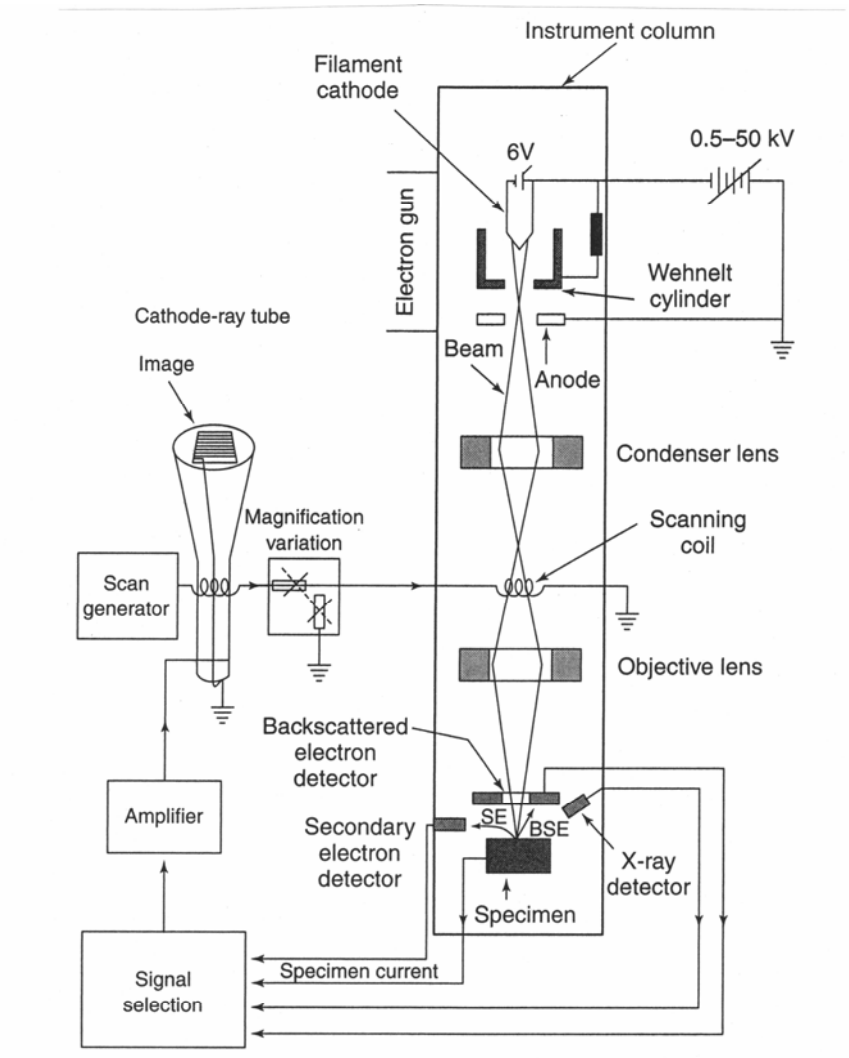
Florida International University
Department of Earth & Environment

GLY 3202L

Earth Materials Lab 3: Mineral Chemistry Using the Scanning Electron Microscope

The Scanning Electron Microscope is used to the look at the shape of the surface of minerals and other materials, and to determine their chemical composition. The sample is bombarded with a beam of electrons. The electrons emerge from a filament cathode and are accelerated and focused by a series of lenses. When they strike the surface of the sample, three kinds of radiation/particles are produced:
1) Secondary electrons (SE) form on the outermost surfaces of materials, where beam electrons cause ionization (loss of valence electrons from atoms). The secondary electrons produce the high magnification image of the mineral surface.



Scanning electron microscope (SEM)

2) Backscattered electrons (BSE) form when the beam electrons rebound from the negatively charged shells of inner electrons surrounding atoms. Backscattered electrons show both the surface shape and composition of materials. The amount of backscattering is proportional to the atomic mass of the atom that is causing the scattering.

3) X-rays are emitted when beam electrons displace inner shell electrons. Outer shell electrons fall inward to replace them, and X-rays are emitted at the same time. These X-rays have energies that are characteristic of the kind of atom that is producing them – each element has its specific spectrum of characteristic X-ray energies. We can look at the energy of the emitted X-rays to determine which elements are present in the mineral.

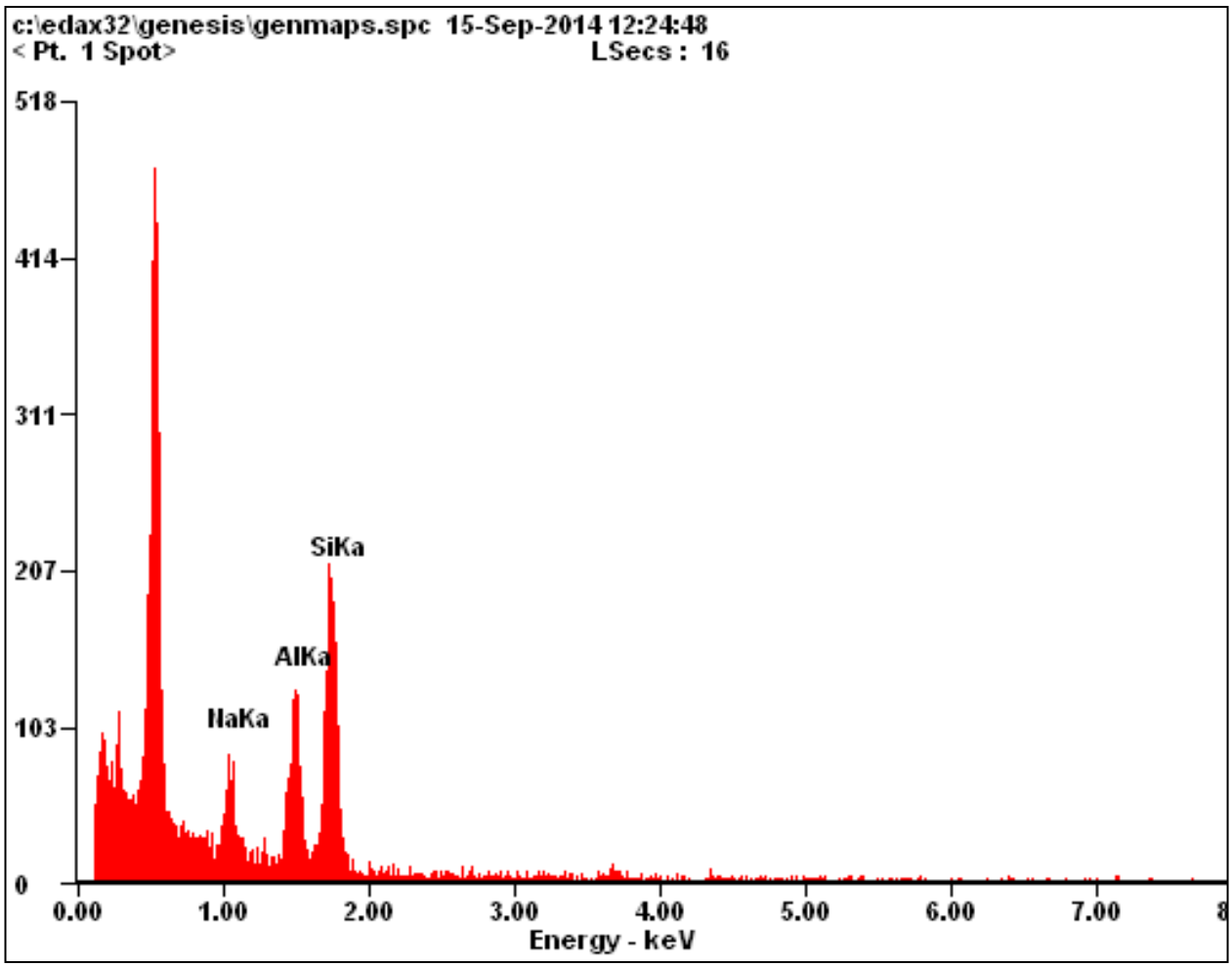
The system that analyzes the X-rays is called the EDS or EDAX (energy dispersive) system.

The result of an EDS analysis is shown on the last page. The Y-axis is counts (a measure of the intensity of the X-ray emission, which is proportional to concentration) and the X-axis is energy (which is a characteristic of the element emitting the X-ray). Concentrations of elements in minerals can be measured quantitatively by comparing the counts to those of standard minerals of known concentration.

In the SEM lab, we will look at some minerals surfaces at high magnification, and do semi-quantitative analysis. Based on the elements present in the minerals, we can do a preliminary identification. Next week we will learn to recalculate the analysis to determine a precise mineral formula.

Procedure: Collect an analysis and ED spectrum for each unknown mineral. Determine the identity of each unknown by comparing its analysis to the formulas of minerals in the list below (formulas are in the textbook).

	Formula	Unknown #
Chromite		
Ilmenite		
Rutile		
Cassiterite		
Apatite		
Corundum		
Feldspar		
Gypsum		
Quartz		
Olivine		
Witherite		
Pyrolusite		
Goethite		
Barite		
Sphalerite		
Chalcopyrite		
Corundum		
Chrysotile		
Sylvite		
Rhodonite		



Example of EDS Analysis

Example of unknown samples on sample holder. Customization of unknown samples is possible.

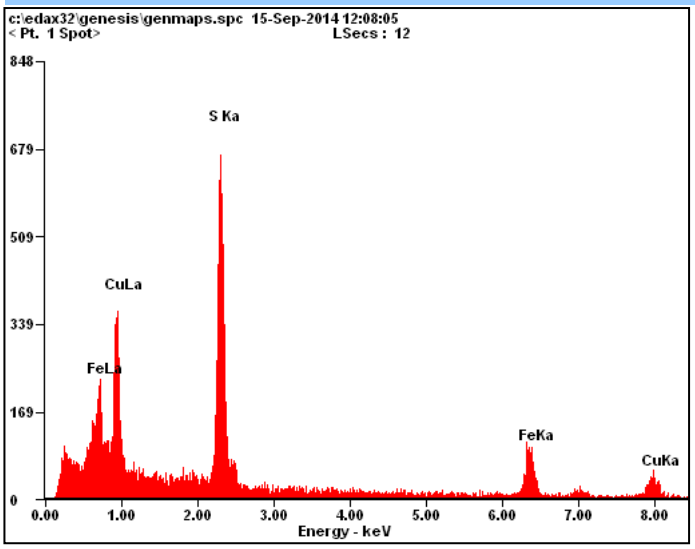
The last page of this document shows an example of the SEM generated microanalysis report of an unknown sample. These types of reports are what students use to identify minerals.

Microanalysis Report

Prepared for: ***GLY3202L***

Prepared by: ***FCAEM*** ***17-Nov-14***

SPECIMEN 1



Element	*Wt%*	*At%*
SK	35.96	51.10
FeK	30.02	24.49
CuK	34.02	24.40
Matrix	Correction	ZAF