POLYGONAL IMPACT CRATERS ON RHEA, DIONE, TETHYS, CERES, AND VESTA. T. Neidhart[1], J. J. Leitner[1,2], and M. G. Firneis[1,2], [1]Institute of Astrophysics, University of Vienna, Türkenschanzstraße 17, A-1180 Vienna, Austria (a1002897@unet.univie.ac.at), [2]Research Platform: ExoLife, University of Vienna (johannes.leitner@univie.ac.at).

Introduction: A polygonal impact crater (PIC) is a crater that does not have a full circular shape in plane view but consists of straight crater rim segments. PICs are common on all objects in our solar system that show a cratered surface. Previous studies showed that PICs make up about 10-25% of craters on Mercury, Venus, Mars, and the Moon [1, 2, 3, 4]. Although there have been several studies on PICs on the terrestrial planets, and the Moon there are only very few investigations on PICs on other moons and asteroids, even though there exist surface maps of Rhea, Tethys, Dione, Ceres, and Vesta that have an appropriate resolution. On Dione 76% of the impact craters analysed in the wispy terrain, a region showing large visible fractures, and 25% of impact craters outside the wispy terrain have at least one straight rim segment [5]. Former investigations on Ceres found 258 PICs, most of them having diameters between 10 km and 50 km [6]. The aim of this study is to get more information about the abundance and characteristics of PICs on minor bodies.

Data and Methods: We analysed all approved craters on Rhea, Dione, Tethys, Ceres, and Vesta using images provided by the IAU/NASA/USGS-Planetary Database [7]. The maps had a resolution of 417 m/pixel for Rhea, 154 m/pixel for Dione, 293 m/pixel for Tethys, 140 m/pixel for Ceres, and 60 m/pixel for Vesta [7]. For the classification of PICs the definition by [2] was used which states that a crater is polygonal if it consists of at least two straight crater rim segments having a discernable angle.

Results and Discussion: In total 417 impact craters were examined and 227 of them were classified as polygonal. A complete list of PICs found on Tethys is given in Table 2. On Rhea about 48% of the approved craters are PICs, on Dione 59%, on Tethys 34%, on Ceres 74%, and on Vesta 56%. The comparison with studies on PICs on terrestrial planets, and the Moon conducted by [1, 2, 3, 4] showed that the percentage of PICs found on minor objects is much higher. For the mean number of straight rims we got 2.9 for Rhea, 3.4 for Dione, 3.1 for Tethys, 3.6 for Ceres, and 3.2 for Vesta. This results in most of the PICs having two or three straight rim segments and only few PICs being hexagonal or pentagonal. The Figures 1 and 2 show the number of straight crater rim segments of Rhea and Dione. Due to the lack of high resolution maps of the polar regions of Ceres and Vesta, and because of projection effects for the calculation of the angle between the straight segments only PICs between a centre latitude of 60° and -60° were taken into account. The mean angle between the straight rims yields 121° for Rhea, 124° for Dione, 123° for Tethys, 133° for Ceres, and 134° for Vesta. These angles are well in accordance to an average angle of 112° on Mercury [1]. Also the size distribution of PICs is in accordance to results by [4] who proved that PICs seem to favor small to middle size diameters. The comparison between the diameters of normal craters (ICs) to PICs can be seen in Figure 3. The largest diameters of ICs on Vesta range from 0.6 km to 450 km while the diameters of PICs only range from 3.1 km to 53.2 km [7]. A comparison between the number of examined craters, the number of PICs, and the mean angle between the straight rims of the different objects, can be found in Table 1.

Summary: The study proves that a large number of polygonal impact craters on the moons Rhea, Dione, Tethys and the asteroids Ceres and Vesta exist but it is still unclear why the fraction of PICs on these bodies is much higher than for terrestrial planets and the Moon. One possible solution could be the different composition of the surfaces of these bodies in comparison to the terrestrial planets but for definite answers to this question further understanding of the formation process of PICs, which is still unclear, is necessary.

Table 1: Number of examined impact craters (ICs), polygonal impact craters (PICs), percentage of PICs, and the angle between the straight rims of the terrestrial planets, the Moon and selected minor bodies by [1, 2, 3, 4, 8], and the authors.
*Craters larger than 12 km in diameter.

Object	ICs	PICs	% of PICs	Angle (°)
Mercury	291	33	11	112
Venus*	550	121	22	-
Moon (10°W-40°E, 10°N-50°S)	656	167	25	-
Mars (Greater Hellas region and Argyre region)	-	1575	16	-
Rhea	128	61	48	121
Dione	73	43	59	124
Tethys	50	17	34	123
Ceres	76	56	74	133
Vesta	90	50	56	134

Table 2: PICs found on Tethys.

Crater	Diameter (km)	Latitude (°)	Longitude (°)
Achilles	58.6	0.6	324.38
Ajax	88	-28.41	282
Alcinous	50	30.31	212.61
Antinous	138	-59.89	286.15
Arete	13	-4.67	299
Euanthes	33	7.86	238.91
Eupithes	22.3	18.71	171.21
Eurylochus	44.8	-5.07	27.68
Eurymachus	38.4	-35.65	65
Halius	29.5	44.4	4.96
Icarius	54.4	-5.89	305.85
Irus	26.5	-27	244.81
Leocritus	12.5	21.53	118.66
Naubolos	54.5	-72.19	305.18
Neleus	37.6	-19.38	25.72
Odysseus	445	32.82	128.89
Ormenus	39.8	-20.39	43.85

Figure 1: Number of straight rims on Rhea.

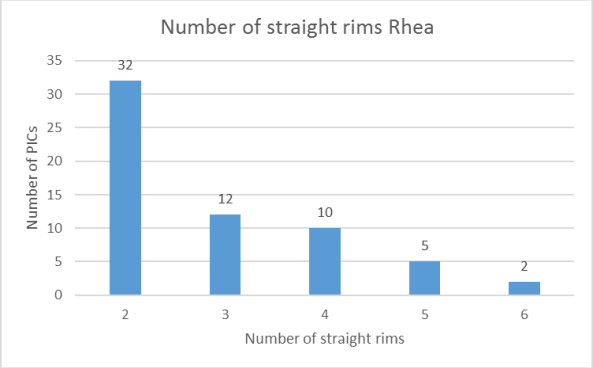


Figure 2: Number of straight rims on Dione.

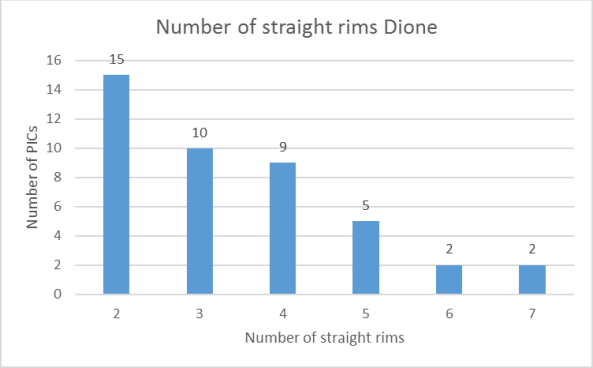
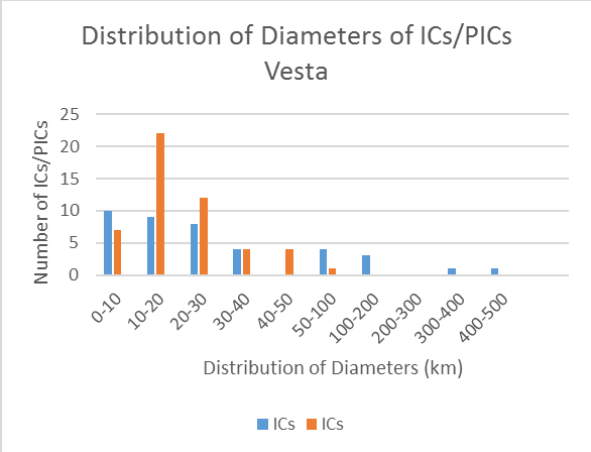


Figure 3: Distribution of diameters of ICs/PICs on Vesta.



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