Thin section mineral grain boundy analysis using unsupervised machune learning clustering algorithms on Scanning Electron Microscope data - Jon Barnes, Portland State University

How do we use mineralogical and petrological techniques to analyze thin sections?  One method is to use Scanning Electron Microscopes (SEM) to determine the elemental composition of thin sections, as well as the variation of trace elements between similar mineral grains.  In the summer of 2013, I created a Python code to automate the identification of mineral grain boundaries from SEM data of a thin section. The SEM has a variety of detectors to get different types of elemental data.  The Backscattered Electron Detector (BSE) can be used to scan a rectangle of the thin section to get elemental data for every point. The BSE creates a layered photograph; while similar to the red, blue, and green layers of a normal photograph, the BSE creates a photograph with 256 layers called a Data Cube. The layers in the Data Cube show different energy levels. These raw layers of different energy levels can be reduced down to show the presence and amount of about 50 elements. To convert the multidimensional Data Cube into a two-dimensional image that could have an unsupervised-machine-learning-algorithm automate the classification of mineral grain boundaries, Principal Component Analysis (PCA) first had to be used to convert the Data Cube into an image. Future programing is needed to show which mineral grains are the same minerals and how they vary in their elemental (especially trace element) composition, as well as doing statistical breakdowns of the population of mineral grain size and mineral types.