

conditions. Gold has a high affinity for mercury so that if mercury vapour is present in the soil gas it will be adsorbed. The increase in the mass of the crystal lowers its natural frequency by approximately 2.6 cycles/sec per nanogram of additional mass; the other reference crystal frequency is virtually unaffected. The difference between the two frequencies " F_D " is then fed to a mini-computer contained in the display unit (shown in the photograph). As the measurement proceeds and mercury continues to be adsorbed, the value of F_D increases continuously. The shift is automatically monitored and displayed at predetermined intervals on a digital readout, the accumulated shift over a preset measurement time is a measure of the concentration of mercury vapour in the soil gas.

The crystals and associated oscillator circuits are contained in a detector unit about one-tenth of the volume of the display unit. The equipment is battery operated from four 1.5V "D" cells and two smaller 5.4V cells. An analogue output for driving a strip chart recorder is provided.

The quantity price of gold electrode crystals is of the order of \$2.50 and it is anticipated that each crystal will be good for about 10 determinations before its ability to adsorb mercury has deteriorated to the point where it affects the accuracy of the result.

This approach is still in the development stage and has yet to undergo field tests. However, if successful, it may well have application to other vapours by coating one of the crystals with appropriate selective absorbents.

23. LAKE SAMPLING vs. STREAM SAMPLING FOR REGIONAL GEOCHEMICAL SURVEYS

Project 680028

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At the end of the 1969 regional geochemical survey of the Beaverlodge, Sask. region, in order to determine whether lake samples give the same information as do stream samples, a 30-square-mile area situated about 5 miles east of Eldorado was sampled at a density of 4 lake water and sediment samples per square mile and 4 stream water and sediment samples per square mile. This detailed sampling program was carried out as follows: while one man sampled the lake-bay from a helicopter, about 20 feet from the inlet or outlet of a stream, another man took two stream samples roughly 200 feet apart. A total of 63 such lake-stream groups were sampled; another 62 lake sites alone were sampled and included 33 inactive bays. The following variables were determined: temperature, uranium, radon, pH, and alkalinity in waters and uranium, radium, zinc, copper, lead, and nickel in sediments. Except for radon and uranium in water, all variables give significant positive correlations between the lake bay sites and the stream sites. Radon and uranium correlate only weakly, with probabilities of significance of 44 and 77 per cent respectively.

Comparison of the geometric means of element concentrations leads to several interesting observations and rough but useful generalizations.

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As was already observed in the regional survey, the pH and temperature was lower, and the radon alkalinity and uranium higher, in stream waters. Analysis of sediments from the detailed survey show that the concentration of U, Cu, Pb, Ni, and Ra is roughly 25 per cent higher in streams than in lakes; Zn shows just the opposite trend. Also, sediments from outflow bays and from streams near outflow bays contain roughly 25 per cent more U, Zn, Cu, Pb, and Ni than do sediments from inflow bays or from streams near inflow bays; in this case Ra shows the opposite trend. It is believed that the organic content, which is about 40 per cent higher in stream sediments than in lake sediments and about 15 per cent higher in outflow sites, and the relative mobility of the elements are responsible, either directly or in combination with iron and manganese hydroxides, for the observed differences in trace element contents.

The results indicate the following relative mobility of trace elements in the Beaverlodge surface environment: $Zn > U > Cu > Ni > Pb > Ra$.

The results suggest that lake waters are a good medium for geochemical reconnaissance of large regions. However, sampling and analytical problems limit this approach at present. Adsorption on containers and desorption from suspended matter, when acid is added to prevent adsorption, are the toughest problems to overcome. Nevertheless, the regional uranium survey of the Beaverlodge area showed that with the detection of definite amounts of uranium in about 30 per cent of the lake and stream waters out of a total of 1,300 samples, uraniferous zones can be outlined successfully. In contrast, out of 350 lake and stream water samples only 16 per cent had Zn contents above the detection limit and none had detectable amounts of Cu and Ni using direct atomic absorption analytical methods. Even with preconcentration of 90 samples, only 70 per cent contained detectable amounts of Zn and 13 per cent detectable amounts of Cu and Ni.

Apart from confirming the existence of three uranium 'highs' detected during the regional survey, the detailed sampling program also showed that sediment sampling of small lakes near the inflow or outflow of streams will give essentially the same information as stream sampling. In rugged terrain like that encountered in the Beaverlodge area where landing on land is practically impossible, lake sampling can result in considerable savings to the exploration geochemist.

Considering the present state of methods of sampling and analysis of geochemical materials, it appears that sediment sampling by helicopter of inflow and outflow lake bays offers the most economical method of assessing the mineral potential of large regions of the Canadian Shield. For U and Zn lake water sampling should suffice.