

Mars for Earthlings

LESSON 10: Meteorite and Impact Craters**Homework 1**

Ages and Times of Earth & Mars

Crater Counting

The number of craters on a planetary surface has age implications. Let's explore how this works!

1. We often use radiometric dating to determine the age of Earth's rocks. Is this technique applicable on Mars? What would be the challenges of performing this technique on Mars?
2. What is the general assumption of age relative to the overall appearance of craters?
3. How can we roughly divide the history of crater formation into three periods, from oldest to newest (list size of crater and corresponding Mars Epoch with age constraints)?
4. Using the map of Mars below, sketch the basic boundaries of the three Mars Epochs that are based on crater counts (Labels: Noachian, Hesperian, Amazonian) For help use <http://www.msss.com/http/ps/age2.html> (**NOTE: This map is centered at a different location than the map below, so you need to be sure to match up appropriate geographic locations)

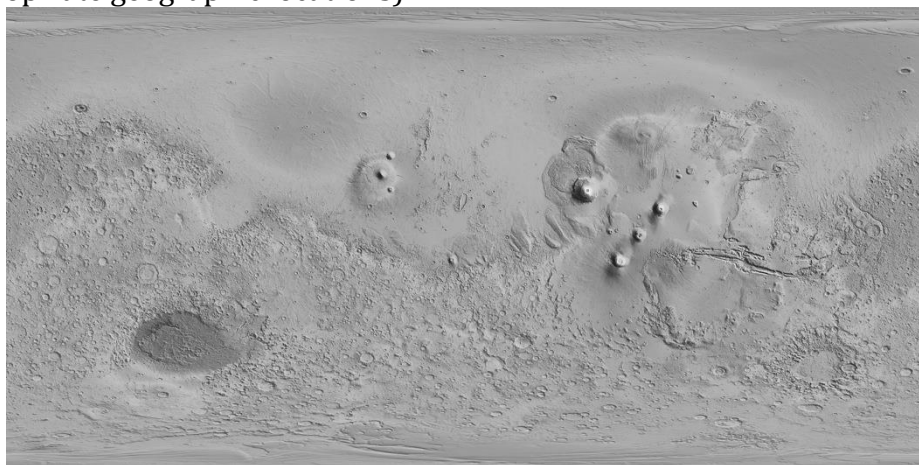


Figure 1 MOLA colorized elevation map in grayscale.

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Crater Counting:

Review this tutorial in order to use the Crater Counting layer in JMARS:

<http://jmars.asu.edu/crater-counting-layer>

- Measure the diameter of as many craters you can using JMARS *Crater Counting* layer. Choose craters that are roughly the same size. Use a 128 zoom OR larger (to give you at least 30 or more craters) and fill in the average crater diameter and # of craters you measured. If you can separate out sizes, do so. Use the measure tool located in the tool bar at the top of the window to measure the x and y dimensions of the area you're counting in, then calculate area by $\text{Area} = x \cdot y$.

Region	Size 1:		Size 2:		Size 3:	
	Ave diameter (X-axis), #	#/ area = plot on Y-axis	Ave diameter (X-axis), #	#/ area = plot on Y-axis	Ave diameter (X-axis), #	#/ area = plot on Y-axis
Amenthes Rupes Area =	Dia: X=		Dia: X=		Dia: X=	
Vichada Valles Area=	Dia: X=		Dia: X=		Dia: X=	
Mawrth Valles Area=	Dia: X=		Dia: X=		Dia: X=	
Astapus Colles Area=	Dia: X=		Dia: X=		Dia: X=	

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6. Use the isochron diagram on the following page to determine the age of the terrain. **PLOT your points on Figure 2.** To scale the Y-axis correctly: use proportions and be sure to square the area you investigated.

Example: 20 counted craters, diameter 4km in a 200km by 200km counted area-
 $20 / (200)^2 = 0.0005$ which gives you a y-axis value of 10^{-5}

Use the diameter of 4km that you measured for the x-axis and plot.

Does your age coincide with the sketch you made in #4?

Amenthes Rupes- Epoch: _____

Vichada Valles- Epoch: _____

Mawrth Valles- Epoch: _____

Astapus Colles- Epoch: _____

7. What are the difficulties you faced in crater counting on Mars? Do you feel like it is too “averaged” and some terrains are not accounted for? Why or why not?



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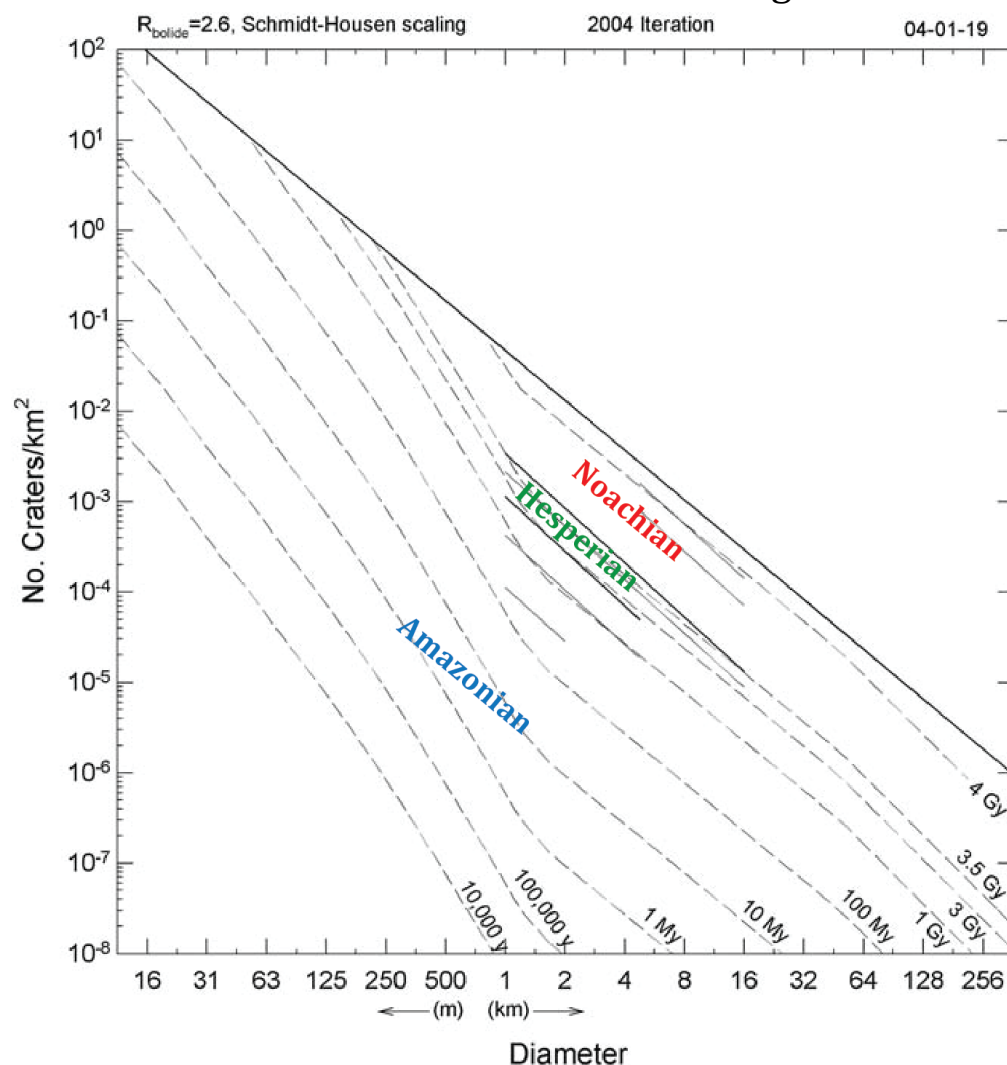


Figure 2. Final 2004 iteration of Martian crater-count isochron diagram. Upper solid line marks saturation equilibrium. Heavier short solid lines ($1 \text{ km} < D < 16 \text{ km}$) mark divisions of Amazonian, Hesperian, and Noachian eras; lighter nearby solid lines mark subdivisions of eras all based on definitions by Tanaka (1986). Uncertainties on isochron positions are estimated at a factor ~ 2 , larger at the smallest D . 100 m (total uncertainties in final model ages, derived from fits at a wide range in D , including uncertainties in counts, are estimated a factor ~ 3).

Figure source: <http://www.psi.edu/sites/default/files/imported/research/isochrons/mc8/fig6.jpg>