

Lesson 5: Why Matter and Minerals Matter!

Summary

This learning module and related laboratory exercise exposes students to the make-up of minerals and rocks on both Earth and Mars.

Learning Goals

Students will be able to:

- Observe different rock-forming minerals and explain their relationship with water.
- Use CRISM and HiRISE images to identify regions on Mars where aqueous conditions might have been present.

Context for Use

This learning module is meant for adaptation in an introductory earth science course and/or planetary science course. Provide students with an introduction to the atom and the periodic table to provide context and a resource to understand mineral formation.

Description and Teaching Materials

In-Class Activity

In-Class Activity 1: Follow the water with minerals

Homework/Lab

Homework 1: Identifying the clay: Endeavor Crater

Teaching Notes and Tips

1. For *In-Class Activity 1* either (a) print off colored copies for students (b) have hand sample specimens of each mineral for students to observe or (c) use the image file to show students the minerals.
2. For a large class size >20 where you would like to use hand-specimens, have a scope attached to your projector so students may observe "up-close".

3. Become familiar with JMARS software prior to class (loaded on whatever machine you will be using for presentation), especially with viewing CRISM and HiRISE image stamps to discern mineralogy on Mars.
4. Students should have a working understanding of how to navigate and use JMARS prior to completing *Homework 1*.

Assessment

Assessment is imbedded within each *In-Class Activity*.

Mars for Earthlings

References and Resources

1. Image File: [Matter and Minerals](#)
2. CRISM webpage: <http://crism-map.jhuapl.edu>
3. HiRISE webpage: <http://hirise.lpl.arizona.edu>



Mars for Earthlings

Homework 1

Matter and Minerals_MFE

Identifying the Clay: Endeavor Crater

Objective: To further utilize the tools offered within the software JMARS and investigate mineralogies observed at Endeavor Crater.

Introduction: In order to accomplish this lab the students will need to register and download JMARS. By this point, they should be familiar with JMARS software and how to navigate to regions of interest on Mars.

1. Using the Nomenclature Layer, navigate to Endeavor Crater (approx. 354.7705°E, -2.2480°N).
 - a. For best viewing results, Zoom to 1024 and center the main screen on the western rim of Endeavor Crater
 - b. If the students still have their nomenclature layer turned on, they will see the labeled “Endeavor” to the right of the rim they are exploring
2. Choosing HiRISE stamps to explore Endeavor Crater with the highest resolution possible.
 - a. Using the stamps layer choose either HiRISE DTMS or HiRISE full stamps. Make sure the students zoom in close so that when they search for HiRISE stamps hundreds do not try to load. Use the “main view” to limit the search of HiRISE stamps. Choose stamps rendered by ASU.
 - b. Compare and contrast the HiRISE DTM images and the HiRISE Full stamps images. Which do the students prefer and why?
 - c. Consult the webpage: <http://hirise.lpl.arizona.edu/dtm/about.php> . After consulting the webpage, which set of imagery would they rather use, DTM or Full stamps? Did their choice change? Why or why not?
 - d. Decide which HiRISE imagery the students will choose to display and explore the western crater rim.



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3. Exploring the mineralogy of Endeavor Crater using CRISM
 - a. Add the CRISM stamps layer and use a different outline color to differentiate CRISM and HiRISE stamps. To display CRISM stamps, use the “Main View” to set the bounds of the image search.
 - b. Provide a rough estimate of the number of CRISM stamps: _____
Do they outnumber the HiRISE DTM stamps or full stamps? Why do the students think this is (think of current/past mission objectives)?
 - c. Start exploring some of the CRISM stamps intersecting the HiRISE DTM stamps. Choose any stamp and the ASU-rendered images. When using ASU images, use the *color overlay*. ASU provides the students with a number of options. List at least three below (i.e. Ferric Mineralogy):
 - d. Find a CRISM stamp that is rendered for phyllosilicates. Where are the phyllosilicates located in the crater (the rim, the rim wall, or the bottom of the crater)? What does this tell them? *Note: the warmer the color the higher content of the respective mineral.
 - e. Compare the sulfate CRISM overlays. Are sulfates found in the same region as the phyllosilicates? Why or why not?
 - f. Select another crater on Mars that has CRISM stamps available. Compare and contrast the phyllosilicates abundance between the two craters below. Please name the crater and its coordinates for verification.

