

Problem 3

In this exercise, we will explore the usefulness of different types of images collected with an electron microprobe. An electron microprobe with scanning electron imaging capability is needed to complete this exercise. If a cathodoluminescence (CL) detector is not available, remove the optical microscope eye-piece and the photomultiplier tube from the secondary electron detector port. Attach the photomultiplier tube to the optical microscope port. The photomultiplier will serve as a CL detector.

Part 3.1: In this part, we will acquire a backscattered electron (BE) image and elemental x-ray images of a sample composed of metal and silicate phases, and will use a digital image analysis program to study compositional variation in the sample. The metal phase has a higher average atomic number than the silicate phases. Hence, it will appear lighter in the BE image.

Acquire a mosaic BE image and a set of x-ray images with the dPict program. Store these images in the TIF format. Now open these images with an image analysis program. Find the area percent of each phase using the statistics option of the program. The area percent data provides a two-dimensional bulk analysis of a cross section of the material if the composition of each phase in the image is known.

Part 3.2: In this part of this exercise, we will acquire a BE image, a secondary electron (SE) image and a cathodoluminescence (CL) image of a zircon grain. Zircon is a mineral with an approximate chemical formula of $ZrSiO_4$. It often contains traces of Th and rare-earth elements in chemically distinct zones of the crystal. These zones often reflect the complex history of growth of the zircon crystal during crystallization from a magma and subsequent modification.

Acquire a BE, an SE and a CL image of the zircon grain separately at the same magnification. The SE image shows the physical shape and relief of the zircon grain, whereas, both the BE and the CL images may show compositional zoning. Is there any difference in the zoning pattern shown by the BE image compared to the CL image? If so, why?