THE CHARACTERISTICS AND DISTRIBUTION OF POLYGONAL CRATERS ON CERES. M. F. Zeilnhofer and N. G. Barlow, Dept. Physics and Astronomy, Northern Arizona University, Flagstaff, AZ 86011-6010 mfz3@nau.edu, Nadine.Barlow@nau.edu

Introduction: Polygonal impact craters (PICs) are non-circular craters which display at least two linear rim segments with a distinguishable angle between them. PICs can form as any regular polygon, but the most common shape observed are hexagons which display at least two to four distinct linear rim segments [1]. Previous studies show polygonal craters are mainly found between one and five times the simple-to-complex transition diameter (D_{sc}), even though polygonal craters have been observed in all crater diameter sizes [1-3]. PICs have been reported on both rocky and icy bodies and their formation is attributed to a weakened target comprised of preexisting joint patterns or faults [4]. Investigation of polygonal craters can provide further insight into underlying tectonic structures not visible on the body's surface as well as previous events which affected the strength of the target [4]. The overall relationship between the shape and formation of PICs with respect to the preexisting joint patterns is still not well understood [5].

Various investigations have been conducted on polygonal craters throughout the solar system due to their presence on both rocky and icy bodies. Investigations of impact craters on rocky bodies show generally 10-20% of all known impact craters on these bodies are polygonal [6]. Studies of impact craters on Ceres reveal a number of polygonal craters distributed across the surface [6-8]. These studies reported the number of polygonal craters, the number of linear rim segments, and the mean angle between linear rim segments for the overall crater. Initial studies of Ceres' impact craters with diameters between 5-280 km reveal 258 polygonal craters [7]. Of these 258 polygonal craters ~120 of them displayed six linear rim segments [7]. Additional studies on the 76 IAU-approved named craters on Ceres show 74% are polygonal with an overall mean angle of 133º, similar to the angle found for polygonal craters on Vesta [6]. A more recent study of Cerean craters between 1 and 280 km revealed 276 of them were polygonal [8].

This study establishes a comprehensive method for classifying and analyzing polygonal craters on Ceres using a global crater database in a larger diameter range than previously reported for Ceres. These data include the number of polygonal craters, their number of linear rim segments, the mean angle for each crater, the orientation of these polygonal caters in relation to surface fractures (either inside or outside of the crater), and the mean angle for the linear rim segments in relation to the visible fractures.

Methodology: We have compiled a global Cerean crater database containing 44,594 craters ≥1.0 km in diameter. Data were attained from the Framing Camera (FC) onboard NASA's Dawn spacecraft with a resolution of 400m/pixel. The polygonal craters were analyzed using the imagery obtained from the Low Altitude Mapping Orbit (LAMO) with a resolution of 35m/pixel [9]. A separate database was developed for the 1,466 polygonal craters marked in the global crater database for further study. This PIC database includes four distinct categories: a polygonal crater with no visible fractures located inside or outside of the crater, a polygonal crater with visible fractures located inside of the crater, a polygonal crater with visible fractures located outside of the crater, and a polygonal crater with visible fractures located inside and outside of the crater. Visible fractures located outside of the crater were only considered related to a linear segment if the distance from each linear rim segment of the crater was no more than 10 crater radii away. Each of these measurements were taken with the crater in the center of the frame in the due north position.

This analysis includes a comparison of the orientation of the linear rim segments with previously mapped linear features across the surface [10]. These features include the catenae systems of Samhain, Uhola, Pongal, Baltay, Gerner, and Junina. Fractures found within a crater were reported as floor fractured craters (FFCs) in the global crater database used for this analysis.

Angle measurements for the angle between linear rim segments and the angles between the linear segments and the fractures were obtained using the angle measurement tool in the ImageJ software. The PIC database contains information about each polygonal crater including the number of sides (ranging from 4-12), the angle measurements for each linear rim segment to the adjacent segment, the mean angle for the crater, the angle between the linear rim segments and the visible fractures (either within the crater or outside of the crater), the mean angle for the linear rim segments with relation to fractures, the direction of the fracture in relation to the crater (i.e north, south, east , west), and the name of the fracture associated with the crater, if applicable.

Preliminary Results: Polygonal craters were found in all degradation states as well as diameter sizes. The smallest polygonal crater reported was 1.0 km and the largest was 282.0 km (Kerwan). Polygonal craters were distributed across the entire surface with higher concentrations occurring in the Northern hemisphere [Figure 1]. Table 1 shows the number of the 1,466 polygonal craters which fell into one of the four categories analyzed along with the range of crater diameters for each category.

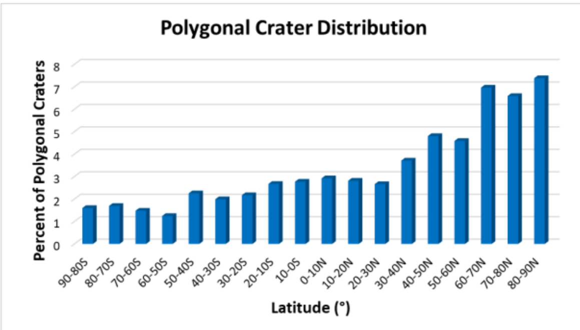

Figure 1: The percent of polygonal craters in relation to all craters in the latitude range observed on Ceres.

Polygonal Crater Classification	Number of Craters	Diameter Range (km)
No Fractures	1230	1.0-97.4
Fractures Inside of the Crater	3	24.7-55.6
Fractures Outside the Crater	222	2.1-155.0
Fractures Inside & Outside	11	20.8-282.0

Table 1: Number of polygonal craters in the four categories analyzed.

The most common class of polygonal craters were ones not displaying visible fractures. These craters did not display fractures inside of the crater and were out of range of any visible linear features, mainly due to the limitation of the 10 crater radii distance which affected smaller crater diameters. Figure 2 shows the distribution of these craters across the surface of Ceres.

Six sided polygonal craters were frequently observed on Ceres similar to a previous study identifying six sides as being the most frequent number of sides [7]. A comparison between the number of sides and crater diameter does not show any distinct relationship between the two. However, there is an increase in the percent of polygonal craters with increasing crater diameter compared to other craters of the same diameter size. The average angle between linear rim segments was 122.7° which is smaller than

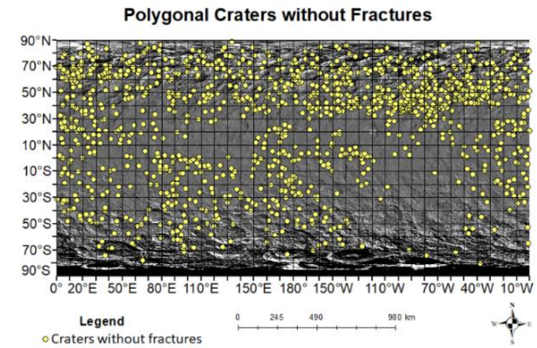

Figure 2: The distribution of polygonal craters with no effect to visible fractures.

what has been previously reported [6]. This is due to the increase in sample size in this study.

Conclusions: Our preliminary results show polygonal craters are the most dominant feature seen in our near-global crater database (3% of the total number of craters). Hexagonal craters are the most common shape seen across Ceres which is consistent with other findings for Ceres as well as the expected shape of polygonal craters reported throughout the solar system. However, there is no distinct relationship between crater diameter and the number of sides. There is, however, an increase in the percent of polygonal craters with increasing crater diameter indicating large craters are influenced by fracture systems at proper depths. The most frequent class of polygonal crater is one which shows no effect due to visible fractures, suggesting the influence of subsurface fractures, as theorized for Samhain Catenae [10]. Future work includes comparing these data to the morphometric information acquired for the central peaks and central pits. Results of this work will provide additional insight into the evolution and nature of the crust of Ceres.

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