PHOBOS: NATURE OF CRATER POPULATIONS AND POSSIBLE EVIDENCE FOR INTERIOR VOLATILES

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Crater populations on Phobos appear to be at or near the saturation equilibrium level. This level is defined from other cratered surfaces in the solar system, and also by numerical modeling of crater populations (Hartmann and Gaskell 1997). In the region of Mars, craters smaller than ~ 90 meters go into saturation equilibrium within about 1 Gy, so the small-crater populations do not provide tight constraints on Phobos age. Near-saturation levels for the few larger craters suggest a very old surface.

Crater saturation on Phobos's surface does prove that saturation can be reached in the Martian environment. This is a useful indication, in turn, that the primordial Martian surface should have been saturated. Thus, the lack of saturation around 1 km crater diameters in even the oldest parts of Mars is due to crater loss processes, not a unique size distribution of early Martian impactors.

Some craters in crater chains around Stickney appear to have raised rims. The linear chains suggest that the craters mark drainage of (dry) regolith into fractures, but the raised rims suggest that blowout of volatiles along the fractures may have accompanied their formation. This is consistent with Phobos having formed as a D, P, or C class asteroid.

Hartmann (1987) suggested that massive scattering of C-class and related black asteroids from the outer solar system might have been involved in the very early origin of Phobos and Deimos by capture. A similar model may have more relevance in view of the recent work of Bottke and others on cataclysmic scattering of such bodies (the "Nice" model).

References

Hartmann, W. K. 1987. A satellite-asteroid mystery and a possible early flux of scattered C-class asteroids. Icarus 71: 57-68.

Hartmann, W. K. and Gaskell 1997. Planetary Cratering 2: Studies of Saturation Equilibrium. Meteoritics Planet Sci. 32:109-121.