



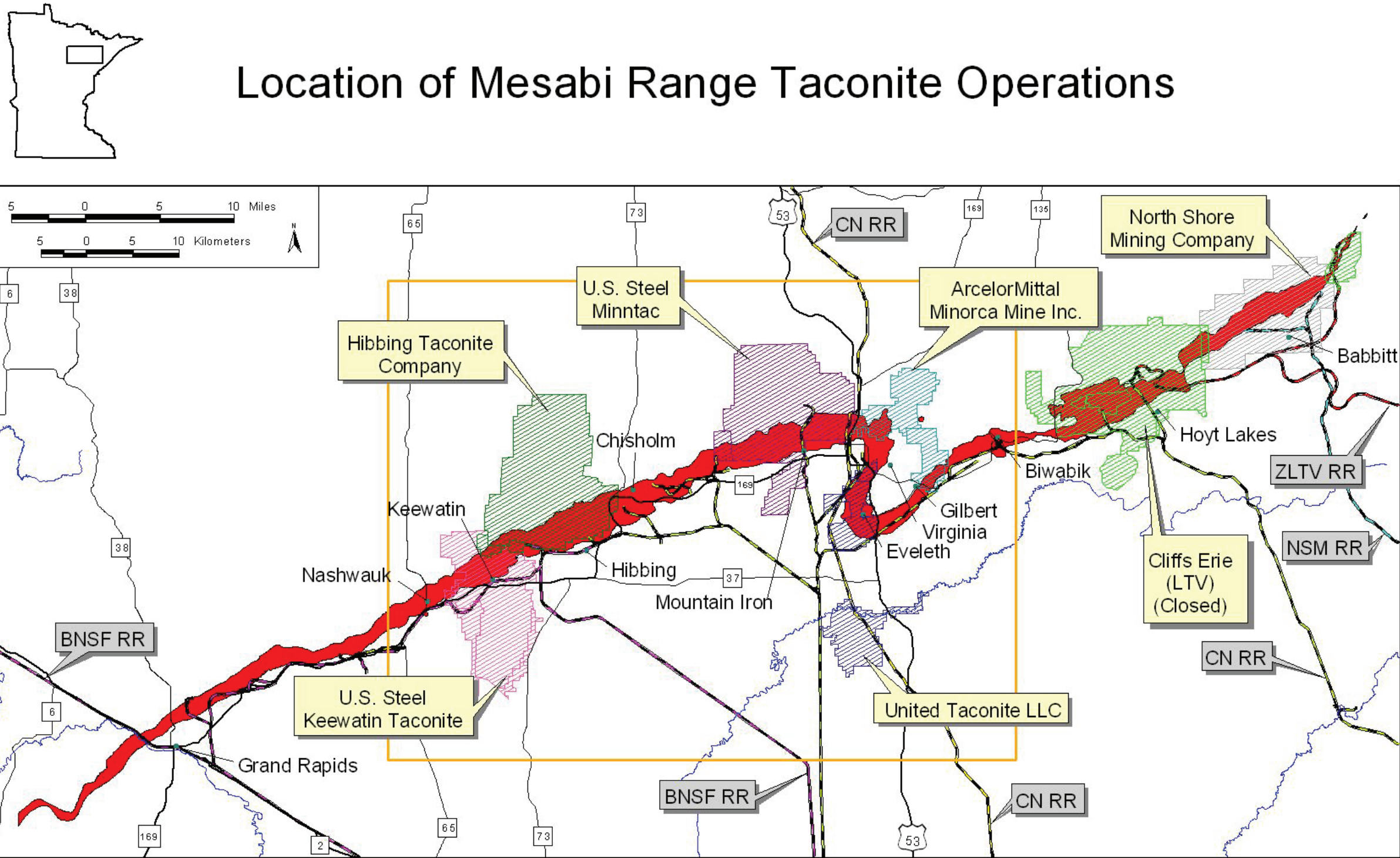
Environmental Study of Airborne Particulates in Population Centers on the Mesabi Iron Range: Progress Report April 2011

OBJECTIVE: Characterize mineral dust produced by mining and processing taconite in northeastern Minnesota with emphasis on elongated mineral particles.

Key Questions:

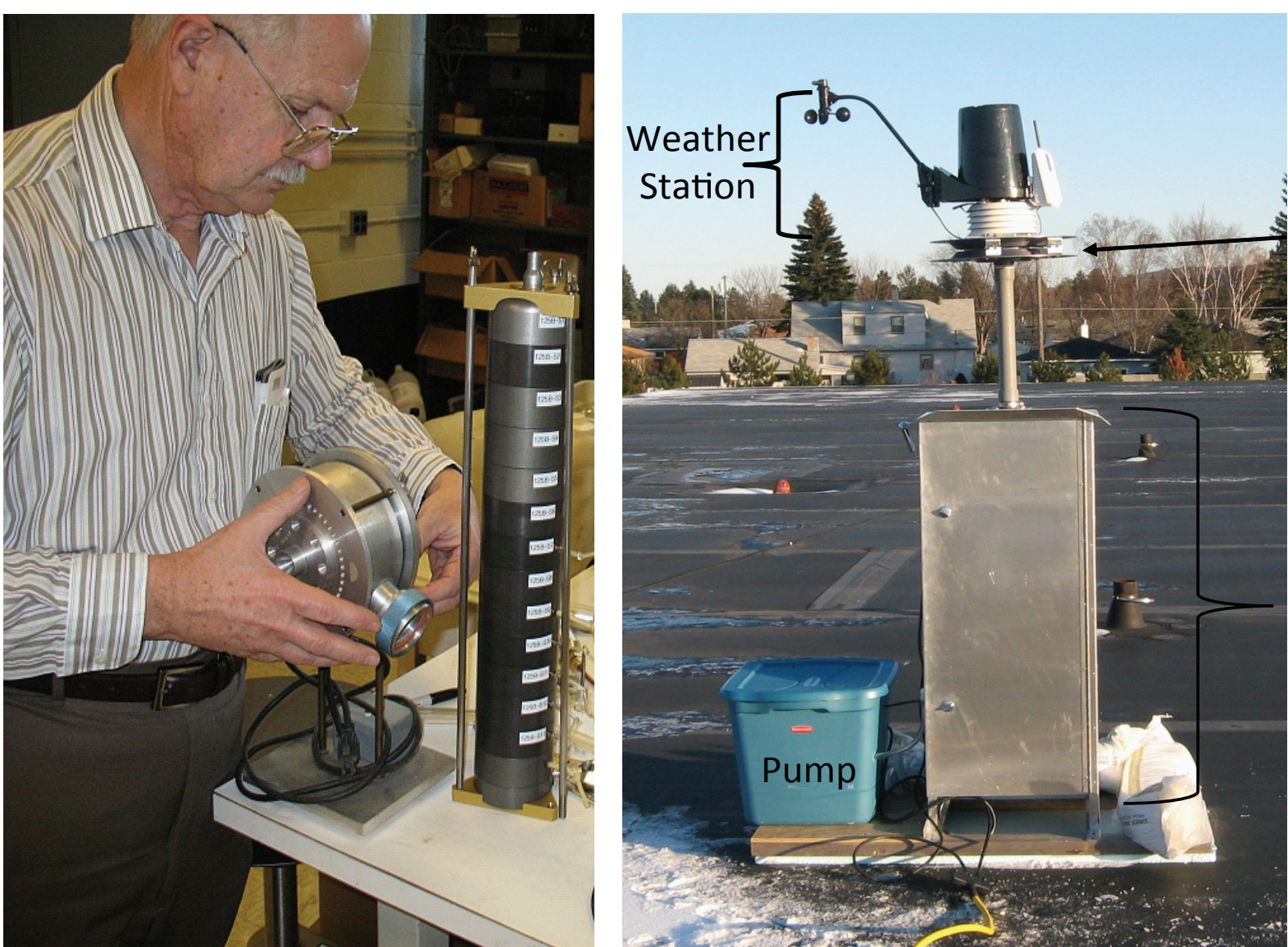
- *What are the long-term average particulate matter characteristics (size, shape, composition, mineral species) in Mesabi Iron Range population centers, and do they differ significantly from the particulate matter characteristics in non-Mesabi Iron Range towns/cities in northeastern Minnesota?*
- *What are the ambient long-term average elongated mineral particle (EMP) concentrations in population centers on Mesabi Iron Range?*
- *Has the mineral dust emitted from taconite operations changed over time in response to increased regulation, and the implementation of more effective dust control procedures?*

Community and In-Plant Sampling



Locations of taconite processing plants on the Mesabi Iron Range being sampled during this study (after Oreskovich and Patelke, 2006).

Air Sampling Strategy



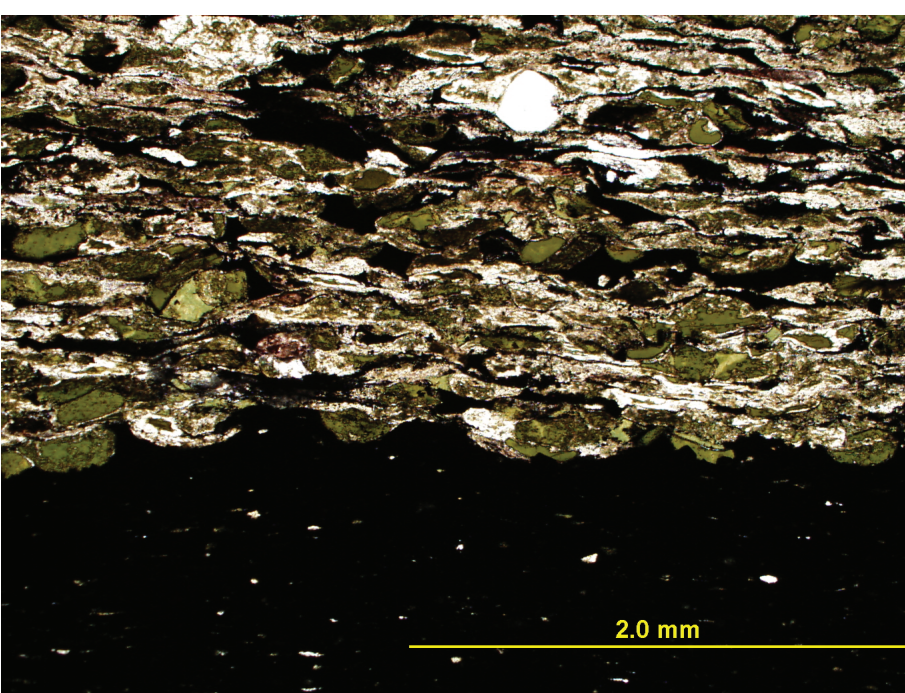
Air samples are collected using Microorifice Uniform Deposit Impactors (MOUDI) and are housed at sampling stations. Example of impactors at University of Minnesota’s Particle Calibration Laboratory (Prof. Virgil Marple, Department of Mechanical Engineering, left) and sampling station Babbitt Municipal Building (right).

Lake Sediment Sampling Strategy

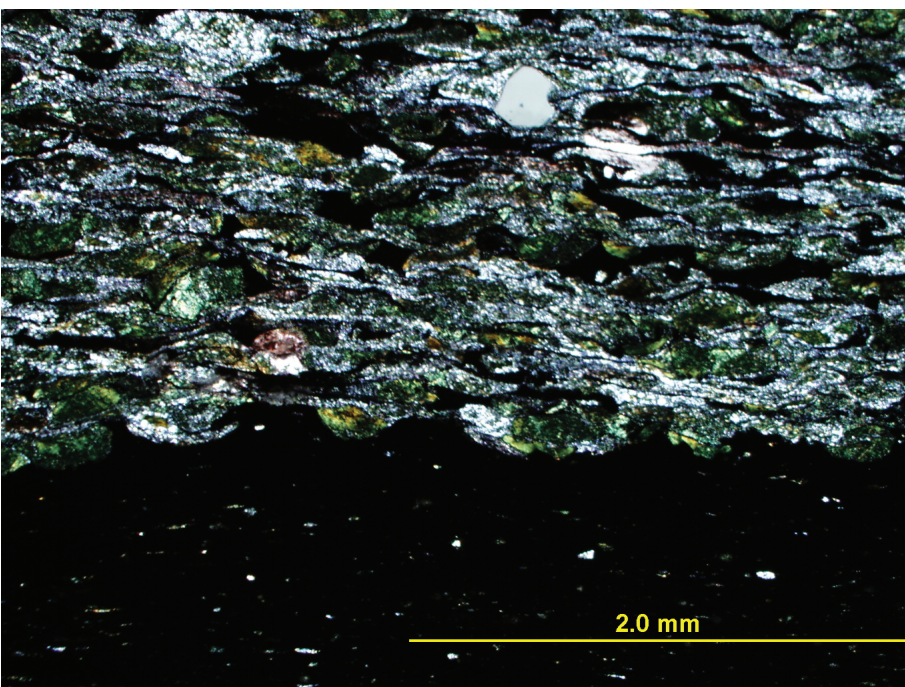


Lake sediment cores collected from the eastern and western regions of the Mesabi Iron Range offer insights into historic production of mineral dust. Example of lake sediment core sampling at “North-of-Snort” Lake by scientist Lisa Allinger (left) and Dr. Euan Reavie (right).

Petrographic Analysis



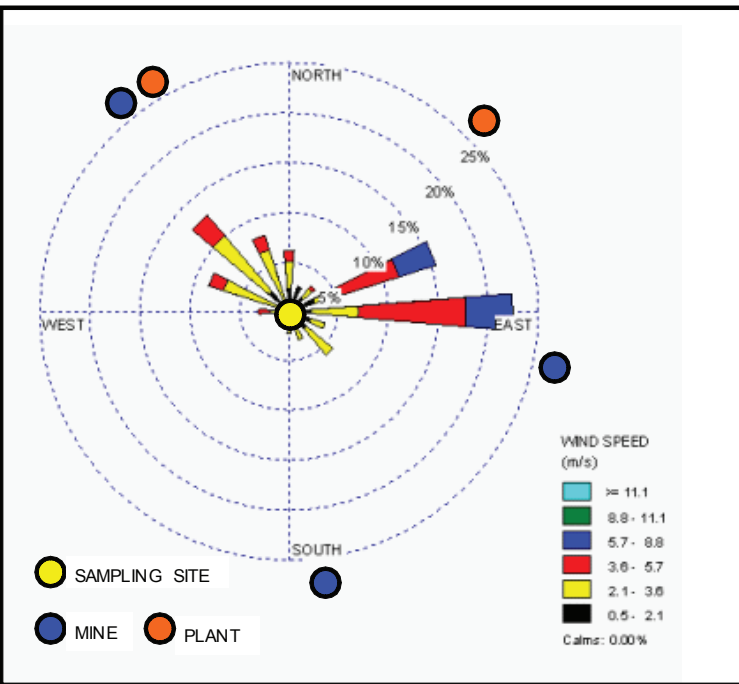
Plane Polarized Light



Crossed Polarized Light

Petrographic analysis enables NRRI scientists to identify minerals and textures in Mesabi Iron Range rock samples. This thin section(left), taken from the upper cherty unit of the Biwabik Iron-Formation is composed of quartz, siderite, iron oxides, and stilpnomelane.

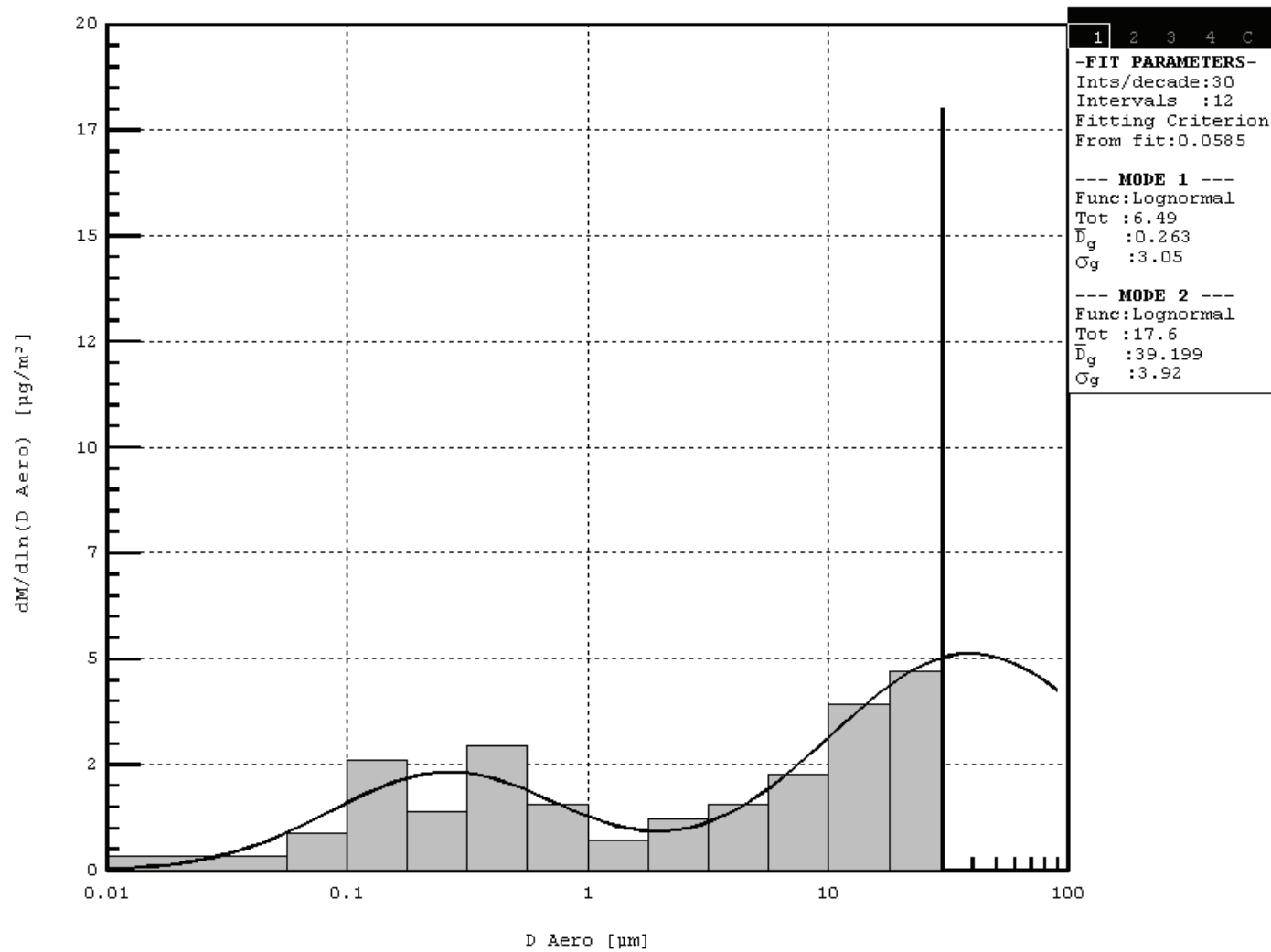
Wind Distribution Compass



Meteorologic wind direction and intensity data is collected during sampling events. The data is plotted to produce a compass graph. The graph displays locations of nearby taconite mines and plants relative to the sampling site.

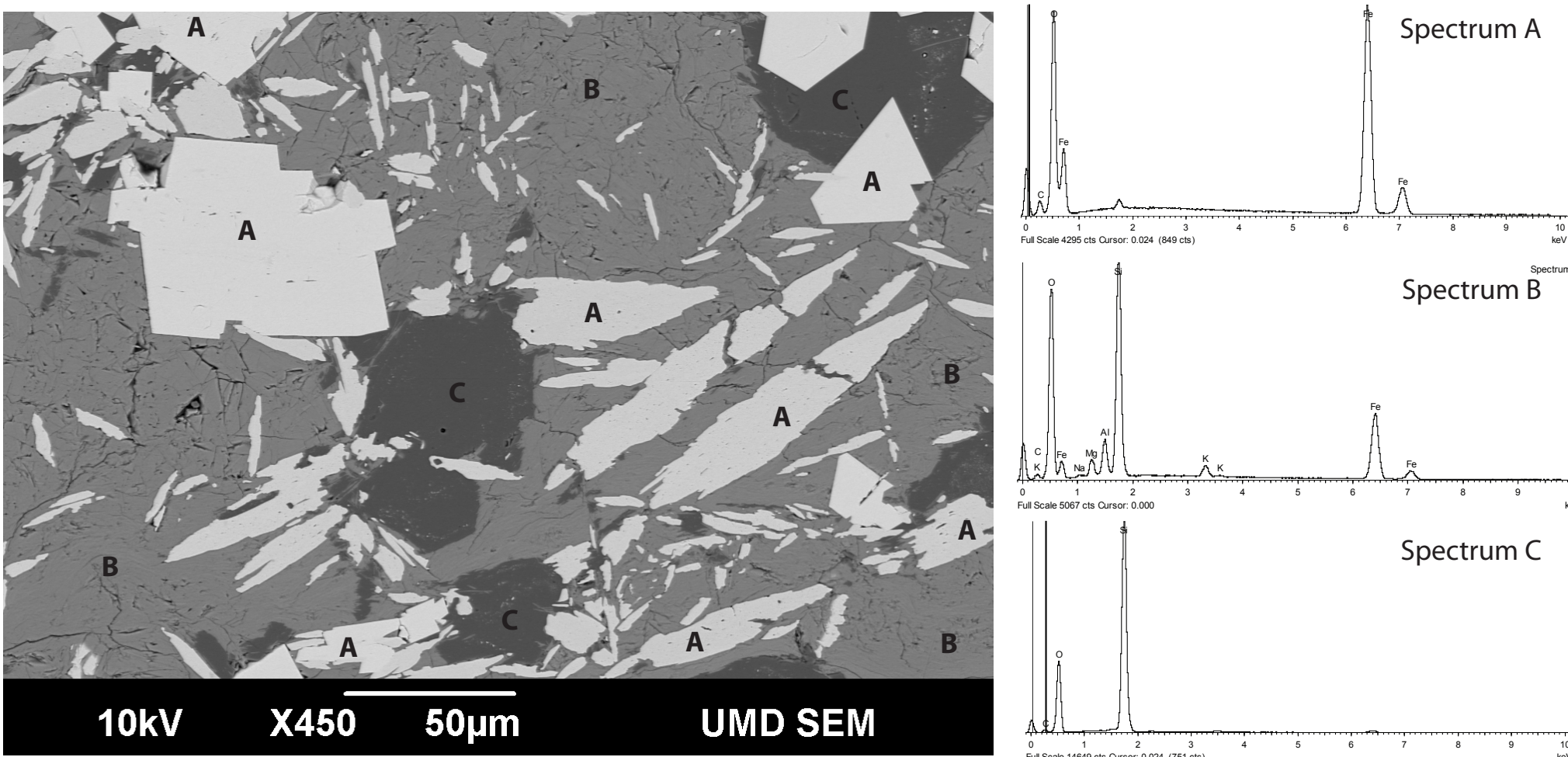
Gravimetric Analysis

Gravimetric analysis is completed on MOUDI filter samples, and the particle weight distribution is graphed. This distribution plot suggests a bimodal distribution of particle size.



Scanning Electron Microscope Analysis

Backscatter electron image of a Mesabi Iron Range drill core sample in thin section. Mineral chemistry is obtained using energy dispersive spectroscopy (EDS) and is used as a reference for environmental particles.



Spectra obtained from this sample show that the lightest grey minerals are iron oxides (magnetite/hematite), that the medium gray regions are an iron-silicate mineral, and that the darkest grey minerals are silicon dioxide (quartz).

Community Sampling Events to Date

	Winter (November-April)	Summer (May-October)
Keewatin Elementary School	3	3
Hibbing High School	4	5
Virginia Courthouse	4	5
Babbitt Municipal Building	7	8
Silver Bay High School	4	7

In-Plant Sampling Events to Date

	Active	Inactive
U.S. Steel Keetac	1	1
Cliff’s Natural Resources Hibbing Taconite (Hibtac)	1	1
U. S. Steel Minntac	1	0
ArcelorMittal Minorca Mine	3	0
Cliff’s Natural Resources United Taconite (Utac)	2	0
Cliff’s Natural Resources Northshore Mine	3	1

Plans for 2011

- *Continued laboratory analysis of samples*
- *Evaluation and interpretation of data*
- *Preparation and completion of project reports*

Citation

Oreskovich, J.A., and Patelke, M.M., 2006, Historical use of taconite byproducts as construction aggregate materials in Minnesota: A Progress Report: Natural Resources Research Institute Report of Investigation NRRI-RI-2006-02, 10p.