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SDP SOIL-GAS GEOCHEMISTRY AT CROSS LAKE, ONTARIO

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A study was undertaken to assess the effectiveness of the Soil Desorption Pyrolysis (SDP) method at Cross Lake, Ontario. Mineralization at Cross Lake consists of massive-sulfide style copper and zinc lenses in a sequence of steeply dipping volcanics, covered by 15 to 30 meters of glaciolacustrine clay and silt. A total of 119 samples were taken along a traverse with good geological control from field mapping and boreholes (line 6 of Hamilton et al, 2004). The samples were in the form of three closely spaced lines, with three samples taken in close proximity at each northing along the traverse. Approximately 1 kg of B-horizon soil was collected at each site. Two of the lines were submitted to the laboratory, with coordinates relative to the known geology and mineralization, to serve as a training dataset. The third line of samples was randomized and submitted as blind test samples. Sample preparation consisted of a Stokes' Law clay separation by suspension in water and centrifuging to isolate the size fraction 0.2 μm to 2 μm. Analysis was by flash pyrolysis at 450°C into a quadrupole mass spectrometer, with simultaneous determination of a wide suite of inorganic gases, sulphur gases and hydrocarbons.

The resulting data are inherently noisy, with quite high variability between points a few meters apart. While some individual compounds (e.g. CS_2, CH_3Br), appear to correlate well spatially with the subcropping zinc and copper sulfide mineralization at Cross Lake, more robust and transportable results can be obtained by using a fingerprinting approach. The distribution of samples above known subcropping mineralization on the first two lines was used to construct a calibration template, the results of which were then applied to the third group of blind samples. The template consists of the sum of compound ratios of the form (A*B)/(C*D), each normalized by division by the appropriate background value. Ratios in the template are selected by a semi-automated process based on designated "mineralized" and "not mineralized" samples in the training dataset. The training set contained 42 "mineralized" and 36 "not mineralized" (background) samples. The level of template anomalism is very sensitive to the choice of samples used to define the background. For a large survey grid (e.g. as used for a porphyry copper target), it is possible to use the median of the whole population. For a single line, typical of testing a geophysical target that may be a VMS deposit or a kimberlite, it may be more appropriate to define the points at each end of the traverse as background. Otherwise, a high proportion of mineralized points are included in the background calculation, leading to higher noise and lower contrast anomalies. The results of both methods are presented.

Using the median of the whole population as background, the Cross Lake template is able to distinguish mineralized from background samples in the test dataset, with an average contrast value of 2.5. However, the data are noisy and the mineralized and background data are only distinguishable at the 80% confidence level. When the background is defined using the samples more than 250 m from known mineralization, the noise decreases dramatically, with a contrast of 3.07 between mineralization and background, and the two groups are distinguishable at the 99% confidence level. Two further templates were used to process the Cross Lake data: one derived from the Caber and Perseverance VMS deposits in the Matagami district, and the other from the Chance deposit in the Timmins district. The Matagami template clearly responds to the mineralization at Cross Lake, defining a clear anomaly over the subcropping mineralization. Using the median of all the samples as background results in high noise levels; however, if the outer ends of the traverse are used as background, the Matagami template can distinguish the mineralized from the background samples at the 95% confidence level. The template from Chance performs even better, achieving a 90% confidence level if the median background is used, and better than 99% if background is defined as the ends of the traverse.

We conclude that the effectiveness of SDP in distinguishing buried VMS systems through transported overburden has been demonstrated at Cross Lake, using a fingerprinting "template" approach. The template may be derived either from an orientation survey in the immediate area, or from another area with similar bedrock geology and overburden. When the location of the target to be tested is known (normally the case for VMS targets in the Abitibi), the confidence limits of the measurement may be improved significantly by using the samples located at the ends of the traverse to define the local background values. Work is continuing to generalize these results to other Canadian VMS deposits.

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