# Crater Trail Analysis

## S.T.E.M Academy/Lee High School

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## Abstract

Current images of the moon show what appear to be flow-like patterns behind boulders near fairly young craters. These streaks do not seem to resemble typical ejecta patterns, particularly in the length and shape of the patterns. The width of the boulders, the distance of those boulders from the crater, and the length of the streaks behind them were analyzed and relationships amongst the three were identified. A sample group of 150 boulders was selected from an image taken by the Lunar Reconnaissance Orbiter Camera. The boulders were analyzed with image editing software, ImageJ and MSPaint. It was found that length of the streak and the distance from crater produce a slightly positive correlation, but follow a vertical pattern; the distance and boulder width produced no correlation, while boulder width and streak length appear to have had a slight positive correlation. This investigation is the starting point for further study into non-typical flow patterns.

## Background

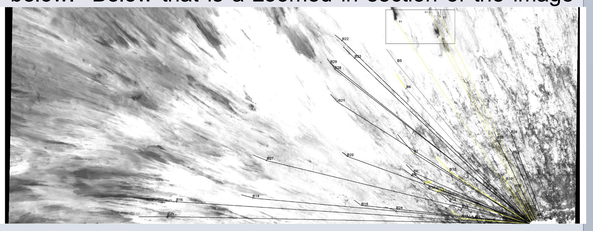
Impact sites on the lunar surface are often characterized by very expansive and pot-marked ejecta zones. These regions vary in appearance but generally contain the same features. Scattered about the whole area of a typical ejecta zone are secondary impacts from the debris of the primary impact that caused the crater along with boulders that either fell off of the object or were already present on the surface. The regolith upturned from the primary impact tends to fall back down to the surface, casting a smooth blanket on the surrounding region. This project takes special interest in the ejecta zones surrounding fairly recent lunar craters that do not seem to display this blanketing quality. “Streaks” of undisturbed regolith appear to form behind boulders surrounding these impact sites. The streaks seem to form flow-like patterns, much like a rock blocking the flow of water around it. Very few craters have displayed this unusual quality; the ones that do are very young. Currently there is no quantifiable explanation for the existence of these unusual streaks.

## Methodology

Data was taken using two similar methods; Microsoft Paint and ImageJ. Using ImageJ, a scale was set to accurately measure each datum. The scale used for the image was 100 meters to 82 pixels. Lines were drawn for the sake of measurement and then values were recorded in a Microsoft Excel document. Each crater was labeled using text boxes. In order to differentiate the boulder from moon background, the contrast had to be changed and in many cases, the image was enlarged using a zoom tool.

Once each interesting boulder was identified, the straight line tool was used to draw dimensions on the image. A multiplier of 100/82 was used to define a true value for the lengths, widths, and distances from the crater of each boulder. The length of the elongated 'shadow' or 'streak' behind the crater, the diameter of the boulder, and the distance of the boulder (approximate) center from a select point on the crater was recorded and then analyzed in hopes of finding a correlation.

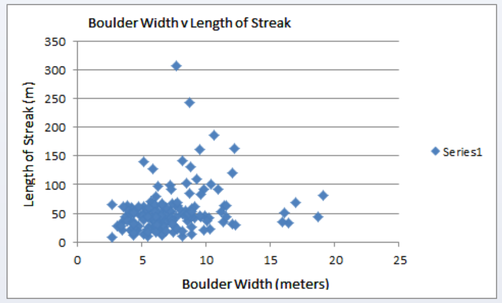
An illustration of the data gathering techniques is shown below. Below that is a zoomed in section of the image

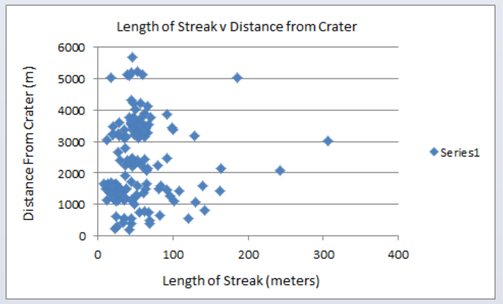


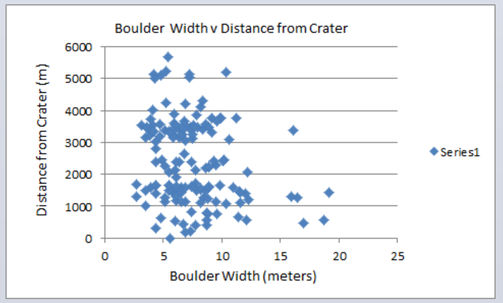
Method of data gathering on ImageJ with LROC crater image

Sample of ejecta zone with unusual streak patterns behind boulders

## Data and Results




## Conclusion

- We have found that the width of the boulder has a slight positive correlation in relation to the length of the streak behind the boulder. The larger the boulder, the longer the streak.
- There were quite a few outliers when comparing the length of the streak to the distance of the boulder from the crater. No correlation was found between length and distance from the crater; however, we found that most streaks were confidently around 100 meters long.
- Boulder width did not significantly deviate as the distance from the crater increased; however there is a slight positive correlation between 0 to 2000 meters away from the crater. When boulders were farther than 2000 meters from the crater, there was no such correlation.

## Future Studies

This project is the initial inquiry into further study of flow-like patterns occurring within recent ejecta zones along the lunar surface. Data will continue to be gathered by professional researchers. As such, the structure of a model will continue to develop until a one is agreed upon that best explains the manner of the streaks' formation.

## References

Dr. Paul Hayne
- Postdoctoral Scholar in Planetary Sciece
- Mentor

Mrs. Penny McCool
-STEM AP Physics teacher and coach

Andrew Shaner
- High School Lunar Research Organizer

http://www.lroc.asu.edu/
-Optical images of craters taken by the LROC

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