A Landsat-Based Study of Black Rock Coatings Proximal to Base Metal Smelters, Sudbury, Ontario, Canada

Kelly J. Malcolm¹, David W. Leverington²*, and Michael Schindler³

¹. Student, Department of Earth Sciences, Laurentian University, Sudbury, ON, Canada
². Associate Professor, Department of Geosciences, Texas Tech University, Lubbock, TX, USA
³. Associate Professor, Department of Earth Sciences, Laurentian University, Sudbury, ON, Canada

* Presenting Author: David Leverington

ABSTRACT

Past emission of metal-bearing particulate matter, sulfur dioxide, and sulfuric acid by base metal smelters in the Sudbury region led to widespread loss of vegetation, contamination of soils, and formation of black coatings on rock surfaces. These black coatings formed through the incorporation of smelter-borne particulate matter into the partly-dissolved uppermost layers of siliceous minerals on exposed rock.

This study involved assessment of the reflectance properties of black coatings in the Sudbury region, and determination of the spatial distribution of coatings through supervised classification of reflectance data derived from a Landsat Enhanced Thematic Mapper Plus (ETM+) image. Classifications involved the use of the spectral angle mapper (SAM) and maximum likelihood algorithms.

The reflectance spectra of black coatings in the Sudbury region are generally flat and relatively featureless, and are characterized by low reflectance values of under 12% across the visible, near-infrared, and short-wave infrared. Weak absorption features variously exist in some spectra at ~950-1000, 1400, 1915, 2200, 2210, 2260, 2310, 2350, and 2385 nm. Though SAM classification results are characterized by the widespread mislabeling of uncoated urban and open-pit sites as mantled by black coatings, results generated by the maximum likelihood algorithm properly depict the general distribution of exposed black coatings in the Sudbury region. The mapping of black coatings using remote sensing methods can provide useful information on the spatial character of environmental degradation in the vicinity of smelters, and should be helpful in the monitoring of environmental recovery where emissions have been reduced or eliminated.