

# 6

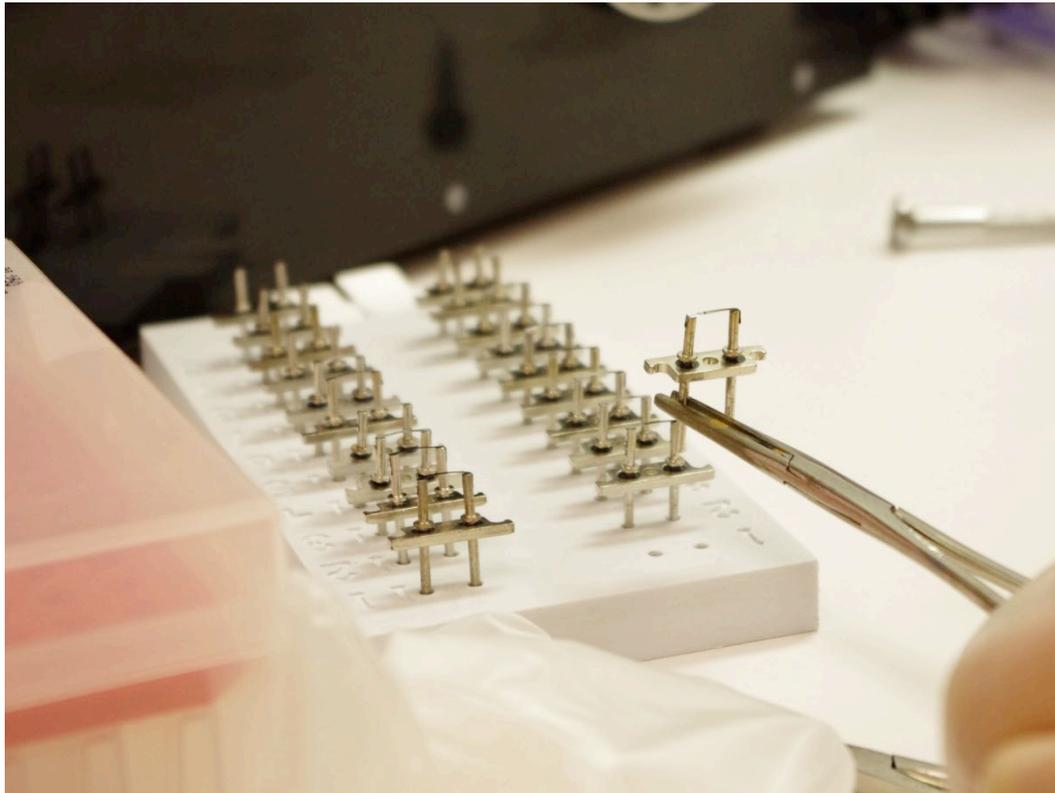
## Thermal Ionization Mass Spectrometry

After the Pb and U are separated from the zircon crystal, they are loaded onto a metal filament and placed in the thermal ionization mass spectrometer (TIMS) for analysis



## Loading Bench

The U and Pb separated from each zircon crystal are loaded onto metal filaments in a clean environment.



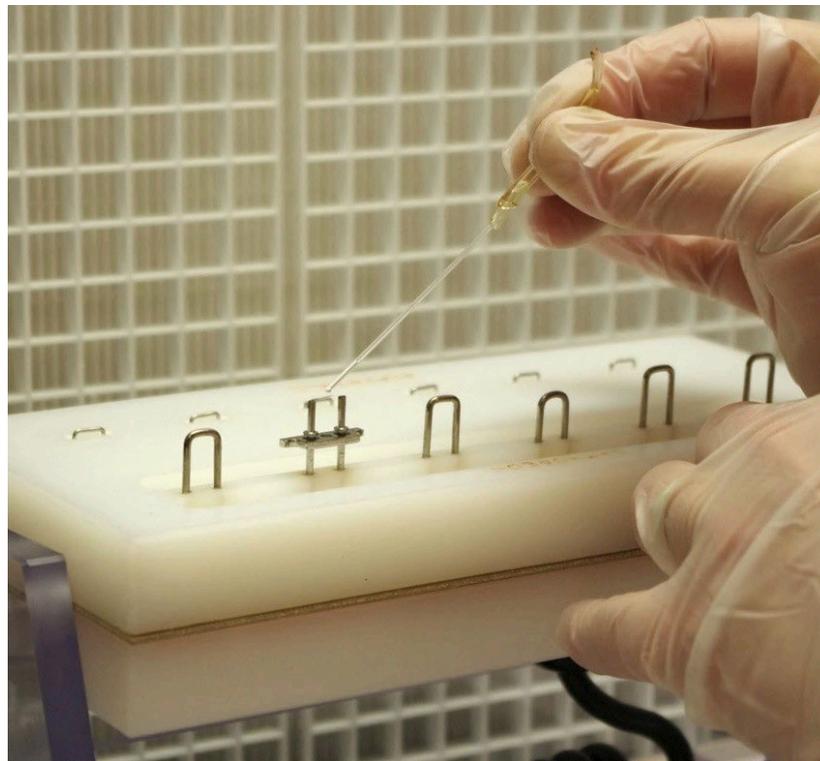
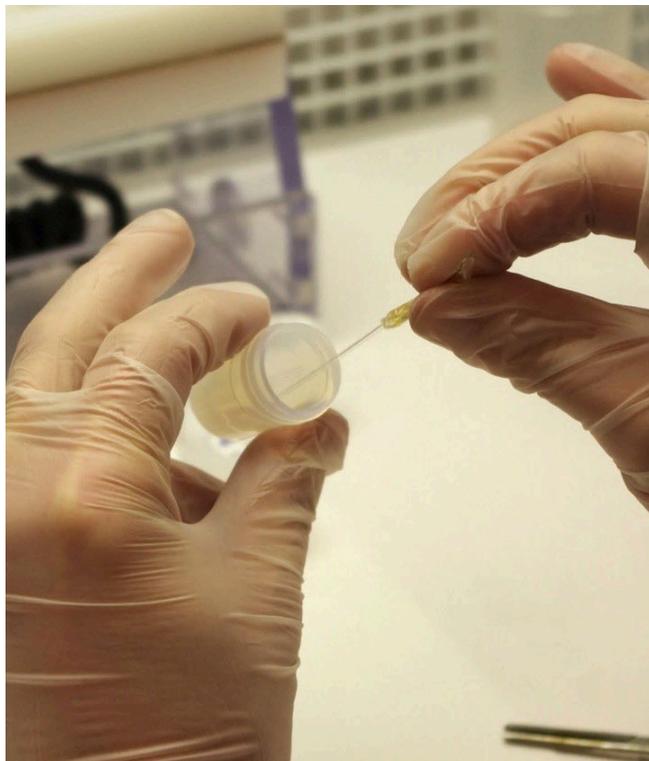
## Filaments

The U and Pb separated from a zircon is loaded onto a metal filament. Much like an incandescent light bulb, the filament is a thin strip of refractory (high melting point) metal (in this case rhenium) which can be heated to very high temperatures.



## Locating the Sample

The sample in this picture is a small brown speck on the right side of the beaker near the top of the holder's thumb.



## Transferring the Sample to the Filament

A tiny drop of acid and a teflon “pipette” tube are used to transfer the sample from the beaker onto the center of the filament.



## Drying the Sample onto a Filament

The sample is dried by passing an electric current through the filament to warm it. The dried sample on the right is ready to go into the mass spectrometer.



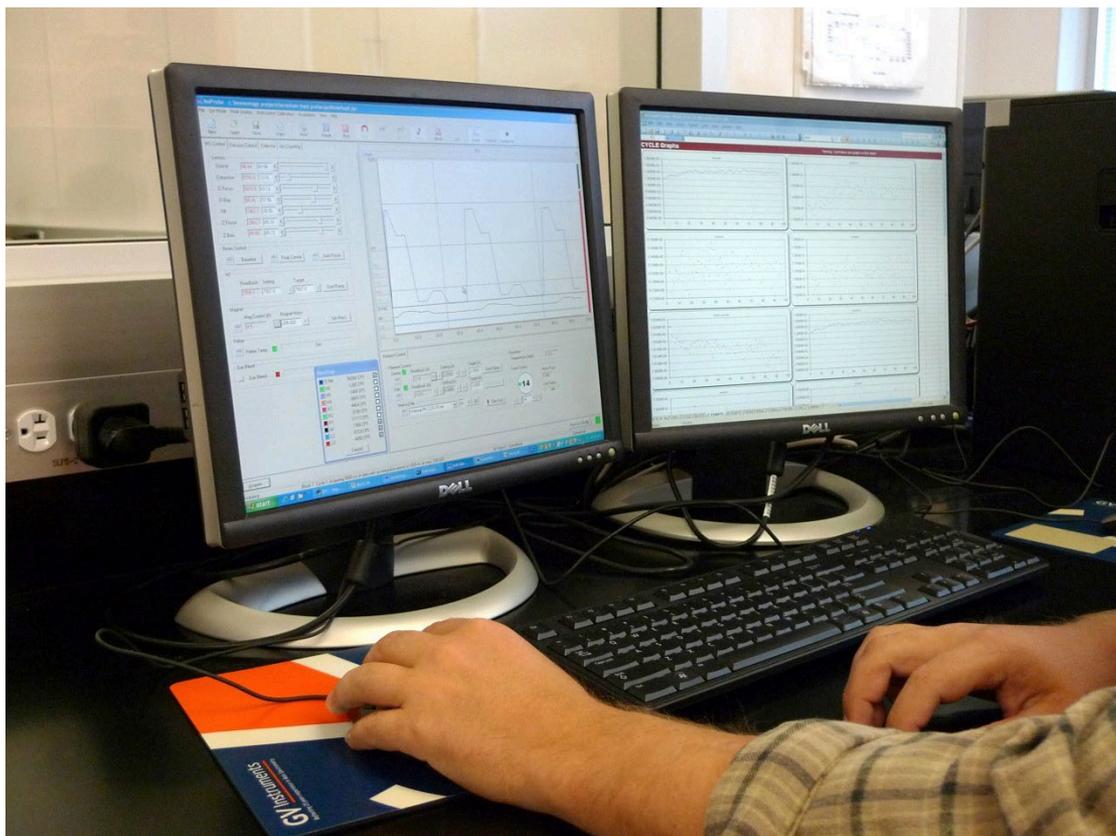
## Loading Samples into the Mass Spectrometer

The individual filaments are screwed into a holder called the turret and the turret is screwed into the source chamber of the thermal ionization mass spectrometer.



## Evacuating the Mass Spectrometer

The air in the source chamber that holds the turret is pumped out to form a vacuum and the samples in the mass spectrometer are ready for analysis.



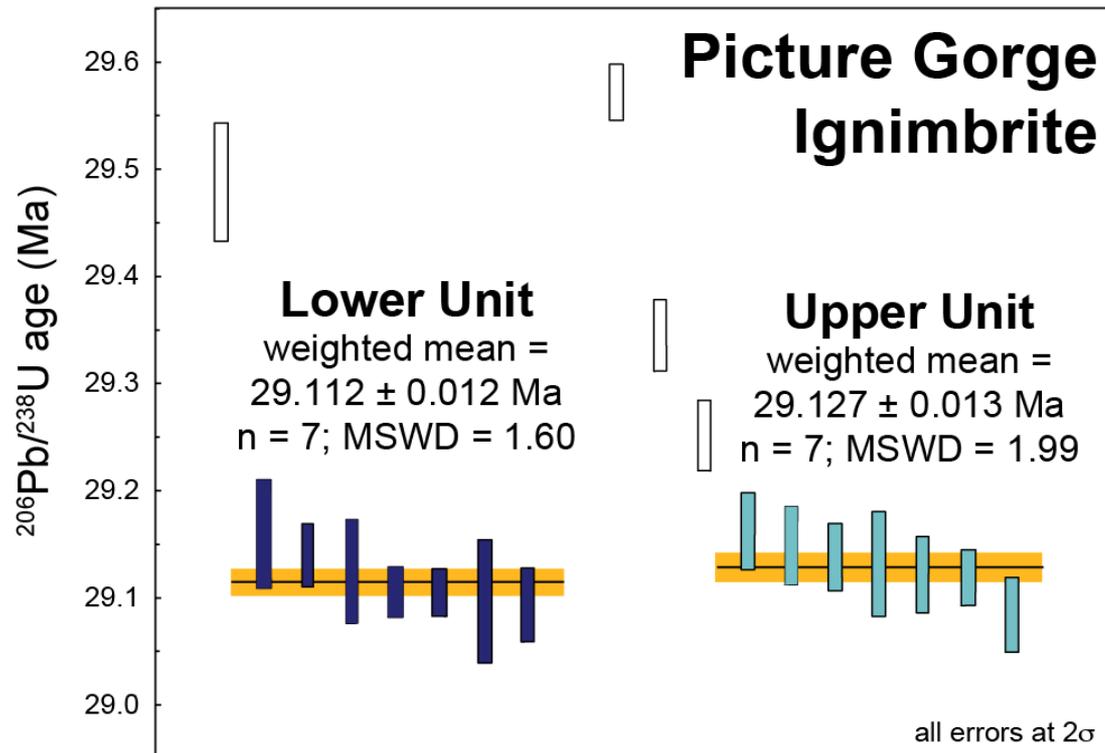
## Computer-controlled Analysis

All of the functions of the mass spectrometer are under computer control. Using the analysis software, the sample filament is heated to the ionization point, the ions are focused and accelerated into the electromagnet, the isotopes of each element are separated by the magnetic field, and then measured.



## Analyzing the Data

Each isotope of Pb and U is measured in the mass spectrometer as a count rate of ions per second. Using computer software, these count rates are calibrated into ratios of daughter to parent atoms, for example  $^{206}\text{Pb}/^{238}\text{U}$ , using the known quantities of radioactive tracers in the isotope dilution spike. From this isotope ratio an age can be calculated using the decay equation.



## Interpreting the Age

The ages calculated using the decay equation are then used to interpret the crystallization age of the zircon crystals. These two samples from the Picture Gorge Ignimbrite at John Day Fossil Beds, OR have identical, very precise ages based upon multiple zircon analyses from each sample (each colored bar represents one zircon crystal). The white bars represent unrelated zircon crystals which were “inherited” into the magma from older volcanic rocks.