Lab Exercise:

Timing of mineralization in the palm of your hand Cross-cutting relations, copper minerals and ore-forming hydrothermal fluid evolution

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Name:

Introduction:

Economic 'ore-forming' minerals are those from which we extract many of our necessary metals, such as copper. Often these Cu-bearing minerals occur as hydrothermal products associated with late-stage igneous activity. Because these magmas are emplaced at near critical conditions of water, that also fracture the rock by fluid expansion), mineralized fractures i.e. fossilized fluid pathways that we observe as veins, are characteristic occurrences of the minerals. The hydrothermal fluids are rich in ore-forming elements, which combine to form several Cu-bearing minerals, dependent on the fluid composition. This mineralogy changes as fluids evolve.

Purpose:

This lab is designed to familiarize you with the geologic history of an ore-deposit, deciphered in the palm of your hand. By determining cross cutting relations and mineralogy, you will decipher the evolution of mineralizing fluids that formed the minerals of a copper ore deposit.

1. Using the rock slab or image provided, examine the slab carefully. You will notice that several veins, of different colors, cross-cut the matrix. Most of the matrix was rhyolite and is now clays plus quartz.

2. Based on your visual inspection, determine the number of different veins present in the slab, based on color e.g. red, blue. Some of the same veins may be cut by different minerals. Count each different mineral as a different vein.

3. Determine the relative age of the different veins using cross-cutting relationships. In some cases, vein material may be altered. Determine the relative age of alteration. In the table below, list the veins, by color, from oldest to youngest.

4. Based on the mineral color, determine the mineralogy of the veins. Fill in the appropriate column of the table.

   Why can we use color to identify these minerals?

5. Determine the oxidation state of the copper, % copper in the mineral, and the necessary elements to form these minerals. Add to the table.

6. What is the general environment in which these vein minerals are found?

7. Optional:
   Easier: Use the attached a-a diagram to help decipher the fluid evolution for the plotted minerals. Consider how the fluid change must change to move from the stability field of one mineral to another e.g. What must increase/decrease?

   Harder: Determine the components that best describe this system. Write the appropriate hydrolysis reactions for this system. Using the thermodynamic data for the phases of interest, construct activity - activity diagrams for this system. Include saturation limits of various phases.

   From these diagrams, determine the fluid evolution of the ore deposit.

8. Write a paragraph describing the geologic history of these samples. Begin with the matrix of the samples, followed by the geologic events and processes that must have occurred to form these samples. Include the chemical evolution of the fluids required to produce the sequence of minerals observed. Now you've observed the formation of an ore deposit!

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Slab Number _____

Relative Age	Color	Mineral	Formula	% Cu	Cu State	Fluid Compo
Oldest						
Matrix						
Generation 1						
Generation 2						
Generation 3						
Generation 4						
Generation 5						
Youngest						