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GEOCHEMICAL DISPERSION OVER MASSIVE SULPHIDES
WITHIN THE ZONE OF CONTINUOUS PERMAFROST,
BATHURST NORSEMINES, DISTRICT OF MACKENZIE, N.W.T.

by

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We accept this thesis as conforming
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ABSTRACT

A geochemical survey was undertaken in the vicinity of massive sulphides at Anne-Cleaver and Camp Lakes to assess secondary geochemical dispersion within the zone of continuous permafrost. Samples were collected at several depths within the active layer together with snow-melt runoff, seepage, pit and lake waters and sediments.

For each element (Ag, Cd, Cu, Fe, Mn, Pb and Zn) geochemical patterns are similar in all three soil layers (L-F-H 0 to 14 and 14 to 25 inch depths); therefore, sample depth does not appear to be critical. Ag, Fe and Pb display similar, well developed patterns and, except for Fe, possess high geochemical contrast. Conversely, Cd, Cu and Zn patterns are poorly developed and have low contrast, particularly in mineral soil. In areas of low pH, high levels of Ag, Fe and Pb can be found while Cu and Zn values are low and often form negative anomalies. High Zn levels are usually confined to areas of relatively high pH.

Relative to total patterns, partial extraction (0.05M EDTA and 1.0M HCl) patterns provide little additional information; however, low partial to total ratio patterns are well developed, which suggests clastic dispersion.

Because Pb is immobile, it can be used as a model for glacial dispersion of sulphides. Dispersion of Pb is in narrow thin zones of sulphide-rich till which rise at low ($<2^{\circ}$) angles 1000 to 2000 feet down ice from the source. Anomalous metal concentrations and gossan are detectable in excess of

4000 feet down ice.

Cu and Zn, although dispersed initially the same as Pb, have subsequently been subjected to extensive hydromorphic dispersion as a result of intensive oxidation and leaching in the acidic, water-rich soils of the active layer. Consequently, high levels of Cu and, in particular, Zn with high geochemical contrast are found in the surrounding waters and sediments.

Relative to Cu and Zn, Pb is much more restricted and less concentrated in sediments and waters. This is because Cu and Zn enter the lake largely as dissolved species while Pb enters as a sorbed constituent on clay-sized particulate matter. High Cu-Pb-Zn levels in sediments and waters are restricted to lakes lying down drainage from mineralization and/or down ice in areas of metal-rich till. Within individual lakes, sediments display erratic metal levels with fluctuations often $\geq 10\times$. Conversely, lake waters are homogeneous but possess more limited dispersion halos relative to center-lake sediments. Pb is more likely than Cu and Zn to locate mineralization in all sample media; however, in waters, Cu and Zn are more easily detected and offer a much larger target than Pb.

The effects of permafrost on geochemical dispersion are minimal. Hydromorphic and clastic dispersion patterns are well developed, perhaps better developed than in temperate climates. Significant inhibiting or complicating factors, with regard to geochemical dispersion are not present.

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