Our microanalytical capabilities for the SEM center around our **Hitachi S3400 Variable Pressure Scanning Electron Microscope**. It is versatile as a traditional scanning electron microscope including secondary electron imaging (SE) and backscattered electron imagine (BSE) with capabilities that include:

Electron Back Scattered Diffraction (EBSD)
Cathodoluminescence (CL) Detection
Energy Dispersive Spectroscopy (EDS)

In addition, our SEM can operate in ***variable pressure*** mode allowing samples to be viewed under minimal vacuum. This feature allows samples that would be compromised by beam energy or vacuum to be imaged and analyzed without any carbon or heavy metal coatings required. Our SEM can view:

Biological specimens
Moist Soils
Fragile Natural and Man-made Composites

Our lab has the capability to Carbon coat or Iridium coat samples for high vacuum analysis.

Exploring fundamental questions about the earth, life, and the environment.

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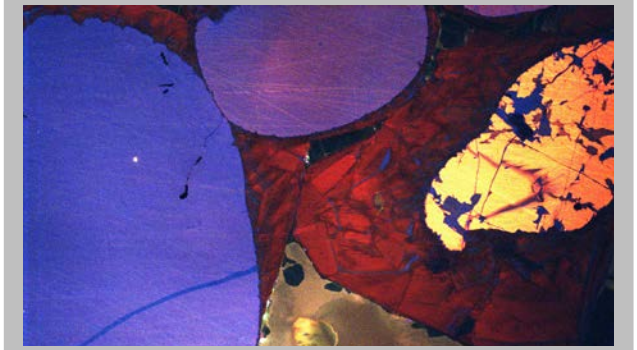
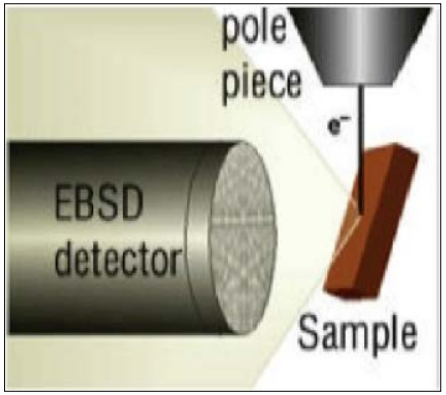


EBSD - Electron Back Scattered Diffraction

Diffraction patterns obtained from minerals are a precise record of crystallographic orientation. The patterns that arise from beam-specimen interactions may take the form of points or bands – Kikuchi lines. The interpretation of Kikuchi line patterns requires only an empirical data set of patterns for crystals of known structure and orientation (and known composition for minerals exhibiting solid solution). Most minerals and most rock forming phases typically produce good Kikuchi lines. There are a variety of reasons to use EBSD in samples of interest: to evaluate the crystallographic orientations of mineral grains, lattice preferred orientations, and identify different phases that have the same chemistry.



As shown above, the sample is tilted at 70° to the beam, with the EBSD camera driven to a short distance away. The electrons are diffracted from the top layers of atoms into the camera, producing the Kikuchi lines, which the software then analyses for crystallographic information (atomic layer spacing and orientation), compared to potential “matches” the user has set up in a library. Polished (rock) sections need a special final polish to remove all strain induced during grinding and polishing. However, NO special polish is needed for individual crystals as they occur naturally (or in experiments), with natural faces.

EDS - Electron Dispersive Spectroscopy

As scientists, we deal with a variety of minerals and materials. EDS is essential for rapid identification of samples in a multiphase assemblage. Our EDS detector is a Si(Li) detector with a thin film window, allowing detection of elements down to carbon. The software has a variety of features. *“Point and Shoot”* when you collect an image, then click on the point of interest where a spectrum is collected. *“Feature Analysis and Chemical Typing”* when you have a large area of interest but only a small population of grains you are trying to find. The imaging can be configured so your desired feature stands out in BSE (usually bright on a black background). The software picks out the discrete grains and then acquires EDS spectra on each. An overnight analysis will then offer a multitude of information and data to analyze and find your "needles in a haystack".

CL - Cathodoluminescence

Several key rock-forming minerals exhibit cathodoluminescence, which varies in intensity with variations in outer shell electron configuration. This in turn is a function of stress and/or trace element chemistry that provides an effective record of episodes of mineral growth, dissolution, cementation and/or overgrowth. This is important when you are trying to unravel the history of a sample especially when using a sensitive tool such as the ion probe to determine precise isotopic compositions of a population of minerals (e.g. zircons, quartz).

The CL system (Gatan PanaCL/F) has the ability to insert filters, and thus recreate a color CL image, or filter out particular wavelengths. This is useful for CL imaging of carbonates, where the orange-red wavelengths have a dwell causing a smearing of the SEM-CL image. The blue (bandpass) filter yields a useful CL image.

St. Peters Sandstone RGB CL Overlay Image.