



Soft X-Ray Spectroscopy of Environmental Soil Samples Using the SGM Beamline at the CLS



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Introduction

Soil samples from Saskatoon and the surrounding area were collected and prepared and the x-ray absorption spectra for each sample was obtained for photon energies between 300 and 2000 eV. The objective was to determine what elements could be detected in soil samples through the use of soft x-ray absorption spectroscopy and to determine if any differences in the absorption spectra could be observed. The SGM has already been used to examine the absorption spectra of nitrogen (see posters by Walley, Gillespie and Leinweber) so these tests were carried out to find out if the same techniques could be applied to other elements.

Methods

Samples were collected and prepared by Grade 11 physics students from St. Joseph's High School. A table of sample sites is shown below. The soil was collected, dried for two days at 60 °C and finely ground. The samples were placed in the solid state absorption chamber of the SGM beamline and the TEY and

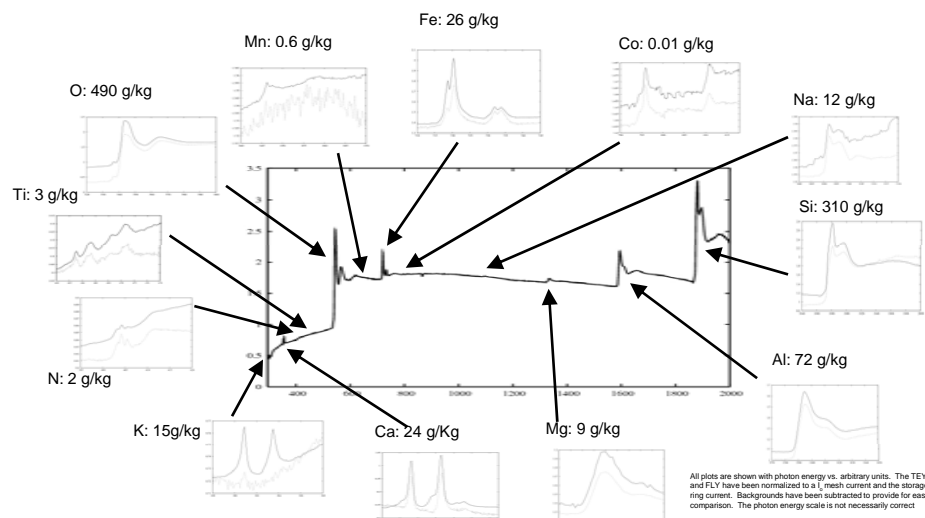


FLY were measured for the 300 to 2000 eV energy range. It took just over 8 hours to measure all six samples. An additional 8 hours being spent on acquiring higher resolution measurements on one of the samples.

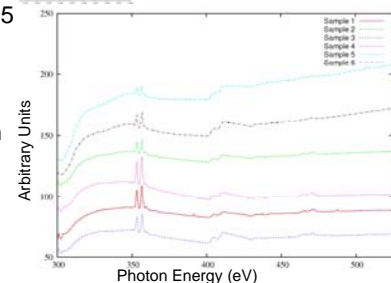
Sample	Location	Site Description
1	St. Joseph's High School, Saskatoon	Reclaimed fescue
2	Montgomery, Saskatoon	Natural grassland
3	Spiritwood, Saskatchewan	Pasture and grazing land
4	Arbor Creek, Saskatoon	Residential flower bed
5	Saskatoon Natural Grassland	Grassland – near aspen
6	Saskatoon Natural Grassland	Grassland – near buckthorne

Results

The TEY spectra of sample 6 is shown to the right, with high resolution TEY and FLY spectra from all of the absorption features shown in detail. Typical concentration numbers for North American soils, taken from the U.S. Geological Survey are also shown. The spectra are dominated by the K edge absorption edges of O, Na, Mg, Al and Si with strong contributions from the L edges of K, Ca and Fe. Also noticeable were the N K edge and the Ti, Mn and Co L edges. Clear structure is seen in many of the edges, indicating that speciation between different chemical forms of the element.



A comparison of the FLY spectra in the 300 to 525 eV region of all six samples is shown to the left. Clear differences in peak heights are seen at the K, Ca and N edges. The Ca edge is most prominent in samples 1 and 3, the samples taken from St. Joseph's fescue and and Arbor Creek flower bed. Samples 5 and 6, both taken from near the base of trees, show small K and Ca peaks and large N peaks.



Conclusions

The SGM beamline at the CLS can be used as a tool for the analysis of environmental samples. It was shown that all major soil constituents with absorption features in the SGM energy range can be detected and heavier elements at low concentrations, such as Co, can also be detected. Furthermore, the speciation of different chemical forms of many of the detected elements, as previously performed by Walley, Gillespie and Lienweber for N, is possible for other elements. Of particular interest is the ability of the SGM beamline to analyze the L edges of heavier elements, normally studied in hard x-ray beamlines, which provides more quantitative information on the chemical form in which the element is found.

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