Arsenic and Landfills: Protecting Water Quality

Session VI. Old Landfills and Waste Sites

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General Questions

What do we know?

What do we not know?

Who knows – and needs to know – what?

Where do we go from here?

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Specific and synthesis questions

1. How prevalent is arsenic contamination in the groundwater down-gradient of old, unlined landfills?
2. How arsenic contaminations at waste sites compare to arsenic contaminations down-gradient of old landfills? Do they share any field and/or chemical characteristics?
3. Is there any evidence that might suggest that some arsenic contamination at old landfills may originate from within the landfills?
4. What is the arsenic content of iron floc deposits commonly observed down-gradient of unlined landfills and what risks do iron flocs pose?

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Specific and synthesis questions (cont'd)

5. By comparing analytical data from sampling of leachate collection systems to data from leachate-impacted groundwater what can we deduce about relative impacts of landfilled arsenic wastes *vs* naturally occurring arsenic mobilized by leachate?
6. What experience do we have with respect to arsenic as a contaminant of concern at C&D debris landfills or in C&D debris that is proposed for beneficial uses?
7. Laboratory forward experiments/tests vs inverse problem solutions of data from old landfills.

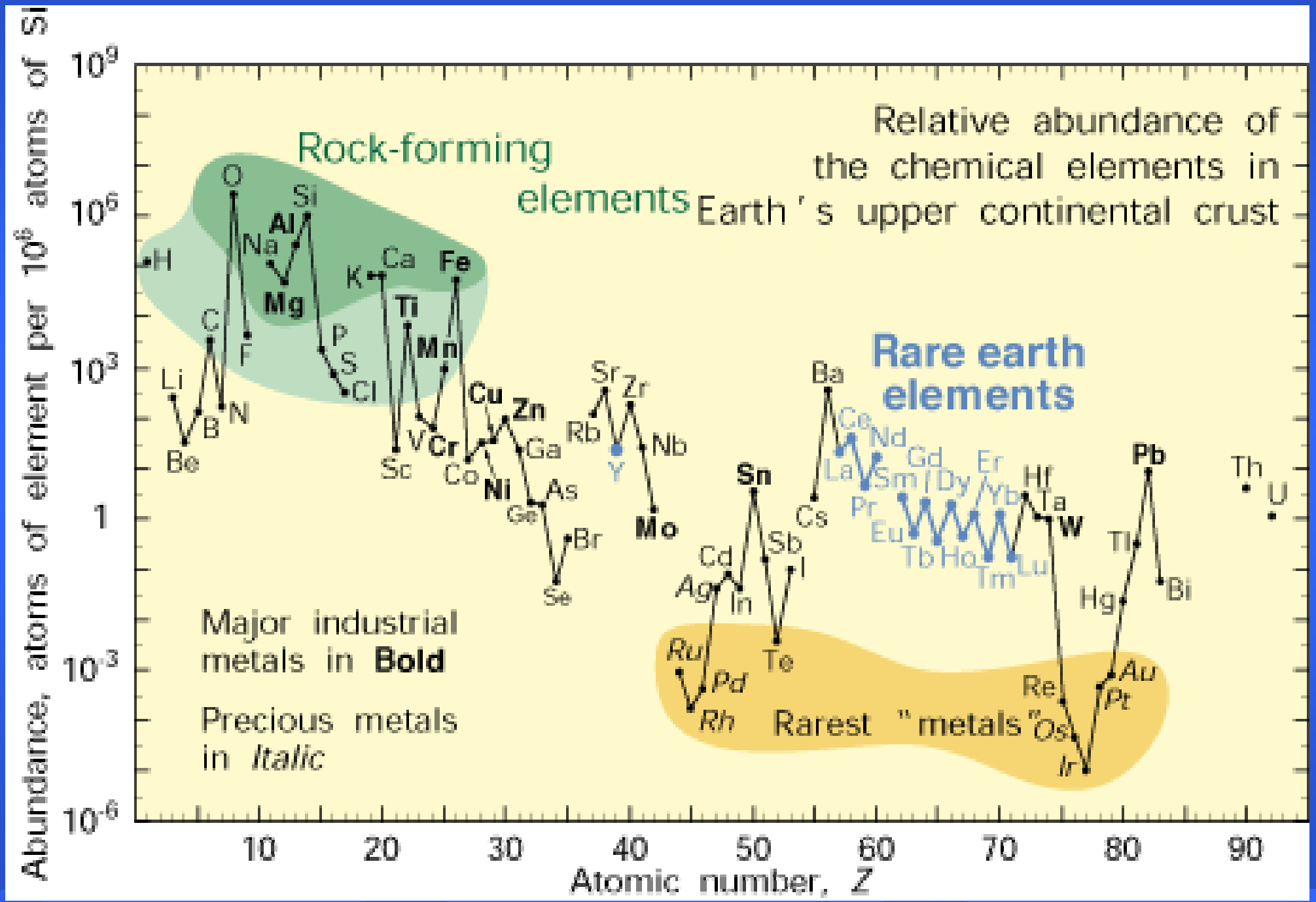
Chemical Composition of Human Body
70-kg person

Element	Mass	Element	Mass
Oxygen	43 kg	Rubidium	0.68 g
Carbon	16 kg	Strontium	0.32 g
Hydrogen	7 kg	Bromine	0.26 g
Nitrogen	1.8 kg	Lead	0.12 g
Calcium	1.0 kg	Copper	72 mg
Phosphorus	780 g	Aluminum	60 mg
Potassium	140 g	Cadmium	50 mg
Sulfur	140 g	Cerium	40 mg
Sodium	100 g	Barium	22 mg
Chlorine	95 g	Iodine	20 mg
Magnesium	19 g	Tin	20 mg
Iron	4.2 g	Titanium	20 mg
Fluorine	2.6 g	Boron	18 mg
Zinc	2.3 g	Nickel	15 mg
Silicon	1.0 g	Selenium	15 mg

Chemical Composition of Human Body

70-kg person

Element	Mass	Element	Mass
Chromium	14 mg	Tellurium	0.7 mg
Manganese	12 mg	Yttrium	0.6 mg
Arsenic	7 mg	Bismuth	0.5 mg
Lithium	7 mg	Thallium	0.5 mg
Cesium	6 mg	Indium	0.4 mg
Mercury	6 mg	Gold	0.2 mg
Germanium	5 mg	Scandium	0.2 mg
Molybdenum	5 mg	Tantalum	0.2 mg
Cobalt	3 mg	Vanadium	0.11 mg
Antimony	2 mg	Thorium	0.1 mg
Silver	2 mg	Uranium	0.1 mg
Niobium	1.5 mg	Samarium	50 µg
Zirconium	1 mg	Beryllium	36 µg
Lanthanium	0.8 mg	Tungsten	20 µg
Gallium	0.7 mg		


Relative abundance of the chemical elements in Earth's upper continental crust
Rock-forming elements
Rare earth elements
Major industrial metals in Bold
Precious metals in Italic
Rarest "metals"
Abundance, atoms of element per 10^6 atoms of Si
Atomic number, Z
10^9
10^6
10^3
1
10^-3
10^-6
10
20
30
40
50
60
70
80
90
H
Li
Be
B
C
N
O
F
Na
Mg
Al
Si
P
S
Cl
K
Ca
Sc
Ti
V
Cr
Mn
Fe
Co
Ni
Cu
Zn
Ga
Ge
As
Se
Br
Rb
Sr
Y
Zr
Nb
Mo
Ru
Rh
Pd
Ag
Cd
In
Sn
Sb
Te
I
Cs
Ba
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
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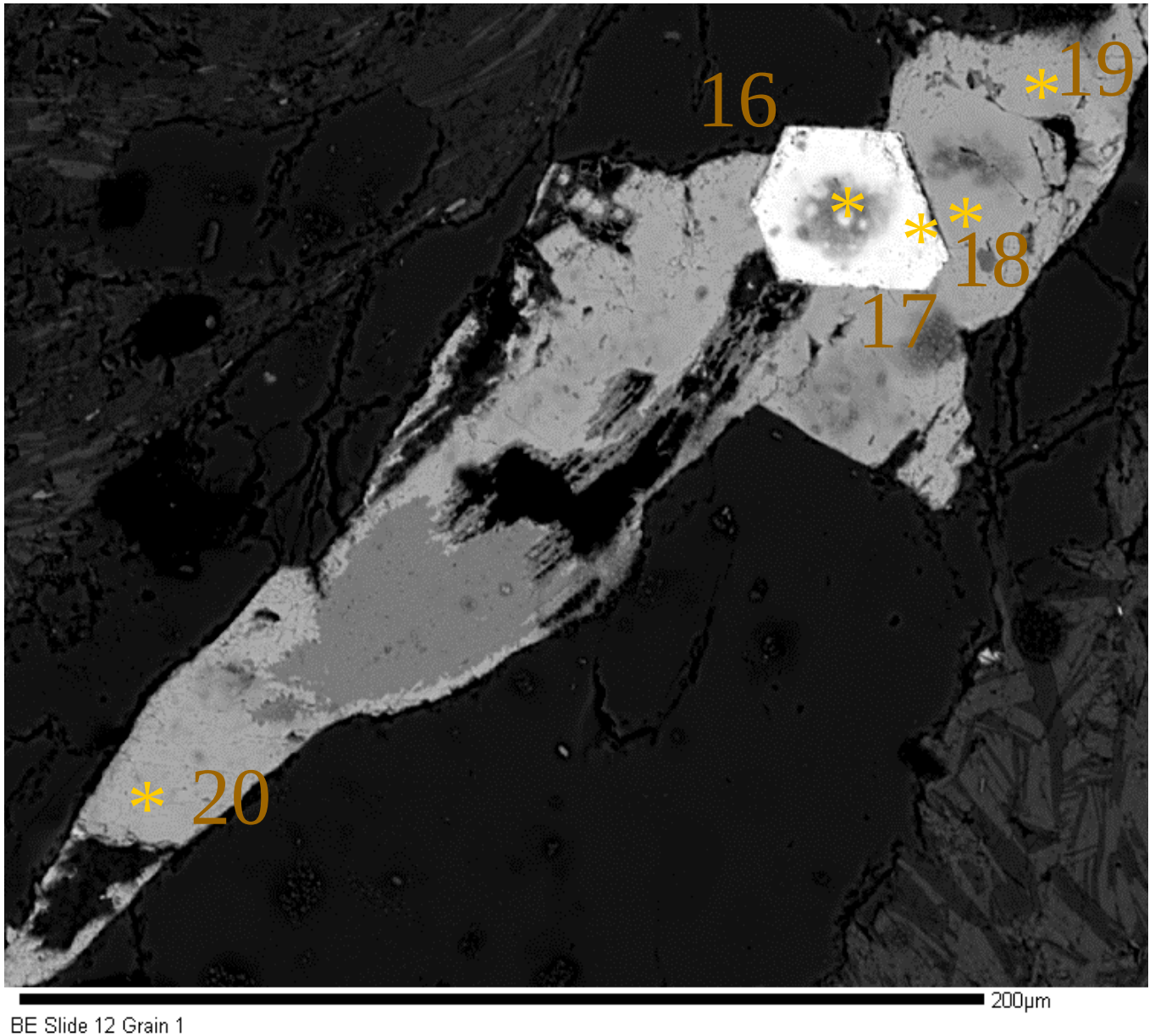
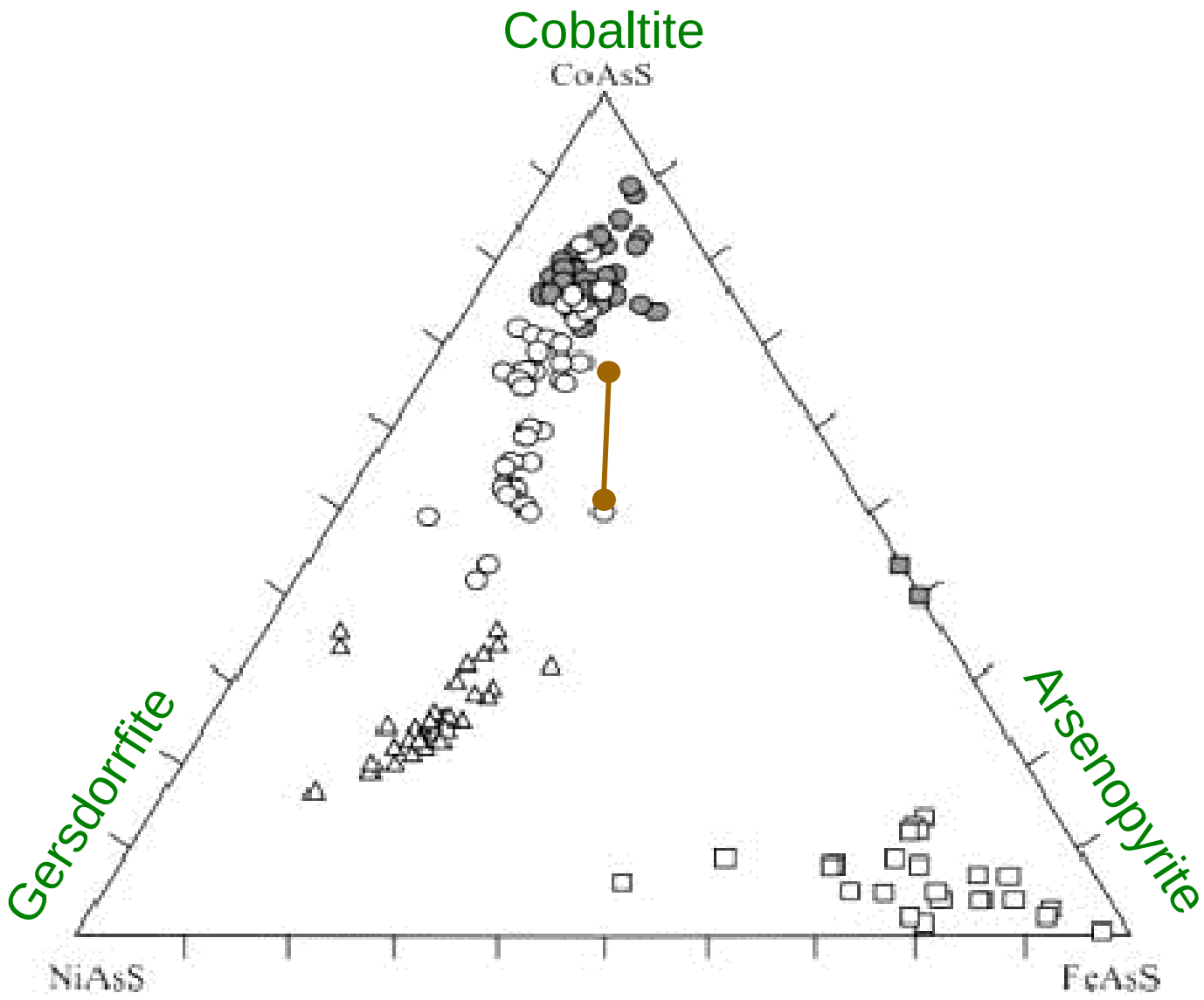
Tl
Pb
Bi
Th
U

Spot Analysis - Grain 12/1



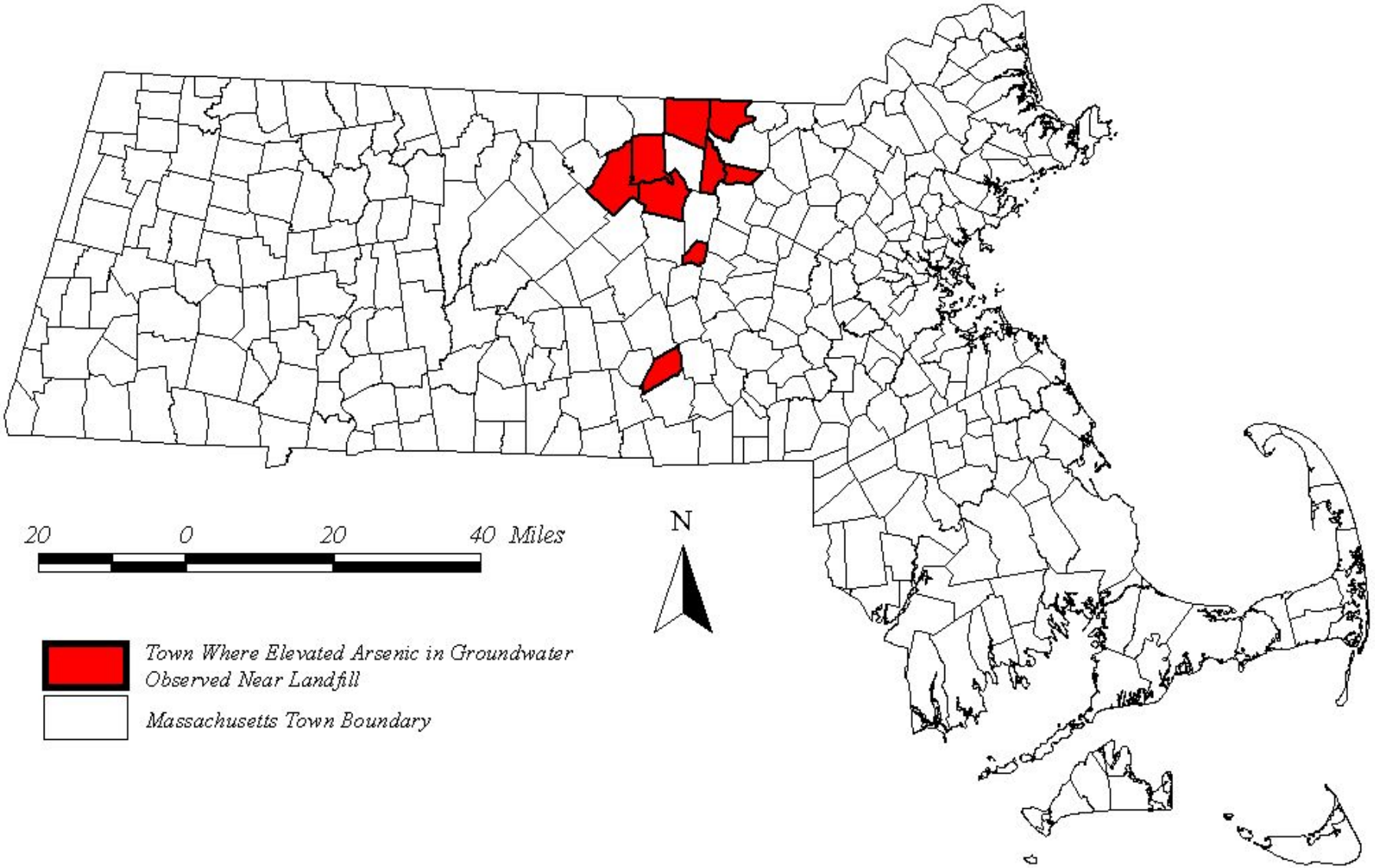


Background diagram reference: Melekestseva, Zaykov, Belogub, and Tesalina, (**2004**): Sulpharsenides and Arsenides in Massive Sulphide Deposits Connected with Ultramafites, South Urals; Applied Mineralogy, Pecchio et al. (eds) 2004 ICAM-BR, São Paulo.

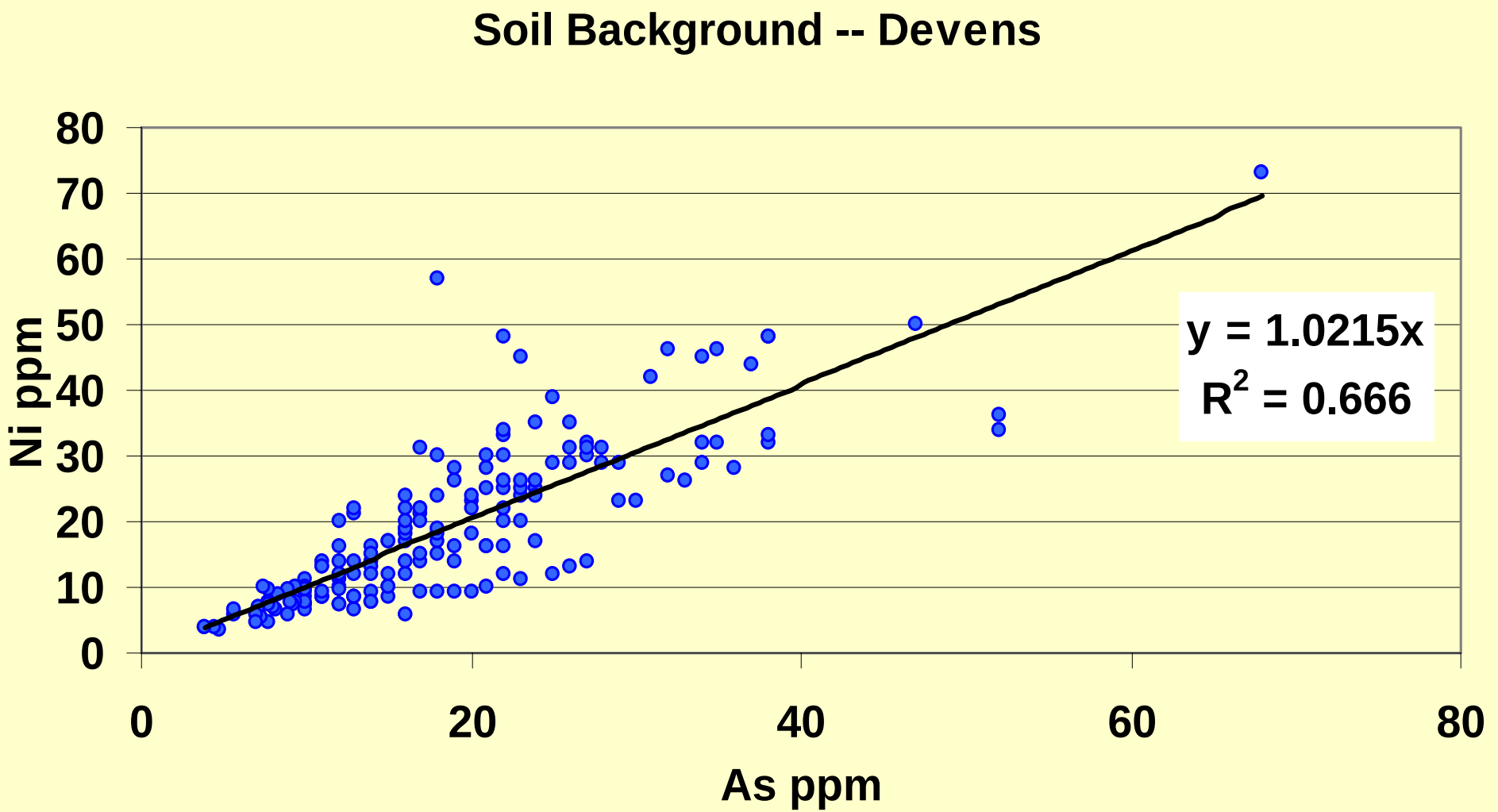
Cobaltite - Gersdorrfite
Solid Solution Range – Bedrock,
Central Massacusetts

Background diagram:
cobaltite - white circles
gersdorrfite - triangles
arsenopyrite - white blocks

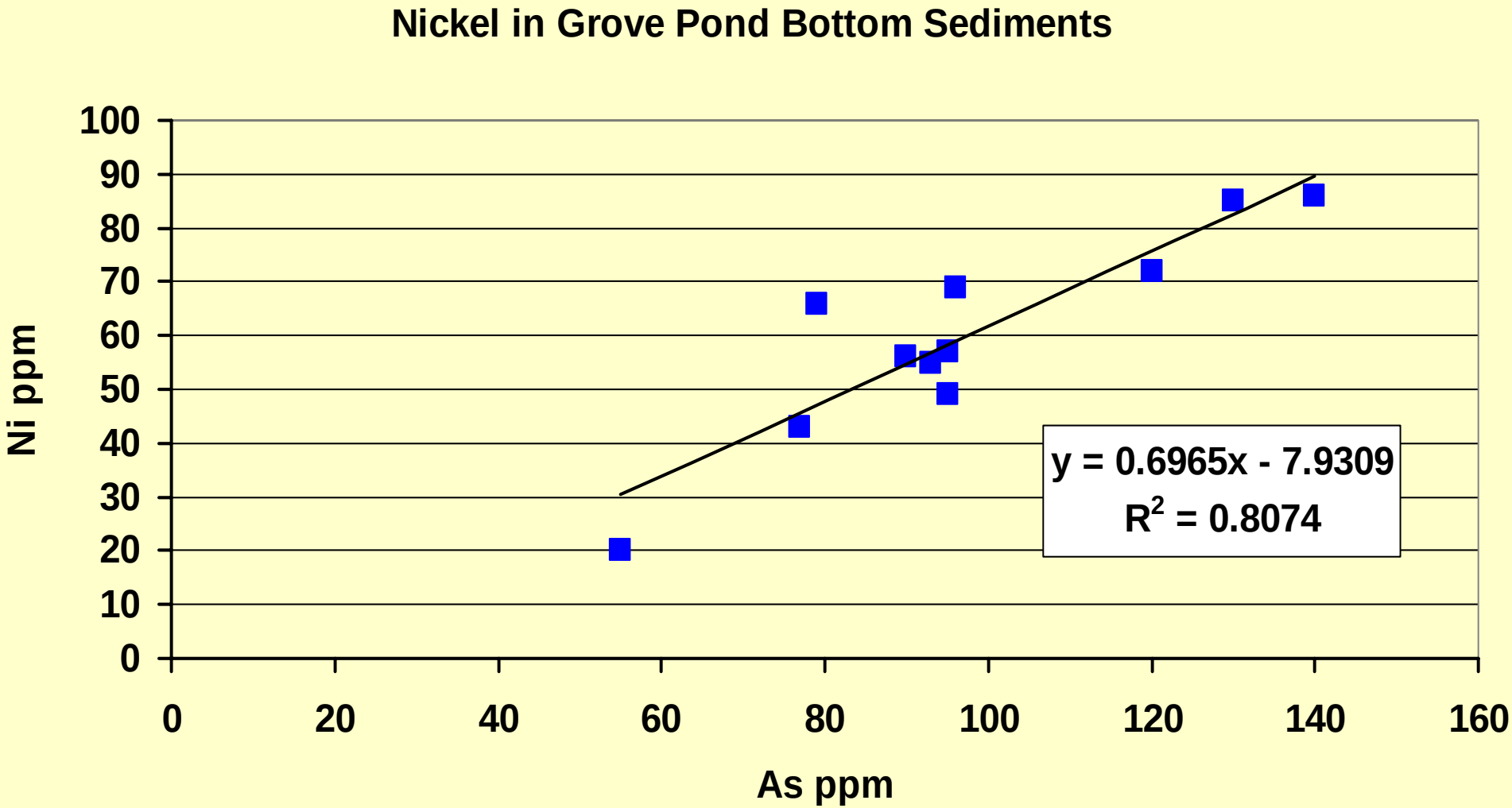
Towns in Massachusetts Where Elevated Arsenic in Groundwater has been Observed Near Landfills

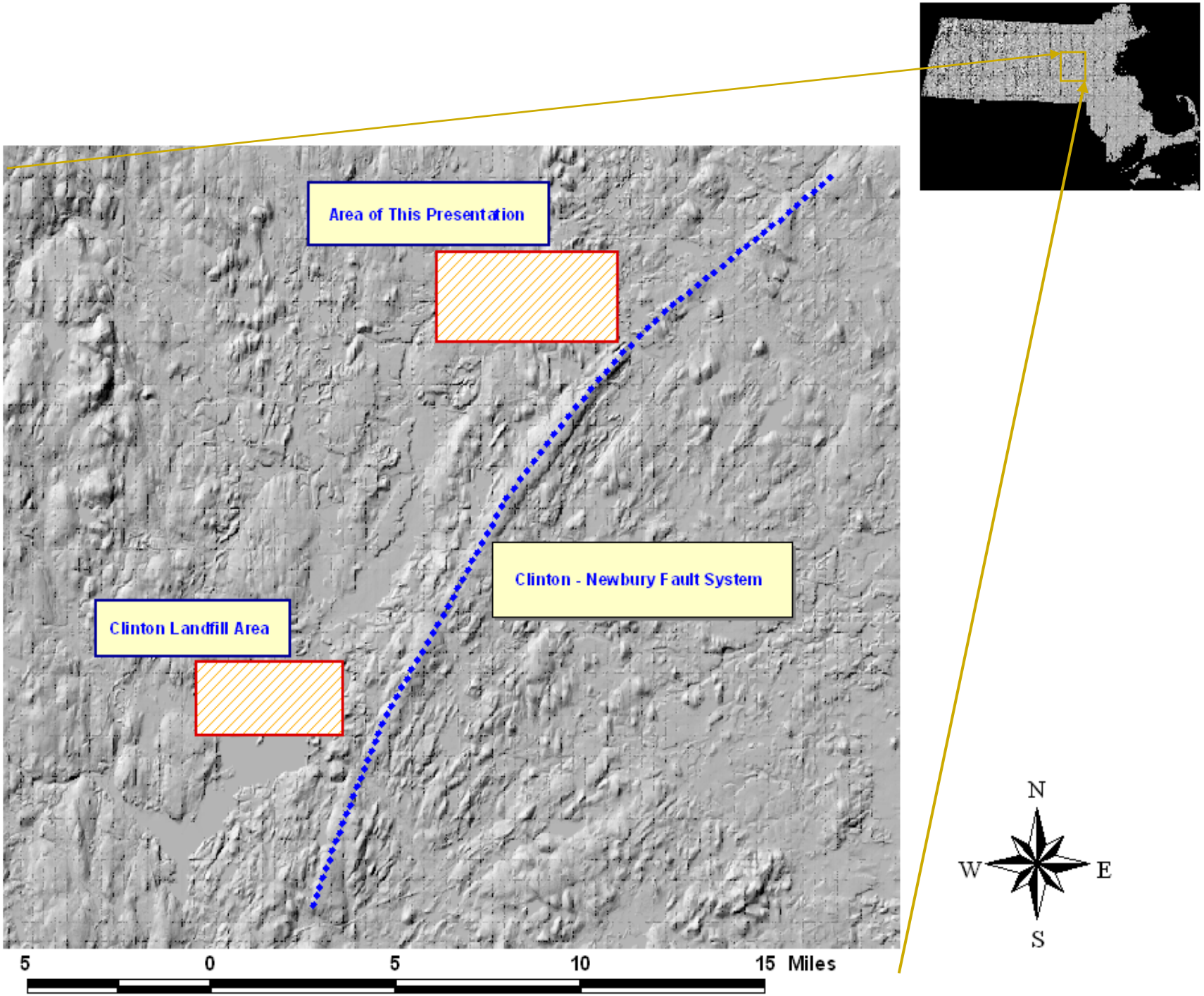


Nickel vs Arsenic in Soils -- Devens



Central Mass Bottom Sediments




Area of This Presentation
Clinton - Newbury Fault System
Clinton Landfill Area
5
0
5
10
15 Miles
N
W
E
S

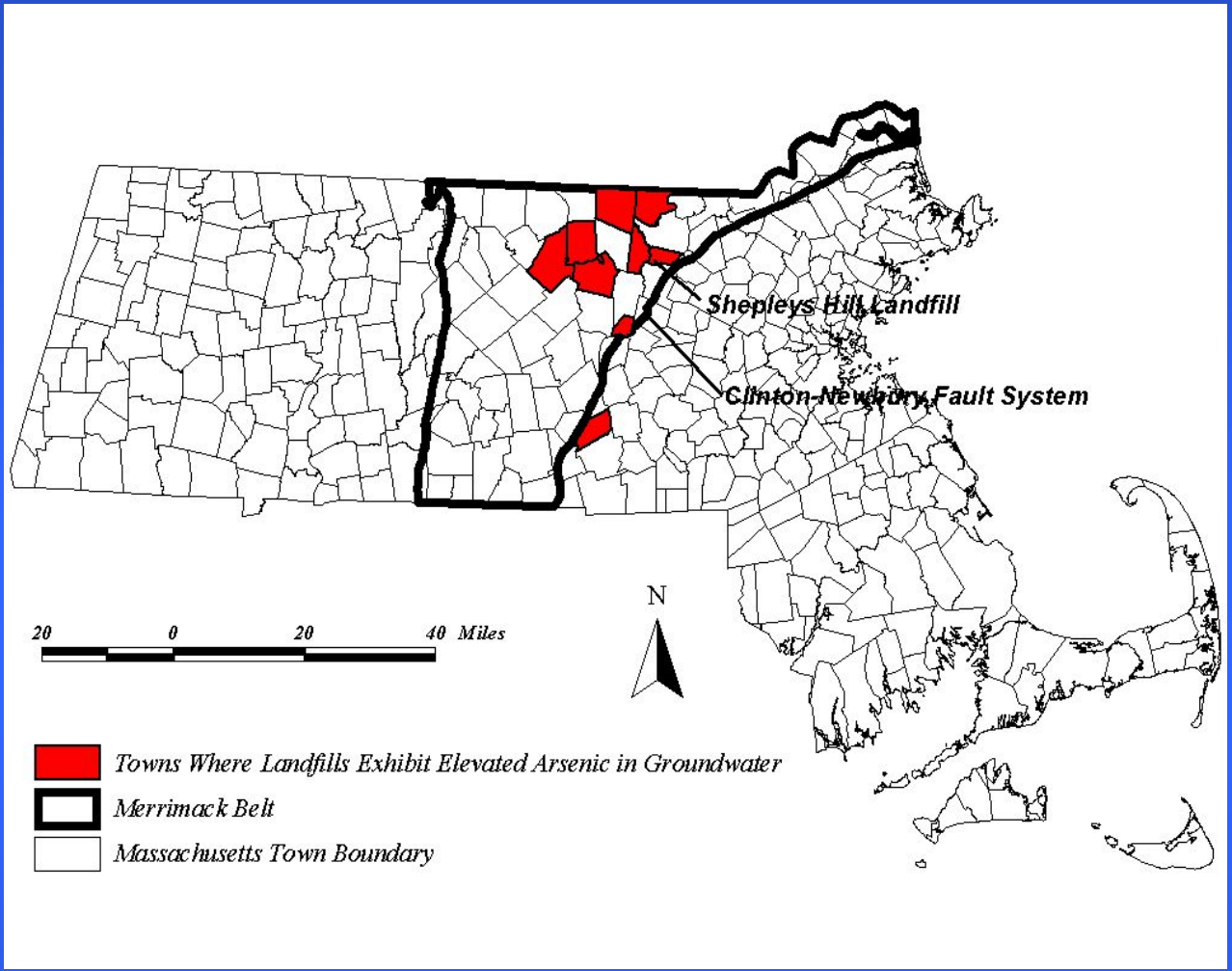


Figure 13: Map showing the extent of the Merrimack Belt, position of the Clinton-Newbury Fault System, and the location of the towns where elevated arsenic in groundwater has been observed near landfills.