



Metals in the Canadian Surface Environment: Sources, Fate, and Risks

Michael Parsons, Project Leader (*GSC-Atlantic*)

ESS Project Participants:

Steve Adcock, Graeme Bonham-Carter, Peter Davenport, Steve Day, Peter Friske, Bob Garrett, Fari Goodarzi, Eric Grunsky, Gwendy Hall, Rod Klassen, Ross Knight, Martin McCurdy, Rick McNeil, Jeanne Percival, Al Sangster, Wendy Spirito





Project Overview



This project has characterized the distribution, chemical form, and potential risks associated with metal(loid)s released into the Canadian surface environment from natural sources, and activities related to their exploitation.

Primary objectives

- Define areas posing potential risks to ecological / human health
- Improve understanding of processes controlling metal distribution & fate
- Provide clients and stakeholders with geoscience knowledge necessary for informed risk assessments and land-management decisions
 - » Some project activities responded directly to external drivers; in others, ESS took the lead in defining issues important to the health of Canadians





Project Structure



The project consisted of four main activities:

1) Environmental Legacy of Historical Gold Mining Activities

(M. Parsons, G. Hall, J. Percival, A. Sangster)

2) Geochemical Baseline Protocols for Soil Monitoring

(R. Garrett, G. Hall, R. Klassen, F. Goodarzi)

3) Geochemical Modeling of Soil Mineralogy

(R. Klassen, R. Garrett, R. Knight, P. Davenport)

4) Risk Assessment Mapping *(E. Grunsky)*

- Compilation of Legacy NGR Data (P. Friske, R. Garrett, S. Day, E. Grunsky)
- NWT Geochemical Field Survey (S. Day, P. Friske)
- Yukon Geochemical Field Survey (R. McNeil, M. McCurdy, S. Day, P. Friske)
- Establishing Natural Background in Geochemical Surveys
(G. Bonham-Carter, R. Garrett, S. Adcock, A. Rencz)
- Geochemistry for Risk Management in Canada (W. Spirito, S. Adcock, A. Rencz)





Contribution to MITE Outcomes



This project contributes to 3 of 4 MITE outcomes:

Outcome	Activity
Environment Canada and Health Canada have sufficient understanding of ambient concentrations of metals in the environment to identify areas that exceed specified limits as required by the Canada Wide Standards and Suggested Quality Guidelines.	Risk Assessment Mapping, Abandoned Gold Mines
Federal departments positioned to implement a soils component to a “nationally integrated monitoring system on ecosystem and human health” as recommended by the Commissioner for the Environment and Sustainable Development.	Geochemical Baselines Protocols, Geochemical Modeling
Risk management decisions taken in accordance with the federal Toxic Substances Management Policy, encompass protocols that distinguish concentrations of metals in the environment that are primarily anthropogenic, from those that are natural in origin.	All activities



Natural Resources
Canada

Ressources naturelles
Canada

Canada



Environments of Concern



Abandoned Mines:

Aim: Assess the Distribution, Speciation, and Fate of Metals Around Abandoned Mines, and Identify Potential Risks to Ecosystem and Human Health

HOW:

- Multidisciplinary studies of abandoned gold mines (Hg-amalgamation sites)
- ~~Assessment of abandoned mines in North~~

PARTNERS:

- NS Dept. of Natural Resources, Environment Canada, DFO, Geomatics Canada, Univ. Ottawa, Queen's, Dalhousie, RMC

OUTCOMES:

- Improved understanding of the ecological and human health risks associated with abandoned metal mines
- Risk-management decisions based on geoscience knowledge of natural background levels and metal speciation



Children playing in gold mine tailings, Goldenville, NS



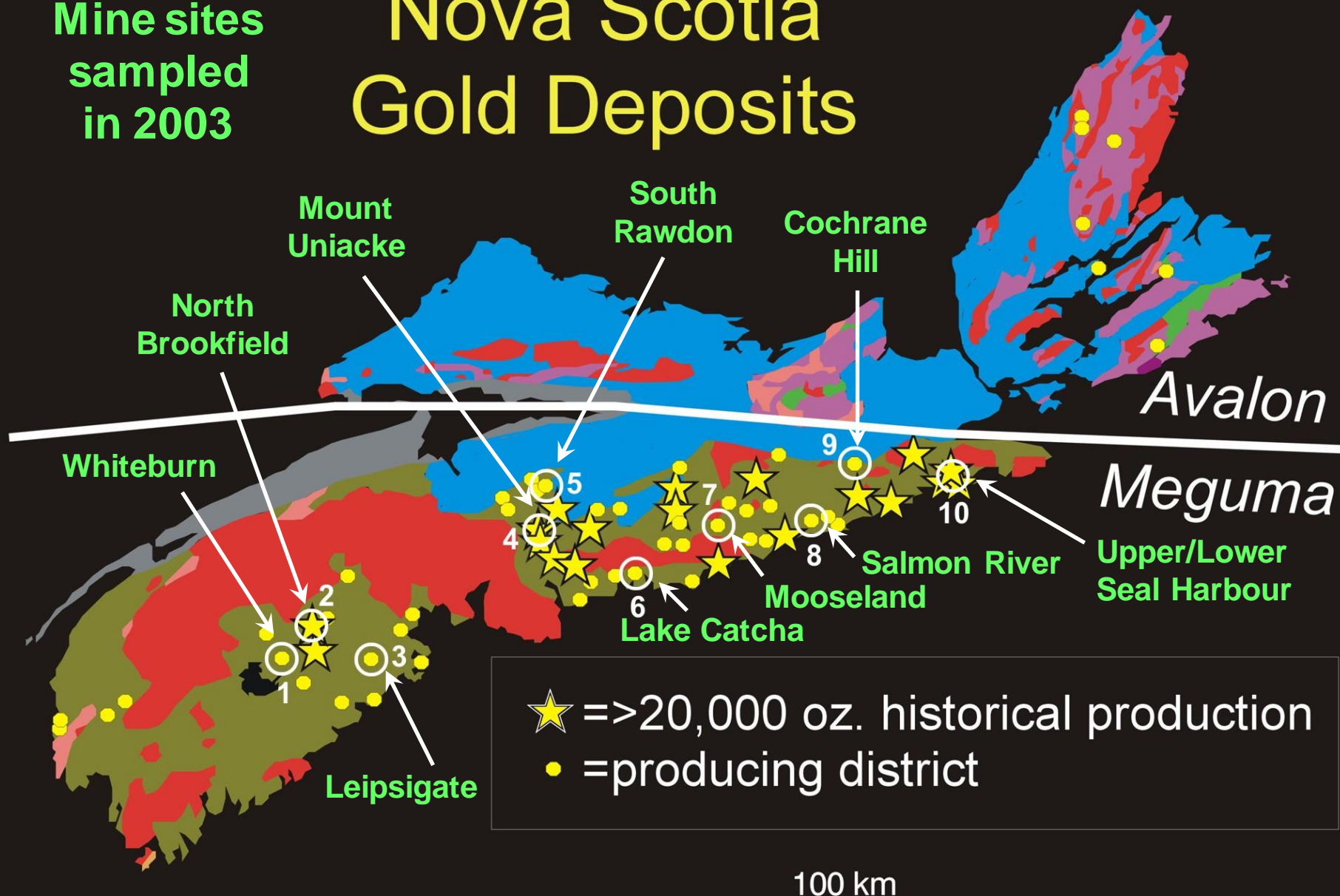
Natural Resources
Canada

Ressources naturelles
Canada

Canada

Mine sites
sampled
in 2003

Nova Scotia Gold Deposits



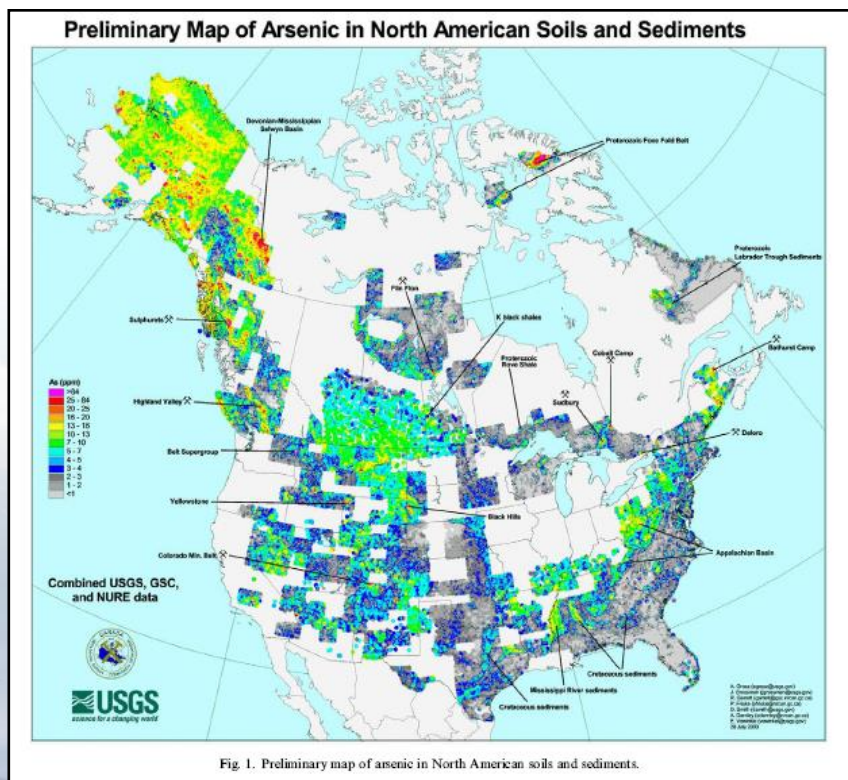


Identifying Geochemical Background and Relevance



Soil Mapping - Risk Assessment:

Aim: Collection and Re-interpretation of Geochemical Data for Risk-Assessment Purposes



Grosz et al. (2004) *Applied Geochemistry*, v. 19, pp. 257-260.

HOW:

- Development of soil sampling protocols
- Consideration of mineralogical data
- Re-interpretation of existing datasets

PARTNERS:

- USGS, Mexican Geological Survey
- AAFC, EC, HC, USEPA, Universities

OUTCOMES:

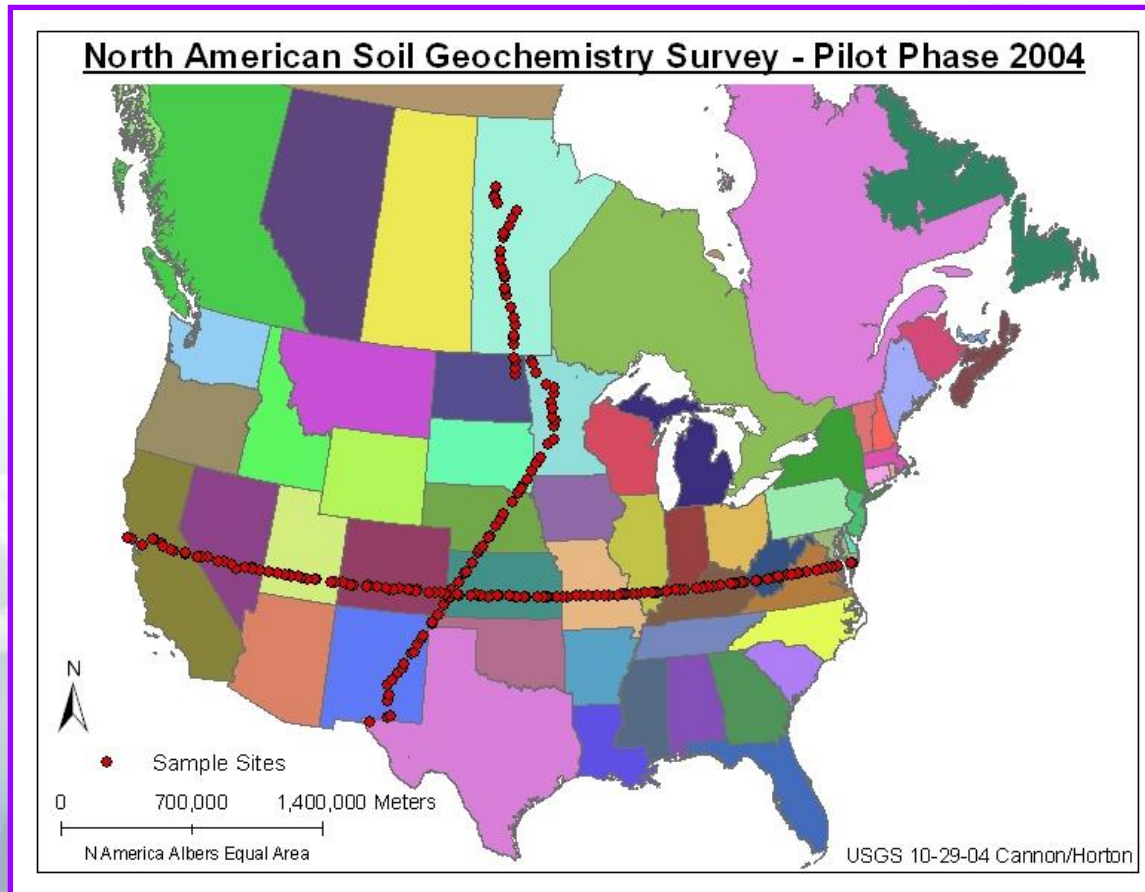
- Risk management decisions consider natural variations in metal concentrations
- Development of Tri-National Soil Monitoring Program



Natural Resources
Canada

Geochemical Modeling / Geochemical Baselines Protocols

Major field program in 2004: Contributing towards sampling & analytical protocol development, mineralogical understanding



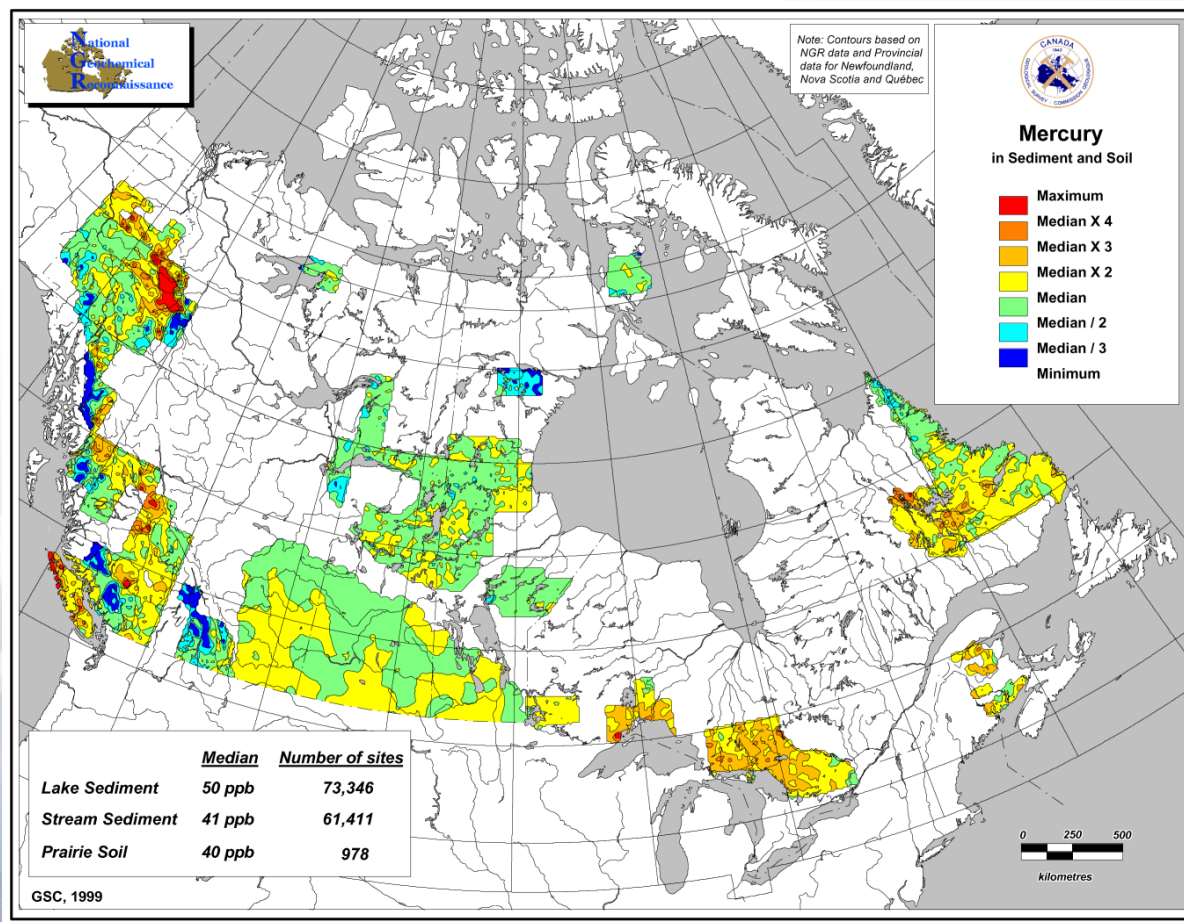
Natural Resources
Canada

Ressources naturelles
Canada

Canada

NGR Compilation & Dissemination

National Atlas maps for Cu, Ni, Zn and Hg in NGR lake and stream sediments to be released in 2006



Natural Resources
Canada

Ressources naturelles
Canada

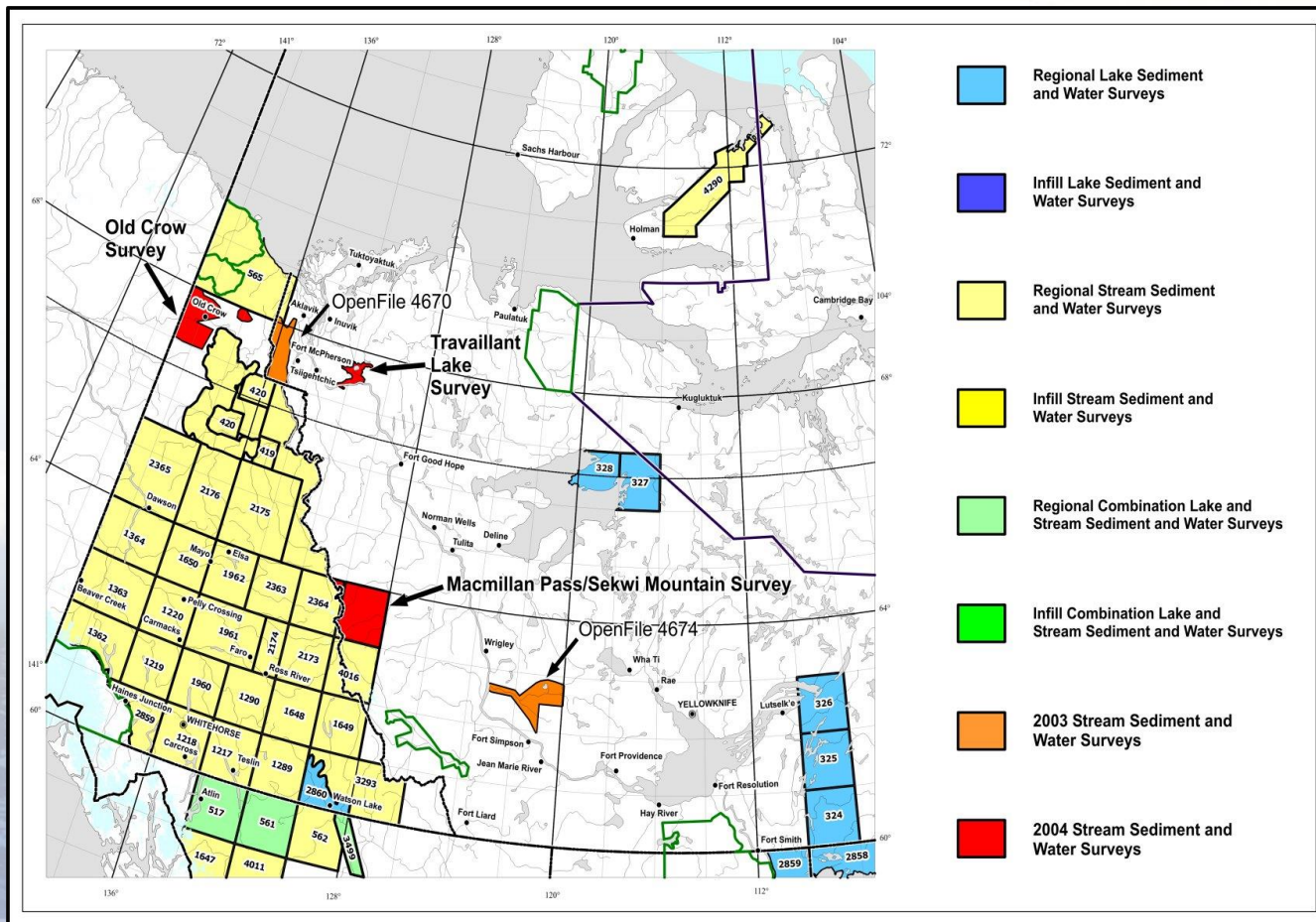
Canada



NGR Field Surveys in 2004/2005



Within the MITE program, roughly 40,000 km² of Canada's landmass has been covered by eight new stream silt sediment and water surveys totaling over 2,768 sites including 459 bulk sediment samples from the Northwest Territories and Yukon.



Natural Resources
Canada

Ressources naturelles
Canada

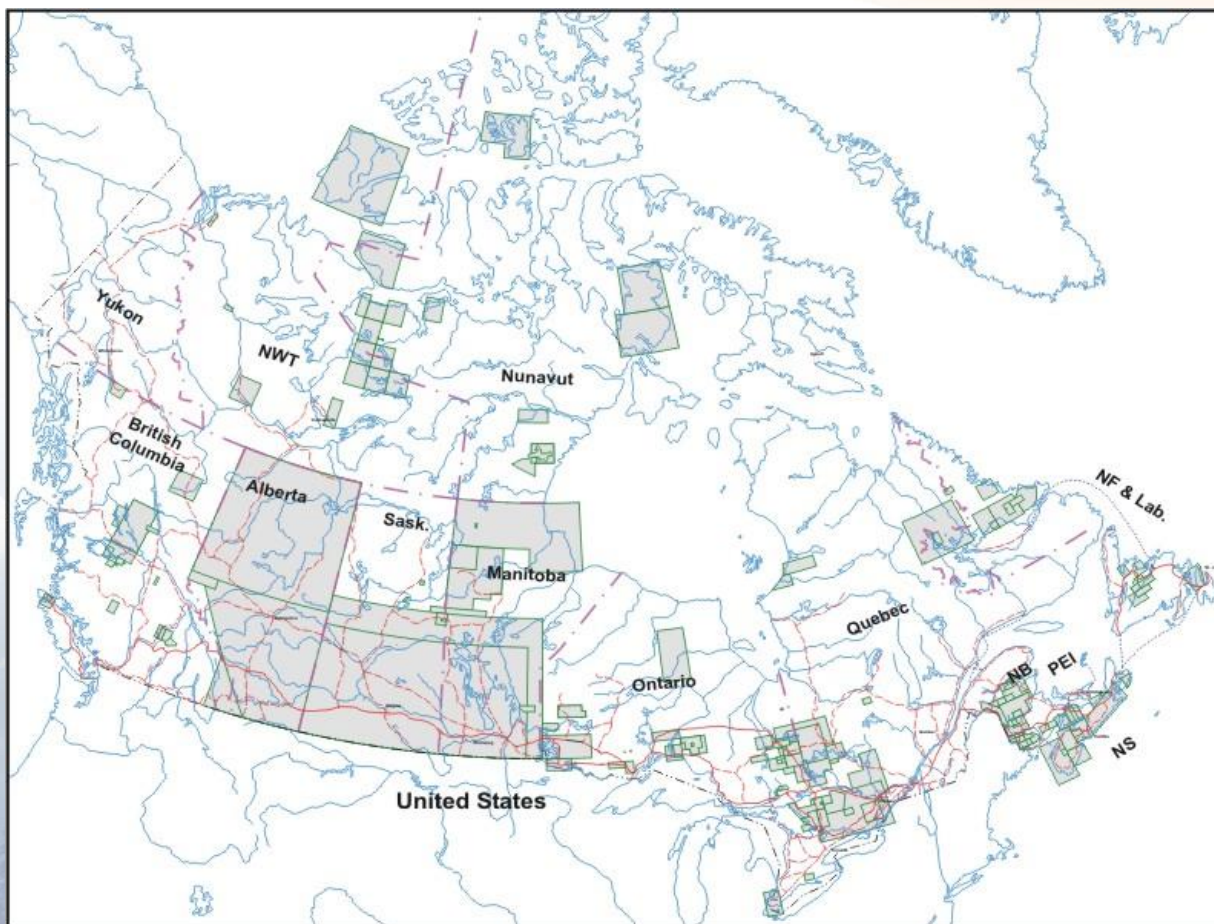
Canada



Soil and Till Metadata Compilation



Provides Health Canada with knowledge on the geochemistry of soils and tills, including background values to support risk-management decisions as part of the Federal Contaminated Sites Program.



Natural Resources
Canada

Ressources naturelles
Canada

Canada



Summary of Project Outputs



Most milestones in SPS achieved. The Northern Mines scoping activity dropped from project because of a lack of MITE personnel, and increased demands from other activities. Final publication of results is ongoing.

Key outputs:

- *Abandoned Gold Mines in NS: GEEA Special Issue* (12 papers), GSC/NSDNR Open Files, GAC/MAC Field Trip Guide, student theses (1 BSc, 3 MSc, 1 PhD), and 16+ conference pres.
- MAC Mercury Short Course Volume (*Parsons & Percival* (eds.), 4 chapters by GSC staff)
- Report to Environment Canada on estimating geochemical background (*Bonham-Carter, Garrett*)
- Report to HC on the role of geoscience for ecosystem and human health (*Klassen*)
- Chapter on Geochemical Background in major Medical Geology textbook, and co-authored journal papers in *Science of the Total Environment* (*Garrett*)
- Three NGR Open Files (4670, 4674, 4949) for stream & lake sediments in NWT (*Day et al.*), and compilation maps for Cu, Ni, Hg, & Zn to be released in 2006 via National Atlas
- Online/Open File metadata/data compilation for soils and tills in Canada (*Spirito, Adcock, ...*)

Challenges for future

- Retirements of key MITE personnel (*Garrett, Bonham-Carter, Sangster*) have left a significant void in the environmental geochemistry capacity of ESS. Staffing actions (e.g. hiring of PDFs) should be undertaken ASAP in support of the new Environment & Health business line.

