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Cratering Chronologies and Ages of the Major Saturnian Satellites

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The two cameras aboard the Cassini spacecraft in orbit around Saturn since July 2004 have provided a wealth of new image data of the major Saturnian moons Mimas, Enceladus, Tethys, Dione, Rhea, Iapetus and Phoebe and of their cratering record [1][2]. Especially from the data obtained in the 2005 flybys, we are now able to understand the cratering record in much greater detail, can construct cratering chronology models and derive ages for individual parts of the Saturnian satellite surfaces from crater statistics. With the exception of some areas on Enceladus, the surfaces of the Saturnian Moons are heavily cratered and suggest ages of 4 Gyr or higher. Regional variations in crater frequency are found on each one of the satellites, caused by geological processes rather than by changes in the size-frequency distribution of impactors [e.g. 3, 4]. The lunar-like shape of the crater size-frequency distributions measured on these satellites is compatible with a preferentially asteroidal source of impactors. If the underlying projectile distribution was, or still is, primarily due to cometary bodies derived from the Kuiper Belt, as suggested by e.g. [5], their collisional evolution must have been similar to that of the asteroids. The existence of two different projectile populations as suggested by [3, 4] cannot be seen in our data. Instead, the results imply a single population of impactors. Resurfacing by geological processes (such as basin-creating events) more likely explains the observed changes (kinks) in slope, otherwise interpreted as the effect of different impactor populations [e.g. 4]. The leftward shift in log-D of the lunar production function towards smaller crater diameters is, within the uncertainties of the still poorly understood crater scaling on icy bodies, in good agreement with differences in average impact velocities between the Moon and the

Saturnian satellites derived by [6] and can mostly be reconciled with primarily planetocentric projectiles. Since the age of the surface of Iapetus as we see it now in its main structures has been determined by other methods than cratering methods [7] and we therefore have an independant age point of 4.4 Gyr to fix the cratering record of Iapetus for a lunar-like cratering decay, we can determine individual cratering chronologies for the satellites of Saturn. On the basis of the Iapetus data and the assumption of a planetocentric bombardement [6] we can construct lunar-like cratering chronologies for all Saturnian moons. We also will treat the case of a bombardment by cometary impactors as suggested by [5], and compare this with our lunar-like chronology models. On the basis of these models, ages of prominent structures of Mimas, Enceladus, Tethys, Dione, Iapetus, and Phoebe will be presented. References: [1] Porco C. C. et al. (2004), Space Sci. Rev., 115, 363-497. [2] Porco C. C. et al. (2005), Science, 307, 1237-1242. [3] Smith B. A. et al (1982), Science, 215, 504-536. [4] Woronow A. et al. (1982), in: Satellites of Jupiter (ed. D. Morrison), 237-276, UofA Press, Tucson, Az. [5] Zahnle K. et al. (2003), Icarus, 163, 263-289. [6] Horedt G. P. and Neukum G. (1984), J. Geophys. Res., 89, No. B12, 10,405-10,410.[7] Castillo et al. (2005), submitted to Science.