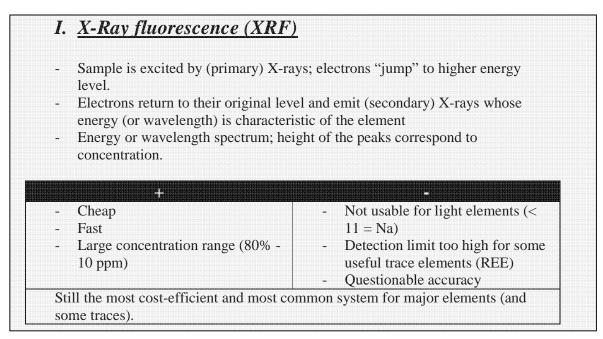
Analytical techniques

(Equipments in grey boxes are present at U.S.)



II. Inductively Coupled Plasma (ICP)

"Flame" spectrometry (6000 – 10000 C)

- Sample solution nebulized into an Argon plasma, heated by sparks and contained in a magnetic field
- Sample dissociates into single ions (ionic plasma)

A. <u>Atomic Emission Spectrophotometry ICP (ICP-AES)</u>

- Excited atoms in the plasma emit light in specific wavelengths
- The peak size is proportional to the concentration

+	-
- Low detection limits (1 ppm)	- Needs a "clean" chemistry
Good precisionCan analyze light elements	- Less precise for major elements
Once the standard instrument for traces	; is now being replaced by ICP-MS.

B. Mass Spectrometry ICP (ICP-MS)

- Mass spectrometry takes advantage of the fact that ions in a magnetic field follow circular trajectories, radius is a function of the charge/mass ratio
- Ions are extracted from the plasma, accelerated and pumped into a magnetic field onto the mass detector

+	-
 Very low detection limits (down to 1 <i>ppb</i> for modern instruments) Good precision Can analyze light elements Limited isotopic capacity 	 Needs a "clean" chemistry Can't do major elements Expensive and hi-tech (1-5 millions ZAR)
Becoming the de facto standard for trac	e elements.

+ Same as "normal" ICP-MS, plus	
 In situ analysis of individual minerals, etc. No chemistry needed Now routinely built by the industry and commonly used, relatively robust and simple to use once installed 	 Additional complexity (coupling the laser and the ICP) <i>Very</i> expensive!

III.Isotopic Dilution and Thermo-Ionization MassSpectrometry (ID-TIMS)

- Samples are put in solution, generally chemically separated to keep only the elements of interest
- A "spike" of known concentration and isotopic composition is added
- Mass spectrometry takes advantage of the fact that ions in a magnetic field follow circular trajectories, radius is a function of the charge/mass ratio
- Isotopic *ratios* are measured (no need for calibration, so less error)
- Ratios are commonly interpreted; spiking allows to calculate the concentrations.

+	-	
 Very low detection limits Excellent precision Can do isotopes 	 Needs a "ultra-clean" chemistry Can not do all elements Time consuming and difficult 	
Normally not used for trace elements, but still common for isotopes. Slowly concurenced by LA-ICP-MS.		

- Sar to l - Ele wa	higher energy level. ctrons return to their origina velength) is characteristic of	
	centration.	; height of the peaks correspond to
- In-	n-destructive situ, very small spatial olution	 High detection limits and poor precision for anything other than majors Light elements are difficult to

V. Ion microprobe

- -
- A beam of O ions is fired at the sample The sample is ionized in a small volume (actually drilling a small hole) and secondary ions are emitted
- Secondary ions are analyzed by mass spectrometry -

+	-	
 Very low detection limits Excellent precision Can do isotopes In situ analysis 	 Very expensive Very complex and difficult to use Likely to be replaced by LA-ICP- MS in the next few years 	
Very popular during the 90's, became the standard for Pb geochronology. Its cost and complexity always restricted its use (no more than 10-20 machines worldwide in Earth sciences), and it is now replaced by LA-ICP-MS.		