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U-Pb Dating by Laser Ablation ICP-MS

Small spots on individual zircon grains can be dated using a mass spectrometer coupled to a laser. The laser ablates (removes) a small volume of the zircon which is then carried to the inductively coupled plasma mass spectrometer (ICP-MS) by a helium gas stream. In the ICP-MS, the sample is ionized in an argon plasma, the Pb and U isotopes are separated in an electromagnetic field, and their abundances measured by an electron multiplier.



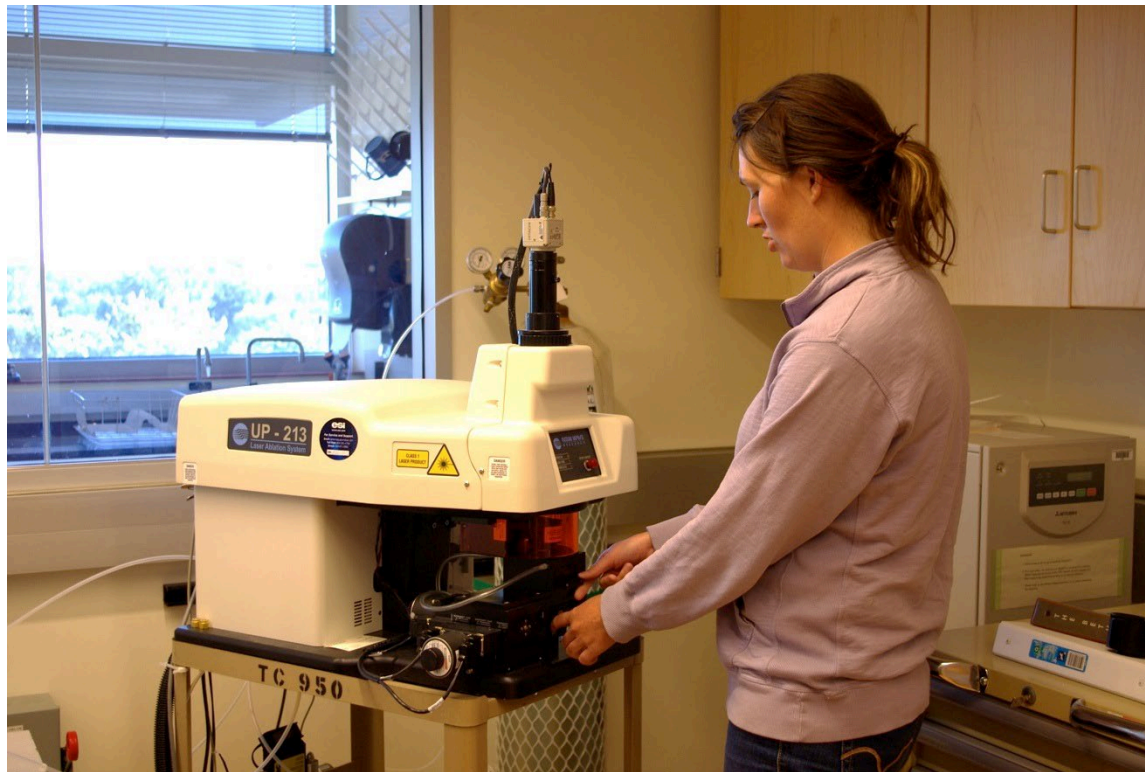
Zircon Grain Mounts Ready for Laser Ablation

These small round sections were drilled out of three larger grain mounts and placed in a holder that is compatible with the ICP-MS.



Aligning Samples and Standards in a Holder

The zircon grain mounts are placed in a sample holder with special grains of zircon called “standards.” These standards are of known age and chemical composition, and are analyzed along with the sample to calibrate the measurements.



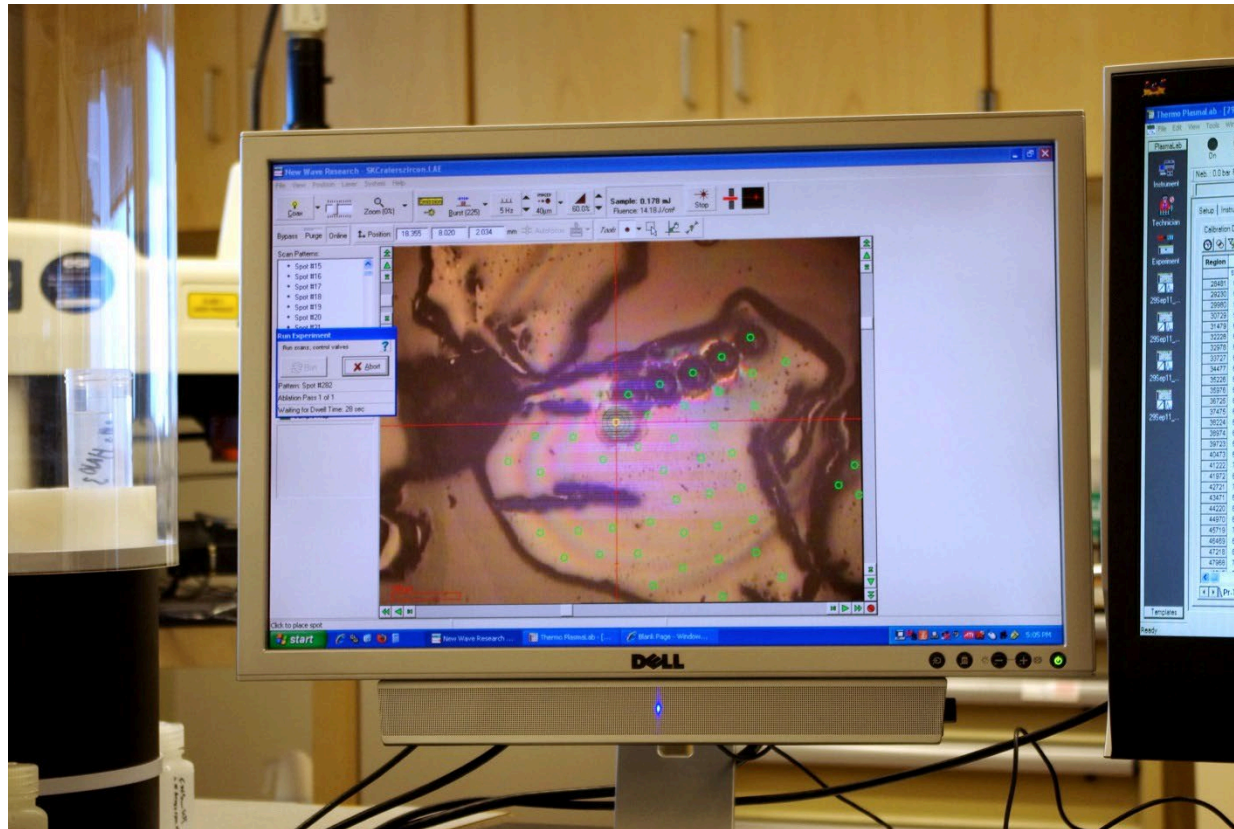
Loading the Zircon Samples into the Laser Chamber

The samples and standards are placed in the laser chamber.



Selecting Spots for Ablation

Cathodoluminescence (CL) images of the zircons are used to guide the selection of spots on each zircon for analysis.



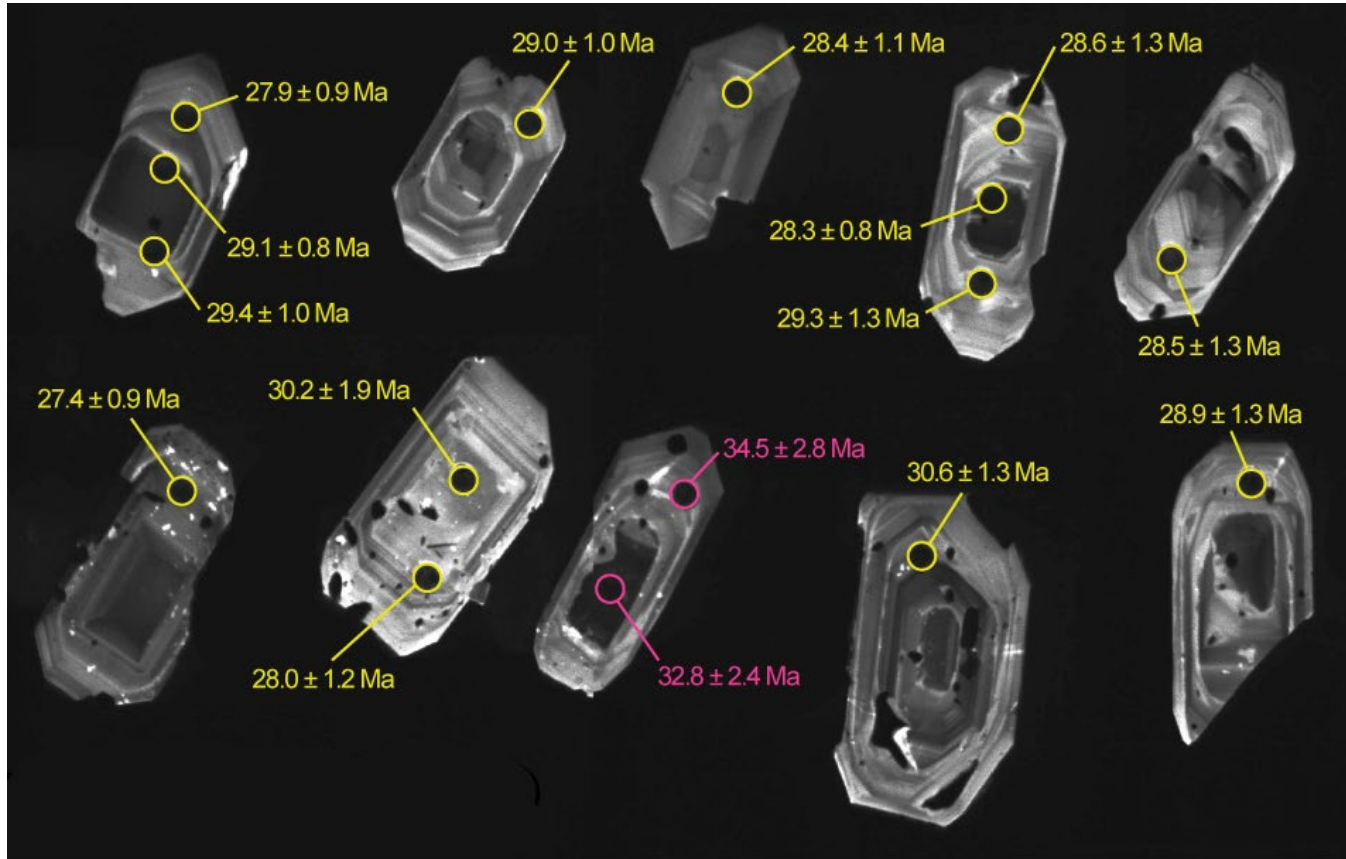
Computer-controlled Analysis

Each green spot on the computer screen is the location of an analysis. Five analyses on this grain have already been made as evidenced by the line of dark circles near the top of the zircon grain. A sixth spot analysis is in progress.



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 standard zircons of known composition and age. 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 history of the zircon crystals. This cathodoluminescence image shows the black laser ablation pits and the corresponding calculated ages for each spot analysis from zircons of the Blue Basin Tuff at John Day Fossil Beds, OR. Note how one “inherited” grain yields older ages.