MAPPING THE SURFACE OF MARS

What will you learn in this lab?

How can we determine the geologic history of a planet or satellite without travelling to the planetary body? In this lab you will create a simple feature map of a region of Mars in a similar way used by photogeologists. Using this map of the surface you will hypothesize a geologic history of the part of the Martian surface.

What do I need to bring to the Class with me to do this Lab?

- A copy of this lab script
- Pencil and eraser
- Scientific calculator

Introduction:

What is a **geologic history**? When looking at a planetary body a scientist wants to know how certain features were developed, what the sequence of events was, the age of certain features, etc. After gathering facts, data, and evidence, a geologic scientist can piece together a geologic history of the planet. A geologic history is just a story of how a planetary body formed from beginning to end.

A geologic history can include many different things. It can include a geologic map of the planet similar to a map of Arizona that tells us where things are and what things might look like. The history can also include a geologic timeline that includes both relative time and absolute time. **Relative time** is where one determines the ages of events by comparing them against other events. The events are then ordered by when they occurred. With relative dating no exact date is identified (e.g. WWI and WWII). **Absolute time** is where the exact time or date of an event can be identified (e.g. 65 million years ago). A geologic history can also include pictures, fossils, practically anything that will help us determine the life story of the planet. What types of things would you include in a geologic history of the Earth? When geologists want to determine the geologic history of another planet what do they do? What instruments can be used?

If we had a geologic map of a planet this would give us a large amount of data and evidence and allow us to determine a geologic history. It would tell us how the planet looks in the present and from that we can arrive at hypotheses of how those features came to be. But how do we make geologic maps? Let's first think about how we would map the Earth's surface. What instruments would we use? What information would we want to try to find?

Geologic maps are made of a planet or moon by looking at present day features – land masses, bodies of water, volcanoes, channels, impact craters, etc. This can be done both by using photographs taken by orbiting satellites and from human physical research of the surface. The maps can give geologic scientists a relative time for the planet - show if the features were formed earlier or later than each other - but not any absolute times (specific dates). When geologic scientists just look at the appearance of features on a planet or moon without denoting the relative time on the map then they are looking at the geomorphology of the region. A map that only looks at the appearance of features is called a **geomorphic map**.

What happens if we can't travel to and physically stand on a planet's surface to conduct research? So far in space travel we have only been able to stand on the Earth and the Moon. What can we use to tell us the geologic history of a planet like Mars or Venus? In such cases, all we can do is rely on the geologic map of the planet determined from images taken by orbiting satellites (**remote sensing**) or rovers that land on the surface for us. Photogeologists examine the images carefully and use all available data to make a representative map of the surface.

In this lab you will use images of the Chryse Planitia and Elysium Planitia regions of Mars taken by the Viking orbiter to make your own simple geomorphic map. You will need to distinguish between and identify a few different features: **craters** and **channels**. The following image and descriptions define examples of these features.

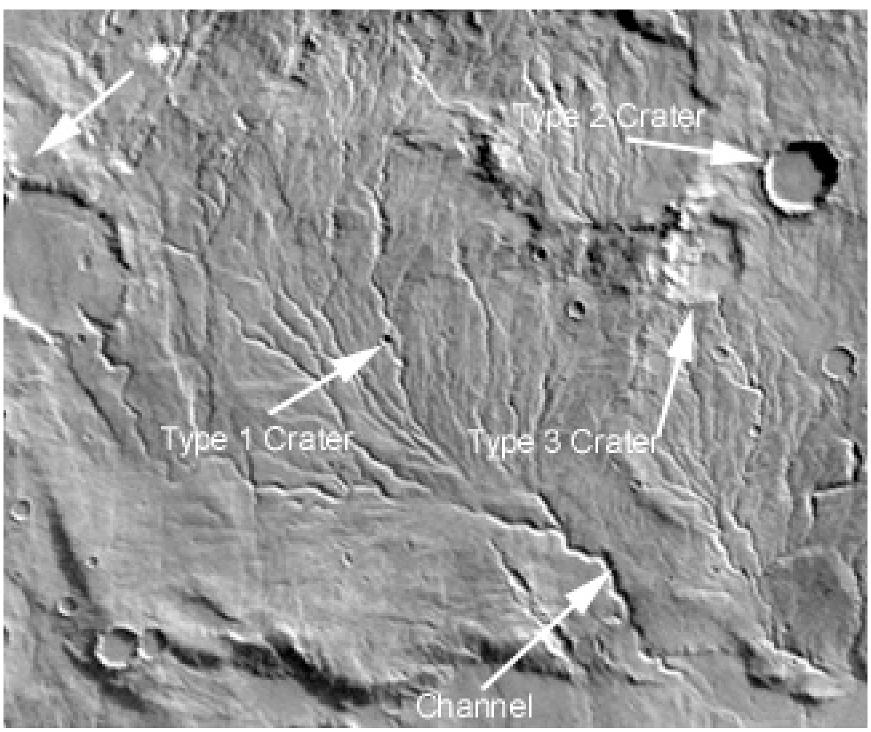

Figure 1 - Examples of features on Mars

There are 3 types of craters you will be asked to find:

Type 1: Craters that have continuous, sharp-edged, unbroken rims. This means the rims have a full circular shape. They have depths that are relatively large compared to their width. Little or no signs of erosion can be seen. For large craters an ejecta blanket should be visible. Details on the crater floor (if visible on map) should be clear.

Type 2: Craters that have mostly sharp rims. The shape should be mostly circular, meaning there can be some slight deformity in the rim. The rims of these craters can look bumpy rather than smooth. The larger craters will have a less defined ejecta blanket.

Type 3: Craters that have uneven and broken rims. These craters are disturbed by breaks and overlapping features that usually wipe out portions of the craters. These craters usually do not show definable ejecta blankets.

Channels look as though they were carved out by flowing water. They are relatively linear in direction, but they wander back and forth, similar to rivers on earth.

At this point, examine the images of Chryse Planitia and Elysium Planitia given to you by your TA. You will be using this map to determine a geologic history for the Chryse Planitia and Elysium Planitia regions of Mars.

Procedure:

After attaching the transparency sheets to the images you will need to trace out each of the above named features in different colors of your choosing. Trace the rim of the craters including any features on the crater floor. For the channels draw a characteristic line down the center of the channel. As you do this, create a key or legend to describe which colors go with which crater type or channel and put this legend on the transparency. Remember to label the region (Chryse or Elysium).

Once your map is done, remove the transparency from the map and examine it.

- Are craters older or younger than channels? Explain your answer.

Focus now on the craters only. Fill in the tables below with the number of craters that fall into each bin. Remember, a quick measurement to see which data bin your crater falls into is all that is necessary. Precise measurements, in this case, are not important. Also label what color you chose for each of the crater types and put it in the tables as well.

Chryse Planitia

Crater Diameter (cm)	Type 1 (color?)	Type 2 (color?)	Type 3 (color?)
0.0 – 0.5			
0.5 – 1.0			
1.0 – 1.5			
1.5 – 2.0			
2.0 – 3.0			
3.0 – 4.0			
4.0 or larger			

Elysium Planitia

Crater Diameter (cm)	Type 1 (color?)	Type 2 (color?)	Type 3 (color?)
0.0 – 0.5			
0.5 – 1.0			
1.0 – 1.5			
1.5 – 2.0			
2.0 – 3.0			
3.0 – 4.0			
4.0 or larger			

Answer the following using the data from your tables:

- Which crater type is most frequent?

- Which crater type is the largest?

- Which crater type is the smallest?

- Which crater type is the youngest?

- Which crater type is the oldest?

Now that you have information about the Martian regions you have mapped determine a geologic history for these regions. This should be a simple description of what happened, in what order, and how it affected the surrounding region. Be sure to state your evidence to support your hypothesis.

Geologic History for Chryse Planitia:

Geologic History for Elysium Planitia:

Wrap-up questions:

1. Describe the process used to determine a geologic history for a terrestrial planet. What steps does a scientist take? What evidence does a scientist look for? What instruments can help retrieve supporting data?

2. Do both regions (Chryse and Elysium) look similar? Do they give a similar geologic history for Mars? What are the similarities and differences? Why might there be differences between the two regions you looked at? What would you need to observe in order to have a global geologic history of Mars?

3. Was Mars a geologically active planet based on the two regions you mapped? Explain.

4. Out of the four geologic processes that affect the surface of a terrestrial planet (erosion, tectonic activity, impact cratering, & volcanism) which are evident in the regions you looked at? How can you tell?

Conclusion:

