Mars for Earthlings

LESSON 17: Vast Deserts

In-Class Activity 1

Sand Box Dunes

Purpose: Understand the processes that form sand dunes on Mars and Earth.

Resources:

1. HiRISE Dune Image Source: http://hirise.lpl.arizona.edu/ESP_012202_1390
2. THEMIS Dune Image Source: http://themis.asu.edu/node/5758
3. Mars Global MOLA map: http://mola.gsfc.nasa.gov/images/mercat_med.jpg

Desert Pavement:

1. If you were to travel into a valley and see the rocks shown in Figure 1:
    a. What processes are at work in the valley?

    b. What grain sizes are left?

    c. What happened to the rest of the grains?

Figure 1: Death Valley ventifacts; *Photo by Marjorie Chan*

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Sand Box

1. Watch the sandbox demonstration and answer the following (http://serc.carleton.edu/details/files/44290.html):

    a. How does the surface change?

    b. Which side of the dunes are the steepest? Why?

    c. What happens when the angle becomes too steep? What do we call that angle?

    d. What is the steep side of the dune called?

    e. How does the slip face change through time?

Mars Image Analysis

2. View the following Mars Images

    HiRISE: ESP_012202_1390 Dunes in the Western Nereidum Montes (38.6S, 44W)

    THEMIS: V43323004 Terra Sirenum (39.7S, 150W)

    a. Answer the following:

        i. What is the prevailing wind direction in each image?

        ii. Are the dunes multi-directional? If so, how can you tell?

        iii. Is there more than one dune shape/morphology (barchans, transverse, longitudinal, parabolic etc.)? If so, what are they?

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Sediment Source Determination

Referring to the Mars Images, answer the following:

1. What is the sediment supply like (abundant, sparse)? Explain your answer.

2. According to your knowledge of the geography of Mars and its regions, what might be the source of the sediment (refer to the MOLA map your Instructor has posted)?

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In-Class Activity 2
Vast Deserts_MFE
Martian Ventifacts

Purpose: Explore the existence and formation processes of ventifacts.

Resources:

1. Mojave Desert Ventifact Video: http://www.youtube.com/watch?v=OOqOm3KgGMw&feature=endscreen
2. Mars ventifact images: http://www.psi.edu/pgwg/images/jul09image.html

Ventifacts: For an explanation on ventifacts use the following link (http://www.psi.edu/pgwg/images/jul09image.html)

Death Valley
Observe the Death Valley photo below and answer the following questions:

Figure 1: Death Valley Photo, credit: Marjorie Chan

1. What formation seems odd to you? Have you seen anything like it? Why is there only one?
2. Hypothesize how this might have formed.

Understanding Ventifact Formation
View the following video and answer the following questions.
http://www.youtube.com/watch?v=OOqOm3KgGMw&feature=endscreen

1. What do you look for in order to determine if a rock or feature is a ventifact?

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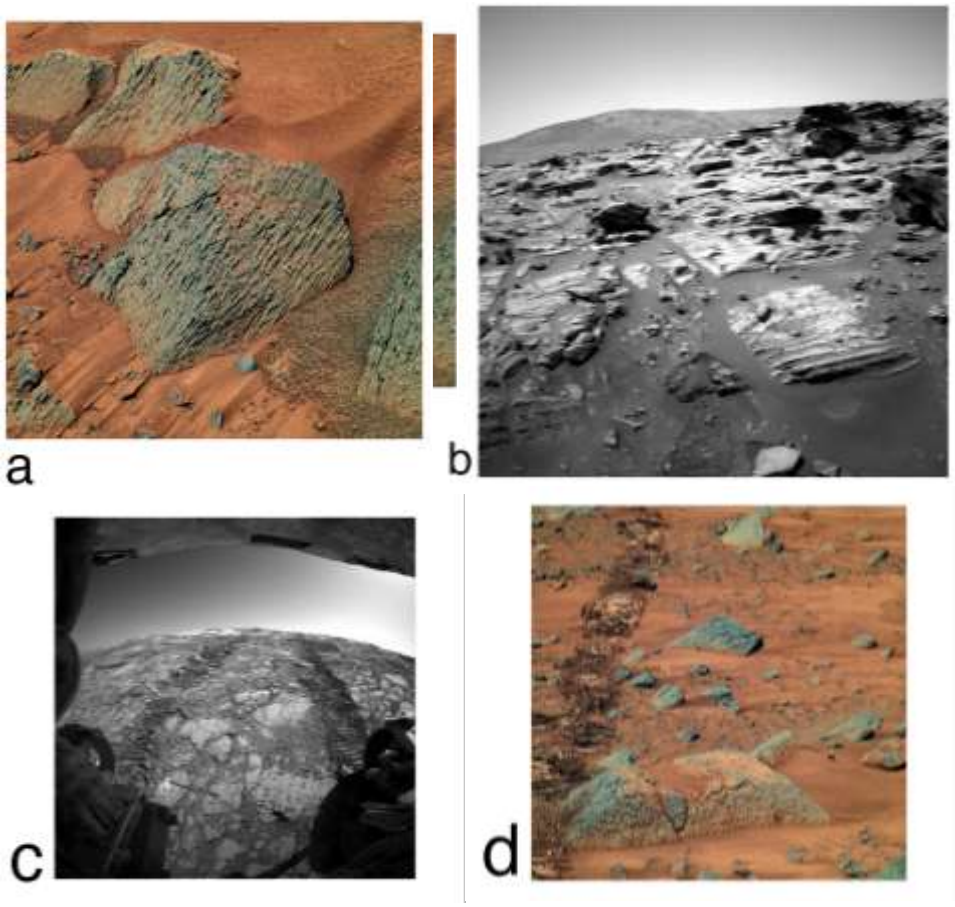
2. How can you discern which direction the wind was/is blowing?

3. What causes the reddish-orange coloration?

Martian Ventifacts?
Here is what might be considered ventifacts on Mars:
Image Source:
http://www.psi.edu/sites/default/files/imported/pgwg/images/VentFig4.jpg



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1. Label the wind direction on each image above with a colored pencil or colored pen.

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2. Is the preservation potential higher on Mars or Earth? Explain your reasoning via images where possible.

3. Do you believe that these are indeed ventifacts? Why or why not? Which images are the best examples of true ventifacts? Explain your reasoning. Which images are more dubious? Explain your reasoning.

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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 you have Google Earth downloaded on your 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 your viewing window.

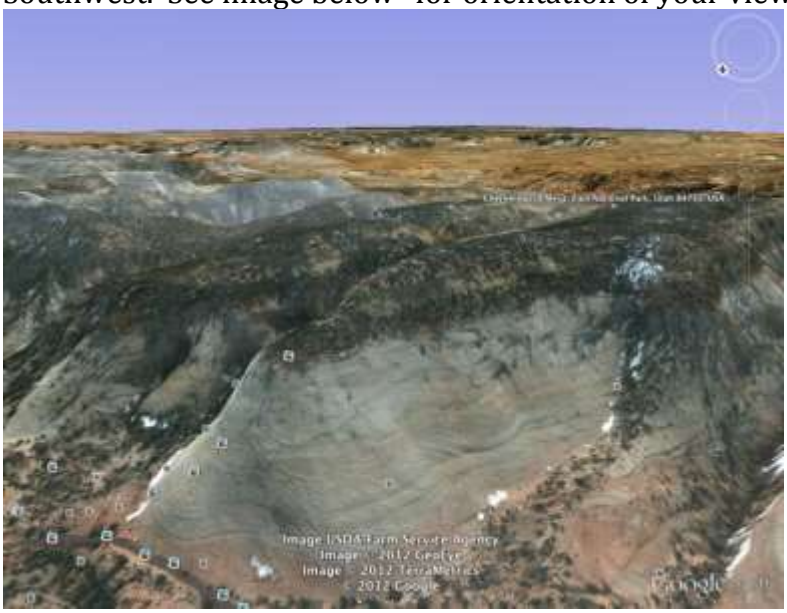

Figure 1 Image captured through Google Earth

Capture your own .jpg and insert your image into a PowerPoint file.
*the image in this exercise is not zoomed in or large enough for your PowerPoint slide

3. In PowerPoint, annotate your 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 you 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 you observe in Image C of Figure 3? Why do some layers "look different"?

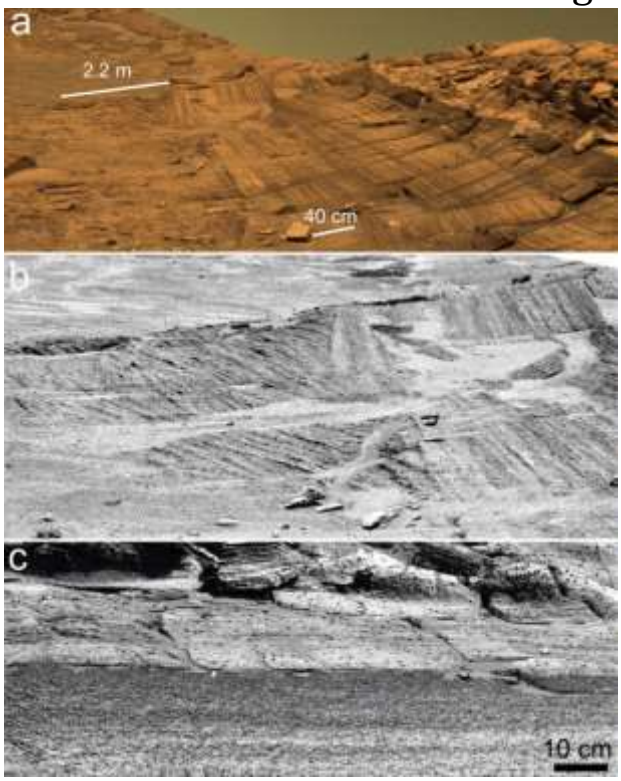

Figure 3: Burns Formation stratigraphy (Grotzinger et al., 2005).

6. Turn your .ppt presentation/slides into your instructor.