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Deciphering regional geology using the new USGS-EWU Mineral Separation Lab

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Abstract

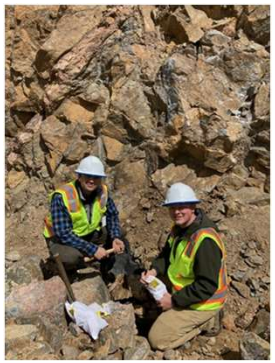
U/Pb radiometric dating of zircon is one of the most widely used methods to determine the crystallization ages of igneous and metamorphic rocks and the provenance of sedimentary rocks. Eastern Washington University (EWU) has collaborated with the U.S. Geological Survey (USGS) to build a mineral separation lab for isolating zircon (and other) minerals for analysis. This lab was completed in Fall 2022 and is currently being transferred to the new ISC for future use. Graphically illustrated below are the methods used for sampling and pulverizing the rock, as well as grain mount preparation techniques. One of the EWU projects that is benefiting from the new lab is a mapping and detrital zircon geochronology study of local steptoes and exposures of rocks formed prior to the Columbia River Flood Basalts. The mineral separation lab is now established, so we are entering into the field work and mineral separation parts of deciphering the tectonic past of Spokane's regional geology.

The Process

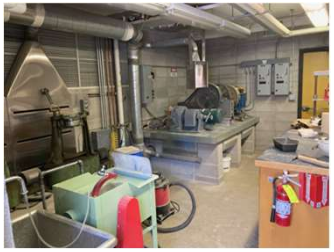
The mineral separation process. EWU already has dedicated space and many of the pieces of equipment for this project to work. Most of these pieces of equipment have been purchased with external money from our existing USGS-EWU Cooperative Contract. This contract also pays three to four EWU students to work with researching USGS geologists giving our students a world-class education and experiences needed to make innovative contributions to the geologic community.

Step 1: Sampling

Sampling is probably THE most important step because analyzing the minerals that make up rocks is only as valid as the field work and sampling. Below and to the right are photos of EWU Geoscience majors and USGS geologists during sampling events in CA and NV, this was part of the EWU-USGS cooperative agreement, giving EWU Students world class experiences with industry leaders!



2. Rock Crushing, Pulverizing, and Sieving



Above: Rock crushing room where we bring in the samples taken from the field then crush them in the chipmunk before running them through the mill which turns the sample into a powder which we then sieve to a specific size for the following steps.

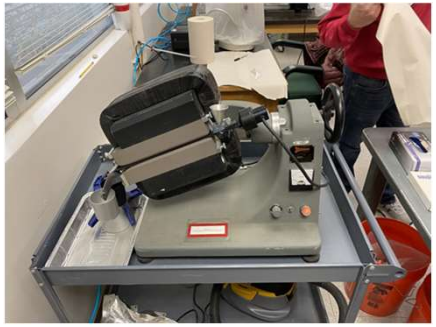
Below: Starting sample (right), Pulverized sample (right)

3. Hydroseperation/Heavy Liquids

Below: Using the hydroseperation table to sperate out most of the lighter material leaving behind the zircons and other heavy minerals. This specialized shake table uses gravity, water flow and density traps to isolate specific minerals.

Above: Using heavy/dense liquid allows us to further separate the zircons from other lighter materials that make it through the hydroseperator. The zircons sink to the bottom while lighter materials float.

4. Magnetic Separation

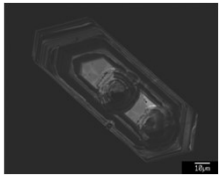


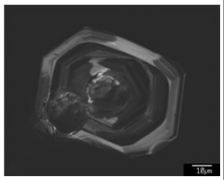
Frantz magnetic separation separates remaining magnetic materials (that commonly have similar density to zircon) leaving behind a sample of mostly zircon grains. The Frantz uses a large electromagnet to separate the material into a non-magnetic and magnetic fraction.

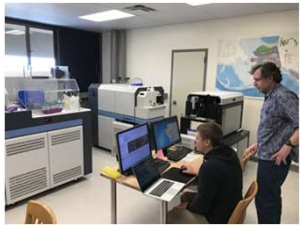
5. Analysis

Above: Mounted Zircons under a microscope

Right: Zircon minerals that have been analyzed using laser-ablation-mass spectrometry at WSU. Holes (dwells) left by the laser can be seen in the images. Material that was blasted from the dwells was pulled into the MS, ionized using a plasma torch, and analyses for U/Pb age determination. Images were taken in cathodoluminescence view with the field emission microprobe at WSU.

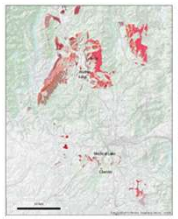


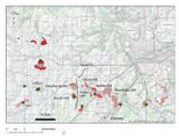




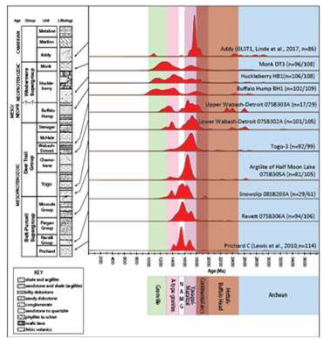
Left: The laser-ablation mass-spectrometry equipment at WSU GeoAnalytical laboratory. Thanks to Charles Knaack for his assistance measuring zircon samples prepared at the EWU Mineral Separation Laboratory.

6. Deciphering the Inland NW





Upper Left: Mapped by the WA Dept. of Natural Resources, from Griggs (1973), Evans (1987) and Joseph (1990). This project will be an attempt to scientifically correlate rocks between NE WA and the isolated hills in Spokane County.



Lower Left: Probability density plots of detrital zircon grains for samples from NE WA. Number of zircon grains used denoted by, n. Samples from Box et al., 2020; Belt samples from Lewis et al. 2007; and Cambrian Addy Quartzite (GLST-1: Linde et al. 2014, 2017). Arrows point to stratigraphic position of samples in generalized stratigraphic column on the left for older stratigraphy from NE WA. Colored intervals behind probability plots are labelled below *x*-axis to identify igneous age intervals found in Precambrian crustal elements during development of the US over the last 1.5 billion years. This is the database that will be used to decipher the geology of NE WA and help EWU project faults.

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