sediments, there is a chance of retrieving a sample containing background metal levels, particularly in lakes somewhat removed from mineralization, although if sampled in more detail anomalous values could be obtained. Consequently, sample site selection is critical and more than one sample site per lake (Hoffman, 1976) or an increase in sample density may be warranted for regional lake sediment surveys. It is suggested that multiple samples from different parts of the lake be taken if regional sampling is at low densities (i.e. one lake sampled per 8 to 10 miles^2). Anomalies can then be classified into a priority rating scheme based on the number of anomalous samples, relative to the total collected per lake, and their relative degree of contrast.

2. Detailed

Assuming that a regional geochemical survey has located anomalous metal values a detailed survey and geologic evaluation would be warranted. At this stage, soils, seepage waters, snow-melt runoff or even lake waters could be used. The latter may be preferred as an intermediate or semi-detailed exploration phase if regional sampling was at very low densities (1 sample per ≥ 8 mile^2). In this case, a sample density of at least 1 sample per mile^2, combined with a rough geologic inspection, would be required. The geologic evaluation would consist of sampling any gossan or mineralized float from the area and roughly mapping the area to determine if the geologic environment is conducive to hosting stratabound massive sulphides. Should the area appear favorable during geologic inspection, then several tens of soil samples at wide intervals ($\geq$800 feet) should be collected.

Follow-up work on areas that continue to produce geochemical anomalies, combined with favorable geologic settings, would most certainly involve detailed soil grid sampling at intervals ranging from 50 to 400 feet. Because the anomaly source (mineralization) needs to be precisely determined for drilling, immobile elements (Ag, Fe and Pb) are preferred because they are less affected by post-glacial weathering than mobile elements (Cu and Zn). Consequently, the optimum sample type (organic-rich L-F-H horizon versus mineral soil) and - if the latter type is chosen - sample depth must be established.

Except for the L-F-H horizon, visually recognizable soil horizons are rarely present; therefore, sampling of mineral soil is usually at some arbitrary depth(s) (0 to 14 inches, 14 to 25 inches or deeper). Mobile element patterns are poorly developed in all soil layers but are best defined in the L-F-H horizon; whereas, immobile element patterns are more than adequately developed in all soil layers, although best defined in the deeper soil. Differences between the soil layers, however, are somewhat subjective, especially for immobile elements. As a result, selection of sample type and depth, depends on many factors besides the degree of geochemical pattern development.

Because field seasons are short and exploration expensive, rapid and easy geochemical sampling, preparation and analysis are preferred. Sampling of permafrost where Cu, Pb, Zn patterns have remained relatively unaffected by post-glacial chemical and physical weathering is perhaps ideal. Unfortunately, the time and cost of such sampling procedures excludes these methods. Relative to mineral soil, sampling and preparation of the L-F-H horizon requires more time and effort as large areas (tens of square feet) may need to be scavenged to obtain sufficient sample. Consequently, unless resources are freely available, sampling of the shallow (0 to 14 inches depth) mineral soil is preferred.

Although this study shows the minus 80-mesh fraction to be more than adequate, the use of a finer soil fraction, may be more advantageous (cf. Shilts, 1973a). It is suggested that decreasing the size fraction may well decrease extraneous variation; thereby, enabling geochemical anomalies to be better defined and, for elements where the detection limit is an inhibiting factor (e.g. Pb), attainment of better precision.

In addition, partial and total extractions on various size fractions suggest that anomalous metal concentrations in coarse fractions composed of rock/mineral fragments seem likely. As a result, sampling and analytical procedures based on this possibility may be useful in relating/tracing highly mobile elements (Cu and Zn), to their bedrock source when 'standard' procedures (i.e. total extraction, minus 80-mesh) appear inadequate due to intense hydromorphic dispersion.

The use of seepage and/or snow-melt waters, although potentially quite effective, has many disadvantages. For example, seepages occur at insufficient densities for highly detailed surveys. Furthermore, the actual source of mineralization revealed by seepage anomalies can be some distance away. Although snow-melt runoff can very effectively outline areas of Cu-Zn mineralization, timing the sample program is critical as the bulk of snow-melt runoff occurs over short ($\leq$3 weeks) time periods. Most importantly, however, is the restriction of analysis to the more mobile elements and the possibility of poor reproduction in both media.

IV CONCLUSIONS

Geochemical studies at Bathurst Norsemines reveal extensive geochemical dispersion in soil, groundwater, snow-melt runoff and lake waters and sediments. Except for limiting the depth of soil sampling to $\approx$5 feet, the effects of permafrost on geochemical programs 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, in soil, water and sediment are not present.

In soils, extensive well developed glacial dispersion is evident in a west-northwest direction away from mineralized outcrops. The highest metal values occur approximately 1000 to 2000 feet down ice where geochemical indicator trains intercept the soil surface. Extensive chemical weathering has destroyed all traces of Ag, Cu, Pb and Zn sulphides.

Ag, Fe and Pb patterns are well developed and display a classic glacial (mechanical) mode of genesis. Anomalies for these elements are particularly well defined in the deeper soil. Conversely, Cu and Zn patterns are best developed in the L-F-H soil horizon. Although these elements were initially dispersed the same as Ag, Fe and Pb, they have undergone wide scale hydromorphic dispersion. Consequently, geochemical contrast is low and, in some cases, they form negative anomalies. A mobility order of Zn>Cu>Fe>Ag>Pb is suggested.

High levels of dissolved Cu and, in particular, Zn are found in seepage, pit and snow-melt waters. These media provide the highest geochemical contrast and delineate Cu-Zn mineralization better than soil samples.

Because of extensive hydromorphic dispersion, lake waters and sediments provide ideal regional sample media. Within individual lakes, waters are homogeneous while sediments are characterized by rapid changes in texture and metal content. Dispersion halos are somewhat larger in sediments than waters with Zn providing the largest halo followed by Cu and Pb. Within sediments, Cu and Zn trends closely parallel one another. Pb trends often diverge from those of Cu and Zn because Cu and Zn enter the lake largely as dissolved species while Pb enters as a sorbed constituent on silt-clay particles. As a result, high Pb values are restricted to lakes immediately adjacent to mineralization and to water depths greater than 15 feet because at shallower depths, wave action and ice scour prevent deposition of silt-clay particles. Mn and Fe are not important scavengers of Cu, Pb and Zn in lake sediments and usually display negative correlations with these elements.

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APPENDIX A

GEOCHEMICAL DATA FOR SOIL PITS 14, 17, 49, 52, 109, 113 AND 198 FROM THE CAMP LAKE AREA

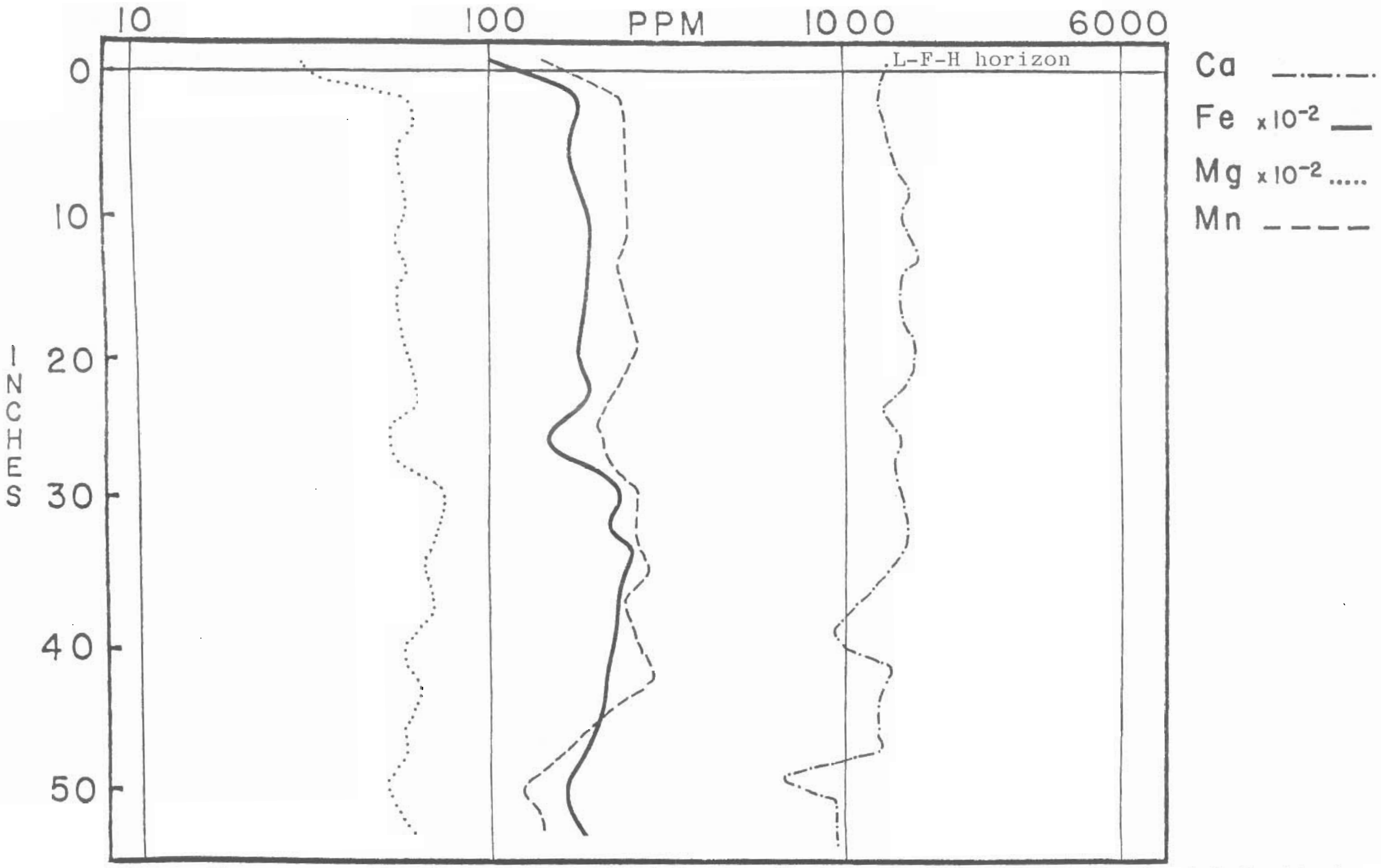

Figure A1. Camp Lake: soil pit 14, metal distribution with depth, -80 mesh, total attack.

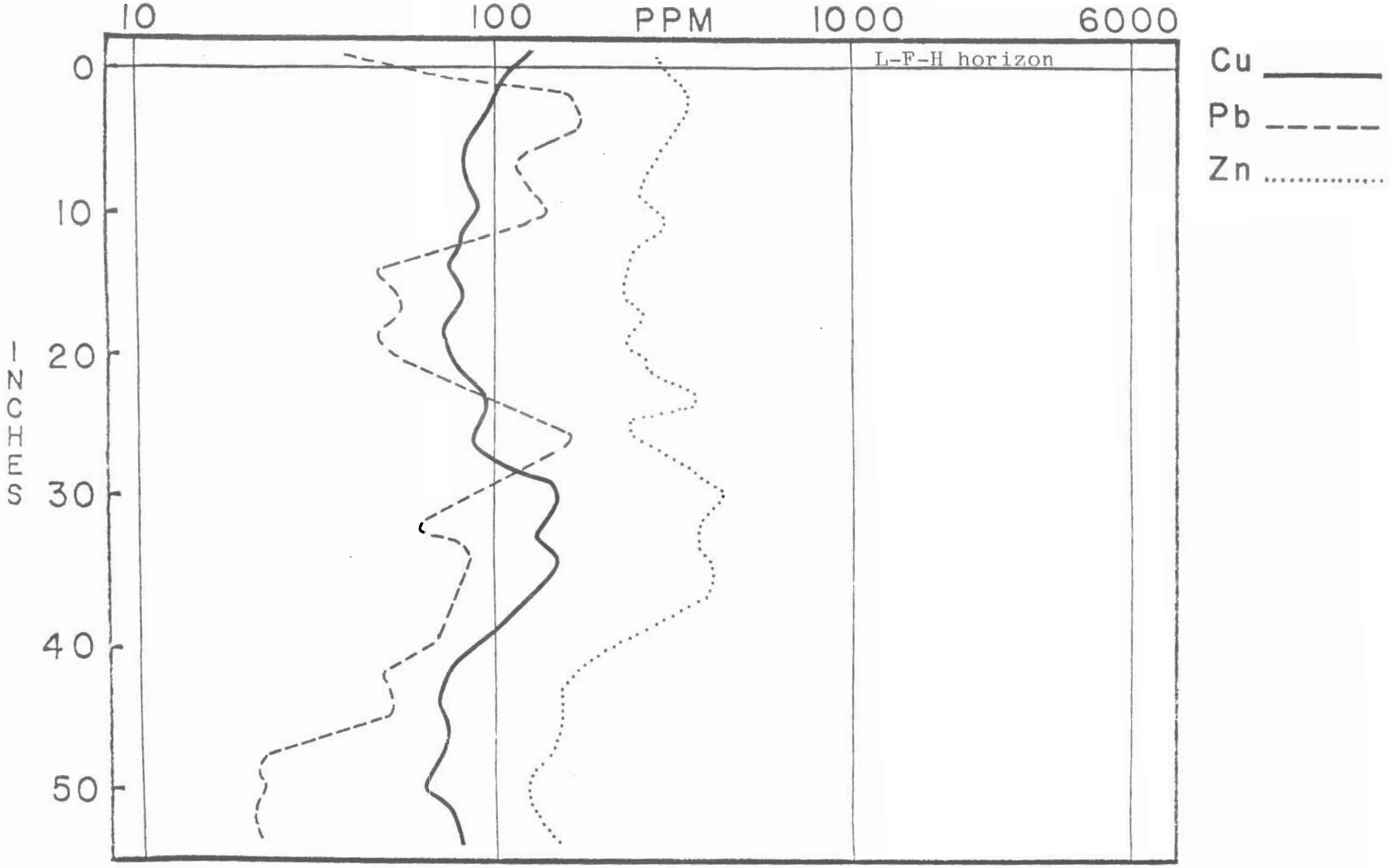

Figure A2. Camp Lake: soil pit 14, metal distribution with depth, -80 mesh, total attack.