Mars Image Analysis

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Mars Image Analysis

Objectives of the Activity:

Students will:

- Engage in a hands-on, critical thinking and collaborative approach to studying images of Mars.

- Use observations, inferences, and measurement to make interpretations of geologic processes that may have occurred.

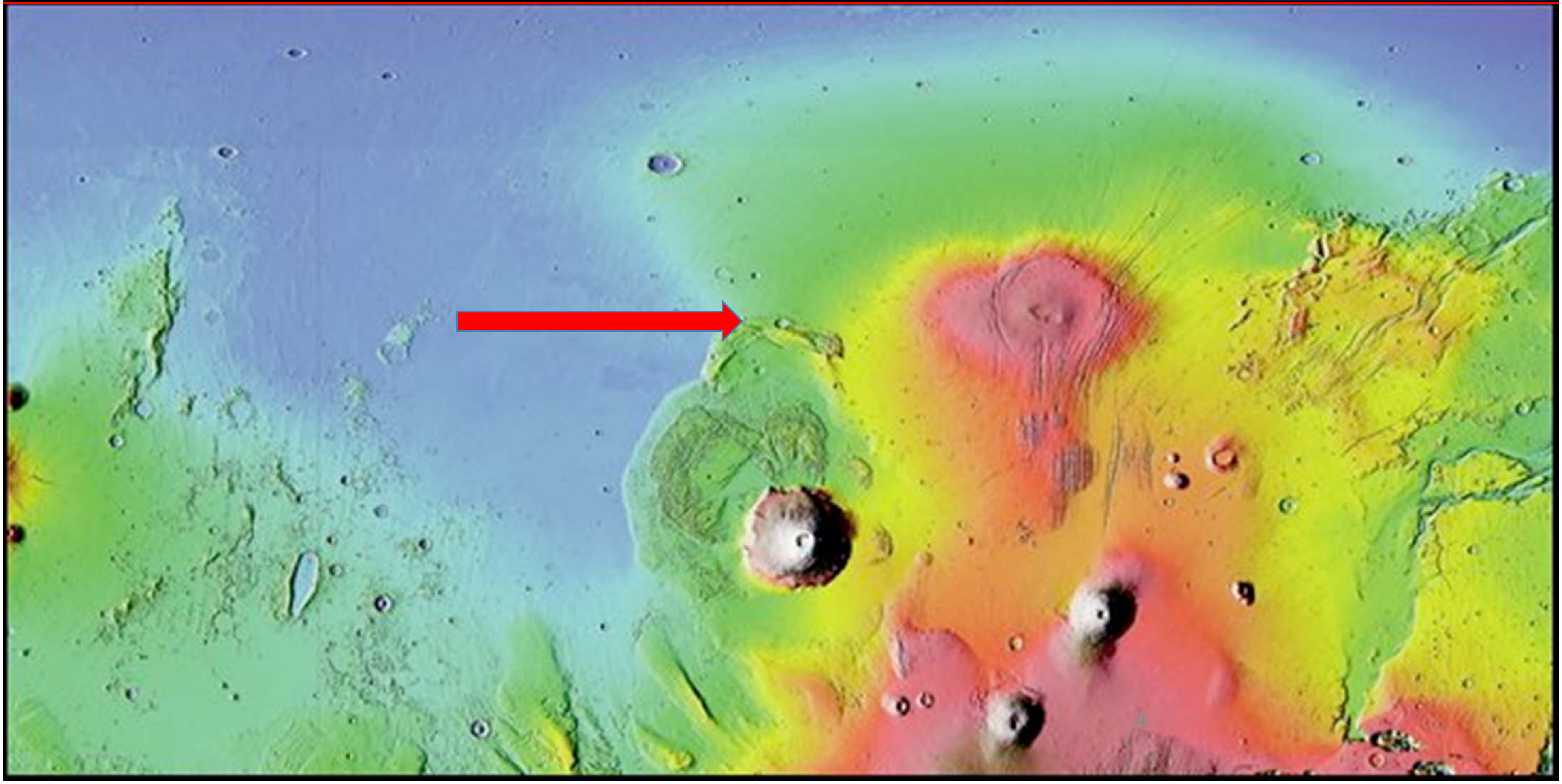
- Interpret those processes into a geologic history of the Imaged region.

5 E Learning Cycle

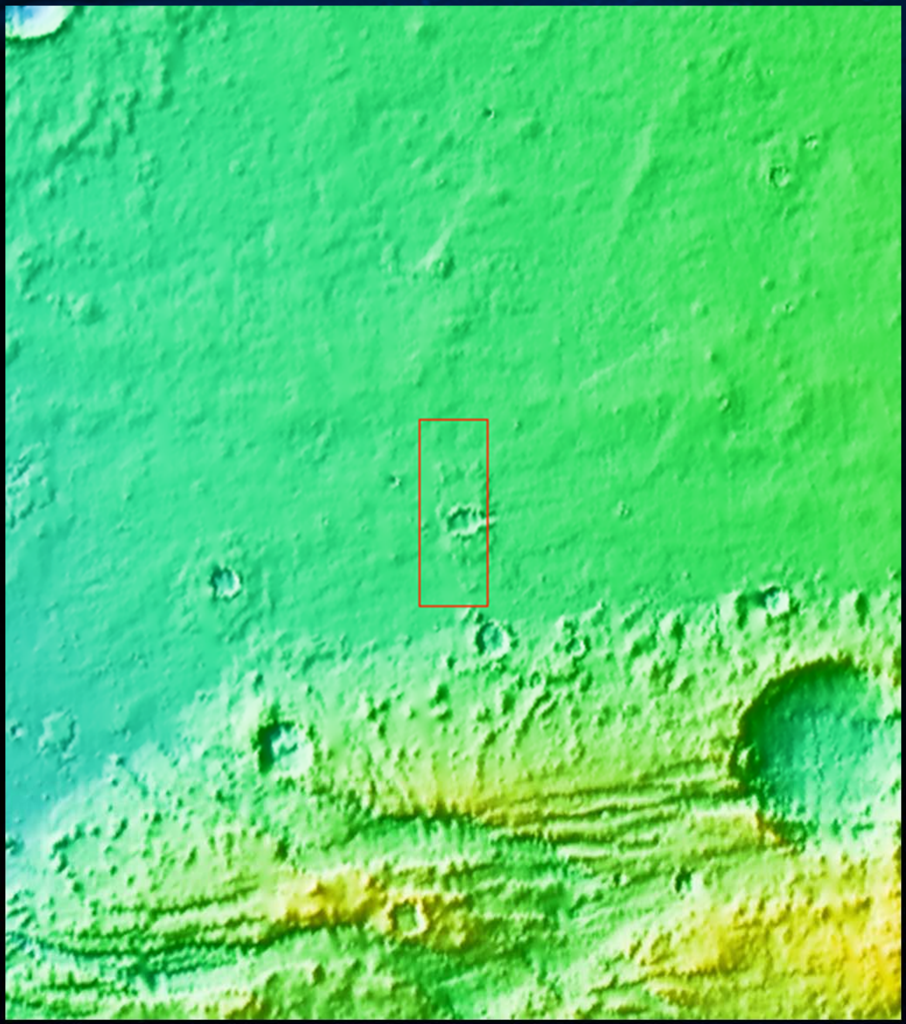
Engage

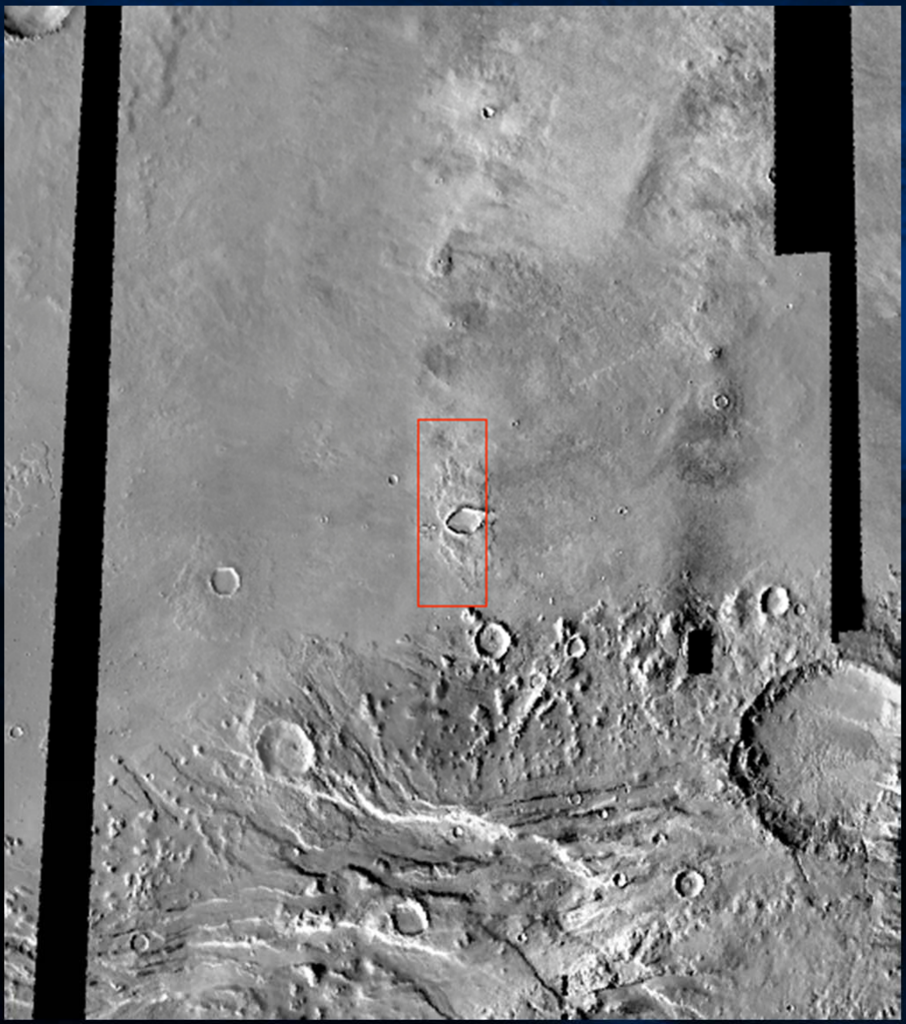
Mars Image Analysis

What can you tell from a picture?



Mars Image Analysis





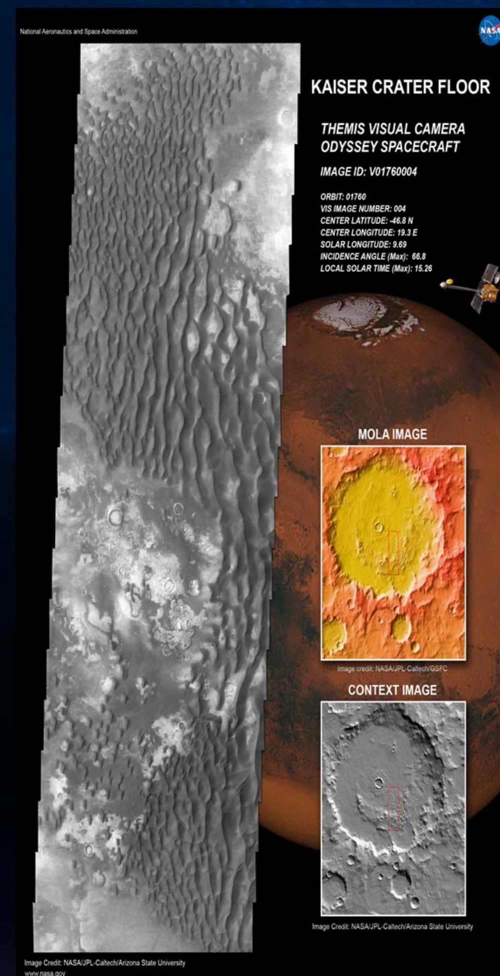
Mars Image Analysis

- New Conclusions?

- What information could you use from all of the images to gather a better understanding of the geologic history of the area?

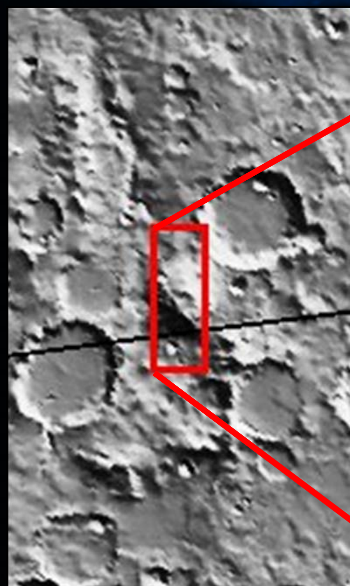
Mars Image Analysis

Activity uses images taken by the Thermal Emission Imaging System (THEMIS) Visible Camera onboard NASA's Mars Odyssey spacecraft.



THEMIS visible images show the morphology or shape of the surface (geologic features).

Getting Familiar with Images of Mars



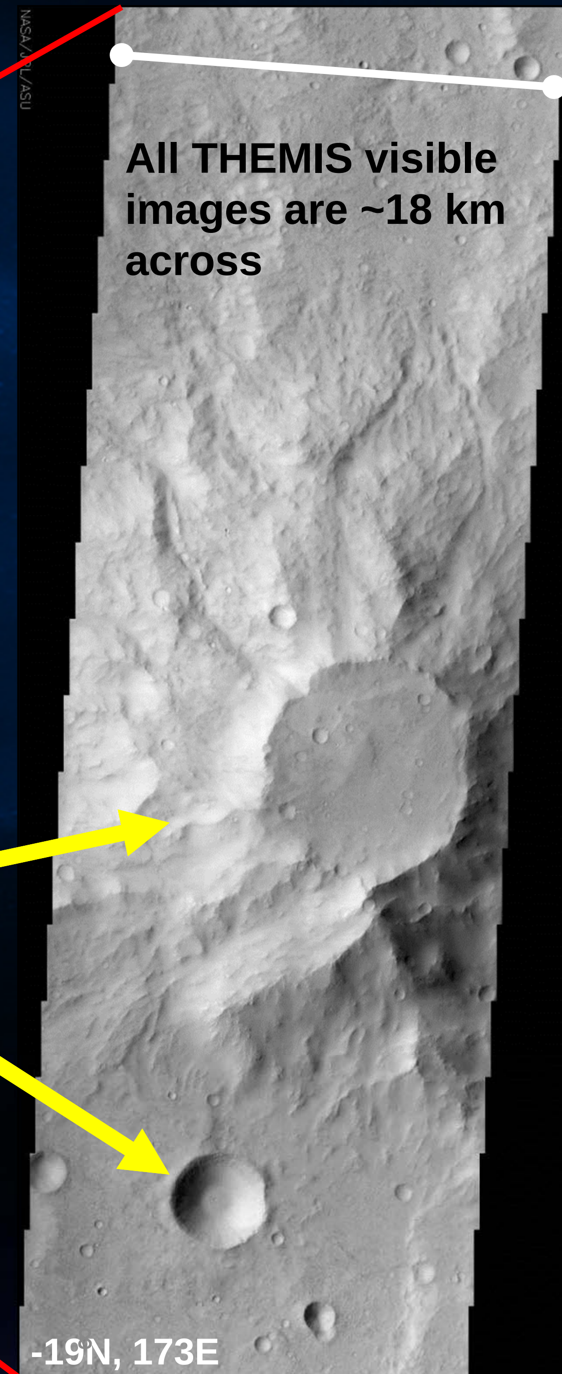
Context Image

MOLA Shaded Relief Map

THEMIS images are taken during the afternoon and the sun is shining from the left

Sunlit side on left = raised feature

Shaded side on left = depression

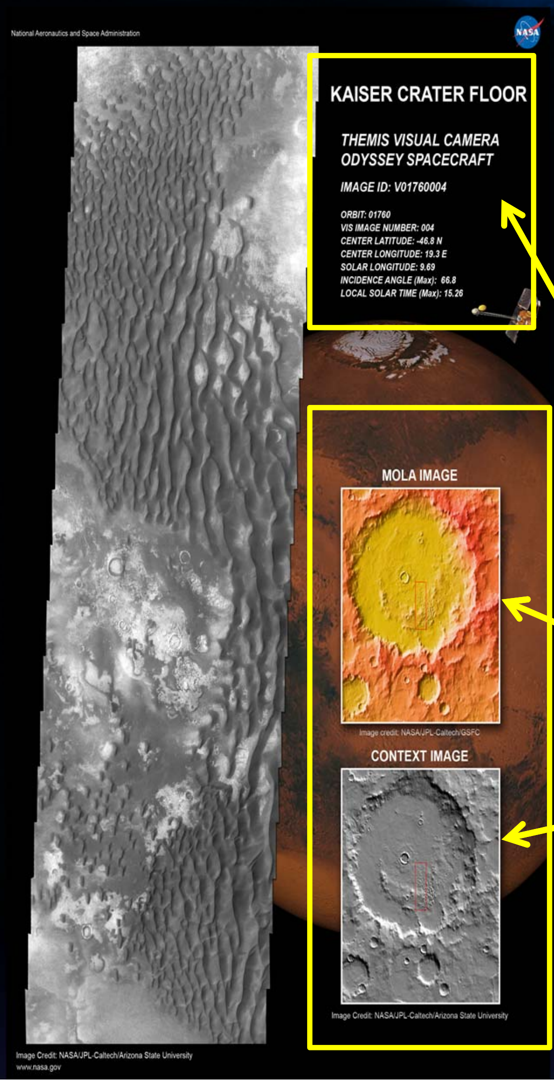


THEMIS Visible Image

5 E Learning Cycle

Explore

PART 1: Identify Features on Images of Mars Using a THEMIS Image

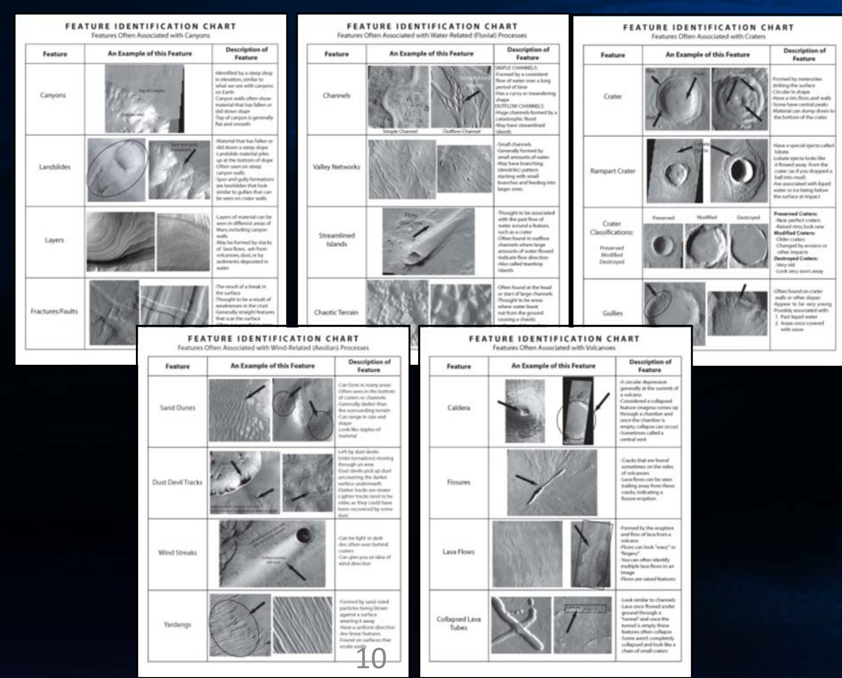


Label identified geologic features on both the THEMIS and CONTEXT images. Use Feature ID charts for assistance.

Image Information

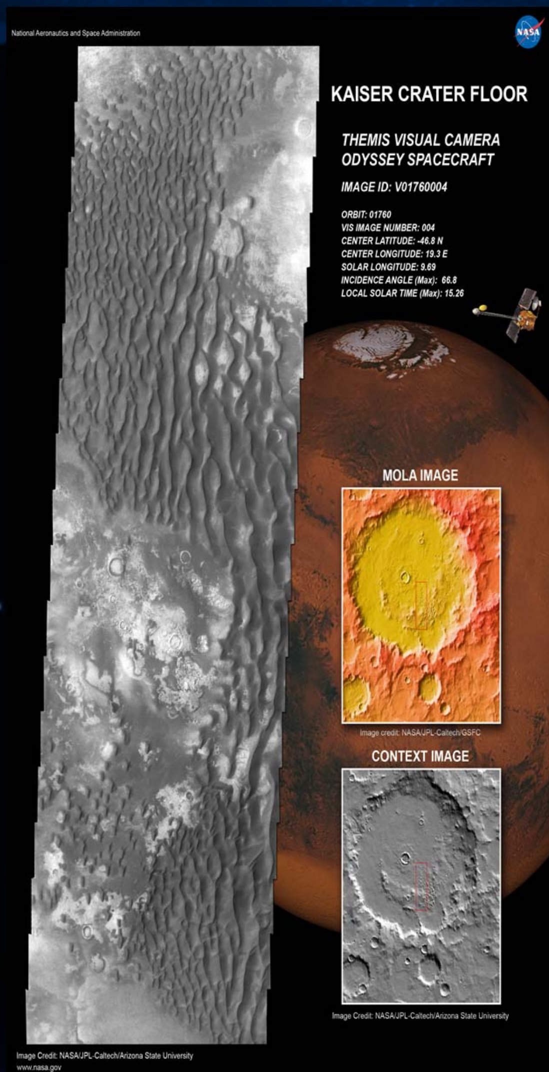
Context Image: MOLA Shaded Relief and Colorized MOLA

FEATURE ID CHARTS



5 E Learning Cycle

Explain



- Explain a few of the features you observed and identified in the area.
- What criteria did you use to identify the feature?
- Is it possible it could be a different feature? What other feature could it be?

5 E Learning Cycle

Evaluate

PART 1: Identify Features on Images of Mars

Sample Student Log

Feature Name		Age Rank	Describe How Feature Formed
Dust Devil Tracks	Oldest		
Crater			
Lobate Ejecta			
Central Peak			
	Youngest		

5 E Learning Cycle

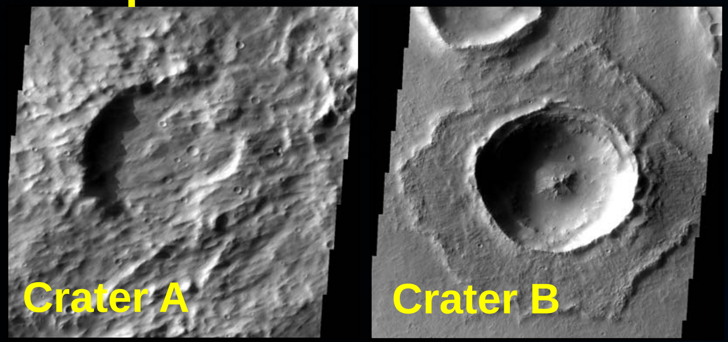
Explore

Relative Ages of Features

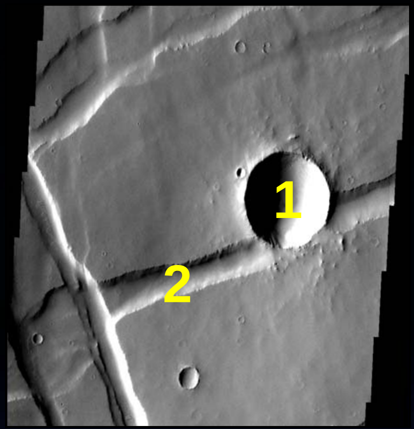
Accessing Prior Knowledge

Discuss the examples below within your group. Be sure you can justify your answers.

Example 1: Which crater is older?

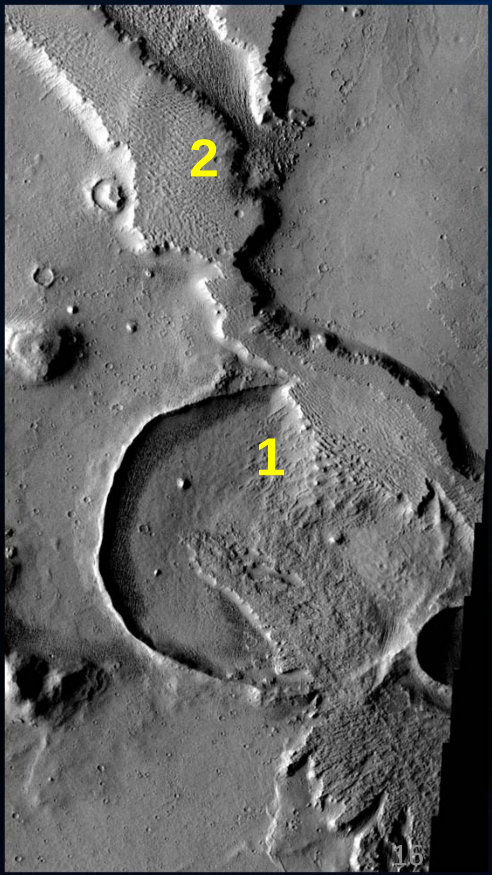


Example 2: Which feature is younger?



Feature 1 = Crater
Feature 2 = Fracture

Example 3: Which feature is younger?



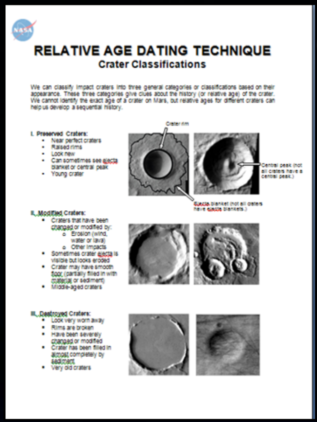
Feature 1 = Crater
Feature 2 = Channel

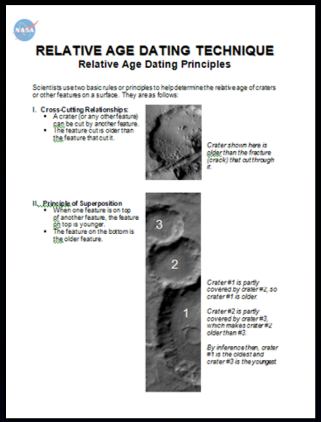
PART 2: Determine Relative Ages of Features

Identify which features are older or younger using the relative age dating principles:

- Crater Classification
- Principles of Superposition
- Principle of Cross-Cutting Relationships

Relative Age Dating Techniques

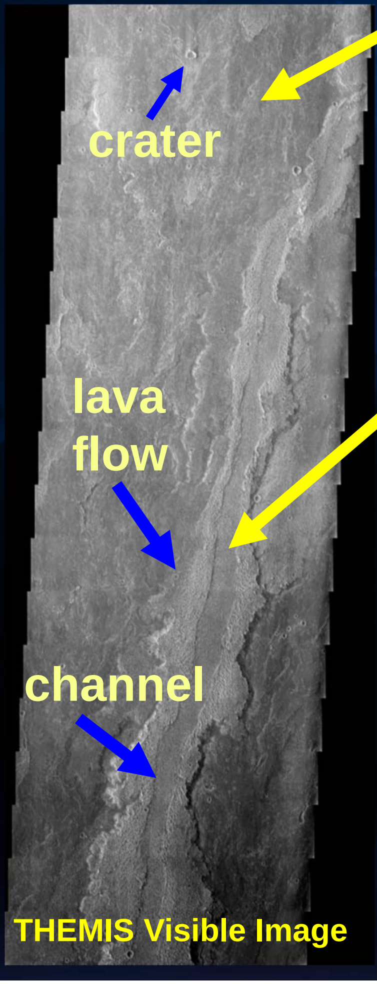

RELATIVE AGE DATING TECHNIQUE
Crater Classifications

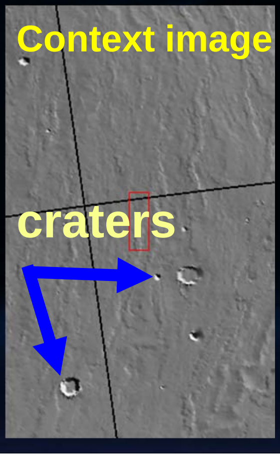

RELATIVE AGE DATING TECHNIQUE
Relative Age Dating Principles

Lava flow is older than the channel but younger than the terrain

Oldest feature (terrain)

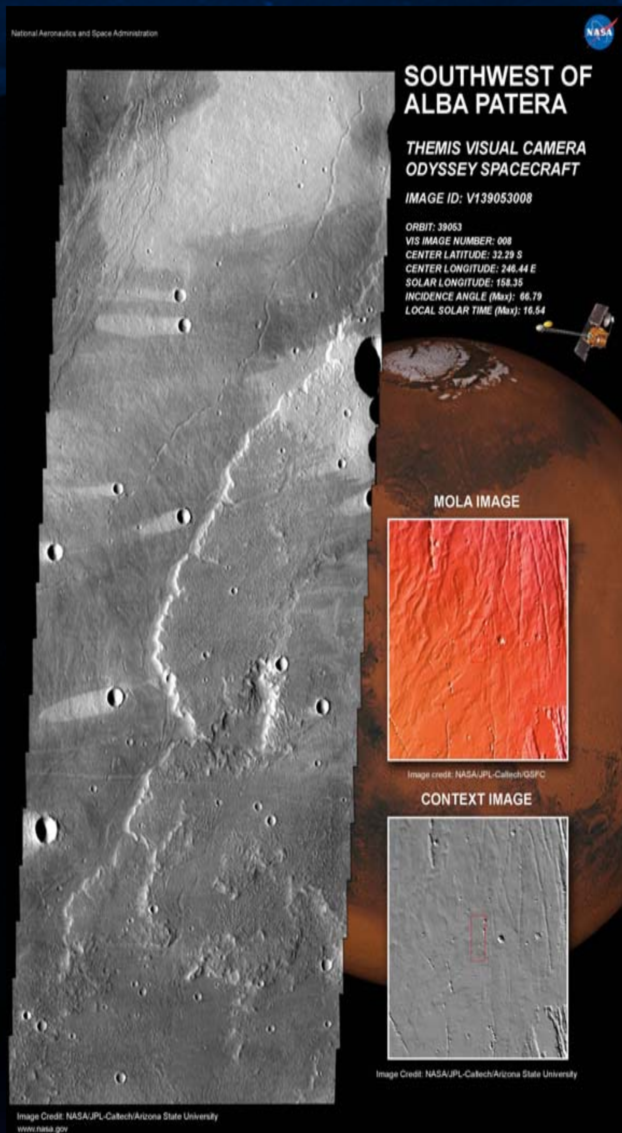
Youngest feature (channel)





5 E Learning Cycle

Explain



- Which features appear to be the youngest?
- Oldest?
- What criteria did you use to identify the age of these features?

5 E Learning Cycle

Evaluate

PART 1: Identify Features on Images of Mars

Sample Student Log

Feature Name	Oldest / Youngest	Age Rank	Describe How Feature Formed
Dust Devil Tracks	Oldest	2	The dust devil track crosses over the crater and terrain
Crater		1	Dust devil is on top of the crater
Lobate Ejecta		1	Forms at the same time as a crater
Central Peak		1	Forms at the same time as a crater
	Youngest		

5 E Learning Cycle

Elaborate

5 E Learning Cycle

Explore

PART 3: Calculate Sizes of Features (THEMIS images)

To determine the size of any feature, you must know a standard measurement:

•THEMIS visible images are 18.0 km across

To calculate the size of features on Mars you will:

1.Determine the *scale factor* for your image:

A. Measure the distance across in centimeters

B. Divide to figure out the scale of your image

18.0 km = _21.0__cm

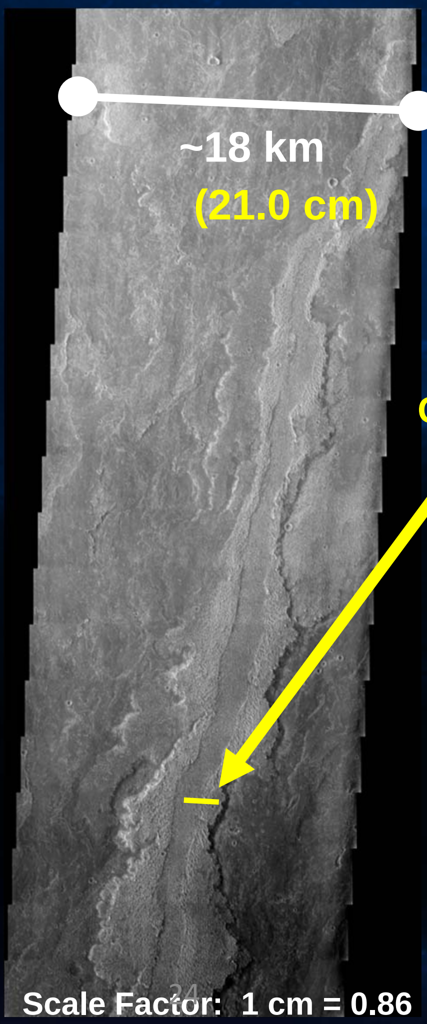
18.0 km / _21.0__ cm = 0.86 km/cm)

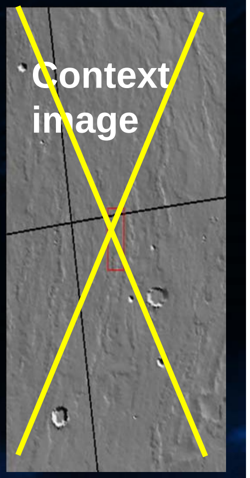
***Scale Factor*: 1.0cm = 0.86 Km**

2. Multiply the size of any feature measured in centimeters by the scale factor:

Example: Width of channel = _2.0__cm

_2.0__ cm X 0.86 km = _1.72_ km





PART 3: Sizes of Features (younger students)

Consider the following options for younger students:

1. Measure features in centimeters without calculating the actual size in km.

2. Find features on image that are greater than, less than or equal to general objects you may have in the classroom.

    a) Pencil Eraser: Example: *This crater is about the size of my pencil eraser.*

    b) Coins (dimes, nickels, quarters, pennies): Example: *This feature is the length of 10 pennies.*

    c) Post-its of different sizes: Example: *This feature is the size of two small post-its.*

PART 3: Sizes of Features (Older students)

Calculating Heights and Depths of Features

To do this calculation, students would use the following steps:

EXAMPLE:

1. Measure the width of the shadow in centimeters.

2. Using the calculated scale factor (From *Calculate the Size of Features*), convert the shadow measurement to kilometers.

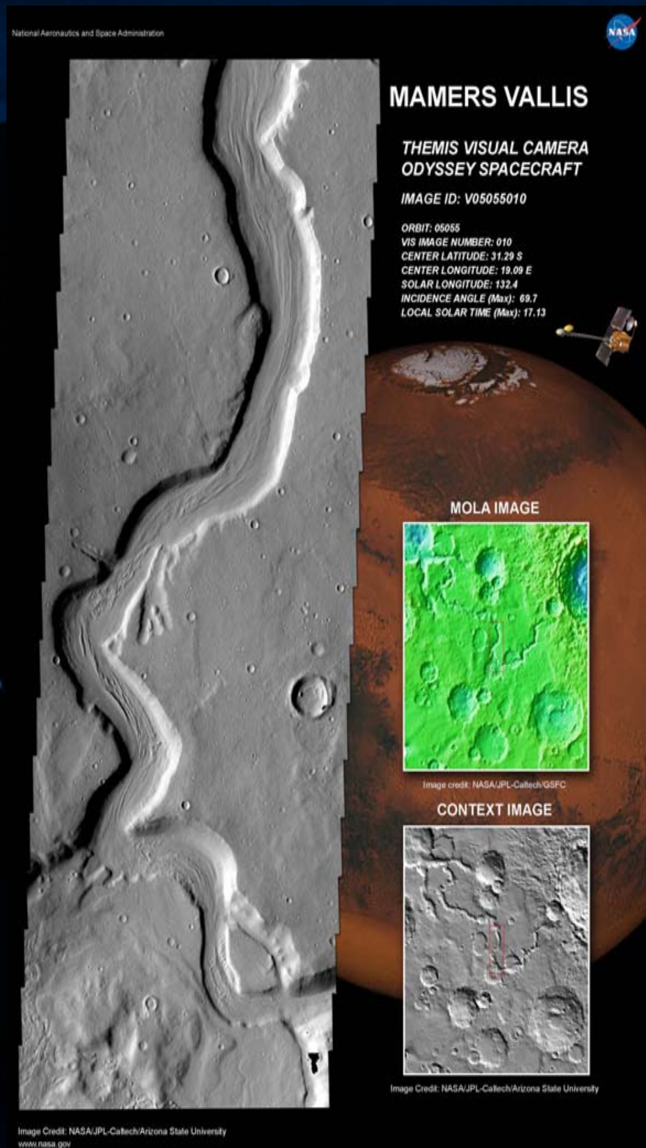
1cm x 0.86 km/cm = 0.86 km

3. Divide that calculated measurement by the tangent of the incidence angle to compute the depth of the feature being observed.

$$\frac{0.86 \text{ km}}{\tan 67.1} = 0.41 \text{ km deep crater}$$

5 E Learning Cycle

Explain



- What is the width of this feature?
- Where did you measure?
- How many measurements do you think are necessary?

5 E Learning Cycle

Evaluate

PART 3: Calculate Sizes of Features

Feature Name	Feature Measurement X	Scale Factor	= Feature Actual Size
Dust Devil Tracks	3.7 cm	0.86 km/cm	3.2 km
Crater	6.9 cm	0.86 km/cm	5.9 km
Lobate Ejecta	2.7 cm	0.86 km/cm	2.3 km
Central Peak	0.5 cm	0.86 km/cm	0.4 km