LAB 6. PLANETARY GEOLOGY

Adam Myers, 2016

Introduction

The relationships between a planet's size, internal heat, geologic activity, and amount of cratering are powerful tools for understanding the terrestrial planets and its satellites. In this lab we explore terrestrial planets' atmospheres, temperatures, landscapes and relative ages of planetary surfaces.

Supplies

Planet fact sheet, images of planetary surfaces (Alpha Regio, Mare Imbrium, Mercury, the Moon)

Exercises

Atmospheres of the Rocky Planets

1. Study the atmospheric compositions of the inner planets given in Table 1.
   (a) Based on the compositions of the atmospheres of Earth's nearest neighbors, what would you *expect* Earth's atmosphere to consist of?

   (b) How does it differ from the expected pattern?

   (c) Why might these differences occur?

2. Speculate about why Mercury lacks an atmosphere and Mars has only a thin one (atmospheric pressure on Mars is only about ½ % that on Earth's surface). Hint: What force might stop gases from escaping from a rocky planet?

3. Study the surface temperatures for the terrestrial planets.
   (a) How does the presence or absence of an atmosphere seem to affect the constancy of surface temperatures on the inner planets?

(b) Which planets have the widest range in surface temperature?

(c) Which planet seems unusually hot for its distance from the Sun?

(d) How many times higher is the weight (pressure) of its atmosphere compared with Earth's?

(e) What is the name for any gas that traps heat close to a planet's surface by transmitting incoming sunlight but blocking heat reflected back from the surface?

Landscapes of the Rocky Planets

4. Look at the images of Mercury and the Earth's Moon. Describe the surface feature that is prominent on both.

5. The light areas on the Moon are called the highlands. The darker landscape or terrain on the Moon's surface are known as the lowlands or maria. Which type of landscape is probably older? Explain your logic.

6. If the surfaces of Mercury and the Moon are covered with impact craters. Why are such craters not conspicuous on Earth?

   (a) First propose a reason why impact craters may not form as often on Earth.

   (b) Next propose two separate reasons why those impact craters that do form may become less evident or conspicuous over time.

Relative Ages of Planetary Surfaces

When one does not have radiogenic ages available from samples of rocks (for example from planets where we just have images of the surface), the following three rules can be used to judge the relative age of surfaces. (The rules are often grouped together under the general name of "Steno's rules.")

- Law of superposition: Material deposited on top is generally younger. (Exceptions come from intrusion, tectonic overrun, etc.)
- Principle of cross-cutting relationships: A feature which cross-cuts another is younger than the rock in which it lies.
- Principle of inclusion (of younger material in older): Newer material included in or bounded by other material must be younger, for example sediments bounded in a basin are younger than the basin itself, or lava filling a crater must be younger than the crater. On a smaller scale, a dike must be younger than the host rock.

7. Venusian ages through superposition: Examine the image of the Alpha Regio area of Venus[1] showing several dome-shaped hills thought to represent mounds of very viscous lava. Use the principles listed above to try to find the relative ages of domes A, B, C and fracture D. Explain your logic and note all cases in which the relative ages of any two features cannot be resolved.

   Oldest

   i. _____ Explain Why:

   ii. _____ Explain Why:

   iii. _____ Explain Why:

   iv. _____ Explain Why:

   Youngest

8. Lunar ages through superposition: Using the image of the large and relatively young Mare Imbrium, find the relative age (from oldest to youngest) of the following features, using principles of superposition. Explain briefly how you decided the relative age of the various features. If there are features whose relative age you can't specify, state that.

   Remember the important distinction between the age of a crater or basin, and the age of the basalt flows which may later fill it.

   Determine the ages of the following features:

   (a) The two small craters marked "a"

   (b) The moderate size crater Archimedes, marked "b"

   (c) The crater Eratosthenes marked "c"

   (d) The moderately large crater Sinus Iridum, marked "d"

   (e) The large Imbrium Basin (i.e. the Imbrium crater itself)[2]

   (f) The Mare Imbrium basalt lava flows (i.e. the resurfacing within the crater)

   Oldest

   i. _____ Explain Why:

   ii. _____ Explain Why:

   iii. _____ Explain Why:

   iv. _____ Explain Why:

   v. _____ Explain Why:

   vi. _____ Explain Why:

   Youngest