

Comparison between 3 common ICP analytical tools

	MC-ICP-MS	ICP-MS	ICP-OES
Principal	Mass-to-charge ratio	Mass-to-charge ratio	Optical emission from excited atoms and ions
Sensitivity	Highest	High	Moderate
Dynamic Range	10 ³ or up to 10 ⁶ with SEM	up to 10 ⁹	up to 10 ⁶
Sample Matrix Tolerance	Requires purified sample	Better data with low ionic strength	Tolerate high ionic strength
Interference Removal	Pseudo-high-mass resolution	Gas collision cell	none
TDS tolerance	<<0.2%	<0.2%	up to 30%
Example applications	Paleoredox proxies, movement of humans	Major and trace element of many sample types	Monitoring waste water or stormwater

MC-ICP-MS - Multi-collector Inductively Coupled Plasma Mass Spectrometry

ICP-MS - Inductively Coupled Plasma Mass Spectrometry

ICP-OES - Inductively Coupled Plasma – Optical Emission Spectroscopy

Selecting elemental analysis technique for thin film samples

	XPS	SEM EDS/EDX	ED-XRF	
Probed Volume Cartoon				
				Analysis Volume
				Film
				Substrate
Measurement Depth	1 - 10 nm	~ 1 μ m	0.1 - 1 mm <i>Composition dependent</i>	
Lateral Resolution	~ 10-100 μ m	~ 1 μ m	>10 mm	
Typical Sample Size	10x10 mm thickness < 3 mm	10-25 mm diameter thickness < 10 mm	20-50 mm diameter thickness > 1mm	
Elements Measured	Li-U Quantitative	can see <i>Li</i> -Be-F Semi-Quant Na-U	can see C-F Semi-Quant Na-U <i>Quant with standard</i>	XPS - X-ray Photoelectron Spectroscopy
Sample Environment	UHV	Vacuum	Vacuum or Air	SEM EDS/EDX - Scanning Electron Microscopy Energy Dispersive X-ray Spectroscopy
				ED-XRF - Energy Dispersive X-Ray Fluorescence

Selecting elemental analysis technique for bulk samples

	ED-XRF	ICP-MS	ICP-OES
Sample Preparation	None, fine grinding, or fused bead	Acid digestion or laser ablation	Acid digestion
Sample size	1-10 g	>0.01 g - solids 0.1-2mL - liquids	>0.1 g - solids 3-5 mL - liquids
Sensitivity	10s to 100s ppm	ppt** to ppm	high ppb to 10s of ppm
Trace Elements	no	yes	yes but limited
Elements Measured	Semi-Quant Na-U <i>Quant with standard</i>	Most except C,H,N,O,Si,Cl and F	Most except C,H,N,O and F
Information Reported	wt% oxide* or wt% element	ppm or ppb element	ppm element

ED-XRF - Energy Dispersive X-Ray Fluorescence

ICP-MS - Inductively Coupled Plasma Mass Spectrometry

ICP-OES - Inductively Coupled Plasma – Optical Emission Spectroscopy

* wt% oxide based on oxide state assumption

** Part per trillion