

Vacuum Surface Environments and Processes

1. Exosphere at Surface

- a) Moon, Mercury, Asteroids, Phobos, Deimos; Inner Solar System Rocky bodies
- b) Outer Solar System Icy bodies exist in very different surface environments

2. Consequences

- a) No Micrometeorite shielding – smoothing and abrasion on Moon, Mercury
- b) Unmodulated solar heating and reradiation
 - Mercury 10x Moon
 - 180/0 hot pole, 90/270 warm pole (2/1 difference)
- c) Unfiltered solar UV, X, and cosmic radiation degrades minerals, removes gas
 - Gases lost through direct thermal escape, photo disassociation, collisions
 - General darkening, but composition still shows through
 - Phobos darker than Moon but receives only 1/2.3 radiation
 - Lunar Upland/Maria differ in albedo 2/1
 - Mercury albedo similar to Moon but very little contrast
(Compositionally similar? Saturation?)
- d) Darkening of Rays – divitrified glass beads gardened by impact
- e) Direct implanting of solar wind components; earth's geotail effect
- f) Phobos: 1/1000 g, 1/2.25 solar, 1/90 nighttime – no traps

3. Behavior of Volatiles on Vacuum Surfaces

- a) Stability controlled by vapor pressure of solid phase in coldest location
- b) Water by far the most stable of common volatiles in Inner Solar System
- c) Potential sources: endogenic, meteorites, comets, solar wind
- d) Migration process: random walk in presence of high loss mechanisms
- e) Permanently shaded areas in polar regions; scattered light, dust layers
- f) Loss mechanisms from traps: thermal, UV starlight, plasma, micrometeorites
- g) Episodic vs. smoothed sources; obliquity variations

4. Applications to Moon and Mercury

- a) Originally proposed for Moon in 1961, but many uncertainties including past obliquity variations; virtually unobservable from earth
- b) Radar discovery of ice in polar craters of Mercury in 1992!
 - 10x solar, 0 obliquity
- c) Renewed interest in lunar polar ice: Clementine experiment, Implications for future human activities, Lunar Prospector mission