

Geo 777 Lab 2: Imaging a multi-phase sample with BSE and EDS

Today we will set up and run in “normal” high vacuum mode, on conductive materials. We will be using a carbon-coated, polished multi-phase geological specimen (basaltic lava) in this week’s lab.

The objective this week is:

- (1) Gain further experience with the controls of the S3400
- (2) Appreciate BSE contrast relative to Z of material
- (3) Compare/contrast BSE with SE images
- (4) Introduction to EDS

Procedure:

1. Imaging a volcanic rock (Aleutian high Al basalt lava, SH5 or SH128¹). There are (at least) 4 different mineral phases present here, plus “holes” (vesicles). Imaging such a sample presents somewhat of a challenge, due to:

- (1) differences in scale of features -- mm size crystals (phenocrysts) vs. micron size crystals (microlites, groundmass), and
- (2) differences in compositions, with Z’s ranging from possibly around 10 to over 20 or 25.
- (3) But you have the advantage of EDS to assist.

Start at the “nominal settings” of 15 kV, Probe Current 60, Aperture 0, Z/WD 10 mm.

Each student should acquire 2 low mag (~50x) and 2 high mag images (~200x), optimizing the contrast between as many phases as possible in one field of view.

One important thing to learn: there always may be something “hiding” in the “white” phase. When the brightness/contrast pushes pixels to maximum brightness (i.e. 255 on the 0-255 intensity scale), you can lose important information. Make sure you play with this and understand this.

Because some people may not have used BSE imaging before, an important part of this exercise relates brightness to composition (usually given as ‘mean atomic number, Z’). Also note that GAIN can be adjusted to go up or down an “Octave” to maximize contrast between the Z of elements present in a field of view.

Below are some ball-park Z values for these phases:

Black: holes = (epoxy or possibly glass slide) (Z could be between 5 and 10)

Darkest grey = plagioclase (feldspar). Note: it may be ‘zoned’ (11-12)

Medium dark grey = augite (pyroxene) or possibly hornblende (12-13)

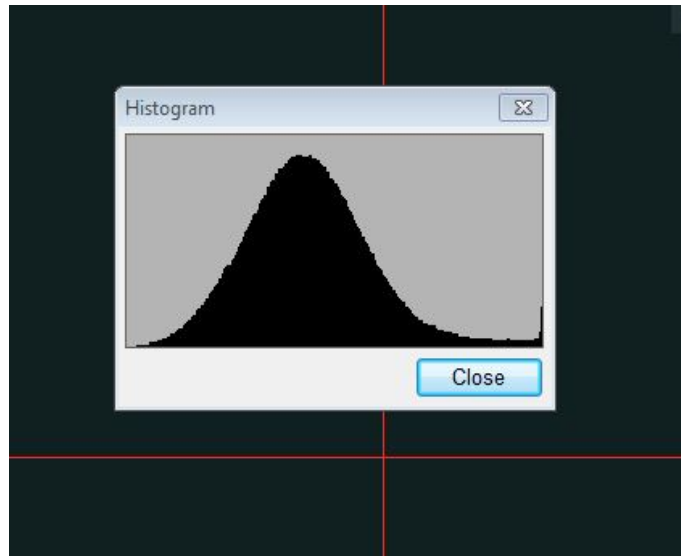
Medium grey = olivine (13-14)

Brightest grey = Ti-magnetite (20-21)

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¹ From Shishaldin Volcano, Unimak Island, the only Aleutian island with grizzly bears

Another useful tool is to use a Histogram that shows how many shades of grey the software is actually recording. Under the IMAGE button on the top of the screen and highlight **Show Histogram**.



A nice Gaussian distribution of channels that covers most of the bottom of the histogram from far left to far right indicates optimal contrast—this is the case where there is only one phase present. However, always be cognizant that the far right end of the histogram is “pure white” and you may have more than one “high Z” phase “hiding” there. ALWAYS assume there is more than one “white” phase

It is also useful to be able to switch back and forth from BSE to SE if/when there are questions such as “is this a hole”? As the shadowing from the off center SE detector many times makes it very easy to determine whether a “black hole” is not a low Z phase but a hole.

You should start to get familiar with the operation of EDS, in characterizing, as best as possible, what each phase (= gray scale) is in terms of composition. For people with geological background, some mineral categories may be tentatively identified.

Turn in next week: A brief report, with images if appropriate, talking about the differences between BSE and SE images; how to optimize BSE images, and possible identities of the phases from EDS.