

ASTRO 1050
Planetary Geology Lab

ABSTRACT

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

Materials

Various images located at <http://physics.uwyo.edu/~admyers/planetary.html>

Table 1. see <http://pds.jpl.nasa.gov/planets> for images and info of the planets

Planet	a (AU)	P	v_{orb} (km/s)	D (km)	Rel Mass (M_{Earth})	Density (g/cm ³)	T_{mean} (K)	T_{max} (K)	T_{min} (K)	Albedo	Pressure (atm)	Atmospheric Comp
Mercury	0.387	88d	47.5	4854	0.056	5.4	452	700	100	0.12	Trace	Trace H ₂ , He
Venus	0.723	224.7d	35.0	12,112	0.82	5.2	726	726	726	0.59	90	CO ₂ (.96) N ₂ (.03) H ₂ O(.00003)
Earth	1.000	365.25d	29.8	12,751	1.00	5.5	281	310	260	0.39	1	N ₂ (.78) O ₂ (.21) Ar(.01)
Mars	1.524	687d	24.1	6788	0.108	3.9	230	310	150	0.15	0.007	CO ₂ (.95) N ₂ (.03) Ar(.016)
Jupiter	5.203	11.86yr	13.1	143,000	317.87	1.3	120			0.44	10 at 100km	H ₂ (.9) He(.1) CH ₄ (.0007)
Saturn	9.539	29.46yr	9.6	121,000	95.14	0.7	88			0.46	20 at 200km	H ₂ (.97) He(.03) CH ₄ (.005)
Uranus	19.18	84yr	6.8	47,000	14.56	1.2	59			0.56		H ₂ (.83) He(.15) CH ₄ (.02)
Neptune	30.06	165yr	5.3	46,529	17.21	1.7	48			0.51		H ₂ (.74) He(.25) CH ₄ (.01)

Note. — The orbital semi-major axis (a), relative mass, and atmospheric pressure are all given relative to Earth- this is why these values are all 1 for Earth. Also, the semi-major axis can be thought of as the "average distance from the Sun" of the planet.

Part III. 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 “superposition”.)

- **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.

7. Venus ages through superposition: Examine the image of the Alpha Regio area of Venus¹ 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. There are craters on both of domes A and B, what are their relative ages?

Oldest

¹<http://faraday.uwyo.edu/~admyers/planetary.html>

i. _____ Explain:

ii. _____ Explain:

iii. _____ Explain:

iv. _____ Explain:

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, then 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.

Crater: from small to large

- (a) The two small craters marked "HL"
- (b) The moderate-size crater Archimedes, just to the lower left of "A"
- (c) The crater Eratosthenes "E"
- (d) The moderately large crater "Sinus Iridum, SI"
- (e) The large Imbrium Basin (i.e. the Imbrium crater itself), whose rim forms the Montes Alpes ("MAI") and Montes Appeninus ("MAp")
- (f) The Mare Imbrium basalt lava flows

Oldest

i. _____ Explain:

ii. _____ Explain:

iii. _____ Explain:

iv. _____ Explain:

v. _____ Explain:

vi. _____ Explain:

Youngest