An Examination of the Causes of Crater Irregularity
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Objective
The craters of the moon are probably its most easily recognizable feature. The majority of the moon’s craters are very close to perfect circles. A significant number of craters, however, are polygonal. Polygonality is the extent to which a 2-dimensional shape relates to a circle, or a 3-dimensional shape relates to a sphere. The reason for this polygonality was completely unknown, although some speculation existed. The objective of our research was to determine the reason for crater irregularity.

Thesis
Our team believes that there are at least two reasons for the formation of irregular craters. The first hypothesis is that a crater’s polygonality is determined by the topography and structure of the impact site. Polygonality in this case is the degree to which the shape in question relates to a circle or sphere. When a meteorite strikes an area of uniform composition, it’s crater has a uniform radius. When a meteorite strikes an area composed of multiple materials, the radius of the “circle” is altered. Each type of material, with its own hardness and density, will have its own radius. The rim of the crater in an area of basalt, for example, will be much closer to the center of the impact than the rim of the crater in an area of layered volcanic ash. The second hypothesis was that the age of the crater, how long it had been since the impact occurred, could conceivably affect the magnitude of the irregularity. The reason behind this hypothesis is that the moon was not around forever. On the moon, the most common and easiest understood method of weathering is mass wasting. Mass Wasting is the geospheric process by which sand, silt, and rock move downwards under the force of gravity. If craters are created where an impactor impacts an area of varying composition, the irregular areas of the crater would be those areas of a less dense or less hard material. As time passes, those less dense/hard areas will experience more dramatic mass wasting.

Introduction
To investigate our hypothesis, we needed maps of our regions overlaid with the geologic information about those regions to allow us to compare both data sets. We found this information in the Geologic Atlas of the Moon, created by the United States Geologic Survey, and we were assisted in accessing this information by the Google Moon and Google Earth programs.

Process
First Attempt: The idea is that you would create a computer program that would find the center of the crater by using the perfectly circular portions of the rim. From there, it would measure the length of the radius for the entire crater, and divide the length of the shortest radius by the length of the longest radius. This method would work, but would require an extensive knowledge of programming not possessed by the researchers.

Second attempt: This method is essentially identical to our final attempt, except for one detail. In this attempt, we failed to take into account the inverse square law, and so our results were skewed heavily based upon crater size.

Determination of Polygonality
1) We obtained our images from the LROC WMS Image Map.
2) Create a circle inside the rim of the crater, as large as possible, without ever crossing the rim of the crater.
3) Create a second ring outside the crater, as small as possible, without crossing the rim. Providing that you use the same units of measurement for both circles, they should cancel out in the division.
4) Multiply the longest radius of the smaller circle by the smallest radius of the smaller, and do the same for the larger circle. To find the area, you would normally multiply both of these numbers by π, but as with the units, π will factor out when you divide.
5) After finding the area of both circles, there are two methods that will work to find the polygonality. For method one, follow steps 6, 7, and 8. For method two, follow steps 9 and 10.
6) Assume that the ratio between all of the smaller circles, from all of the craters, is 1:1.
7) Divide the area of the larger by the area of the smaller.
8) Divide one by the area of the result.
9) Reuse all of the pictures so that the area of the smaller circles for each crater is the same.
10) Divide the area of the smaller circle by the area of the larger. The results for both methods will be the same.

Polygonality versus Size graph
The graph at right is included for multiple reasons:
- To list the craters used as the data set
- To show specifically the results of the quantification
- To show that crater size appears to have no affect on crater polygonality, although the size of our data set might conceal a trend.

Comparison of Polygonality and Geologic Makeup
In order to investigate our hypothesis, we needed maps of our regions overlaid with the geologic information about those regions to allow us to compare both data sets.

Conclusion
Our research supports our hypothesis, while adding to it: crater irregularity appears to be caused by variations in the density of the impact area and preexisting structures present in the area impacted.

Future direction
In order to fully realize the potential of the findings presented here, further research would have to be done.

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References Cited

Large scale, Lunar Orbital Mosaics and Geologic Charts, acquired with the use of the Google Earth

Analysis of the Data Sets
By looking at the craters in both maps, we were able to recognize that the geologic map highlights the anomalies caused by variations in geologic makeup. At the same time, it shows that those geologic changes do not cause all crater irregularities, as shown in the picture of Horrocks to the left.

As you can see in the area highlighted, there is anomaly in the crater's rim. If you look at the area beyond the crater's rim, you see that the crater diameter is less than expected from the crater size. This suggests that there is a second cause for crater irregularities. Crater irregularities must be caused by both variations in the geologic makeup of the area impacted and by preexisting geologic structures in the area impacted.

Ridges, rills, craters, and any other structure, either on the surface or below it, will disrupt the circular nature of the crater.

No relationship between crater size and polygonality is apparent in our data set.