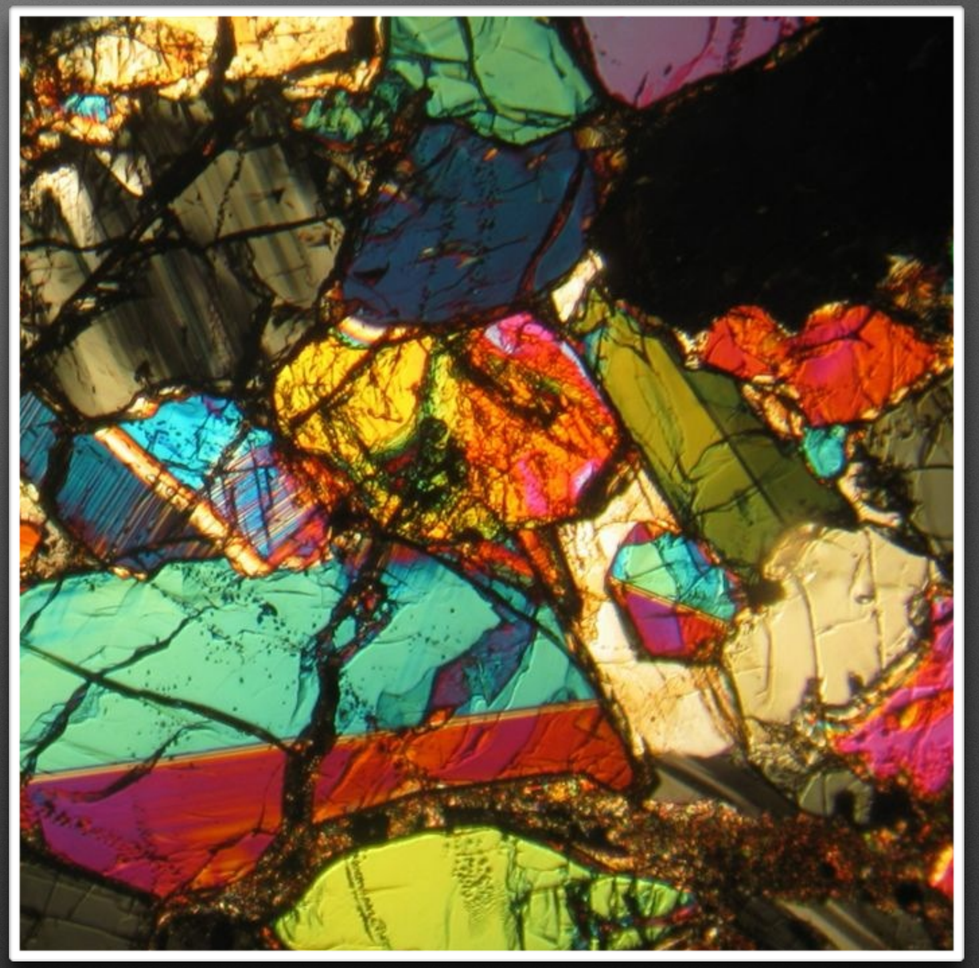
Absolute Dating

How do we use radioactive decay in dating the absolute age of a rock, fossil, or event?

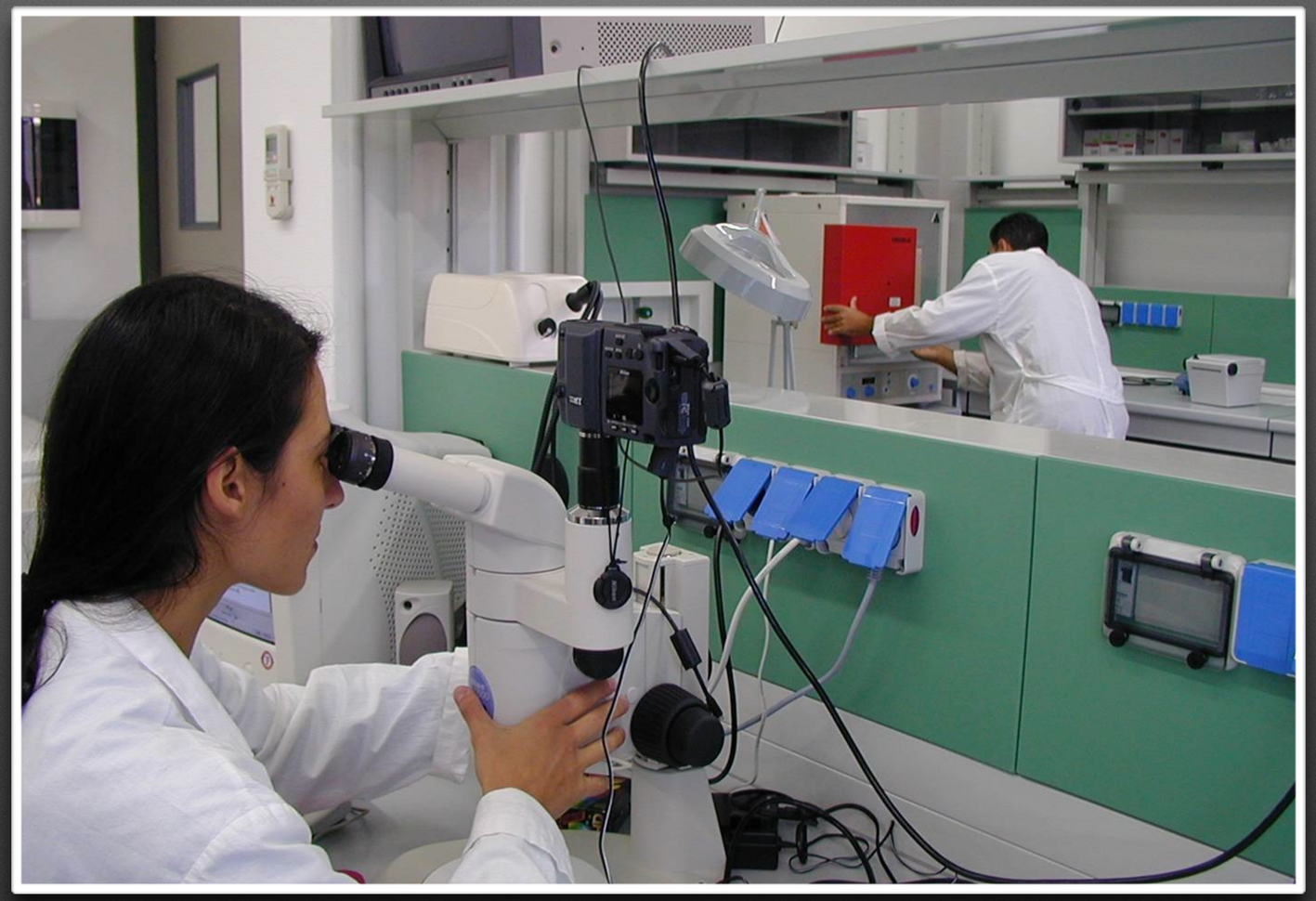
Absolute Dating

- Absolute Dating - using radioactive decay to determine the exact age of a rock, fossil, or event
- Radioactive Decay - the disintegration of an isotope over time

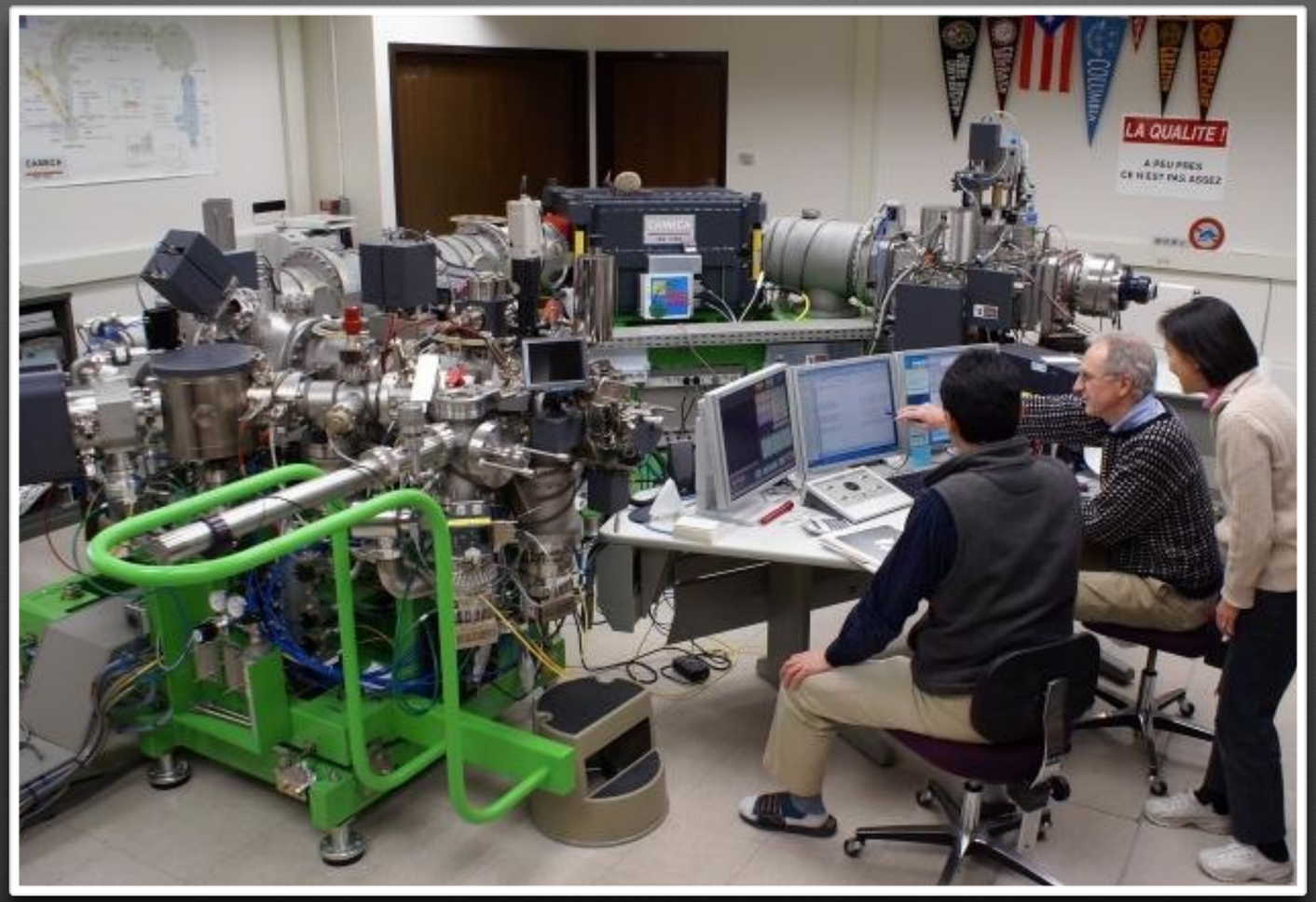
Step 1: Geologists drill for core samples.



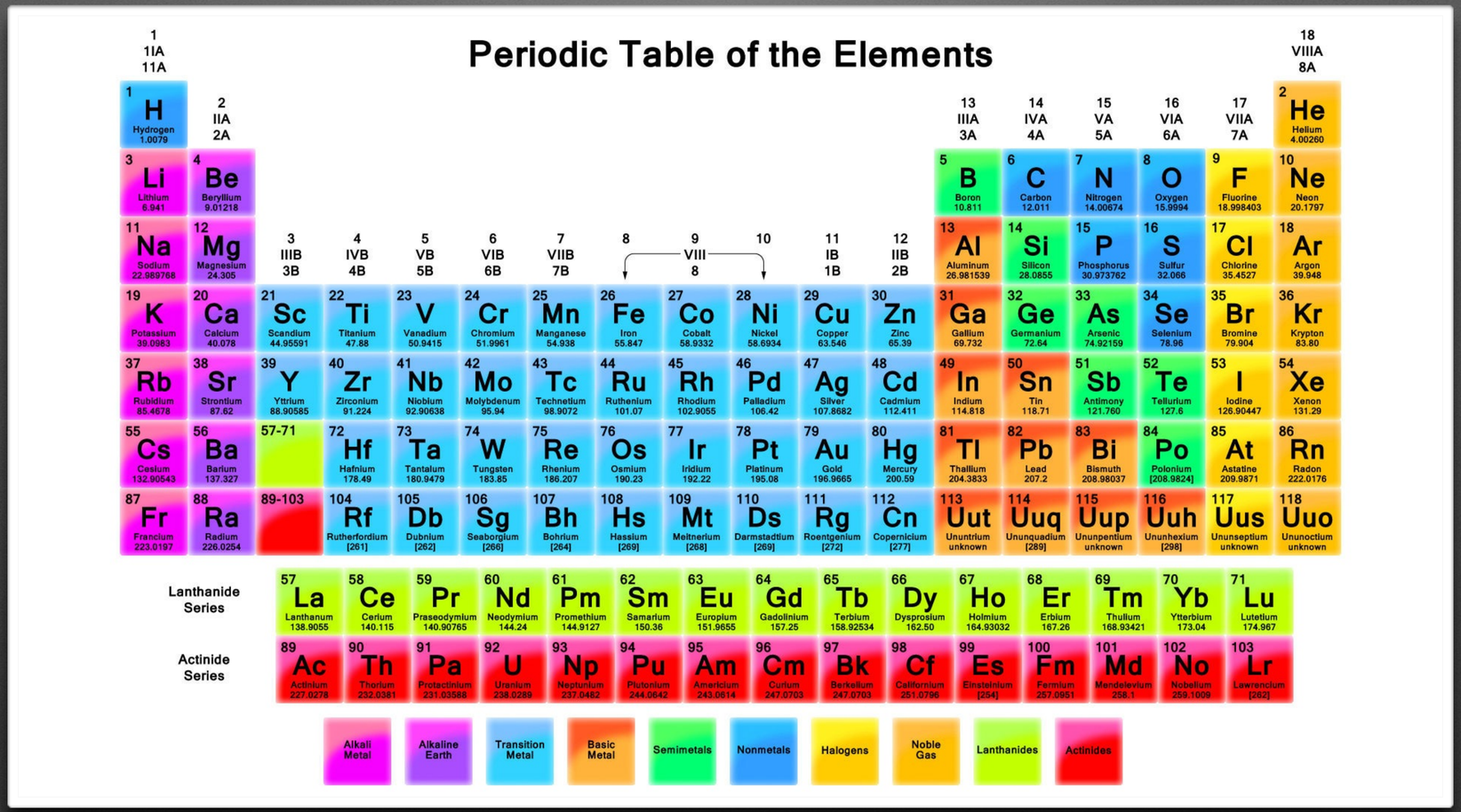
Step 2: Geologists crush the samples into thin sections and a fine powder.



Step 3: Geologists analysis the samples for composition and inconsistencies.



Step 4: Geochronologists use spectroscopes to measure the ratio of stable to unstable products.



Periodic Table

Absolute Dating

- Isotopes - variations of an element that have the same atomic number but differing atomic masses
    - Example: Stable carbon has a mass of 12 units called Carbon-12 and isotopic carbon has a mass of 14 units called Carbon-14

Absolute Dating

- Half-Life - the time required for half of a radioactive product to decay to a stable product
    - In a given sample of a radioactive isotope half of the atoms will decay to a stable product, but the remaining half is still radioactive

Absolute Dating

- Each element has its own half-life that range from fractions of a second to billions of years

RADIOACTIVE ISOTOPE	DISINTEGRATION	HALF-LIFE (years)
Carbon-14	$^{14}C \rightarrow {}^{14}N$	5.7×10^3
Potassium-40	$^{40}K \rightarrow {}^{40}Ar$ / $^{40}K \rightarrow {}^{40}Ca$	1.3×10^9
Uranium-238	$^{238}U \rightarrow {}^{206}Pb$	4.5×10^9
Rubidium-87	$^{87}Rb \rightarrow {}^{87}Sr$	4.9×10^{10}

Absolute Dating

- The half-life of an isotope is not effected by any environmental factors such as temperature, pressure, or chemical reactions

Absolute Dating

- Uranium-238 - one of the most important isotopes when dating rocks or events millions of years ago
    - Mass: 238 units
    - Decay: Uranium-238 → Lead-206
    - Half-Life: 4,500,000,000 years

Absolute Dating

- Carbon-14 - one of the most important isotopes when dating organic remains within tens of thousands of years
    - Mass: 14 units
    - Decay: Carbon-14 → Nitrogen-14
    - Half-Life: 5,700 years

Half-life	Percentage of Unstable C-14	Percentage of Stable N-14	Number of Years
0	100%	0%	0
1			
2			
3			
4			
5			

Age of the Earth