PXRF
in NJ & NYC

xxxxx

Richard K Shaw
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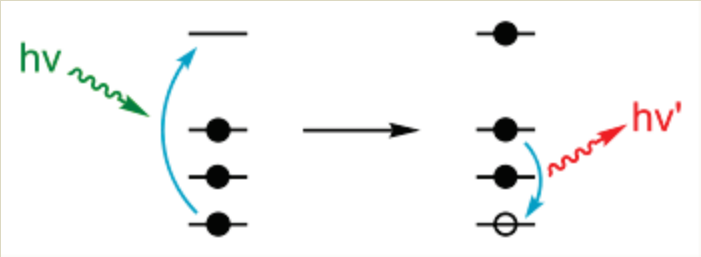
NRCS-NJ

X-ray fluorescence

Fluorescence - absorption of radiation of a specific energy results in the re-emission of radiation of a different energy (generally lower).



- **X-ray photons knock out inner orbital electrons**
- **Outer orbital electrons move into vacancy**
- **Fluorescence emitted at element-specific wavelength**

PXRF

- Portable X-ray fluorescence environmental analyzer

- Innov-X (Olympus) Delta Standard model
  - Good sensitivity
  - Highly recommended
  - Good customer service
  - No software needed

Limits of detection		NYSDEC SCO (Residential Use)
Rb, Sr, Zr, Mo	1 ppm	
As, Se, Br	1 to 3 ppm	16
Pb, Hg	2 to 4 ppm	400, 0.8
Zn, Mn, Ga	3 to 5 ppm	2200
Cu, Fe	5 to 7 ppm	270
Ag, Cd	6 to 8 ppm	2.5
Cr	5 to 10 ppm	
Ti, V	7 to 15 ppm	
Sn, Sb	12 to 15 ppm	
Co, Ni, Ba	10 to 20 ppm	140
Ca	20 to 30 ppm	
K	30 to 50 ppm	
S	100 to 250 ppm	
P	500 to 700 ppm	

Radiation Safety

Maximum exposure

< 1uSv* at the trigger ~ < 2mSv annually to the hand

(ICRP max to extremity = 50 mSv for gen. public)

100 uSv per dental X-ray

<u>10 seconds exposure to beam = 550 mSv</u>

***1 sievert = 100 rem = 5.5% chance of developing cancer**

Calibration/QA

- energy calibration check at least twice daily
- a blank (SiO_2) is run every 20 samples
- calibration verification with reference standards is run at least once daily
  - NIST ref materials → high & med trace metal soils
  - difference between PXRF measurements and the reference soils should $\leq$ 20%

Sources of error

- ✓ Non-homogenous sample
  - Sieve sample
  - Mortar & pestle (EPA method 6200)

- ✓ Soil moisture - dilution effect
  - Air dry sample

work station

Applications: Research Sample Analyses

- ✓ **Urbanization & adaptation in white-footed mice**
  Stephen Harris, CUNY PhD candidate

  Described in: ***Evolution Right Under Our Noses,*** NY Times, 7/25/11

- ✓ **Evaluation of some NYC Parks restoration efforts**
  Lea Johnson, Rutgers PhD candidate

Serpentine Soils in Staten Island

Sadou Ongoiba & Michael Ochieng, College of Staten Island

Wotalf loam
Lithic Eutrudept

- ✓1/3 S.I. = serpentinite bedrock; all glaciated
- ✓shallow & mod. deep series est.
- ✓How about deep soils?

Depth to Bedrock	Ni	Cr	Ca/Mg	pH	texture
<100 cm	146 to1941	75 to 2133	0.1 to 0.5	7.0 to 8.0	loam
>100 cm	81 to 210	138 to 349	0.4 to 3.3	5.2 to 5.7	sl & fsl

Trace Metal Content of Some Forested Soils on the West Shore of Staten Island

Vladimir Jovanovic, College of Staten Island

Boonton loam
Oxyaquic Fragiudalfs

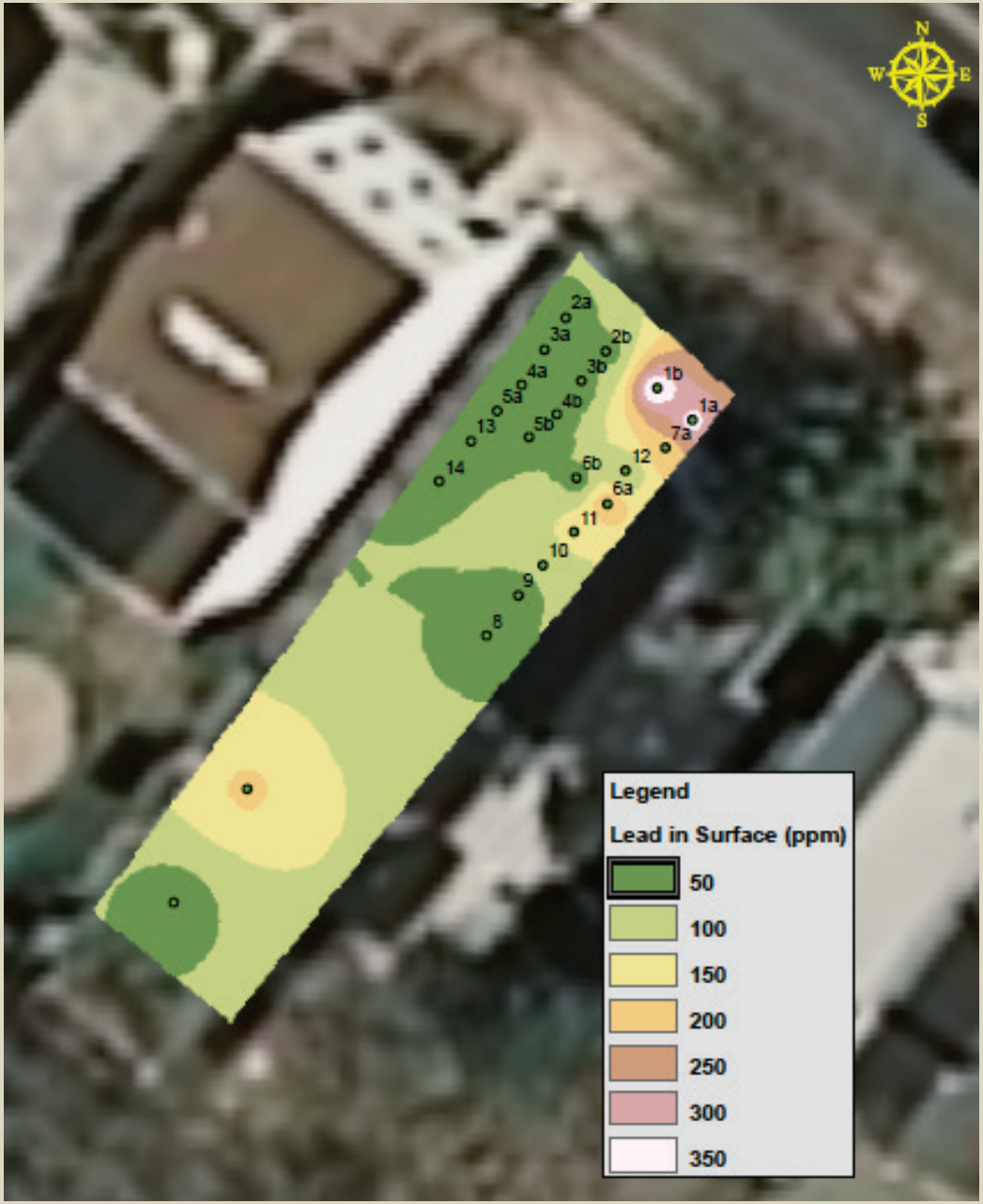
	pH	Pb	Cu	Zn
Oe	5.1	408	260	162
A	5.1	54	42	49
BA	5.2	20	24	48
Bw1	5.3	9	16	43

New Brunswick, NJ

Community Garden - raised beds

New Brunswick

Pb content 200 -400ppm in some raised beds



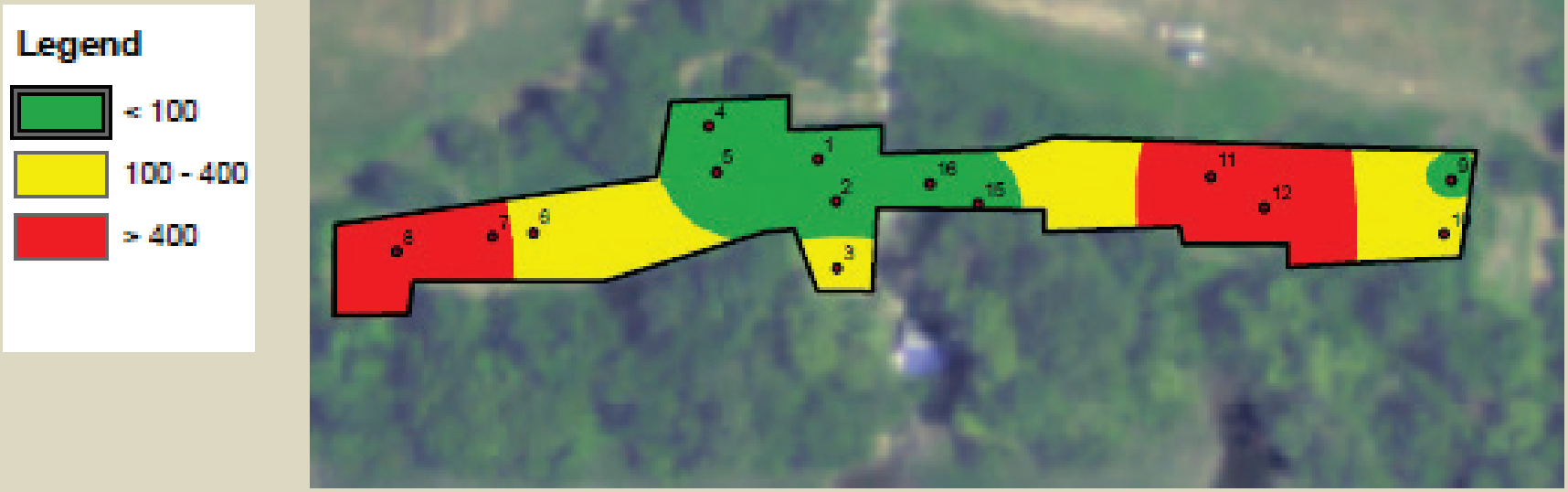
New Brunswick, NJ

Elevated Pb content associated with construction dust/debris

Camden, NJ

Community Garden – in ground

Camden site
Pb content 400 to 939 ppm
6-12” depth



Camden, NJ
High Pb associated with artifactual fill

St Mary's Church, Harlem

Community Garden - raised beds

Paterson, NJ

Community Garden – In ground

Summary

- Not cheap ~$30,000
- Easy to operate & maintain
- Applications
  - soil survey & characterization
  - environmental quality & health
  - soils-based research
- Ideal for assessing spatial variability