Lesson 17: Vast Deserts on Mars

Summary
Using a Sandbox experiment and Google Earth students will study the formation of dunes and relate their observations to Mars dune field imagery.

Learning Goals

Students will be able to:

- Identify wind current directions on Earth and Mars
- Explain the formation of certain dune morphologies.
- Use Google Earth to identify changing paleocurrent direction, bounding surfaces, and their potential to be observed/preserved on Mars.

Context for Use
This learning module is meant for integrating the Martian wind into terrestrial analysis. The *In-Class Activities* can be easily adapted for homework when desired.

Description and Teaching Materials
In-Class Activity

In-Class Activity 1: Sandbox Dunes
In-Class Activity 2: Martian Ventifacts

Homework/Lab

Homework 1: "Bounding" Through Dunes

Teaching Notes and Tips

1. For larger classes (>20 students) you can either create your own Sandbox Dune demonstration or use the Video demonstration (see Resources).
2. In Homework 1: students will need a clear understanding of how dunes and dune processes are recorded in the rock record (marching away from you, toward you, paleocurrent direction etc.).
3. You will often integrate the Explain and Explore sections of the In-Class Activities. Interact with the students as they "explore" and help them define terms/principles (Ex: Sandbox Dunes).

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

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References and Resources

1. Image file: Vast Deserts on Mars
2. Antarctica Ventifacts
3. Sand Box Dune Video: http://serc.carleton.edu/details/files/44290.html
4. Grotzinger, J.P. et al., 2005. Stratigraphy and sedimentology of a dry to wet eolian depositional system, Burns formation, Meridiani Planum, Mars. Earth & Planetary Science Letters, v. 240, p.11-72.
5. Burns Formation PanCam Sol 288 Image Source: http://marsrover.nasa.gov/gallery/all/1/p/288/1P153752565ESF37MIP2544L7M1.HTML

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Homework 1
Vast Deserts_MFE
"Bounding" through Dunes

Purpose:

- Recognize bounding surfaces in Google Earth imagery and their meaning in the geologic record.
- Understand why bounding surfaces are or are not recognized on Mars.

Preparation:
Make sure the students have Google Earth downloaded on their computer to accomplish this exercise. http://www.google.com/earth/download/ge/agree.html

Questions:
Checkerboard Mesa, Zion National Park UT

1. Open Google Earth (load the free program if necessary).
2. Navigate to 37°13'30.75"N 112°52'54.13"W and orient the window looking Southwest. See image below* for orientation of the viewing window.

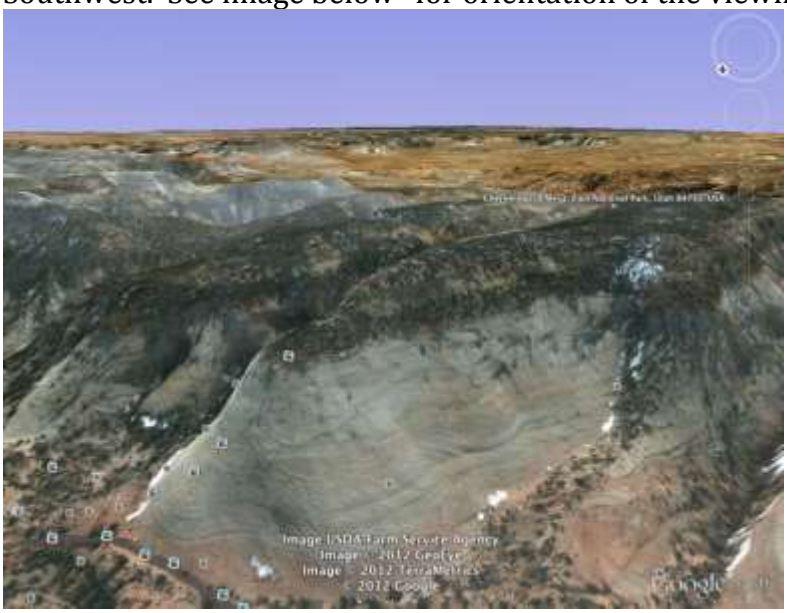

Figure 1 Image captured through Google Earth

Have the students capture their own .jpg and insert their image into a PowerPoint file.
*the image in this exercise is not zoomed in or large enough for their PowerPoint slide

3. In PowerPoint, have students annotate their image with the following:
    a. Paleocurrent direction- red arrows
    b. Bounding surfaces- green lines
    c. Dunes are "marching towards you" – blue triangles
    d. Dune are "marching away from you"…in any direction – orange triangles

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4. On another slide, answer the following questions
    a. What do the bounding surfaces represent?
    b. What created the sinusoid (sine wave) morphology of the beds?

Burns formation, Meridiani Planum Mars

5. Insert the following Burns formation image into a slide and do the following:

Figure 2 Left Panoramic Camera Non-linearized Sub-frame EDR acquired on Sol 288 of Opportunity's mission to Meridiani Planum at approximately 13:10:16 Mars local solar time, camera commanded to use Filter 7 (432 nm). NASA/JPL/Cornell

    a. Follow the same instructions for labeling as for Checkerboard Mesa above (answers to the following questions should be given in a separate slide).
    b. What are the main differences between Checkerboard Mesa and the Burns Formation outcrop? Cite at least 3.
    c. Do the students think the Burns Formation was formed in an eolian environment? Why or why not?
    d. In the below photos, how is the colorized imagery helpful? What do they observe in Image C of Figure 3? Why do some layers "look different"?

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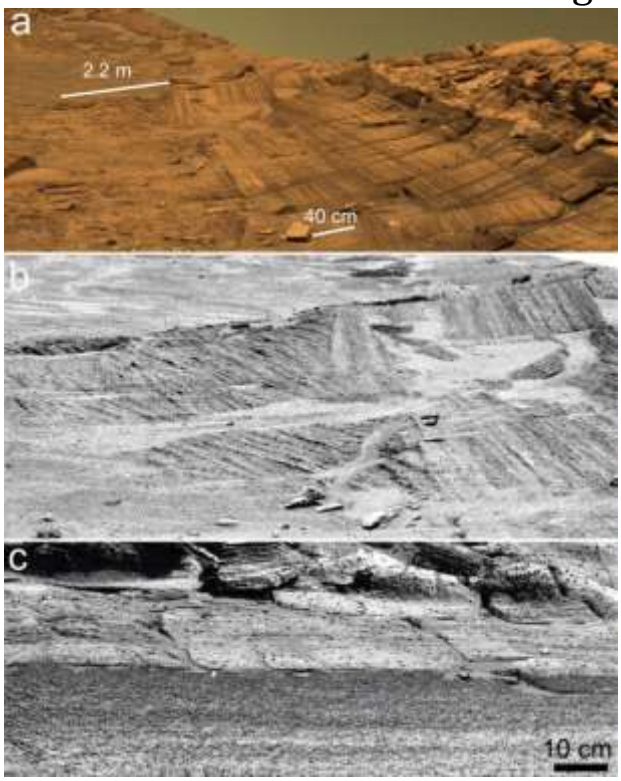

Figure 3: Burns Formation stratigraphy (Grotzinger et al., 2005).