METAL DISPERSION IN LAKE SEDIMENTS RELATED TO MINERALIZATION AND ITS ROLE IN RECONNAISSANCE IN THE SOUTHERN CANADIAN SHIELD

W.B. COKER and IAN NICHOL

Department of Geological Sciences, Queen's University, Kingston, Ont., (Canada)

SUMMARY

In areas of glacial overburden with indefinite and disorganized drainage systems, as exist in large regions of the Canadian Shield, conventional geochemical exploration techniques involving the sampling of stream sediments and soils have found limited application. In such areas lake sediment composition could be an indicator of mineralization if either the host rock or the mineralization itself has some diagnostic geochemical feature which is transmitted to lake sediments. If these conditions are fulfilled, lake sediment sampling would offer a convenient procedure for reconnaissance scale exploration in Shield areas. The usefulness of the procedure has been previously demonstrated in permafrost areas of Canada (Allan, 1971; Allan et al., 1972). In the southern Shield, where organic activity is much greater, metal dispersion in lake sediments is controlled by a number of factors contributing to the existence of a complex relationship between lake sediment geochemistry and mineralization.

Orientation surveys were carried out over the Sturgeon Lake, Shebandowan Lake, Manitouwadge and Upper Manitou Lake greenstone belts within the Superior province to investigate the nature of metal dispersion in lake sediments associated with mineralization in order to evaluate the feasibility of utilizing lake sediments as a sample medium in reconnaissance surveys (Coker, 1974; Coker and Nichol, 1975).

The character of lake water and nature of lake sediment composition was investigated in four lakes in the Sturgeon Lake area associated with mineralization and different bedrock types.Lyon Lake is adjacent to a major Cu—Zn deposit while Darkwater Lake is over acid metavolcanics and granodiorite. Corsica Lake is associated with granitic gneisses and Lake "A" with basic metavolcanics. The above investigations indicated that the most representative and homogeneous sample of a single lake basin occurs in the central regions of a lake (Fig.1). However, it was difficult, if not impossible, to distinguish a lake adjacent to mineralization from one in barren terrain on the basis of the single element analyses of the organic-rich material from the lake centres. High concentrations of dissolved oxygen in the bottom waters of both Corsica Lake and Lake "A" resulted in the oxidation and precipitation of iron and manganese and coprecipitation of zinc to abnormally high levels in the sediments (Fig.1). In Lyon Lake, adjacent to an undeveloped Cu—Zn deposit, the waters are relatively alkaline (pH = 8.0) which limits anomalous zinc contents to the immediate area surrounding the inflow stream (Fig.1).

As the manganese distribution in lake sediments is closely related to the oxygen content and pH of the lake waters, the zinc contents attributable to these features may be screened out using Zn/Mn ratios, thus focussing attention on areas of high zinc related to mineralization. On this basis the lake centre sediments of Lyon Lake, which is adjacent to mineralization, have anomalous zinc >100 ppm associated with Zn/Mn × 100 values >80. In

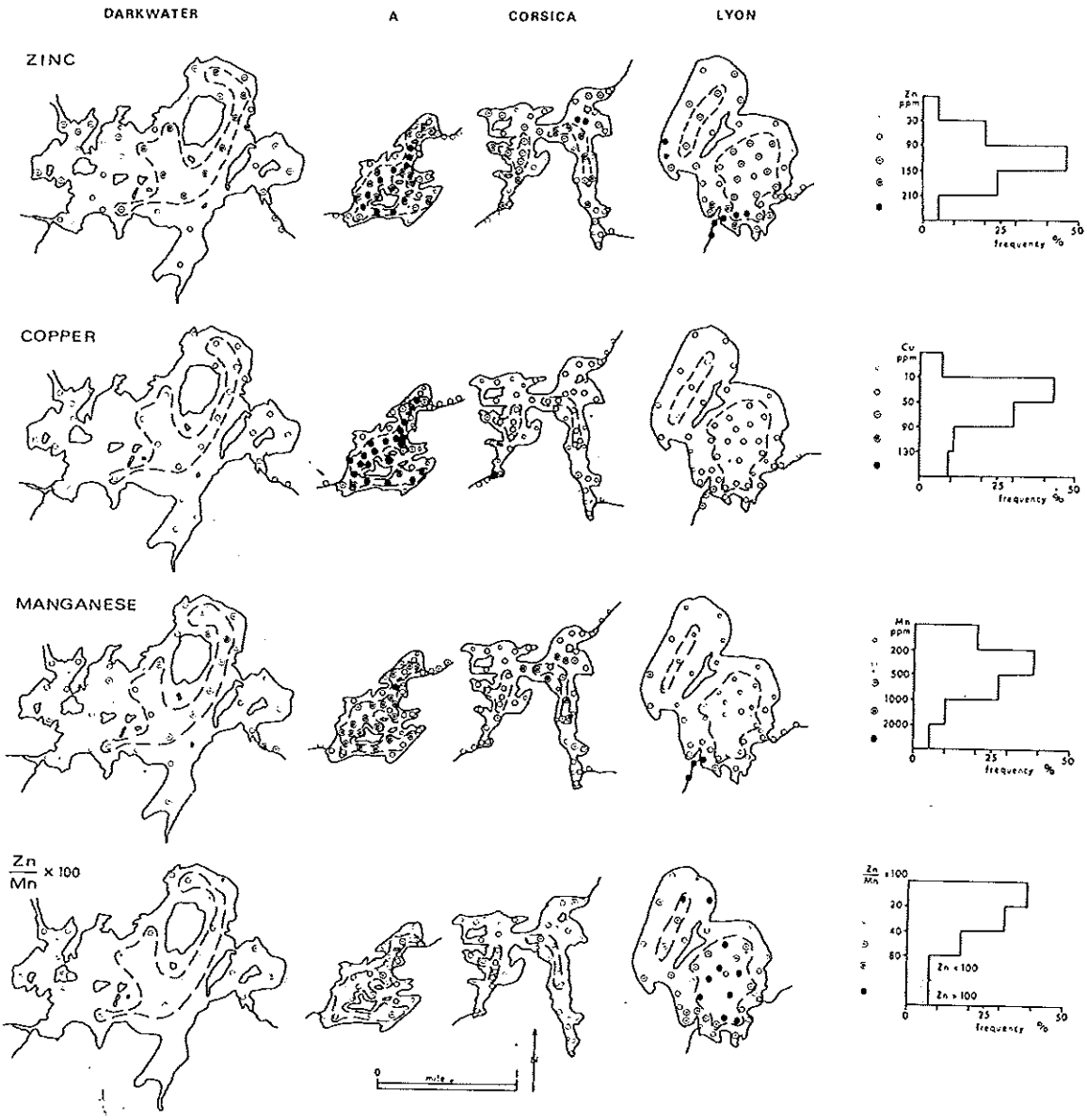

Fig.1. Dispersion of zinc, copper, manganese, Zn/Mn × 100 in lake sediments.

contrast the lake sediments with anomalous zinc contents related to coprecipitation in Corsica Lake and Lake "A" have Zn/Mn × 100 values of generally <40 (Fig.1).

On a regional basis lake sediments from lakes adjacent to the Mattabi Cu–Zn deposit do not have anomalous zinc contents (Fig.2) but do have anomalous Zn/Mn ratios (Fig.3). Lake sediments associated with the Shebandowan Cu—Ni deposit, although not distinguishable on the basis of nickel alone (Fig.4), are characterized by high Ni/Mn ratios (Fig.5).

A reconnaissance survey based on the analysis of organic-rich lake sediments from lake centres, and subsequent screening of the analytical data using Zn/Mn ratios, revealed the existence of prominent anomalous zones, one of which was comparable to that associated with the Mattabi mines deposit. Follow-up investigations confirmed the reconnaissance anomalies to be associated with favourable geology. Further geological and geophysical investigations are currently underway to evaluate the significance of the anomalous zones. Final assessment of the technique must await the results of the current programme to

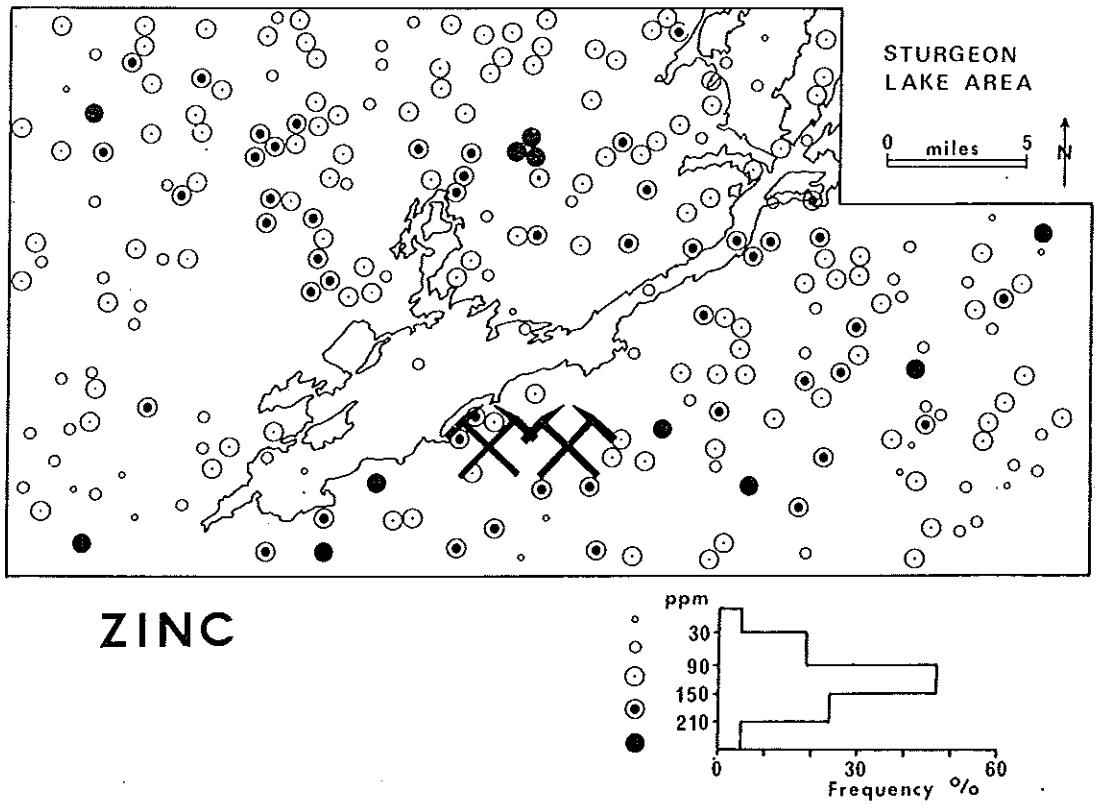

Fig.2. Dispersion of zinc in lake sediments, Sturgeon Lake area.

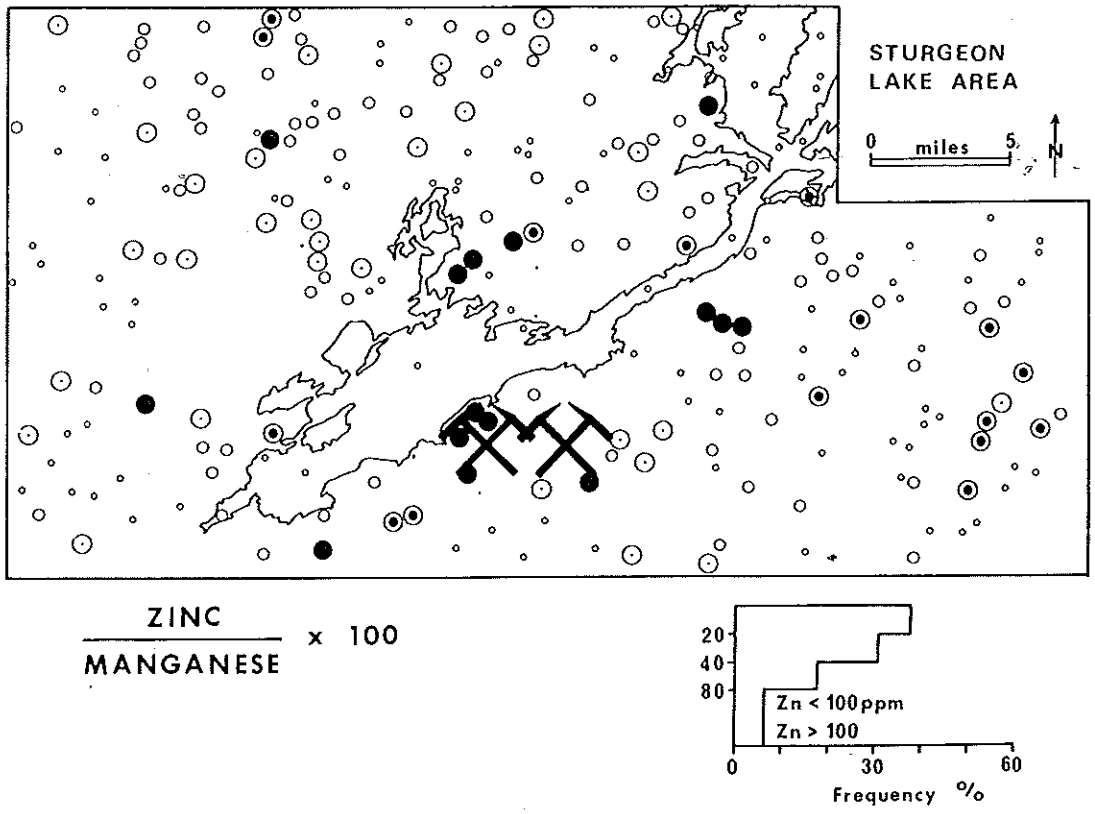

Fig.3. Dispersion of Zn/Mn X 100 in lake sediments, Sturgeon Lake area.

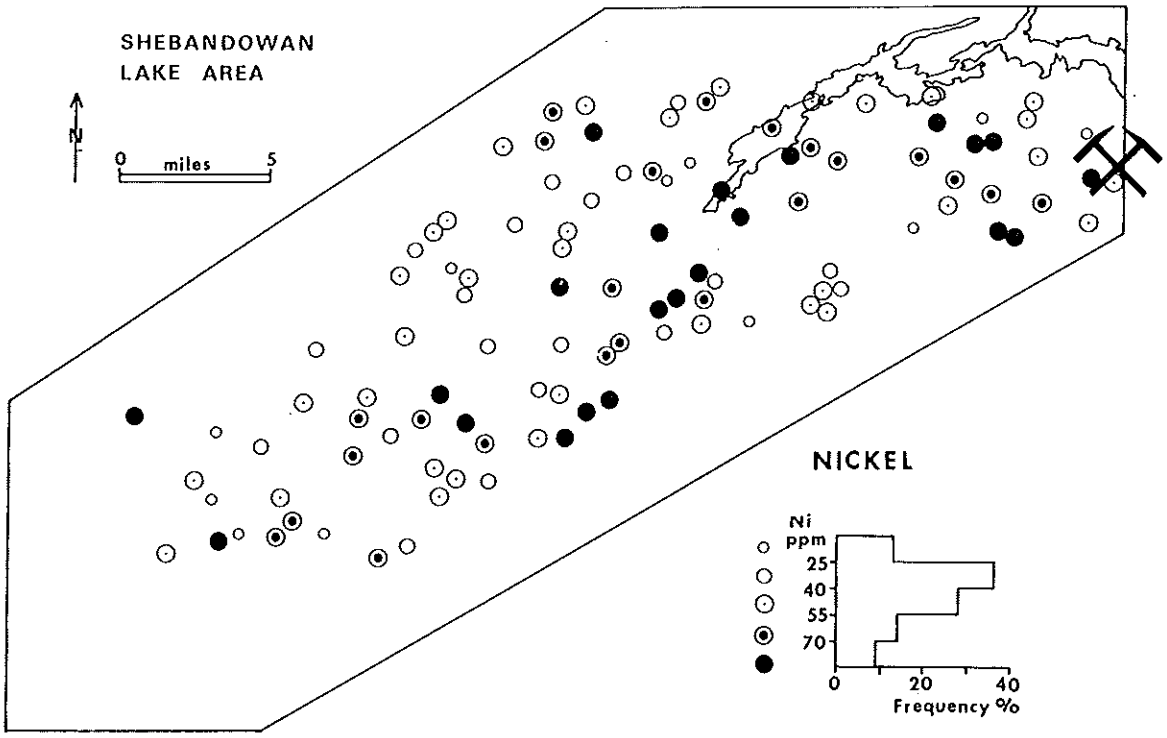

Fig.4. Dispersion of nickel in lake sediments, Shebandowan Lake area.

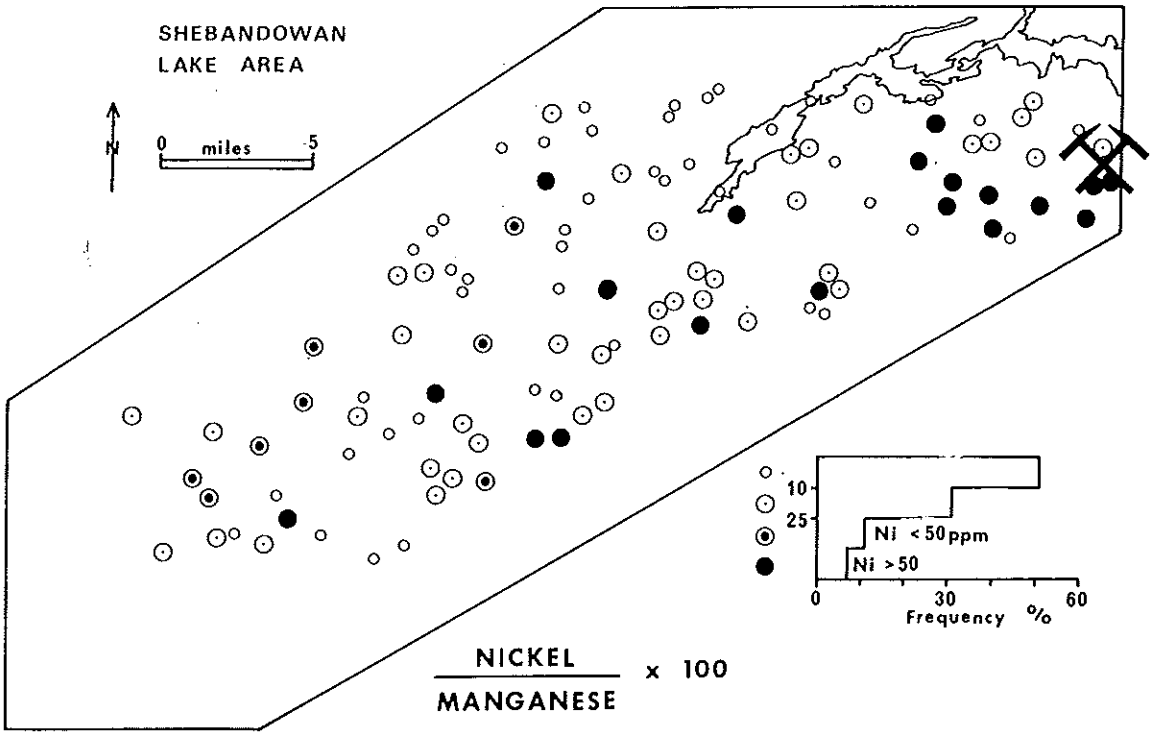

Fig.5. Dispersion of Ni/Mn X 100 in lake sediments, Shebandowan Lake area.

evaluate the significance of the anomalies revealed by the reconnaissance. Provisionally, however, it is concluded that sampling and analysis of organic-rich lake sediments followed by screening of the data may be a viable exploration procedure in the southern areas of the Canadian Shield in the search for Cu—Ni and base-metal massive sulphide deposits.

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REFERENCES

Allan, R.J., 1971. Lake sediment: a medium for regional geochemical exploration of the Canadian Shield. Can. Inst. Min. Metall. Bull., 64: 43—59

Allan, R.J., Cameron, E.M. and Durham, C.C., 1972. Lake geochemistry — a low density sample technique for reconnaissance geochemical exploration and mapping of the Canadian Shield. In: M.J. Jones (Editor), Geochemical Exploration 1972. Institution of Mining and Metallurgy, London, pp.131—160

Coker, W.B., 1974. Lake sediment geochemistry in the Superior province of the Canadian Shield. Thesis, Queen's University, Kingston, Ont. (unpublished)

Coker, W.B. and Nichol, I., 1975. The relation of lake sediment geochemistry to mineralization in the southern Canadian Shield. Econ. Geol. (in press)