

Lesson 6: Olympus Mons and Igneous Rocks

Summary

This learning module and related laboratory exercise exposes students to volcanic styles, eruptions, igneous rock textures and their evidence in the Martian landscape.

Learning Goals

Students will be able to:

- Differentiate between pahoehoe and a'a lava flows through USGS video and subsequent discussion. Students will then observe Mars imaging of lava flows and hypothesize which lava flow is more likely on Mars.
- Observe a columnar joint experiment using cornstarch, observe the process and discuss its potential formation on Mars. Students will observe columnar jointing on Mars using HiRISE imaging and compare the features to the Columbia River basalts on Earth as an analog.
- Use Google Mars and JMARS software, students will increase their literacy with the software packages as well as recognize and analyze different mineralogies on Mars and the nature of Olympus Mons in comparison to Earth analog volcanoes.

Context for Use

This learning module is meant for adaptation in an introductory earth science course and/or planetary science course. Before engaging in the In-Class Activities and/or Homework, students will need to be provided with an overview of igneous rocks (see Teaching Notes and Tips). All In-Class Activities can be adapted to a homework set if desired. Online access is essential for video viewing in association with the In-Class Activities.

Description and Teaching Materials

In-Class Activity

In-Class Activity 1: Lava flows

In-Class Activity 2: Cornstarch columnar joints

Homework/Lab

Homework 1: Google Olympus Mons

Homework 2: Basalt & JMARS

Teaching Notes and Tips

1. Provide students with a background in the rock cycle, igneous rock textures, volcanic styles, and rates of cooling for *In-Class Activity 1*.

Mars for Earthlings

- Instructors may choose to develop their own cornstarch experiment by the adaptation of the following published experiment and results: http://www.physics.utoronto.ca/~nonlin/papers_mud.html
- Make sure students are familiar with both Google Mars and JMARS software. The introduction module “Introduction to Mars and Earth Analogs” provide homework and/or In-Class activities to expose and orient students to the software packages.

Assessment

- One of the goals of MFE is to have students become familiar with Mars imagery and navigating the mission online archives as well as software programs available to explore Mars imagery. The homework assignments, if completed, will provide students with increased competence in navigating both Google Mars and JMARS software.
- Through comparison of various Mars images students will be asked to identify common minerals on Mars, their abundance in terms of geographic location, as well as style of igneous rock formation.



Mars for Earthlings

References and Resources

1. Image file: [Igneous Rocks and Volcanics](#)
2. Rock Cycle Background:
http://www.classzone.com/books/earth_science/terc/content/investigations/es0602/es0602page02.cfm
3. Columnar Joint Experiment Video: www.youtube.com/watch?v=CJWfneKdv08
4. Columnar Joint Article:
<http://www.sciencedaily.com/releases/2008/12/081216104325.htm>
5. Columnar Jointing in Columbia River Gorge Oregon:
http://www.youtube.com/watch?v=WLGXmJZ_KIU
6. Mars columnar jointing discovery by HIRISE in Geology:
<http://geology.gsapubs.org/content/37/2/171/F1.expansion.html>
7. HIRIES columnar jointing image:
http://www.nasa.gov/mission_pages/MRO/multimedia/mro20090225.html
8. Pahoehoe lava flow video:
<http://www.youtube.com/watch?v=qTTLyx4Xo2k&feature=related>
9. A'a lava flow video: <http://www.youtube.com/watch?v=bWswq8PmRII>
10. Basalt on Mars (Hawaii): <http://www.psr.d.hawaii.edu/May09/Mars.Basaltic.Crust.html>
11. Athabasca Spiral lava flows: Discovery news article: <http://www.space.com/15446-mars-lava-volcanoes.html>
Image source: <http://www.space.com/15446-mars-lava-volcanoes.html>
12. Mars Plagioclase mineralogy animation:
<http://www.youtube.com/watch?v=FRU0cHb31JM>



Mars for Earthlings

Homework 1

Igneous Rocks & Volcanics_MFE

Google Olympus Mons

Purpose: Explore Olympus Mons using the Google Mars platform through HiRISE imagery and Colorized Terrain maps.

Preparation: Download Google Earth 6

<http://www.google.com/earth/download/ge/agree.html>

Directions/Questions:

Navigate to Olympus Mons

1. Open Google Mars (click on the planet with a ring)
2. Turn on the Global Maps Layer *Colorized Terrain*
3. Navigate to Olympus Mons- the tallest point on Mars
 - a. What is the elevation of Olympus Mons?
4. Activate the *HIRISE Image layer* under the Spacecraft Image Layer Folder

Analyze Olympus Mons Images

5. Zoom in to the top of the Olympus Mons Caldera
 - a. Find image PSP_004821_1985 from HIRISE [near the Hiker icon]
 - b. Have the students sketch what they see in the image below.
 - c. What might they be seeing? Consider the context image of the Colorized Terrain map and have them list their observations.
6. Find image PSP_004531_1990: NW flank of Olympus Mons (note the compass in the upper right ~ 15-18km elevation, 18.56N 224.28E)
 - a. Have the students sketch what they see in the image below.



Mars for Earthlings

- b. Can they make some interpretations about what they are observing?

Comparing Olympus Mons and Earth Analogs

7. Of the volcanic styles (mafic vs. felsic), which volcanic type fits Olympus Mons the best? Have students explain their choice and why Olympus Mons cannot be classified as the other choices.

8. If they wanted to be sure about their volcano classification, what additional data would they need to confirm their choice in #7?

9. What volcano on Earth serves as the best comparison to Olympus Mons (the students may need to do some outside research to answer this question adequately)?

