EPSC Abstracts
Vol. 6, EPSC-DPS2011-1545, 2011
EPSC-DPS Joint Meeting 2011

Expanding the global impact cratering record of Saturn's moon Dione: Investigating the geological history

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1. Introduction

Previous work by the authors [1] has presented a portion of global spatial crater density map (Fig. 1b), size-frequency distributions (Fig. 2), and relative ages (Table 1) for Dione obtained from crater measurements on *Cassini* images. Results indicated that the heavily cratered terrain (hct) was the oldest, and the smooth plains (sp), wispy terrain (wt), and Evander's ejecta (ejecta) blanket may all have the same age. Furthermore, after smooth plains formation the impactor population changed, with fewer large impacts and more small ones, possibly Evander secondaries. Finally, the spatial map (Fig. 1b) indicated that Evander ejecta is asymmetric with more to the east, implying a lower inclination impact from the west. Much of this interpretation has greatly expanded on previous work from *Voyager* and *Cassini* imaging [2-9]. Newer *Cassini* images, however, now allow us to extend on the partial map and confirm our initial interpretations. Therefore, we will perform new crater measurements on the regions indicated by the semi-transparent, filled-in polygons in Fig. 1a to expand our database and density map.

2. Methods

In Fig. 1a we show the new version of the global mosaic to be used to expand our counts. This mosaic has a base resolution of 400 m/pixel, same as the previous. Regions of the mosaic that have been (solid outlines) or will be (semi-transparent, filled-in) used for craters measurements are shown in Fig. 1a. Portions of the surface outside of these regions are not used either because they have a resolution considerably below the mosaic base resolution or have a solar incidence angle that is poor for recognizing craters [see 10]. These regions were also initially divided into the three different terrains before the first set of crater measurements as discussed in [1]. After the analysis in Kirchoff and Schenk [1] indicated the region effected by Evander's ejecta blanket, we now also have included this terrain in our divisions.

Crater measurements are made upon quadrants generated from the global mosaic: polar quadrants in Polar Stereographic, mid-latitude quadrants in Lambert Conformal, and equatorial quadrants in Mercator. The quadrants are viewed in the imaging software SAOImage DS9 and an add-on Perl script is used to place points around the crater rim that are then fitted by an ellipse. The output is the long and short diameter, and the center position of the crater. This data is then used to generate the relative plot (R-plot) in the standard method [11] and the spatial crater density map. The spatial crater density map is generated by a counting circle analysis. A circle of radius 10° is stepped across the map in 5° increments in latitude and longitude space. At each new location the number of craters in the circle is determined and divided by the area of the circle to obtain the crater density. These densities are then mapped out to a color for the figure. Edges of terrains and the mosaic are taken into account by changing the area of the total circle to only the portion of the circle that contains the data.

References

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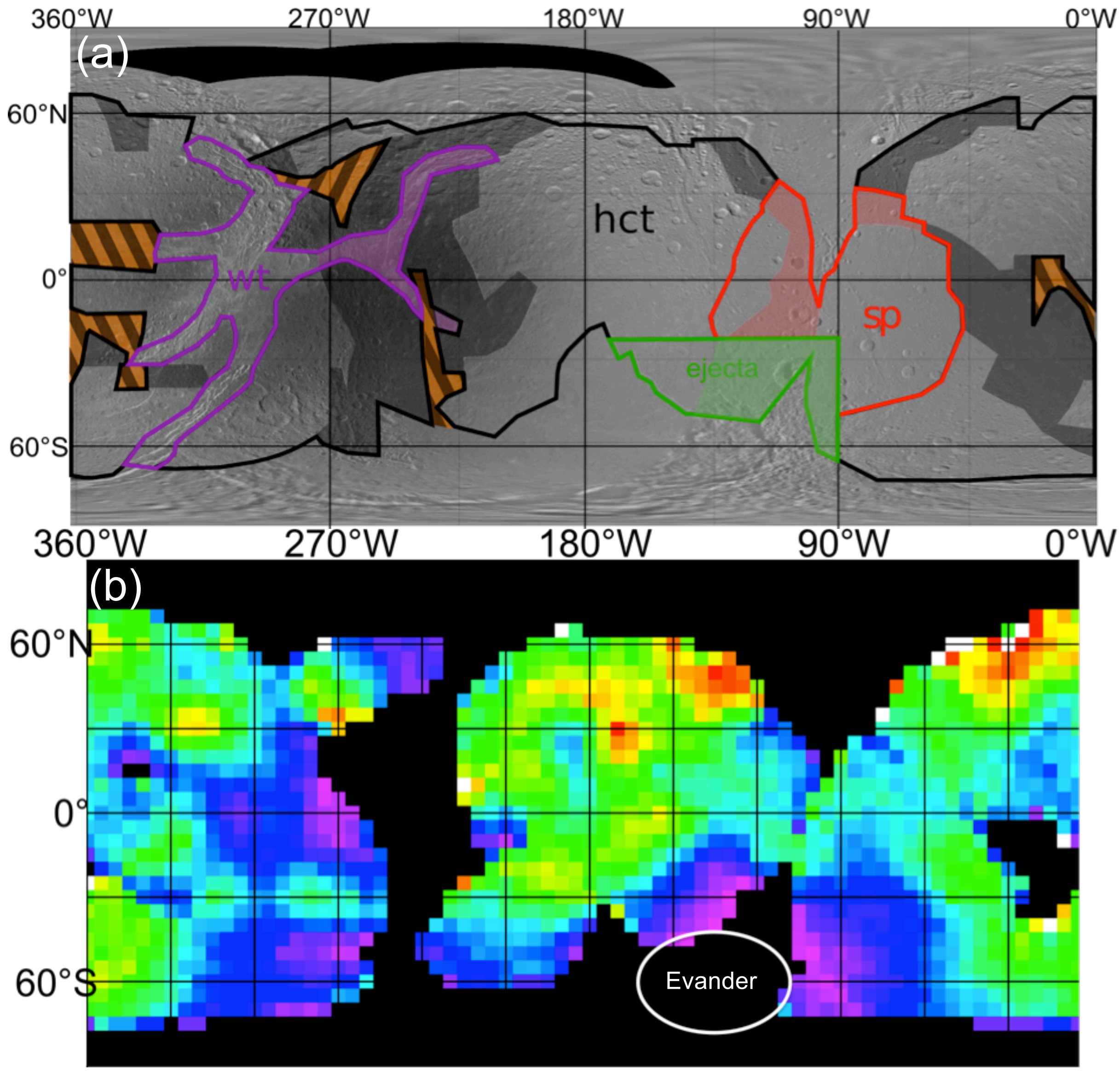

Figure 1. (a) Global mosaic of Dione in simple cylindrical projection. Base resolution is 400 m/pixel. Crater distributions discussed in previous work [1] have been compiled within regions outlined with solid lines. Crater counts to be completed are shown by regions covered by semi-transparent filled-in polygons. The four types of terrains are noted by different colors: black – cratered plains (cp), red – smooth plains (sp), purple – wispy terrain (wt), green – Evander ejecta (ejecta). (b) Crater spatial density map for craters D ≥ 5 km. Hotter colors indicate higher densities, cooler colors lower densities.

Table 1.

	Density (D ≥ 10 km)
hct	720±25
ejecta	350±45
wt	320±40
sp	290±30

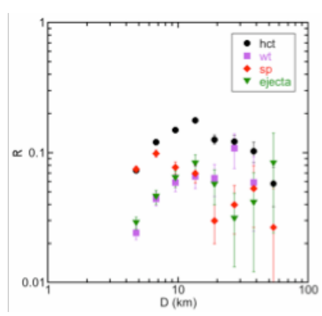

Figure 2. Relative (R) size-frequency impact crater distributions for terrains on Dione. ± $\sqrt{N}$ error bars are given (N is the number of craters in a bin). cp – cratered plains, sp – smooth plains, wt – wispy terrain, ejecta – Evander ejecta.