

# Using Portable X-ray Fluorescence Technology to Protect People and the Environment

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# X-ray Fluorescence (XRF) Technology

- Development & history
- Types
  - Fixed base
  - Portable
- Uses
- Advantages
- Limits

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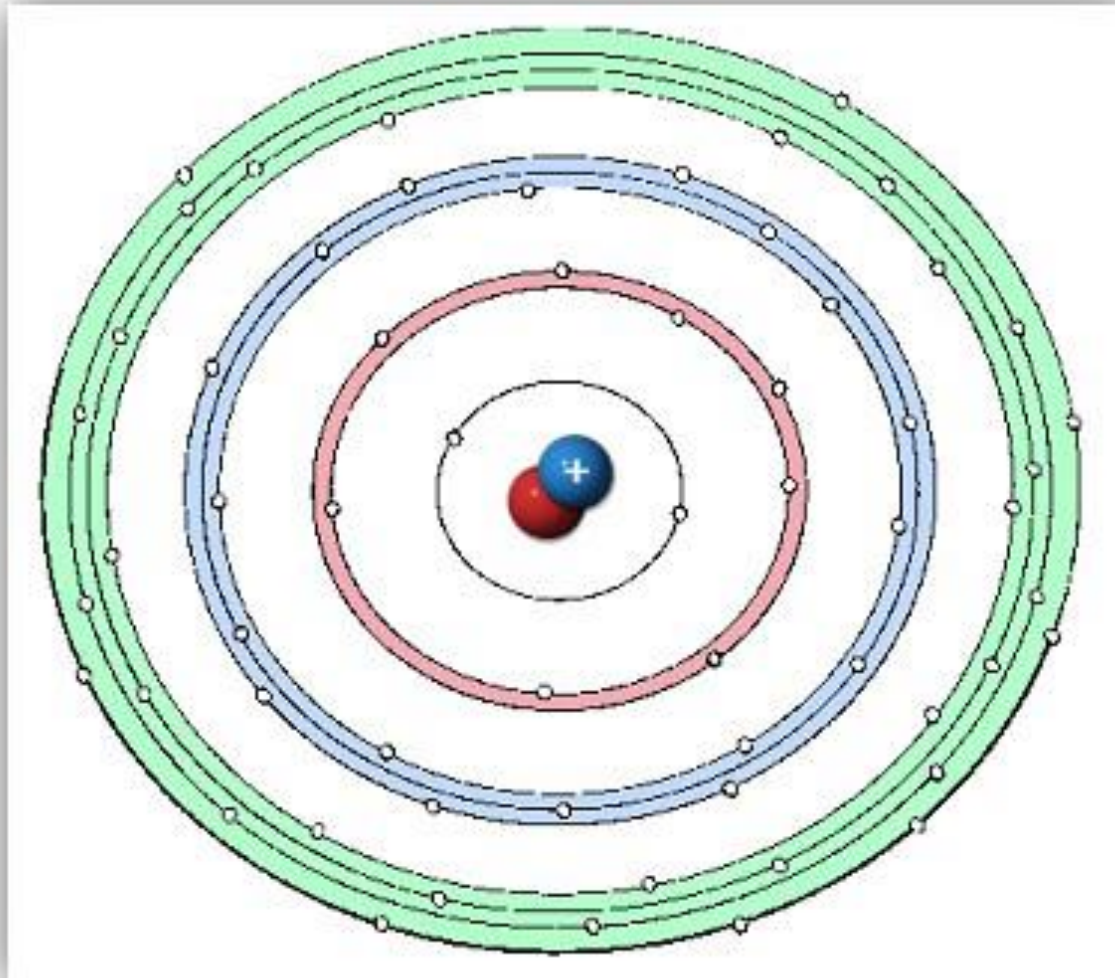
# XRF Physics

## (How do they work?)

- Energy source
  - X-rays
  - Gamma radiation
- Atomic structure
- Fluorescence – secondary energy source
- Detectors – capturing the secondary energy



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# XRF Testing

- Fixed base & portable
  - When appropriate
  - Impact on accuracy
- Media
  - Metals, soil, dust, sediment, air, bone
- Detectable elements

# XRF Common Uses

- Testing for lead in paint
  - Homes, schools, other buildings
  - Toys
- Testing soils & sediments
- Testing dust
- Testing particulates in air
- Hands
- Bone

# XRF Testing Safety Concerns

- Non-destructive testing
- Penetrating radiation
- Radionuclides
- Storage



H 1	IIIA																He 2						
Li 3	Be 4																	B 5	C 6	N 7	O 8	F 9	Ne 10
Na 11	Mg 12																	Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
		IIIB	IVB	VB	VIB	VII B	Group VIII		IB	II B													
K 19	Ca 20	Sc 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36						
Rb 37	Sr 38	Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54						
Cs 55	Ba 56			Hf 72	Ta 73	W 74	Re 75	Os 76	Ir 77	Pt 78	Au 79	Hg 80	Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86					
Fr 87	Ra 88																						

**Lanthanides**  
57-71

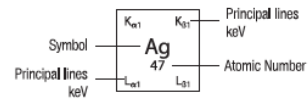
La 57	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71
4.65 5.04	4.84 5.26	5.03 5.49	5.23 5.72	5.43 5.96	5.64 6.21	5.85 6.46	6.06 6.71	6.27 6.98	6.5 7.25	6.72 7.53	6.95 7.81	7.18 8.1	7.42 8.4	7.66 8.71

**Actinides**  
89-103

Ac 89	Th 90	Pa 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103
12.65 15.71	12.97 16.2	13.29 16.7	13.61 17.22	13.95 17.74	14.28 18.28	14.62 18.83	14.96 19.39	15.31 19.97	15.66 20.56	16.02 21.17	16.38 21.79			

**Alloy Elements and Detection Limit Guidelines:**  
 Elements Detected Magnesium (Mg, Z=12) through Silicon (Si, Z=14) and Titanium (Ti, Z=22) through Plutonium (Pu, Z=94) typically 0.1% - some elements as low as 0.01%

**Low-Density Sample Types**  
(Soils, powders, liquids)



- Requires vacuum, LOD 0.2 – 3%
- 250 - 2,500 ppm
- 50 - 150 ppm
- LOD 1% - 5%
- 10 - 100 ppm
- Not Measured

Detection limits are a function of testing time, sample matrix and presence of interfering elements. Detection limits are estimates based on 1-2 minutes test times and detection confidence of 3σ(99.7% confidence). Interference-free detection limits are intended as guidelines; please contact Innov-X Systems to discuss your specific application.

# XRF Output (Results)

- Antimony
- Arsenic
- Barium
- Cadmium
- Caesium
- Cobalt
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Molybdenum
- Nickel
- Palladium
- Rubidium
- Selenium
- Silver
- Strontium
- Tellurium
- Thorium
- Tin
- Tungsten
- Uranium
- Zinc
- Zirconium

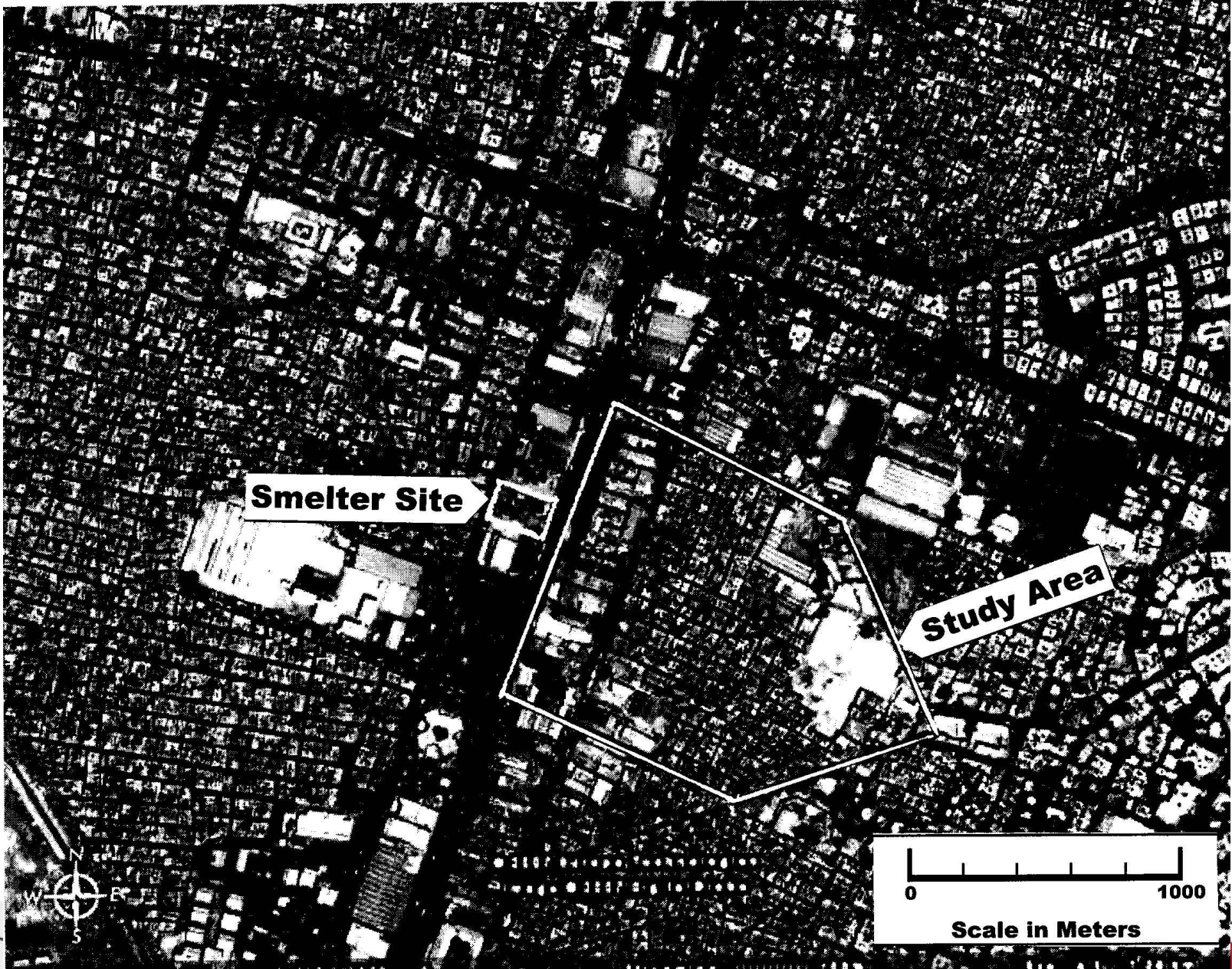
# XRF Output (Results)

Reading No	Time	Dwel_id	Units	Pb	Pb Error	Mo Mo Error	Zr Zr Error	Sr Sr Error			
5	10/26/2008 5:13	B054	ppm	26.4	16.46	24.04	11.72	268.51	22.74	44.82	8.85
102	10/26/2008 6:41	B077	ppm	27.73	14.92	18.28	9.89	< LOD	13.95	42.22	7.93
170	10/26/2008 8:01	B049	ppm	35.68	14.96	19.6	9.45	21.32	8.89	< LOD	6.17
194	10/26/2008 8:20	B053	ppm	35.92	21.21	< LOD	18.08	45.94	17.97	238.13	22.27
92	10/26/2008 6:25	B066	ppm	45.86	19.31	< LOD	15.81	293.36	24.62	210.04	17.6
293	10/26/2008 9:52	B136	ppm	49.3	28.08	< LOD	19.77	170.71	31.46	576.26	38.97
16	10/26/2008 5:21	B055	ppm	51.77	19.75	< LOD	17.14	436.39	28.04	92.59	12.07
188	10/26/2008 8:14	B052	ppm	54.32	30.61	< LOD	23.89	471.04	43.78	321.43	31.29
79	10/26/2008 6:15	B064	ppm	58.44	33.94	< LOD	21.66	72.66	35.12	978.55	55.21
71	10/26/2008 6:09	B063	ppm	73.74	46.21	< LOD	30.79	423.28	69.18	2043.31	97.16
233	10/26/2008 9:00	B126	ppm	74.93	42.68	< LOD	28.93	130.22	45.29	1124.91	67.69
206	10/26/2008 8:39	B092	ppm	80.12	34.38	< LOD	22.22	155.89	29.15	219.12	25.79
260	10/26/2008 9:23	B089	ppm	83.48	35.65	< LOD	20.55	216.43	34.6	422.21	35.1
195	10/26/2008 8:20	B053	ppm	85.72	20.99	15.36	9.57	122.35	14.9	84.44	10.14
60	10/26/2008 6:01	B069	ppm	91.19	21.39	21.97	9.5	47.03	10.5	8.59	4.44
54	10/26/2008 5:54	B067	ppm	101.45	27	< LOD	14.08	33.87	16.45	335.26	22.93
7	10/26/2008 5:14	B054	ppm	104.72	23.72	< LOD	14.26	137.42	15.59	29.67	6.81
13	10/26/2008 5:20	B055	ppm	109.1	26.93	< LOD	16.3	188.01	21.03	194.88	16.95
62	10/26/2008 6:02	B069	ppm	109.2	23.92	< LOD	14.2	111.3	14.37	41.61	7.61
286	10/26/2008 9:48	B137	ppm	110.12	31.3	< LOD	17.13	201.45	25.79	277.42	23.16

# XRF Usage –Case Studies

- Cairo smelter
- Superfund sites
- Lead exposure studies
- Health departments
- Non-governmental organizations







# Lead Safe America FOUNDATION



Supported By  
**LeadCare**  
Instant diagnosis + early intervention

*In the U.S. today 1 in 3 children under 18 has had a blood lead level of 2.5 or higher in their*



*Thank you for supporting our work helping families everywhere!*

*\$2.54 donated to Lead Safe America covers postage for us to help one family, sending them free test kits*



Lead Safe America Foundation is a nonprofit organization founded to provide emergency support to families...

**Malwarebytes Antivirus**  
The database is outdated. Update now.

# Questions??

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