

Lesson 16: Weathering and Soils

Summary

This module is aimed at helping students understand the patterns and drivers of weathering and the formation of soils on Earth and Mars.

Learning Goals

Students will be able to:

- Differentiate, in photos, between mechanical and chemical weathering processes on Mars & Earth
- Discern, in hand sample, weathered vs. non/lesser weathered material
- Recognize and discern a soil and define soil-forming factors
- Critique the presence of “soil” observations on Mars

Context for Use

It is advisable that students are familiar with basic lithology and mineralogy to be successful in these activities and homework sets.

Description and Teaching Materials

In-Class Activity

In-Class Activity 1: Break a Rock!
(need rocks, hammers, and handlenses)

In-Class Activity 2: Is it a Soil?

Homework/Lab

Homework 1: Chemical vs. Mechanical

2. For In-Class Activity 1 conduct the exercise in a lab environment and/or outside

Assessment

Methods of assessment are within each individual *In-Class Activity* and *Homework*.

Teaching Notes and Tips

1. Depending on class size, samples for every student would be advisable to proceed with In-Class Activity 1. With classes size >20 or more students, simply provide a demonstration and have students record the methods and outcomes of what they are observing

Mars for Earthlings

References and Resources:

1. Image File: [Weathering and Soils](#)
2. This NASA webpage has a search function for many images related to weathering.
<http://www.jpl.nasa.gov/spaceimages/details.php?id=PIA12994>
e.g., the word "soil" will pull up images of both Earth and Mars
3. Mars "blueberries" spherules NASA announcement:
http://www.nasa.gov/mission_pages/mer/multimedia/pia16139.html



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Homework 1

Weathering and Soils_MFE

Chemical vs. Mechanical

Introduction: This exercise will focus on the students' ability to identify weathering processes/features on Earth and on Mars. The last part of this exercise will involve using Google Mars to recognize weathering features through high-resolution images.

PART I—Weathering of Earth

For the following 4 images, determine whether they are the result of mechanical or chemical weathering, and identify the specific process that formed the weathering feature.



Sandstone
Australia
Humid continental

Image 1 (Image Source: http://commons.wikimedia.org/wiki/File:Cracked_boulder_DMCR.jpg, "Devil's Marbles" Author: Prince Roy)

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Sandstone
Oregon,
Coastal/temperate

Image 2 (Image Source:

<http://www.earthscienceworld.org/images/search/results.html?Category=&Continent=&ImageID=hhrhsr#null> Photographer: Marli Miller, University of Oregon)



Sandstone
Anza-Borrego Desert State Park,
California,
Semi-arid/rain shadow

Image 3 (Image Credit: Michael Szoenyi/Science Photo Library;
<http://www.sciencephoto.com/media/173681/enlarge>)

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Granite
Enchanted Rock,
Texas
Humid Subtropical

Image 4 (Image Source <http://en.wikipedia.org/wiki/File:GeologicalExfoliationOfGraniteRock.jpg>)

PART II—Weathering of Mars

For the following images, identify whether the features are caused by mechanical or chemical weathering and answer the additional questions for each image.

Image 5

1. What are 3 likely processes causing the pits in the rock in the image below?
2. What does the pitting process mean for the type of environment that could have existed on Mars?
3. Name 3 geographic areas on Earth that would work as an analog to this rock.



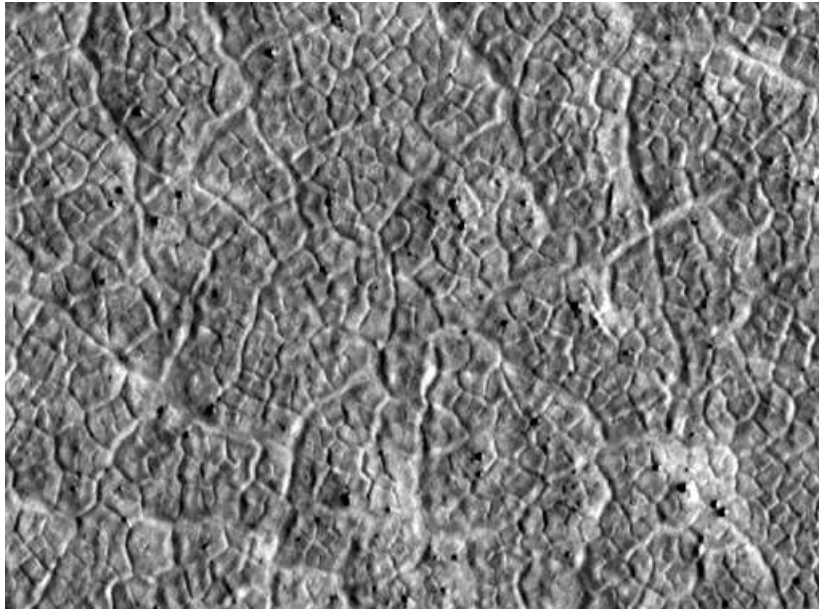
Volcanic rock
Ares Valles region,
Pathfinder landing site

Image 5 (Image Source: <http://science.ksc.nasa.gov/mars/mpf/stereo-arc.html>)

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Image 6

1. What feature is shown below?
2. What are 3 processes/influences that can cause these features?



Likely sand-siltstone
Near North Pole

Image 6 (Image Source: http://web.pdx.edu/~pdx06058/Planetary_Research.html)

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Image 7

1. This is a false-color image of the surrounding area around the Sojourner Rover. What is the red tone on the Martian surface and what does that mean?
2. Which direction is the wind coming from (This does not have to do with weathering)?



Volcanic rock (Yogi rock)
Ares Valles region
Pathfinder Lander location

Image 7 (Image Source: http://nssdc.gsfc.nasa.gov/planetary/marspath_images_2.html)

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Image 8

1. What is the nickname given to the little balls scattered in the image below?
2. What are they? How are they formed and what does that mean for surface processes in the Martian past?
3. What weathers faster: the host rock or the little balls scattered on the surface? Give some reasons to support your answer.



Photo by MER Opportunity Rover
At rock outcrop "Shoemaker's
Patio"

Image 8 (Image Credit: NASA/JPL; Source: <http://photojournal.jpl.nasa.gov/catalog/PIA05584>)

PART III—Google Mars

- 1) The images in questions 1 and 3 were taken by the Mars Pathfinder Lander.
 - a. Where is the lander located (lat/long)?
 - b. Go into the "presidential" panorama and describe the image and features.
 - c. It landed in Ares Valles. Describe the area in terms of the geomorphic features and why it presently looks this way.
- 2) The image in question 2 was taken by the HiRISE camera aboard the Mars Reconnaissance Orbiter. The coordinates are approximately 71° 38' N and 145° 20' E.
 - a. What kind of environment would create a surface like this? Is this process continuing today on Mars? Is it continuing on Earth?
- 3) The MER Opportunity rover took the image 8. Go to the following website:

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<http://mars.nasa.gov/mer/home/>

Click on Multimedia

- Click on images
 - Go to All Raw images for the Opportunity Rover
 - Next go down to Science Cameras/Panoramic Camera and scroll down to Sol 109, Click "View Selected Images"
 - Scroll down and explore images 8-20 under Sub-Frame EDR (not numbered)
- a. Determine why it took so many images of the same spot on the surface.
 - b. Record the Sol from the latest image (go back one page). How does this Sol compare to the expected life of the mission?
 - c. Go back to Google Mars and determine approximately where the rover was when it took these pictures, both geographically and lat/long.
 - d. Go to the panoramic, "Crater of Clues" and have the students briefly describe what they see, both around the rim of the crater as well as within the crater.

