

Lesson 14: Mars Water World

Summary

It is hypothesized that an ocean might have existed on Mars. Students will learn what sedimentary structures and landforms in ancient, Earth, marine environments look like and the processes that formed them. From this Earth-analog approach students will observe Mars imagery and determine whether or not a Mars ocean might have existed in the distant past.

Learning Goals

Students will be able to:

- Identify spits on Mars and Earth and understand their formation.
- Recognize and identify carbonate rocks and the reasons for a lack of carbonates on Mars.
- Critically analyze press releases of Mars discoveries and determine what other data, if any, is needed to make the scientific findings valid.

Context for Use

This learning module is meant for adaptation in an introductory Earth science course and/or planetary science course. The *In-Class Activities* can be easily adapted for homework when desired.

Description and Teaching Materials

In-Class Activity

In-Class Activity 1: Spits on Mars

In-Class Activity 2: Where is the carbonate on Mars?

Homework/Lab

Homework 1: Mars Ocean Press Release

Teaching Notes and Tips

1. *In-Class Activity 2*: for classes >20 students we recommend passing around several specimens of carbonate rocks and/or use an overhead microscope system for the classroom so students can observe

the texture and make observations of the carbonate rocks without a hand specimen.

2. *Homework 1*: You may need to exchange the press release articles for more current articles depending on the year in which you use this material.
3. You will often integrate the Explanation and Exploration sections of the In-Class Activities. Interact with the students as they “explore” and help them define terms/principles.

Assessment

Each In-Class Activity and/or Homework has its own measure of Assessment.

Mars for Earthlings

Resources

1. Image File: [Water World](#).
2. Spit Formation in the UK and longshore drift:
http://www.youtube.com/watch?v=Fe9YBuK_qEo&feature=endscreen&NR=1
3. Lake Bonneville video: <http://www.youtube.com/watch?v=0SJDOluY4OI>
4. NASA Video “Keeping up with Carbon”:
<http://www.youtube.com/watch?v=FgEZpX3n5mo>
5. Beachy Head geology: http://www.discoveringfossils.co.uk/beachy_head_fossils.htm



Mars for Earthlings

In-Class Activity 2

Water World_MFE

Where is the carbonate on Mars?

Purpose: Expose students to the carbon cycle on Earth and how carbonate rocks are created. Students will develop a line of evidence or explanation for the reasons why carbonate rocks are not abundant on Mars.

Preparation

1. Depending on your mode of delivery (in class versus perhaps a homework setting), load the Image File .ppt for the class and make sure you have an Internet connection to view the associated videos.
2. Find 3 specimens of carbonate rocks (micrite, coquina, grainstone/packstone, or chalk) or use *Image File* to show 3 specimens of carbonate rocks.
3. Have JMARS available to view carbonate minerals maps of Mars, as well as MOLA maps for geographic context.

Engage

Have students observe 3 different carbonate rocks and ask the following:

1. What are the similarities between these rocks?
2. Where might these rocks have been deposited or formed? What is the students' evidence?

Explore

Forming carbonate rocks on Earth

1. Have students brainstorm how carbonate rocks are formed. Write their ideas on the board.
2. Watch the following NASA video entitled "Keeping up with Carbon":
<http://www.youtube.com/watch?v=FgEZpX3n5mo>
 - a. How does the student's "formation" history compare/contrast with the video?
 - b. What elements of the video's content exist/do not exist on Mars?

Carbonate rocks on Mars

1. Bring up JMARS maps of carbonate rocks for students to view the extent (or lack thereof) of carbonate rocks.
2. Where are the carbonate minerals most common?

Explain

Carbonates – a class of sedimentary rocks composed primarily of carbonate minerals ranging from calcite to dolomite.

Elaborate

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Mars for Earthlings

Assign to students:

Consider the biosphere, lithosphere, and current atmospheric conditions of Mars at present, when responding to the following questions:

1. What would students need to change about Mars today for Mars to be conducive to carbonate development?

*Note: Answers can be elaborately crazy, i.e. put petroleum-powered cars on Mars and create vast amounts of CO₂ emissions or if possible move Mars closer to the sun so that it isn't so cold....etc.

Evaluate

Present the following image of Mars (for a full resolution image see the *Image File* for this module) and ask students the following questions:

In this hypothetical situation (although *real* imagery)

1. Where might the students find carbonates?
2. On what information did the students base their answers?

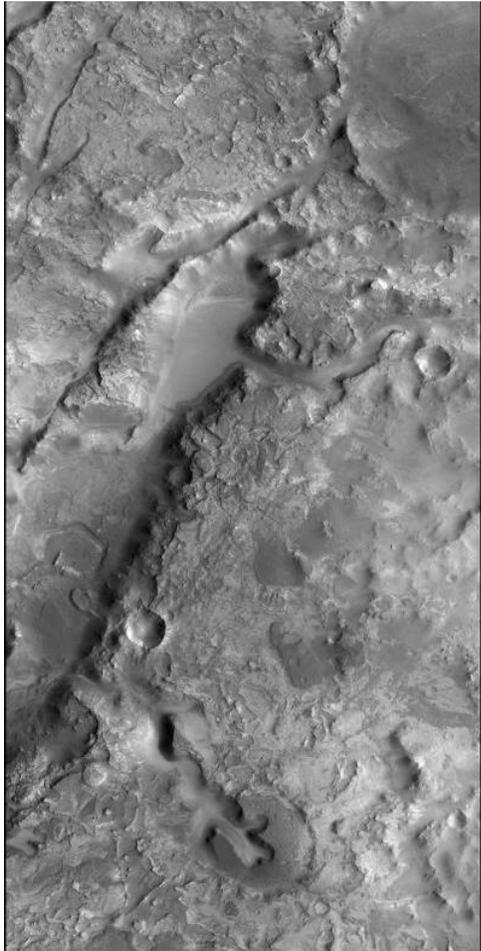


Figure 1: Nili Fossae Region Imaged by CTX, Image Credit: ASU/Malin Space Science Systems