North American Soil Geochemical Landscapes Project

Canadian and Mexican Field Surveys from 2007

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and

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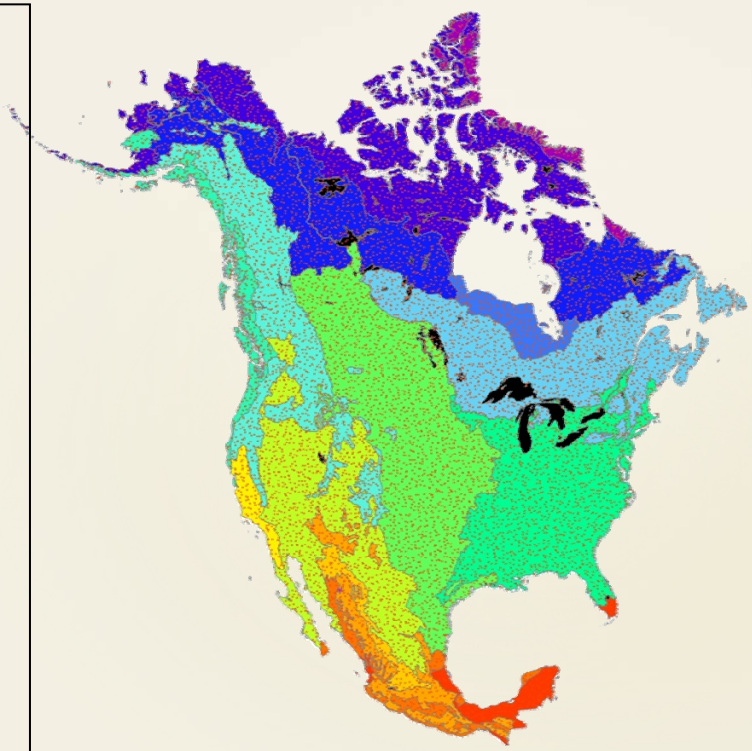
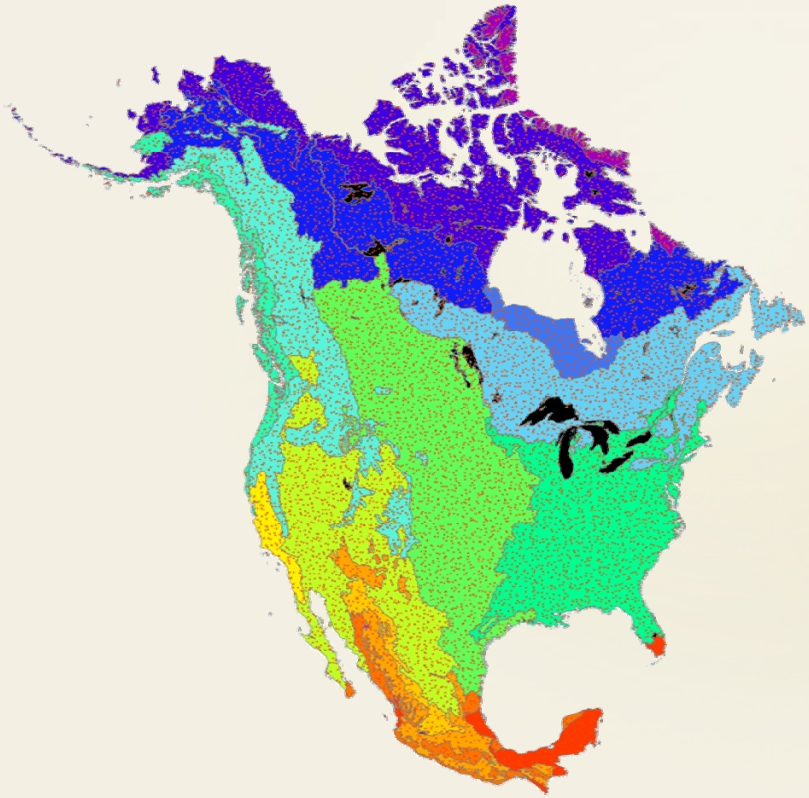
Natural Resources Canada

Geological Survey of Canada



North American Soil Geochemical Landscapes Project

- Background Information on the Tri-national Project



North American Soil Geochemical Landscapes Project

Sample Site Selection

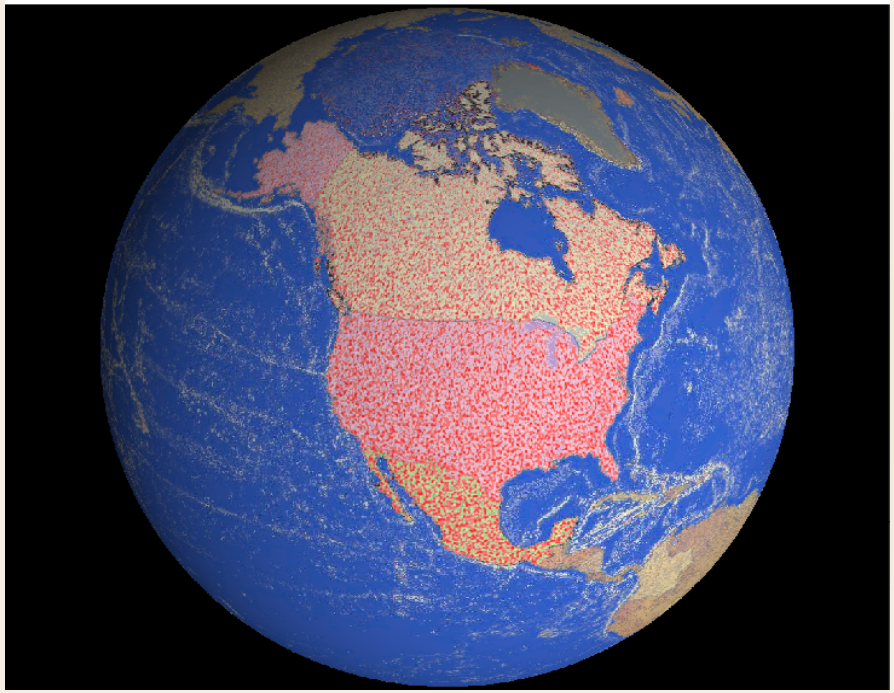
Low Density Sampling:

1 sample site per 1,600 km^2

- 40 km x 40 km grid

Sample Count:

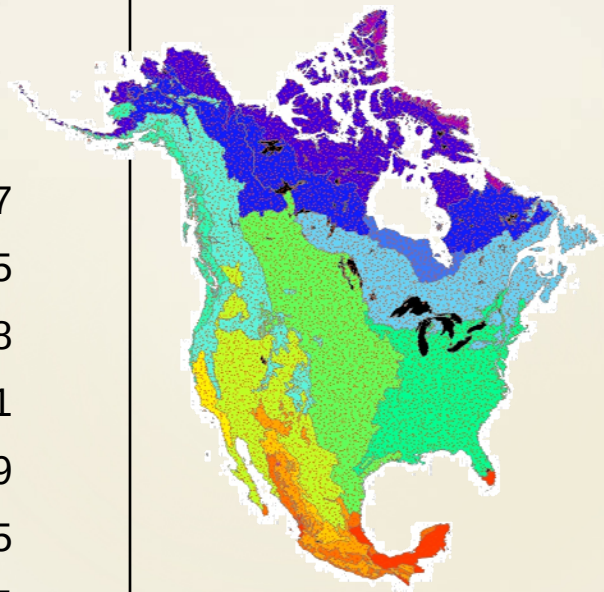
Canada:	6238
United States:	6018
Mexico:	1231
Total:	**13500**



Distribution of Primary Sites

Province/Territory	Abbreviation	Primary Sites
Newfoundland and Labrador	CA-NL	256
Nova Scotia	CA-NS	35
New Brunswick	CA-NB	48
Prince Edward Island	CA-PE	4
Quebec	CA-QC	937
Ontario	CA-ON	625
Manitoba	CA-MB	408
Saskatchewan	CA-SK	401
Alberta	CA-AB	419
British Columbia	CA-BC	595
Yukon Territory	CA-YT	305
Northwest Territories	CA-NT	836
Nunavut	CA-NU	1314
Total		**6183**

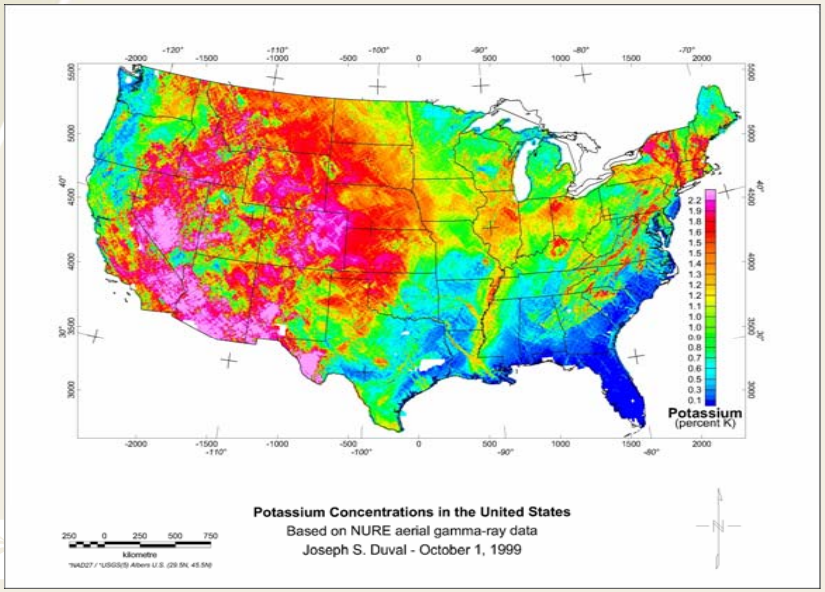
Canada

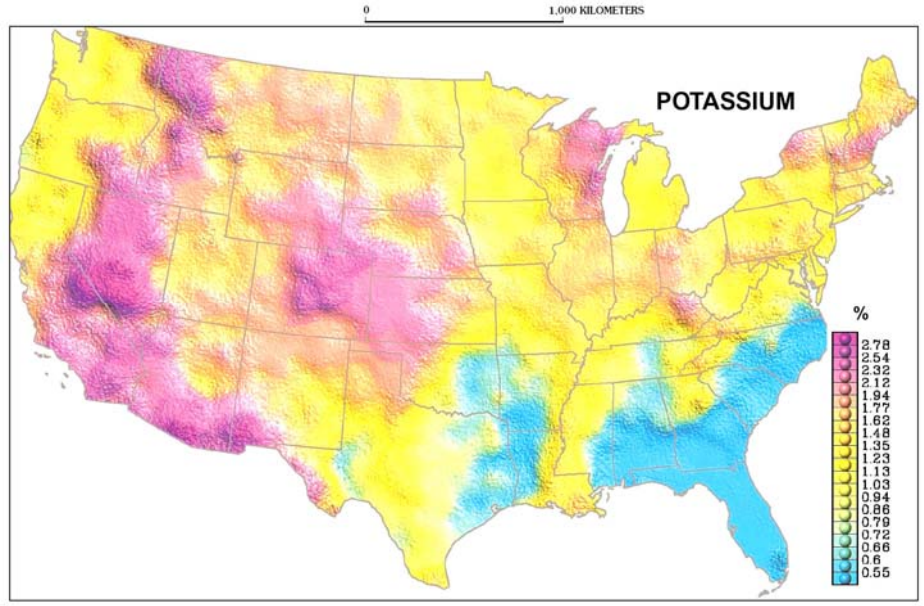


Final Goal

National soil geochemical database

- for a range of environmental and health applications.



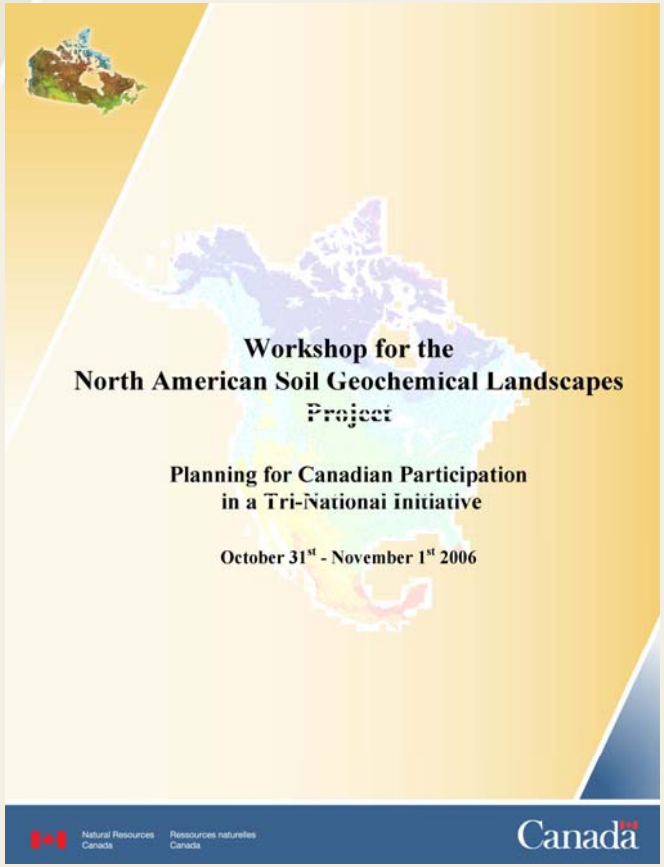


Distribution of potassium based on airborne radiometric data (Duval, 2000) versus ground data (Shacklette and Boergen, 1984)

Moving Forward

The Canadian Perspective

Identifying Partnerships



Participants/Partners

International:

Geological Survey of Canada
United States Geological Survey
Servizio Geologico Mexicano

Federal government departments:
Agriculture and Agri-Food Canada
Environment Canada
Health Canada
Indian and Northern Affairs Canada
Natural Resources Canada

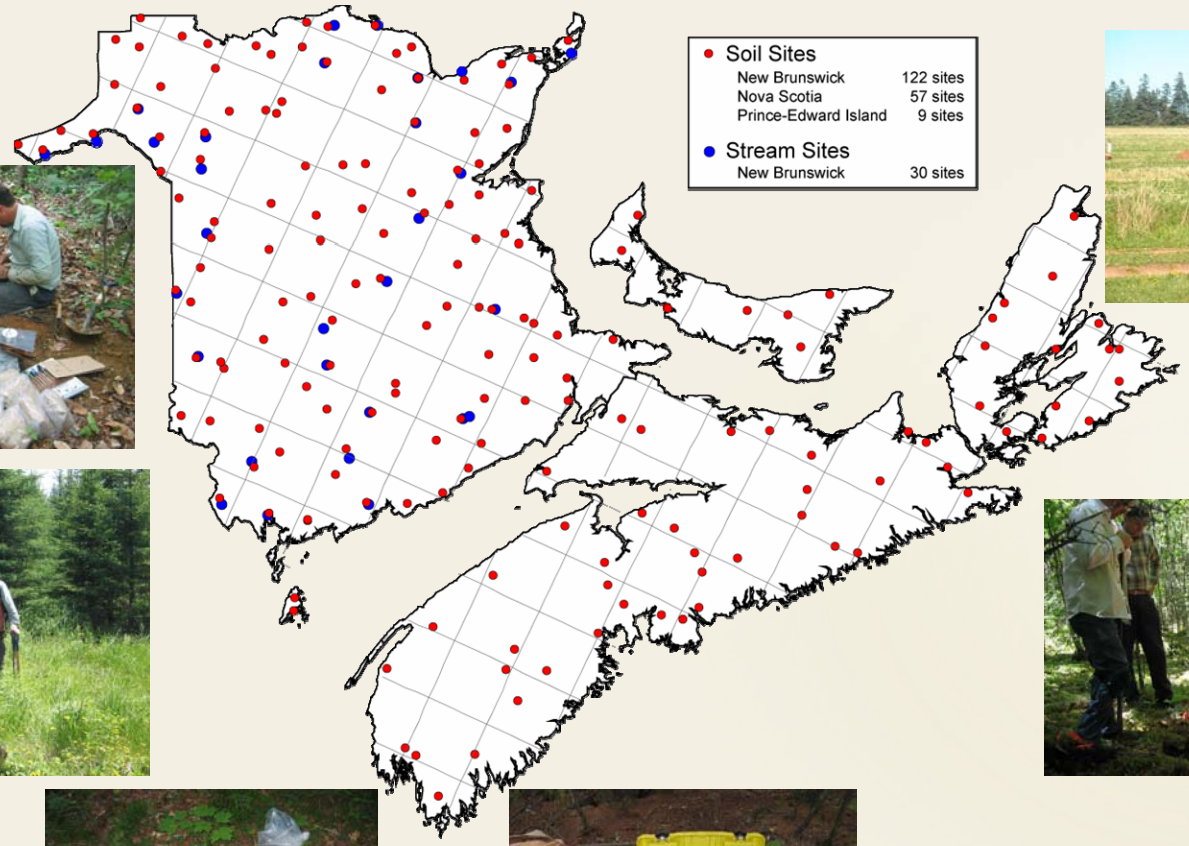
Provincial:
Geological surveys in all provinces

North American Soil Geochemical Landscapes Project

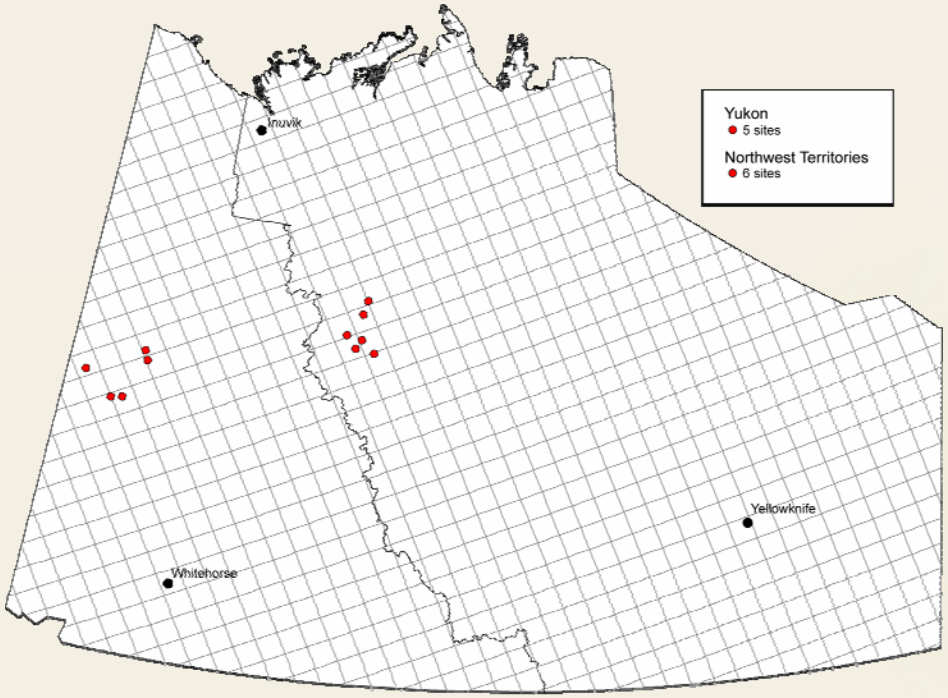
ACCOMPLISHMENTS TO DATE

- Protocol Development – field and lab
  - Core set: GSC-driven (inorganics)
  - Add-On development projects: *partner driven* (core sample splits, additional samples from core site, samples away from Tri-national site)
- Sampling surveys
  - Canada
  - US
  - Mexico
- Data Applications

Tri-national Maritimes Sampling



Tri-national Northern Sampling



Protocols- Field Sampling

PROTOCOLS - Field Sampling

Introduction

- General - Why sample? Why tri-national?
- Common terminology
- Explanation of documentation
- Basic information on soil characteristics

Field Sampling Design

- General
- Site selection
- Office
- Field

Field Sampling Protocols

Mineral soils

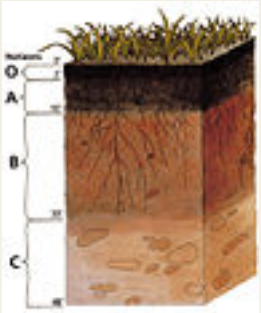
- Field equipment
- Steps for on-site sample collection
- Sampling for geochemical analysis, grain size, ph, water content, bulk density
- Using the field card
- Storing

Organic soils

- Field equipment
- Steps for on-site sample collection
- Using the field card
- Storing

Adjustments for permafrost-affected terrain

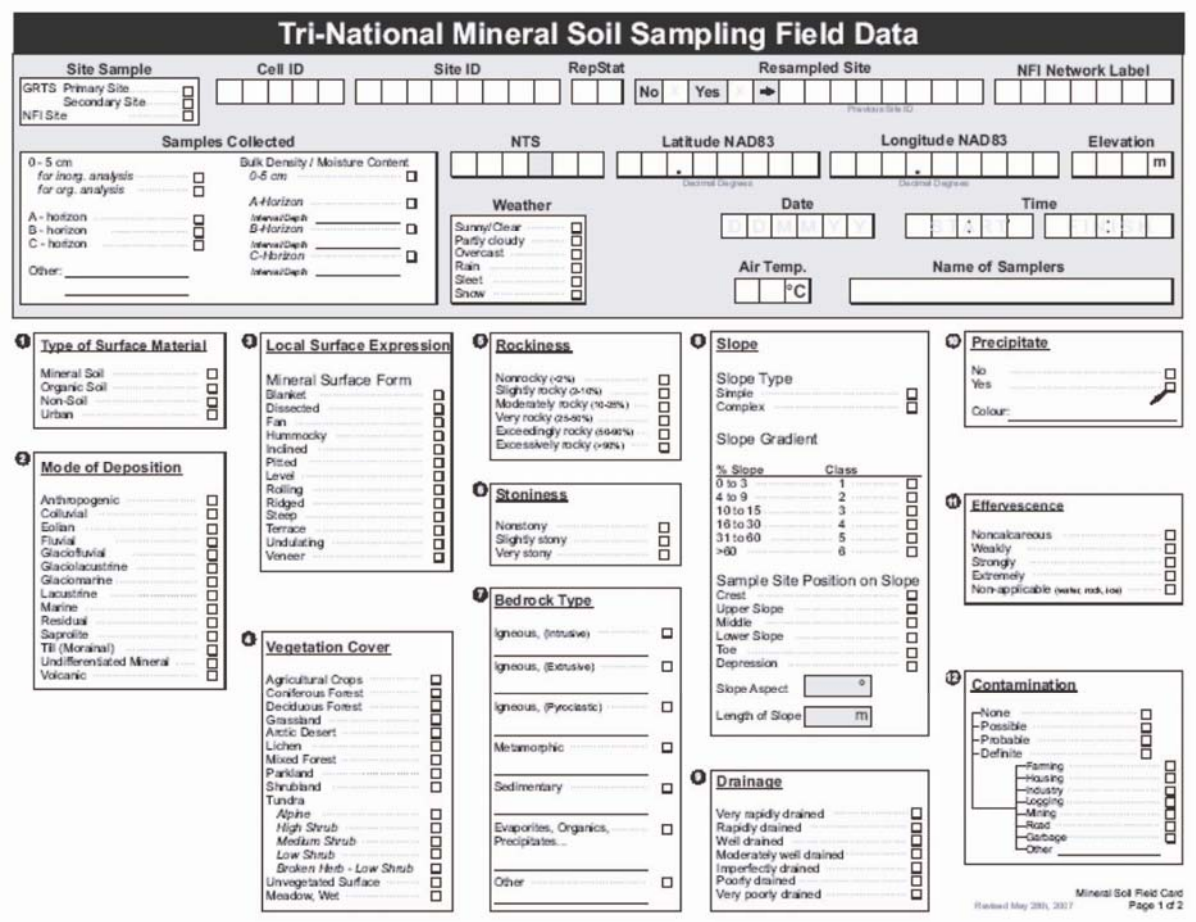
- Collecting of mineral soils
- Collecting of organic soils
- Storing and transportation



Horizon -based sampling

Protocols- Field Sampling

Development of a field card for field sampling mineral soils



Tri-National Mineral Soil Sampling Field Data

Site Sample
GRTS Primary Site
Secondary Site
NFI Site

Cell ID | Site ID | RepStat | Resampled Site (No / Yes) | NFI Network Label

Samples Collected
0 - 5 cm
for inorg. analysis
for org. analysis
A - horizon
B - horizon
C - horizon
Other:
Bulk Density / Moisture Content
0-5 cm
A-Horizon
B-Horizon
C-Horizon
Interval/Depth

NTS | Latitude NAD83 | Longitude NAD83 | Elevation (m)

Weather
Sunny/Clear
Partly cloudy
Overcast
Rain
Sleet
Snow

Date | Time | Air Temp. (°C) | Name of Samplers

1 Type of Surface Material
Mineral Soil
Organic Soil
Non-Soil
Urban

2 Mode of Deposition
Anthropogenic
Colluvial
Eolian
Fluvial
Glaciofluvial
Glaciolacustrine
Glaciomarine
Lacustrine
Marine
Residual
Saprolite
Till (Morainal)
Undifferentiated Mineral
Volcanic

3 Local Surface Expression
Mineral Surface Form
Blanket
Dissected
Fan
Hummocky
Inclined
Pitted
Level
Rolling
Ridged
Steep
Terrace
Undulating
Veneer

4 Vegetation Cover
Agricultural Crops
Coniferous Forest
Deciduous Forest
Grassland
Arctic Desert
Lichen
Mixed Forest
Parkland
Shrubland
Tundra
Alpine
High Shrub
Medium Shrub
Low Shrub
Broken Herb - Low Shrub
Unvegetated Surface
Meadow, Wet

5 Rockiness
Nonrocky (<2%)
Slightly rocky (2-10%)
Moderately rocky (10-25%)
Very rocky (25-50%)
Exceedingly rocky (50-90%)
Excessively rocky (>90%)

6 Stoniness
Nonstony
Slightly stony
Very stony

7 Bedrock Type
Igneous, (Intrusive)
Igneous, (Extrusive)
Igneous, (Pyroclastic)
Metamorphic
Sedimentary
Evaporites, Organics, Precipitates...
Other

8 Slope
Slope Type
Simple
Complex
Slope Gradient

% Slope	Class
0 to 3	1
4 to 9	2
10 to 15	3
16 to 30	4
31 to 60	5
>60	6

Sample Site Position on Slope
Crest
Upper Slope
Middle
Lower Slope
Toe
Depression
Slope Aspect (°)
Length of Slope (m)

9 Drainage
Very rapidly drained
Rapidly drained
Well drained
Moderately well drained
Imperfectly drained
Poorly drained
Very poorly drained

10 Precipitate
No
Yes
Colour:

11 Effervescence
Noncalcareous
Weakly
Strongly
Extremely
Non-applicable (water, rock, ice)

12 Contamination
None
Possible
Probable
Definite
Farming
Housing
Industry
Logging
Mining
Road
Garbage
Other

Mineral Soil Field Card
Page 1 of 2

Protocols- Laboratory

PROTOCOLS - Laboratory Analysis

Background Rationale

Sample Preparation

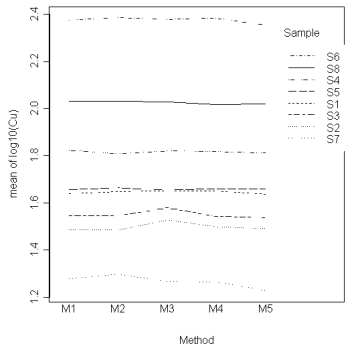
- Air drying
- Munsel colour coding
- Preparing specific size fractions
- Ball-milling procedures
- Storing and archiving sample splits

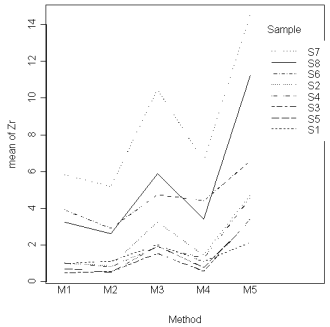
Sample Analysis

- Geochemical tests for selected trace, minor and major elements
- Dissolution techniques – aqua regia, 4-acid, water leach
- Analytical techniques – ICP-MS, radiometric, colourmetric, INAA, XRF

Other Tests

- Particle size; LOI; Bulk density
- Carbon – organic and inorganic
- CEC
- Radiometric
- X-ray mineralogy;
- Bioaccessibility; Perchlorate





Tri-national Project Sampling in Mexico

Geochemical Soil Baselines Mexican Project

Directed by SGM, supported by INEGI and USALP*

personnel Involved

Chief Personnel: 2

Field Personnel: 3

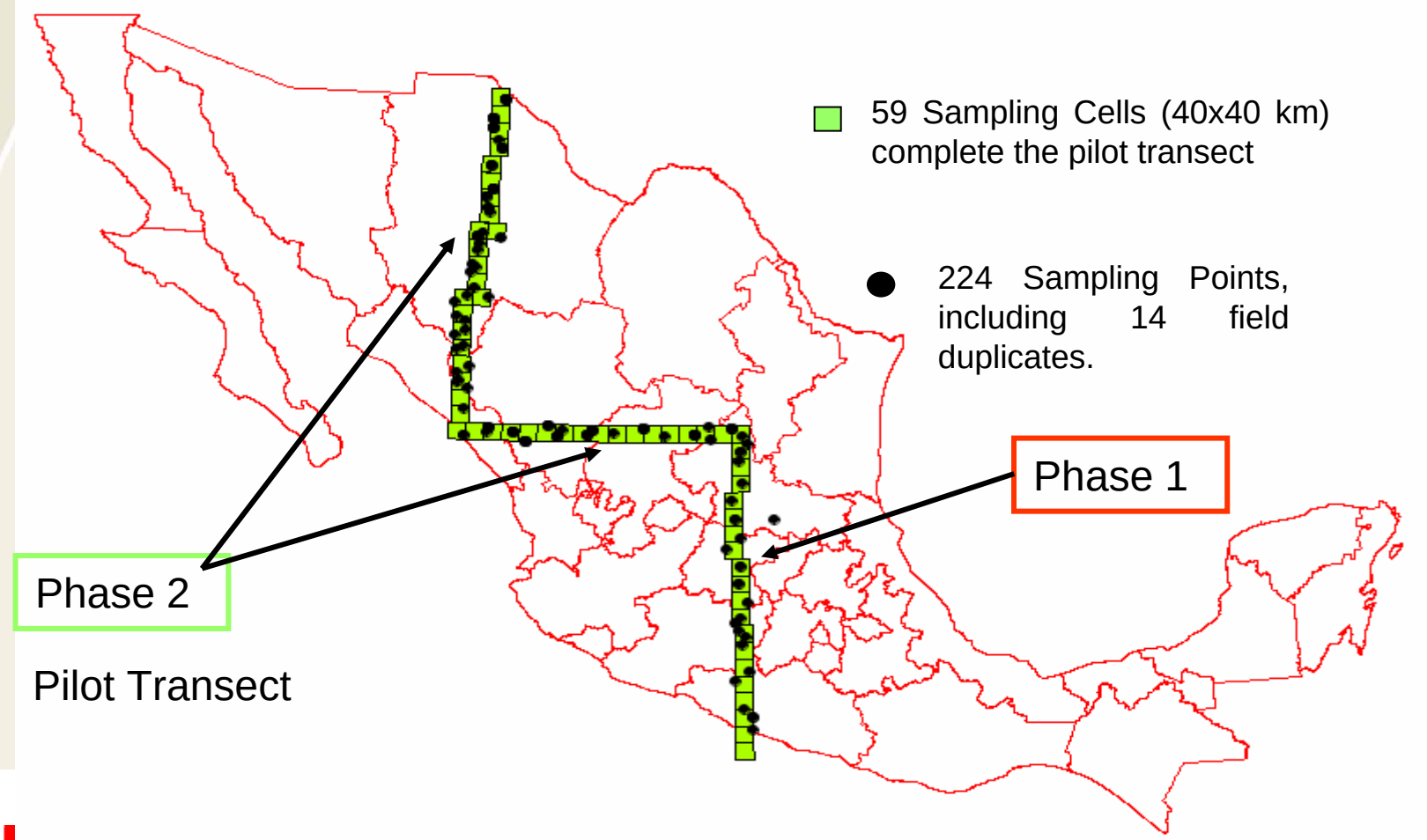
Assessment Personnel: 2

Assessment Personnel: 2

*University of San Luis Potosí

Tri-national Project Sampling in Mexico

Out of the pilot transect, 59 chemical elements have been analyzed in A- and C-horizons. All data were processed and stored.



Tri-national Project in Mexico

Analytical methods applied:

1) Near-total Digestion

2) Elemental Chemical Analysis by ICP-MS and Atomic Absorption.

Analysis have been done until now in ALS Chemex Labs in order to achieve quality and accuracy of results.

IA	IIA	III B	IV B	VB	VI B	VII B		VIII B		IB	IIB	III A	IV A	VA	VI A	VII A	O
Li	Be											B					
Na	Mg											Al		P	S		
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se		
Rb	Sr	Y	Zr	Nb	Mo					Ag	Cd	In	Sn	Sb	Te		
Cs	Ba	La	Hf	Ta	W	Re					Hg	Tl	Pb	Bi			

Ce													
Th		U											

Elementos de interés ambiental y de salud

En azul, elementos esenciales para la mayoría de los organismos

En rojo, elementos considerados tóxicos aún a bajas concentraciones

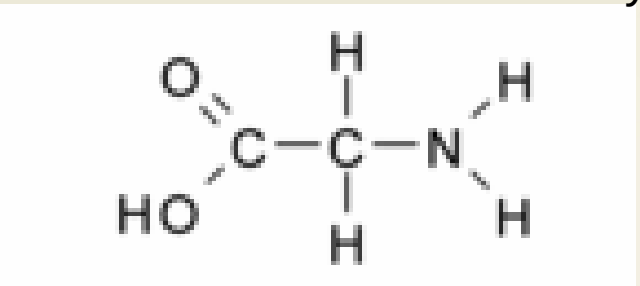
Tri-national Project in Mexico

Proposed chemical tests:

1) Bioaccesibility
2) Mobility

Bioaccesibility procedure is based on NOM-147-SEMARNAT-SSA1-2004 Mexican Official Standard.

The test is an *in vitro* method that uses glycine as gastric solution, 0.4M, buffered at stomach pH in order to assess bioaccesibility of potentially toxic elements (e.g., heavy metals) as an indicator of bioavailability.

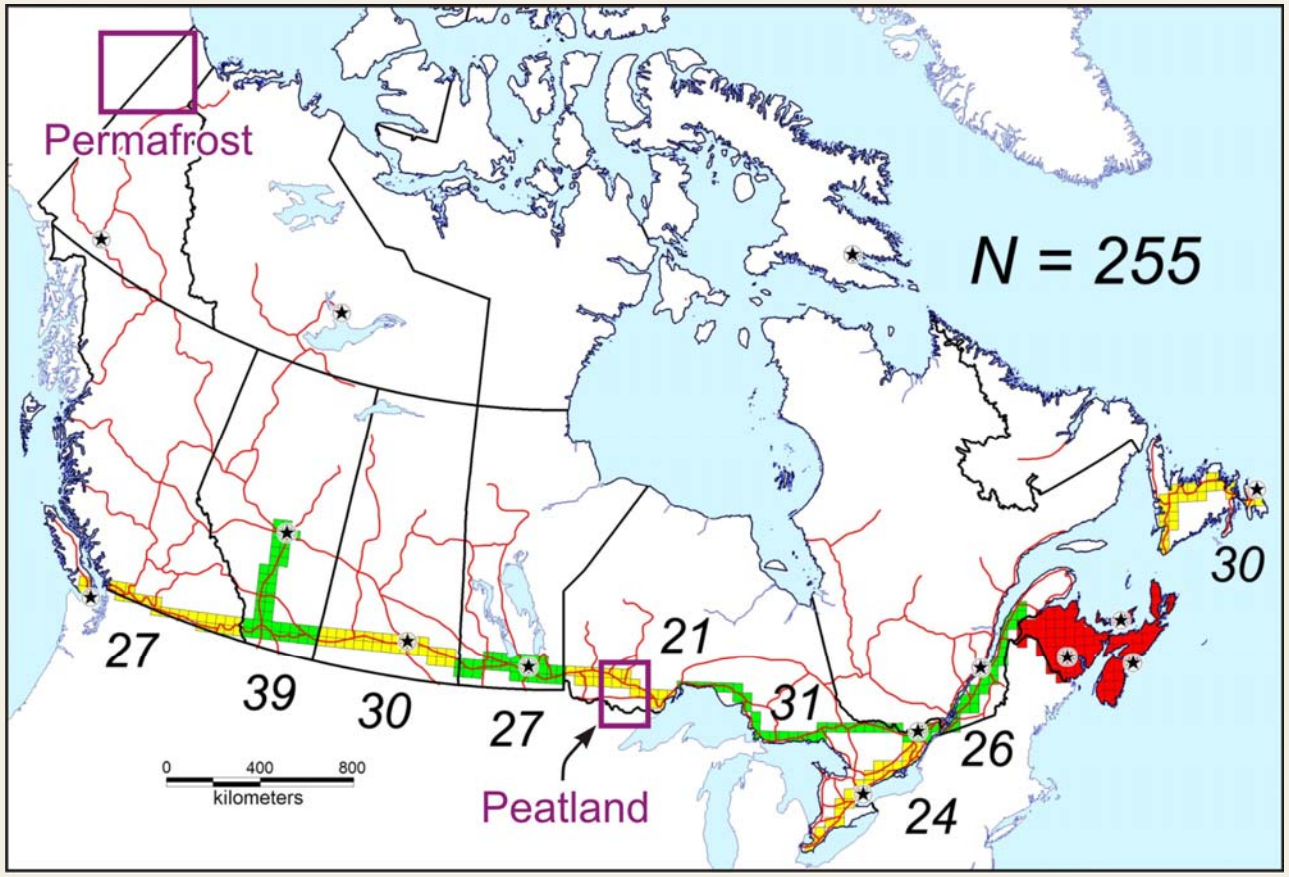


North American Soil Geochemical Landscapes Project

- Moving Forward in 2008

North American Soil Geochemical Landscapes Project

- Plans for 2008 and beyond



North American Soil Geochemical Landscapes Project

- **Important Dates/Plans for 2008-2009.**
  - Workshop 2- Results and identify partnerships-
    - GSC priorities- for field work
    - Provincial initiatives- for field work
    - Other government department (OGD) support
    - Add on evaluation tests
  - Circulate summer plans- middle of March?
  - Undertake Field work – 400 samples ??
  - Protocol Development: Field and Laboratory
    - Radon testing
    - Permafrost sampling protocol
    - Peatland sampling protocol
  - Data and applications release of 2007 data
  - Special Session at Geological Society of America/Soil Science Society of America in Houston October 5-8, 2009

TRI-NATIONAL PROJECT
A Learning Experience

New Brunswick

Southern Ontario

Northwest Territories

Nova Scotia

TRI-NATIONAL PROJECT
A Learning Experience

New Brunswick

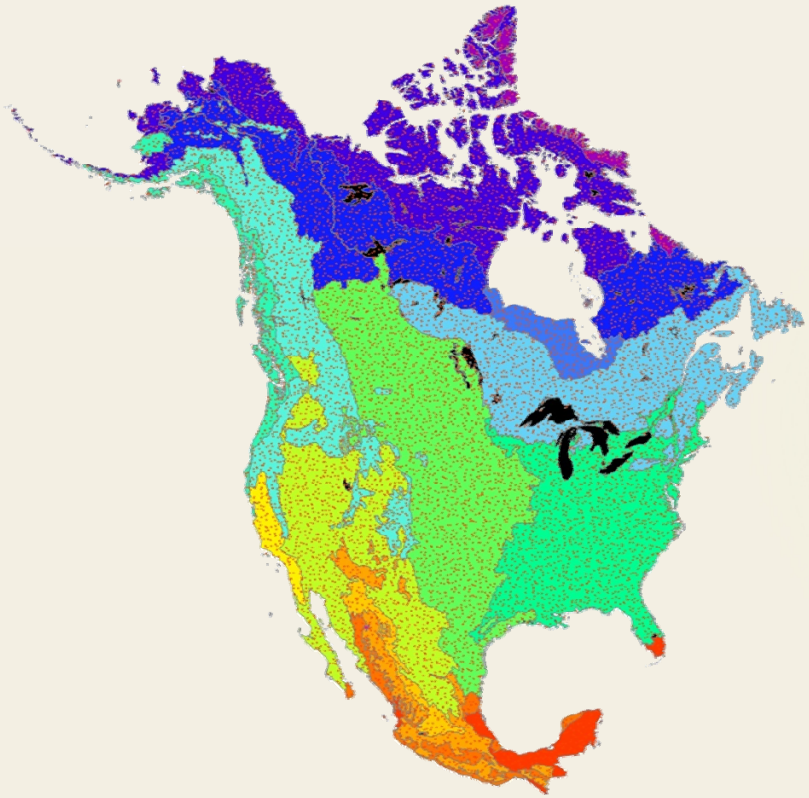
New Brunswick

Nova Scotia

Mexico City

Nova Scotia

TRI-NATIONAL PROJECT



Thank you for your Interest

Questions?

References Cited

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2000: Aerial gamma-ray surveys of the conterminous United States and Alaska: U.S. Geological Survey Open-File Report 99-562, 13 CD-ROMs.

Shacklette, H.T. and Boerngen, J.G.

1984: Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States. United States Geological Survey Professional Paper 1270.