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The North American Soil Geochemical Landscapes Project: History, objectives, accomplishments

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U.S. Department of the Interior
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Outline

- Goals of NASGLP
- History of NASGLP
- Status of existing *national-scale* soil geochemical data for US
- Pilot studies
- Progress and future of NASGLP

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The mission of the NASGLP is to:

- Produce a soil geochemical data base, and its representation in map form, for the continent of North America (21 million km^2)
- Interpret observed geochemical patterns in terms of process
- Establish an archive of soil samples for use by future investigators

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Customer base for NASGLP

- Anyone interested in “background” ranges of elements in soil
  - Risk-based assessment of contaminated land
  - Establishing soil cleanup or action levels (regional or national scale)
  - Soil pathways for chronic or acute exposure to toxic elements
  - Soil-borne pathogens (anthrax)

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NASGLP Timeline

- 2001: Directors of SGM, GSC, USGS identify soil geochemistry as subject of mutual concern
- 4 workshops held (2002, 2003, 2004, 2006)
- 2004-2006 Pilot phase in Canada and US
- 2006-2007 Pilot phase in Mexico
- 2007 Sampling begins for full continental-scale survey

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“Documenting and understanding natural variability is a vexing topic in almost every environmental problem: How do we recognize and understand changes in natural systems if we don’t understand the range of baseline levels?”

Zoback, GSA Today, December 2001

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USGS National-Scale Soil Data (Shacklette Data)

- 1,323 samples (1 per 6,000 sq. km.) collected from areas with native vegetation
- Collected from 1960s to late 1970s
- 40+ elements analyzed
- Still the most-often-quoted data for “background” values of trace elements in soil

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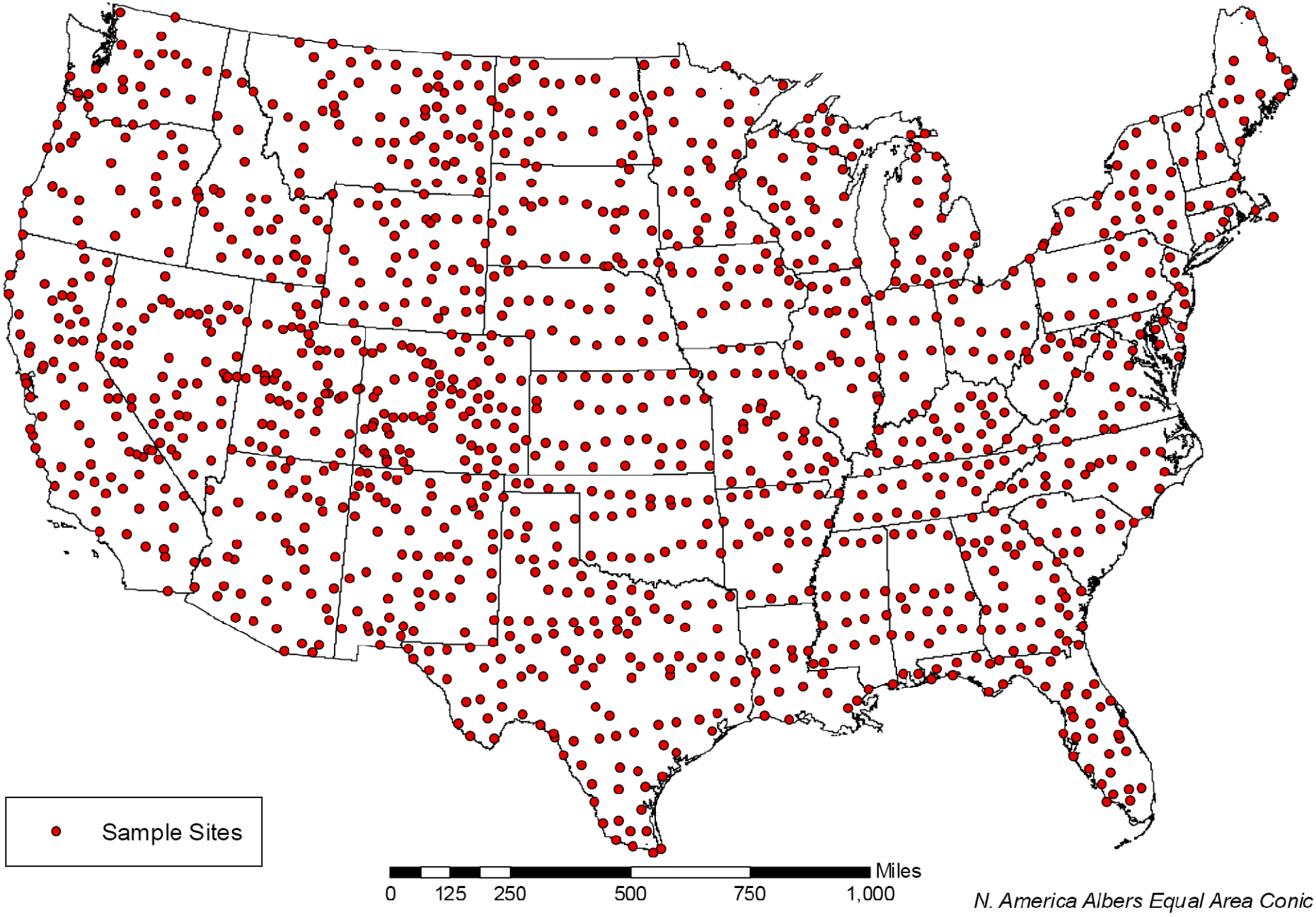
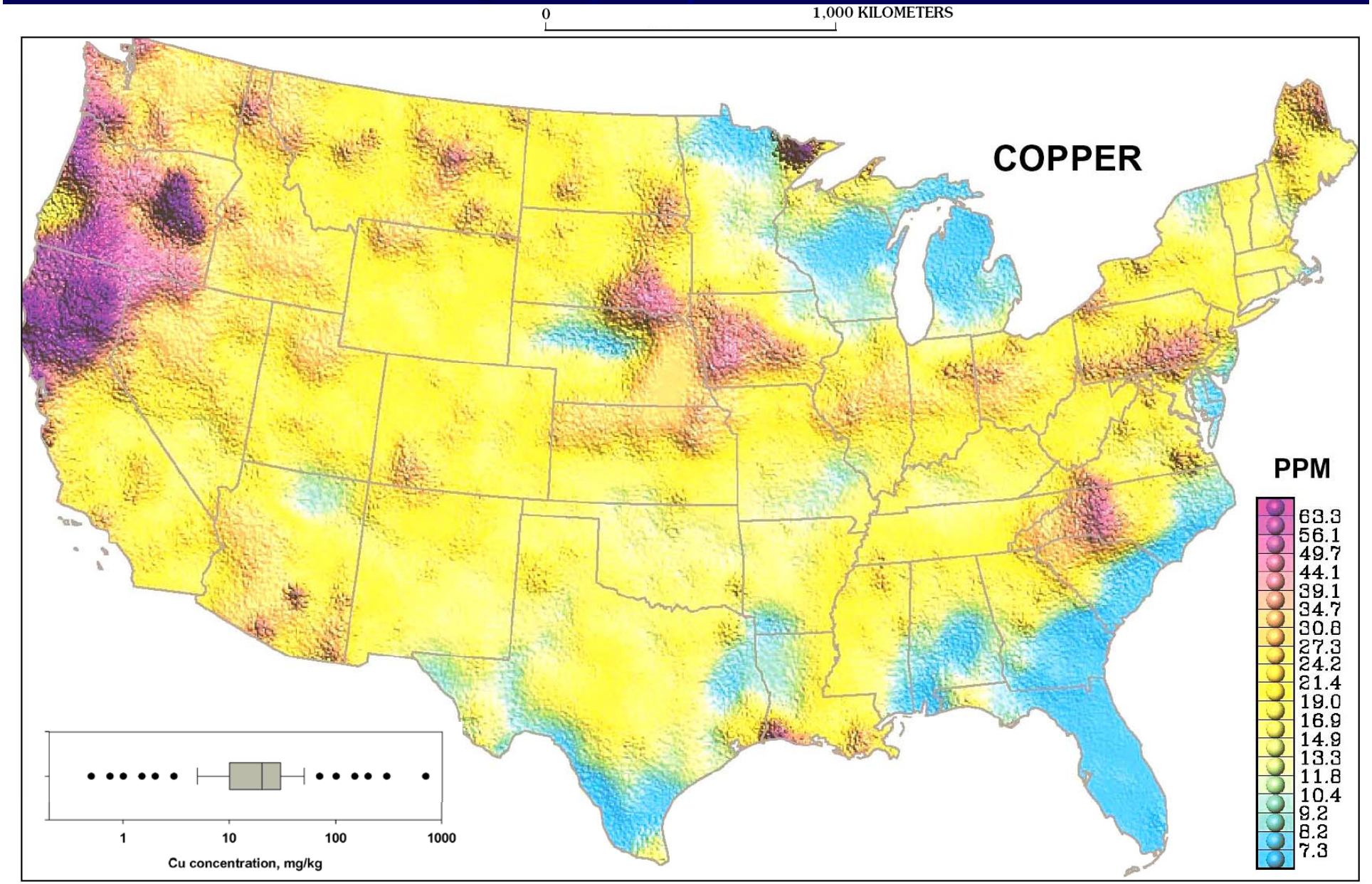
Shacklette sample sites




0
1,000 KILOMETERS
COPPER
PPM
63.3
56.1
49.7
44.1
39.1
34.7
30.8
27.3
24.2
21.4
19.0
16.9
14.9
13.3
11.8
10.4
9.2
8.2
7.3
1
10
100
1000
Cu concentration, mg/kg

Pilot Studies 2004-2006

- Continental-scale pilot study
  - Two transects, samples collected at ~40 km spacing; test sampling and analytical protocols, field logistics
- Regional-scale pilot study
  - Northern California
  - Designed to represent a more detailed follow-up investigation of area of interest identified from low-density continental-scale data

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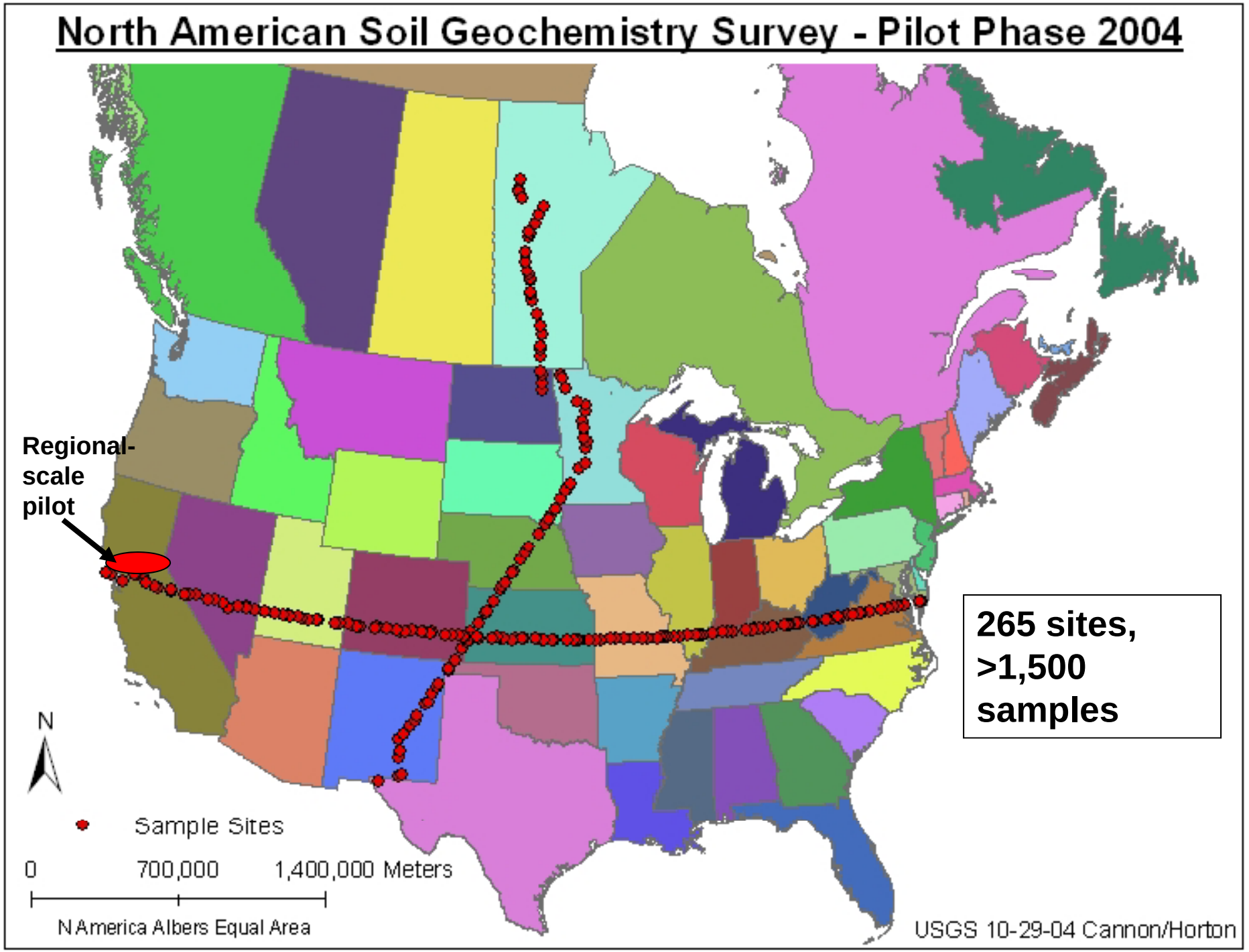
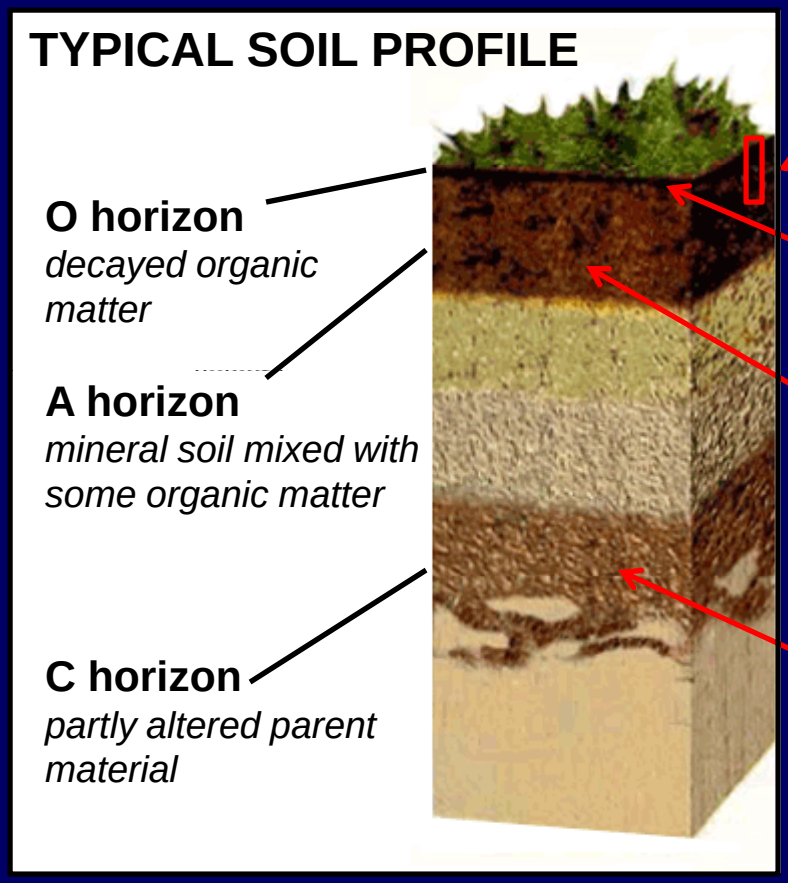

North American Soil Geochemistry Survey - Pilot Phase 2004
Regional-scale pilot
265 sites, >1,500 samples
N
Sample Sites
0
700,000
1,400,000 Meters
NAmerica Albers Equal Area
USGS 10-29-04 Cannon/Horton


Expedia
Continuation of transects into Mexico
Tucson
NEW MEXICO
El Paso
Abilene
Dallas
ARKANSAS
Monroe
Montgomery
Natchitoches
Jackson
ALABAMA
Waco
GREAT PLAINS
UNITED STATES
LA
Baton Rouge
Mobile
Nogales
Cananea
Nuevo Casas Grandes
Austin
30°
SONORA
Lafayette
New Orleans
Hermosillo
CHIHUAHUA
San Antonio
Houston
Guaymas
Ciudad Obregón
Chihuahua
Piedras Negras
TEXAS
Laredo
Corpus Christi
Monclova
Los Mochis
Reynosa
Matamoros
Torreón
25°
Guamúchil
DURANGO
Saltillo
Monterrey
Culiacán
Durango
Gulf of Mexico
La Paz
Tropic of Cancer
Ciudad Victoria
Mazatlán
Zacatecas
San Luis Potosí
Tepic
Mérida
Poza Rica
20°
Guadalajara
Jalapa
Campeche
Morelia
Colima
MEXICO
Mexico City
Veracruz
Villahermosa
Chetumal
OAXACA
GUERRERO
BELIZE
La Ceiba
Oaxaca
Acapulco
Tuxtla Gutiérrez
15°
GUATEMALA
Tegucigalpa
Quetzaltenango
PACIFIC OCEAN
EL SALVADOR
León
© 2000 Microsoft Corp and/or its suppliers.
105°
100°
95°
90°

Samples collected from each site



1: 0 to 5 cm depth (265 samples) – regardless of horizon

2: O horizon (38 samples)

3: A horizon (244 samples)

4: C horizon or closest approximation (258 samples)

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Sample Analysis

- Near-total extraction for major and trace elements (ICPMS/ICPAES) – USGS
- Forms of carbon, total sulfur - USGS
- Water extraction (A horizon) – GSC
- Gastric fluid and lung fluid extraction (0-5 cm) – USGS
- Gamma-ray spectrometry – GSC
- Phospholipid fatty acid analysis – UC Davis
- Enzyme assays – Oregon State University

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Sample analysis (continued)

- BioLog community profiling – USGS
- Human and agricultural pathogen screening – USGS
- Quantitative XRD (A and C horizon) – USGS
- Screen for 22 organochlorine pesticides – contract laboratory

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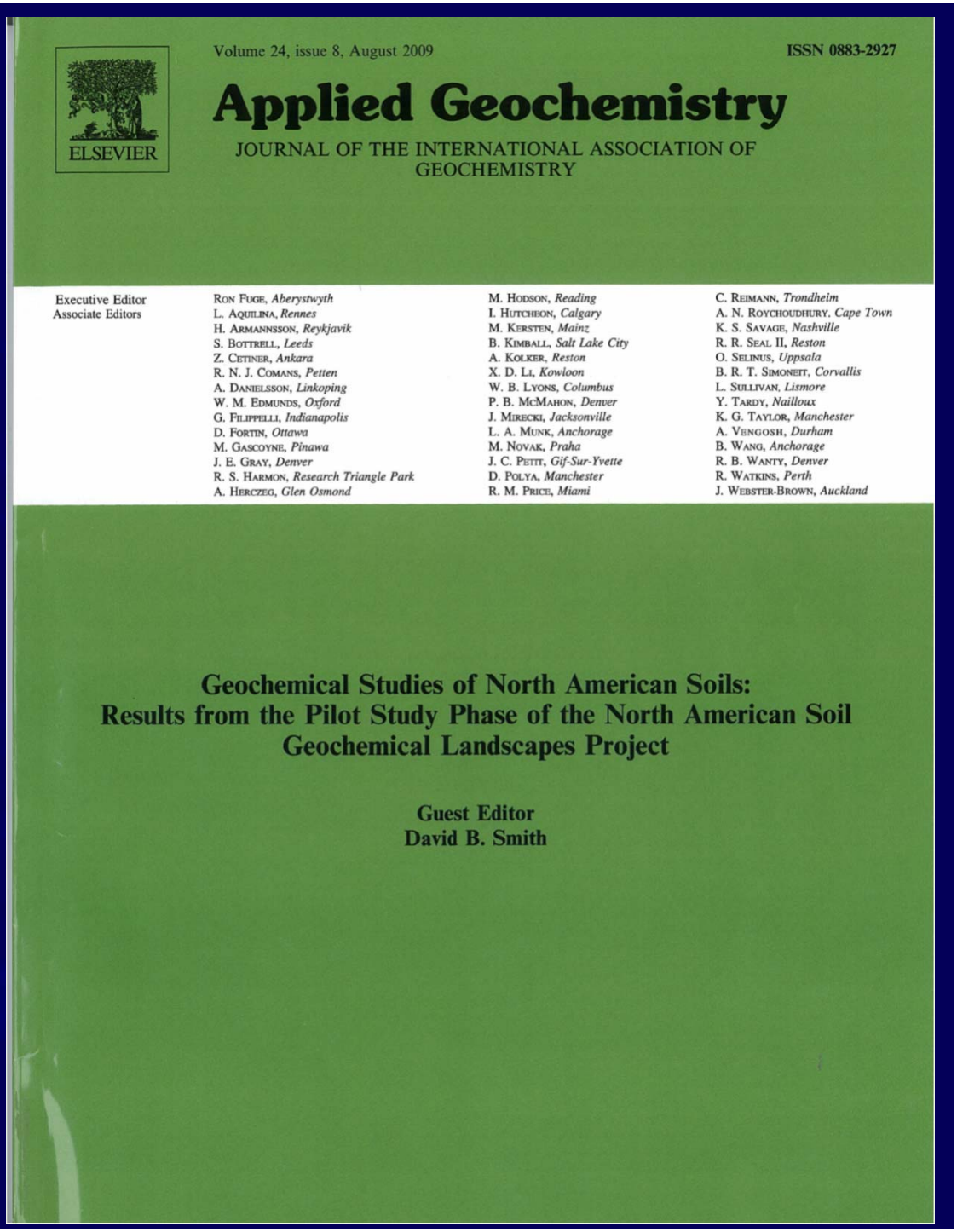
Results from pilot phase published as special issue of *Applied Geochemistry* (Vol. 24, Issue 8, August 2009)



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Geochemical Studies of North American Soils: Results from the Pilot Study Phase of the North American Soil Geochemical Landscapes Project

Guest Editor
David B. Smith

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Sample design

- Generalized Random Tessellation Stratified (GRTS) design
- 13,323 sites for North America (about 1 per 1,600 km^2)
  - US = 5,813; Canada = 6,183; Mexico = 1,327

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Sample types collected at each site for NASGLP

- 0-5 cm
  - Separate sample for anthrax
- A horizon
- C horizon or closest approximation

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Revised sample analysis

- Near-total extraction for major and trace elements (ICPMS/ICPAES/AA)
- Total carbon, carbonate carbon (organic carbon by difference)
- Presence or absence of *Bacillus anthracis* (anthrax)
- Quantitative XRD

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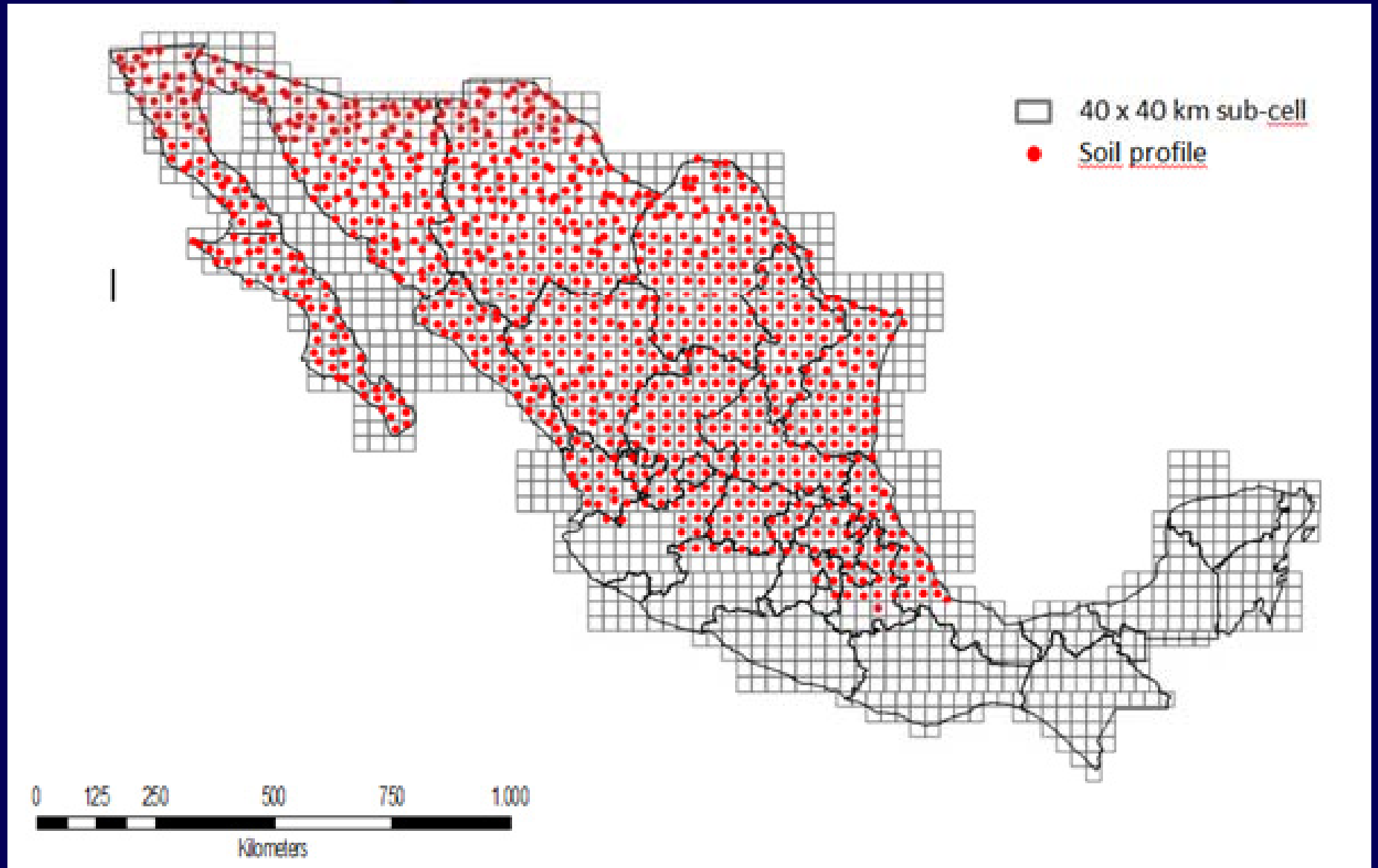
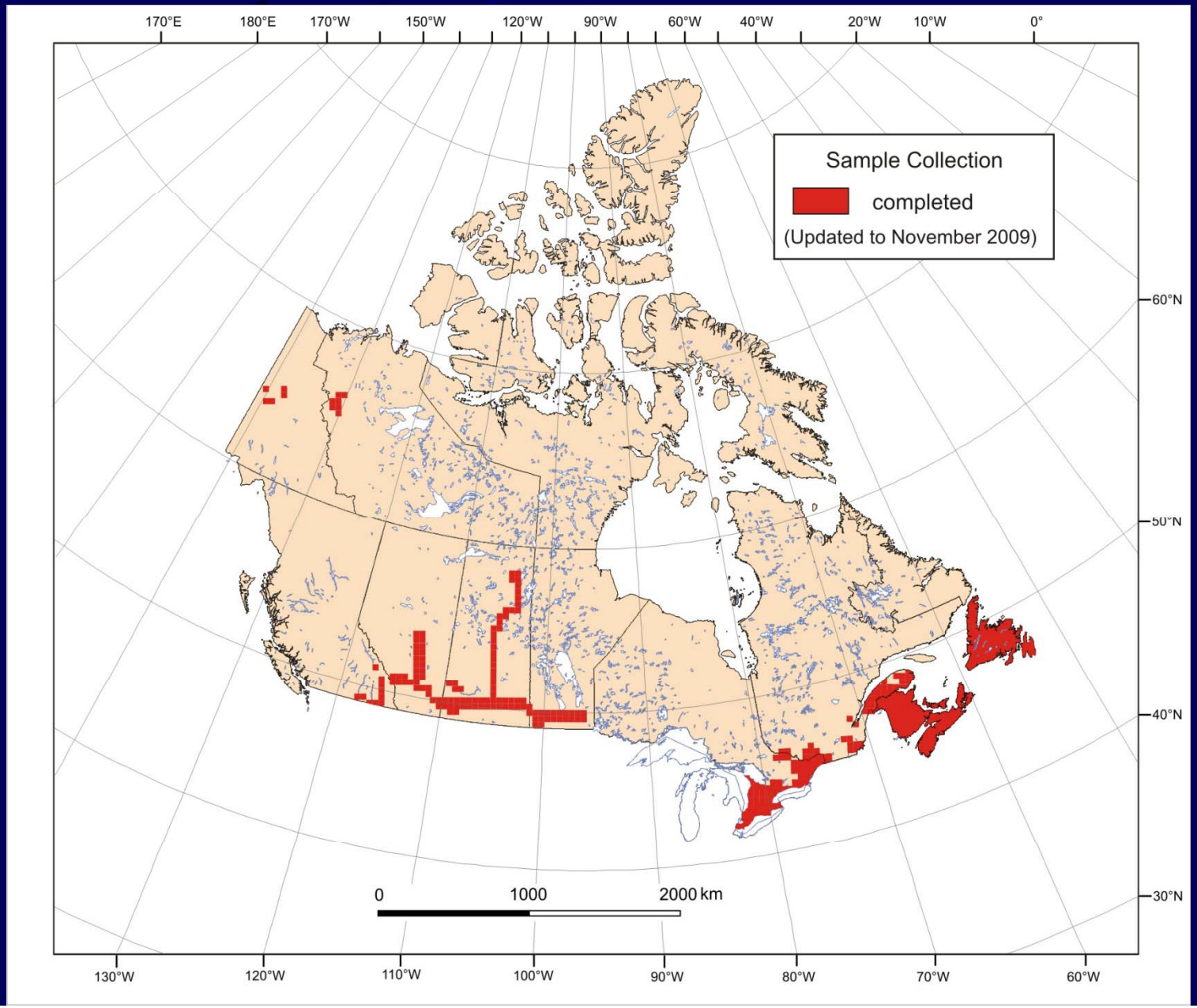
c. 4,800 sites sampled from 2007-2010

Data to be available via USGS web site

871 sites sampled in Mexico (66% of total)



472 sites sampled in Canada (7.6% of total)



Samples archived in glass jars

>14,000 samples; ~70 pallets

Pathogenic bacteria in North American soil: A joint USGS-EPA survey

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EPA needs background levels of naturally occurring high-priority biothreat agents within U.S. soils to establish appropriate cleanup levels if these agents should be used in an intentional contamination event.

- ***Bacillus anthracis*** **(anthrax)—all 0-5 cm samples**
- ***Yersinia pestis*** **(plague)—2,000 samples**
- ***Fransicella tularensis*** **(tularemia or rabbit fever)—2,000 samples**

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Thank you for your attention.

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