRICT OF MACKENZIE (86 O)

Project 680051

R.J. Allan and E.W.H. Hornbrook

A preliminary field study was made to determine the feasibility of geochemical surveys as an exploration method for locating copper deposits in an area of continuous permafrost. The study was conducted near Hope Lake, which is approximately 42 miles southwest of the village of Coppermine on the Arctic coast or 350 miles north of Yellowknife.

Pedogeochemical (silty frost boils; organic surface and B horizons of Arctic Brown soils), water (lakes) and stream sediment geochemical, and biogeochemical surveys were made in the vicinity of known copper deposits.

Analysis of 25 lake water samples produced background values for copper of about 2 ppb, threshold about 8 ppb and anomalous about 18 ppb. No significant variations in Zn, Ni, Co, Pb, or Mn were noted in the same samples. Cu in lake waters can apparently be related to and used to detect known Cu occurrences, including the major 47-zone deposit of Coppermine River Limited. Preliminary examination of data for selected samples of the other types of materials collected, shows that (1) Cu alone appears to have a sufficient contrast for use as an element in geochemical prospecting in the Coppermine Basalts and (2) each type of material appears to be equally useful in this respect.

This preliminary analytical data indicates that (1) there is active dispersal of Cu from known deposits and (2) there is much potential for the development of geochemical prospecting techniques in permafrost regions.

28. GEOLOGY AND GENESIS OF URANIUM DEPOSITS IN THE HURONIAN AND ASSOCIATED GEOLOGY, BLIND RIVER, SUDBURY, AND GOWGANDA AREAS, ONTARIO (41 I, J, O, P)

Project 690014

T.J. Bottrill

A detailed study was undertaken of the well-exposed and lowest reef of the ore-zone in the Manfred Member of the Matinenda Formation. Thirty-four samples were collected from twenty-one surveyed stations to

provide a grid for determining directional variations in the primary structures and geochemical features of the ore. Such variations when correlated will provide a means for testing the placer hypothesis of ore genesis of the conglomerates. The conglomerates were seen in detail to be a series of relatively tightly packed lenses of quartz, and minor chert and jasper pebbles in a matrix and interbedded units of variably feldspathic sandstones. Orientation of the lenses should provide a further test of predicted directional trends in the ore. Preliminary investigation indicated that the uranium distribution was not controlled by features of detrital origin. An alternative is suggested that the reefs represent a suitable geological environment for the syngenetic precipitation of uranium, later enriched by epigenetic groundwaters, probably before deposition of overlying formations.

Contemporaneous volcanics in the Matinenda may have provided suitable local topographical relief as well as geochemical conditions favourable to the concentration of uranium to form ore. The volcanic units were found both in outcrop and in diamond-drill core to be far more extensively distributed than was previously known, but always occur below the Ramsay Lake Conglomerate. These volcanic units were examined and sampled, especially where their relationship to silica-pebble conglomerates is known. It is hoped that chemical analysis will provide a tool for correlating the various volcanic units. It was found that in some cases Huronian volcanics had previously been misinterpreted as diabase dykes or pre-Huronian basement rocks.

Samples of calc-alkali pre-Huronian basement rocks were collected at regular intervals from the Kapuskasing magnetic high, south to the edge of the Huronian unconformity. These samples will provide the preliminary data for an evaluation of the provenance of the various elements in the uraniferous ores, arkosic sandstones and non-ore conglomerates. All radioactive occurrences in the Archean basement are post-Huronian, and so could not constitute a source for syngenetic ores in the Matinenda Formation. This suggests that the uranium in the sedimentary ores was derived from a widely dispersed source, such as granites similar to those currently exposed, which would also provide a source for the uranium in the structurally later shear zone deposits in the Archean. Stratigraphic and sedimentological data were collected throughout a large area of the Huronian from recent diamond drilling. An attempt will be made to correlate across the region, the members and various lithofacies of the dominantly clastic formations of the Huronian, with special attention to the Matinenda.

A measured section of the Hough Lake and Quirke Lake groups was completed on Quirke Lake in co-operation with J.A. Robertson of the Ontario Department of Mines, chairman of the Federal-Provincial Committee on Huronian Stratigraphy.

29. GEOCHEMISTRY OF GOLD AND ITS DEPOSITS

Project 650438

R. W. Boyle

(I) Sampling of waters, gossans, oxidized zones, soils, and muskeg in the vicinity of gold deposits in the following areas were carried out:

1. Falcon Lake area, Manitoba - gold deposits in granite.
2. Bird River area, Manitoba - low gold-bearing deposits associated with Ni-Cu sulphides
3. Uranium City area, Saskatchewan - gold deposits in granite (Box Mine and Athona Mine).
4. Yellowknife - Tibbett Lake area, Northwest Territories - gold deposits in greenstones and sediments.

(II) The work was undertaken to determine the factors bearing on the surficial migration of gold and its associated elements (As, Sb, Te, Ag) in Precambrian glaciated terrains.

(III) Preliminary results indicate that As and Sb are good indicators of gold in most areas in natural waters, gossans, soils, and muskeg.

30. GAMMA-RAY LOGGING OF WATER WELLS, SOUTHEASTERN ALBERTA AND SOUTHWESTERN SASKATCHEWAN (62 E, 72 E AND 72 F)

Project 690021

Jim Bushell

This project was suggested by J.E. Wyder who supervised the installation of and instructed in the operation of the logging equipment, and supervised the field work. The writer is indebted also to E.J.W. Irish and H.W. Little for advice received. The co-operation of the farmers whose wells were probed is gratefully acknowledged.

It was intended to select the water wells that had penetrated continental sediments, particularly the deeper wells. It was found, however, that few logs existed except in the newer wells, and these logs for the most part lacked suitable lithological descriptions. It was necessary, therefore, to depend on geological maps of the areas investigated and on charts that indicated thickness of overburden.

It was realized before the project was undertaken that nearly all wells would have casings which would act as shielding, thus reducing the apparent magnitude of the anomalies, and would also prevent calipering so

that great accuracy in measurement of gamma radiation of the sedimentary strata would not be possible. Nevertheless it was hoped that some trends would be recognized and possibly that a large anomaly might be recorded.

The instrument used, a portable borehole gamma-ray logging unit, built by Gearhart - Owen Industries Incorporated, to Dr. Wyder's specifications, was installed in a panel truck. Although it had been designed to probe deep wells it proved impossible to measure any of these because they were either flowing (artesian), or else had heavy pumping equipment installed that could not be removed by one man and for the most part would require two to six hours work by two men to remove. During the field season 156 water wells were probed.

The first area investigated was in southeastern Alberta mainly north of Cypress Hills where some 68 water wells were tested in a belt extending from Little Plume east to the Interprovincial Boundary. These wells were dug in the Upper Cretaceous Bearpaw and Eastend formations. To the south, in an area between Thelma and Ranchville, seven water wells were probed that penetrate the Bearpaw, Eastend, and the Paleocene Ravenscrag formations. No anomalies were encountered in any of the Alberta wells probed.

In Alberta, within the Eastend and Ravenscrag formations south of Cypress Hills, some lignite seams outcrop. Some of these were tested with the probe and two registered strong anomalies. One of these, in the Eastend Formation 4 1/2 miles west-southwest of Thelma, gave a reading about 4 times background. The other, in the Ravenscrag Formation 1 1/2 miles southwest of Thelma, recorded some 30 times background.

In southwestern Saskatchewan the largest group of water wells investigated lies within a triangular area 25 miles along the base, which lies roughly on a line from Frontier to Olga, and 50 miles to the apex which lies several miles north of Notukeu Lake. The wells tested penetrate the Upper Cretaceous Eastend and Whitemud, the Paleocene Ravenscrag, and the Oligocene Cypress Hills formations. Weak anomalies were detected in single wells 7 miles south-southwest of Eastend, 4 miles south-southeast of Chambery, and 6 miles south of Shaunavon. Stronger anomalies were found in two wells 2 to 3 miles southwest of the last named well. All these wells penetrate Ravenscrag beds. The strongest anomaly, about 4 times background, occurs in a well 3 1/2 miles east of the south end of Notukeu Lake, and nearby another weak anomaly was found. These wells occur in the Eastend Formation. Three miles north of Notukeu Lake and in a well 1 1/2 miles east-northeast of that point, anomalies of 3 times background occur in wells that penetrate the Cypress Hills Formation.

Six other wells in the Ravenscrag Formation west and southwest of Estevan were probed but without anomalous results.

31. COMPARISON OF REGIONAL GEOCHEMICAL URANIUM EXPLORATION IN THE BEAVERLODGE AREA, SASKATCHEWAN (74 N/9)

Project 680028

Willy Dyck, A.S. Dass, C.C. Durham, J.C. Pelchat and J.H. Galbraith

To evaluate the relative merits of regional geochemical exploration methods for uranium, particularly those employing radon and uranium in surface waters, a 500-square-mile area in the Beaverlodge area, Saskatchewan, was sampled during the 1969 field season. The region sampled extends for about 22 miles north from the shore of Lake Athabasca and 23 miles east from the town of Eldorado. Surface lake water samples were collected at an average density of 1.3 samples per square mile. Stream water samples and sediment samples from the same site were collected at a sampling density of about one sample per square mile. Approximately 95 rock samples from the major rock formations were collected also. All field notes and analytical results were recorded on cards for computer storage and processing. Radon, pH, and alkalinity of all samples were determined in the field laboratory, and the temperature measured on site. Acidified aliquots were shipped to Ottawa for uranium and other trace element analyses.

Estimates indicate that the background value for uranium lies under the detection limit of the method employed for this work, i.e. 0.4 parts per billion, for both lake and stream waters. Radon background values in streams and lakes are approximately 30 and 2 picocuries per litre, respectively. The raw data outline a number of known uraniferous zones. There are at least six regions not counting the region within about three miles of Eldorado, in which radon and uranium concentrations in lakes were greater than two times background. These regions are between Cornwall and Fishhook bays, near Gibbs Lake; between Cuttler and Mickey lakes; in the vicinity of Dyke Lake; between Donaldson and Gebee lakes; and south of Dusyk Lake. Another area in the vicinity of Beckwall Lake gave anomalous uranium values in the lakes and streams and anomalous radon values in streams only.

Seasonal tests of samples from four lake sites and four stream sites over an eight week period show little variation in the concentration of ionic species, i.e. uranium, pH, and bicarbonate. The radon content at the surface of lakes on the other hand varies considerably from day to day. In streams the variation in radon concentration with time is less than in lakes.

In general the uranium pattern compared to that of radon is somewhat more diffused, particularly in the lakes. This is most likely due to the fact that uranium is more soluble in natural waters than radium.

In rugged terrain like the Beaverlodge area, lake sampling is more economical than stream sampling. However, analytical costs are somewhat higher for lake samples because of lower concentration levels.

Radon and uranium in surface waters outline uraniferous areas about equally well and should both be used where practical. Being simpler, the radon method is preferable where analytical facilities are scarce.

32. REGIONAL GEOCHEMICAL CENSUS OF PLUTONIC ROCKS IN THE EASTERN YUKON (105 N, O, 106 D)

Project 690036

R.G. Garrett

A preliminary investigation of the areal variability of the granitoid plutonic intrusives of the eastern Yukon and their relationship to known tungsten deposits was carried out. Five plutons of varying size were sampled, of these, two were associated with tungsten mineralization and the remaining three are believed to be unrelated to major mineralization. The plutons were sampled in detail, by a method described elsewhere, in order to assess the local and overall variability[1]. To date the following elements have been determined: Co, Cu, Mo, Ni, Pb, W, and Zn; the major elements together with Mn and Ti are being determined at present.

A study of the results in hand reveals significant differences in geochemistry between the plutons; several of the elements show variations of particular interest. Tungsten is significantly higher in both the plutons associated with scheelite mineralization than in the three plutons unassociated with mineralization. The feldspar megacrysts in the one megacrystic pluton are reflected by significantly higher lead values than are found elsewhere. Cobalt, nickel and zinc appear to behave very similarly in all plutons and to vary inversely with the lead content. The molybdenum results reveal patterns of interest but more work is necessary before these can be interpreted.

In general it would appear that there are significant and mappable variations in the geochemistry of the plutons and that some of these variations are related to possible mineral potential.

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[1] Garrett, R.G.: The determination of sampling and analytical errors in exploration geochemistry; Econ. Geol., vol. 64, No. 5, pp. 568-569 (1969).

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33. TRANSPORT AND DEPOSITION OF ORE INDICATOR ELEMENTS IN STREAMS AND SEDIMENTS, NEW BRUNSWICK (21P/13E, 21P/13W, 21O/7E, 21O/9W, 21O/10E)

Project 690039

Andrew Nigrini

A stream-sediment reconnaissance survey was made in the area of Bathurst, New Brunswick to select a number of anomalous streams associated with known mineral occurrences for detailed geochemical studies. Three

situations were selected: (1) where mineralization is exposed in the bed of the stream; (2) where the mineralized zone is buried under several feet of overburden at the headwaters of a stream; and (3) where a stream is contaminated by the tailings pond of a worked out Cu-Pb-Zn mine.

In each of these three systems, a series of closely spaced stream sediment and water samples was collected. The stream sediments were analyzed, in a mobile field laboratory, for Cu, Pb, Zn and Mn using atomic adsorption spectroscopy. At each sampling site, two 1-litre water samples (one was acidified with nitric acid) were collected for total analysis in Ottawa. Six 4-ounce glass jars of water, for dissolved CO_2 analysis, were also collected. In situ electrode measurements for temperature, dissolved O_2, Eh, pH, Ca^{2+}, M^{2+}, Cu^{2+}, and Cl^- were taken or attempted.

Little difficulty was encountered with the measurements of temperature, dissolved O_2, Eh, and pH. Calibration difficulties with the Ca^{2+} and M^{2+} electrodes forced cancellation of these measurements. Cu^{2+} and Cl^- electrodes functioned well, but their ionic levels were either below or just at the detection limits of the electrodes.

Preliminary observations suggest that (i) Cl^- and Cu^{2+} electrodes are not sufficiently sensitive for measurements in waters that are close to equilibrium with the atmosphere; (ii) the chemical character of stream waters across ore-grade outcrops is constant which suggests a mechanical or adsorption mode of transport; (iii) where chemical leaching of buried deposits occurs, the resultant charged waters equilibrate rapidly upon exposure to the atmosphere and deposit their chemical load within a few tens of feet of exposure and subsequent transport is by mechanical means or by adsorption.

34. THE GEOCHEMISTRY OF ULTRAMAFIC ROCKS AND ORE BEARING POSSIBILITIES FROM THEIR GEOCHEMICAL CONTENT

Project 680061

G. Siddeley

Several ultramafic bodies of the Canadian Shield were visited. Sampling units were located near Waboden (Manitoba), south of the Timmins area (Ontario), and Chibougamau, Renzy Lake, Eastern Townships, Shefferville and Ungava (Quebec).

A variety of ultramafic occurrences are involved, from small lensoid bodies of homogeneous peridotite (Timmins area) to extensive sheets of well-layered to poorly differentiated ultramafics (Ghost Range, Ontario; Ungava, Quebec). Where ores are known to occur, they vary considerably, being local or extensive, massive and/or disseminated, contact phenomena, differentiates, or interstitial. In some areas, mines for nickel and copper are operating or under construction. Ultramafic samples from such bodies provide 'ore associated' chemical values which are being compared to data from presumed barren units. Revisits were made to some of the 1968 localities where preliminary results showed interesting Ni and Cu content.

Approximately 300 selected specimens of peridotite, dunite and serpentinite have been submitted for chemical analysis and thin section study.

The primary dispersion of ore indicator elements appears to be a variable feature largely dependent on the geometry of the ore and the mobility of the elements. Thus fissure deposits have only a local geochemical expression (regarding indicators) in considering the ultramafic body as a whole. Mobile constituents such as Cu depend also on factors such as (solid) rock permeability. Thus erratic Cu values are related to fine chalcopyrite mineralization along irregular veinlets. Higher than average (though still erratic) values are noted from most ore-associated ultramafic bodies.

Generally, indicator elements are related to the presence of sulphide minerals scattered at varying concentrations between and throughout ultramafic units. Samples obtained during 1969 (with those of 1968) will be used to determine element values within units from a standpoint of ore proximity.

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