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Impact Crater Size-Frequency Distributions (SFD) on Saturnian Satellites in Comparison with Possible Impactor Populations

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One of the major goals of the Cassini imaging experiment (ISS) is the examination of the geologic history of the saturnian satellites [1]. The understanding of the impact crater SFD of the saturnian satellites allows insights of the bombardment history of the early outer solar system. Thus it provides not only information of the geologic development of the target bodies but is also key for the determination of the impactor sources as well.
The impact-crater SFD of the mid-sized saturnian satellites has been measured as described by [2]. There are high similarities in the shapes of the asteroid-body SFD around the 3:1 mean motion resonance (MMR) gap with Jupiter and the measured impact crater SFD on the saturnian satellites. This allows for an estimation of the impact-crater scaling. The observationally derived scale factor between the impactor diameter and the respective impact-crater diameter is about three to four in case of Iapetus's larger craters and doesn't change much on other mid-sized saturnian satellites like Rhea or Dione. Hence, by shifting the impact-crater SFD curve of Iapetus to smaller sizes by the amount of the scaling factor of three to four, we get the impactor-body SFD for Iapetus. Thus we can compare the impactor-body SFD of Iapetus with body SFD of possible populations of impacting bodies like Kuiper- Belt objects (KBO), asteroids or the irregular satellites of Saturn.
As stated by [3], intensive analyses of the impact crater diameter SFDs of the surfaces of the inner solar system bodies have revealed a characteristic W-shaped curve in the R-plot. The measurements of the crater-diameter SFD on the saturnian satellites Mimas, Tethys, Dione, Rhea, and Iapetus also show high similarities to those W-shaped curves of the inner solar system bodies. The derived body SFD of the asteroid belt (method of abs. magnitude to size conversion by [4]) around the 3:1 MMR with Jupiter gives a very good match to the lunar SFD and thus to the jovian and saturnian satellites. In addition, the body SFD of irregular saturnian satellites (Data Base: [5]) has been analyzed. This distribution displays also a minimum at about 10 km to 20 km body size as it is visible at the asteroid body SFD and Iapetus's impactor SFD. When examining the SFD from this minimum towards larger diameters, Iapetus's impactor frequencies are rising in a more similar way to the irregular-satellite body frequencies than to the mentioned Main-Belt asteroid body frequency around the 3:1 MMR. Instead, we find a rather high conformity between the saturnian irregular-satellite body SFD and the outer Main-Belt asteroid body SFD in the range of 3.4 to 3.9 AU.
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References:
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[4]Fowler & Chillemi (1992) in "The IRAS minor planet survey"
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