EXAMINING POTENTIAL FOR ICE EXTRUSIONS IN RELATIONSHIPS BETWEEN FURROWS AND RELATED TERRAIN ON GANYMEDE.

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Introduction: Klein High Ganymede Student Imaging Project (GSIP) moved from Enceladus and Europa to another one of Jupiter’s moons, Ganymede, to study the possibility of locations of ice extrusions on the moon’s surface – namely in Galileo Regio and Marius Regio – by examining furrows in those regions.

The regions of Galileo Regio (GR) and Marius Regio (MR) offer two major types of terrain: cratered terrain and smooth terrain. Cratered terrain features a heavy onset of craters, an old surface age, dark surface color, and an average albedo level of .35; smooth terrain features a light onset of craters, a young surface age, light surface color, and an average albedo level of 0.43. As the largest heavily-cratered region on Ganymede, GR contains smooth terrain integrated with the cratered terrain, making it an interesting area of study. It is suspected that furrow systems formed by extensional stresses occurring during crystal solidification. MR, like GR, also has integration between cratered and smooth terrain. In addition, MR contains crater relaxation fraction data not exhibited on GR, making it another region of interest.

We decided to focus our attention on the furrow’s latitude and longitude at the beginning and ending points, furrow location, furrow length, craters’ relaxation fraction data, and surrounding craters’ center latitudes, center longitudes, and relative areas. We hope to support the hypothesis that furrows in GR and MR correlate with high or low albedo and the presence or absence of adjacent craters, thus leading to the existence of possible ice extrusions on Ganymede.

Experimental Setup: Images of Ganymede taken on the Galileo spacecraft allowed us to study images from GR and MR, which are located close to each other. The images were selected based on their large size and varying surface composition as well as the relevancy to relaxation fraction data (MR only).

To eliminate some observer bias, we created “teams” of researchers for each image, with every member taking data from furrows unique from their teammates. In addition to collecting data on regular furrows, to account for relaxation fraction data on MR, the specific team focused on finding furrows next to or near the respective craters containing this data. Each team followed systematic steps to assure consistency in data collection.

Experimental steps followed as such:

Begin by documenting the latitude and longitude of the starting point of each desired furrow.

Measure, in kilometers, the length of the furrow. If multiple distances are recorded due to irregular shape, add the distances together for a total.

Mark the latitude and longitude of the ending point of the furrow. Identify where the furrow is located (light or dark area).

Select up to six craters that either touch, lie underneath, or lie on top of the furrow; gather the center latitude, center latitude, and relative area of each crater.

If applicable on MR, apply relaxation fraction data to each crater.

Results and Discussion: Much analysis led to some interesting findings. When compared together, the lengths of light furrows and the lengths of dark furrows showed contrasting trends. Light furrows exhibit more sporadic lengths; on the other hand, dark furrows exhibit more constant lengths. Lighter areas have a lower average of craters per furrow than darker areas. The less craters per furrow, the more active the area.

Graphing furrow length and crater area together results in a noticeable grouping of short furrows and small craters. The linear and exponential trend lines are flat; therefore, we cannot conclude that short furrow lengths result in small crater areas.

In light or dark areas, latitude doesn’t seem to relate to furrow length. The location of a furrow therefore isn’t a strong factor that would be relevant to length. This suggests that some force not based on latitude determines the location and length of a furrow.

Overall, if there are ice extrusions on Ganymede, they may happen more often in the light area as opposed to the dark area. Light furrows are more prone to change. Visually, the light terrain appears to be less static, and the data supports this.

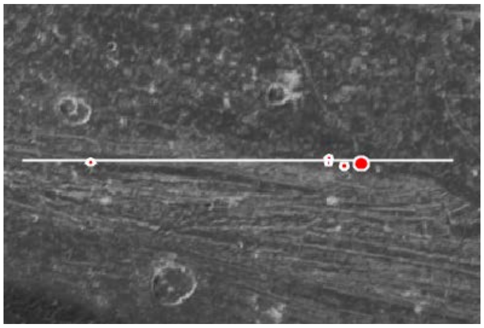

Figure 1. Taking measurement of a furrow and its surrounding craters on Galileo Regio.

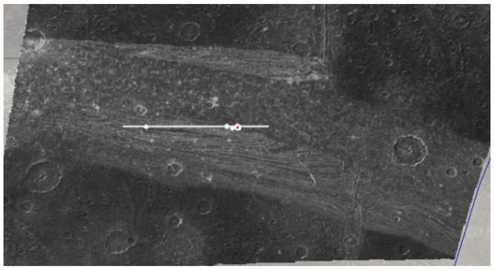

Figure 2. Zoomed out view of the area members were collecting data on Galileo Regio.

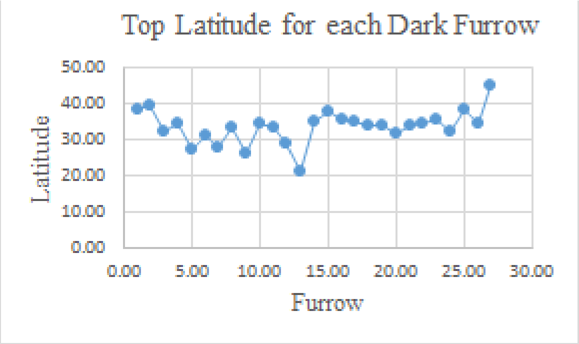

Figure 3. Displays the trends in top latitude for dark furrows.

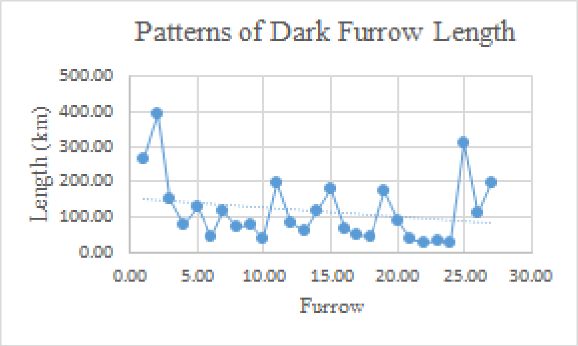

Figure 4. Displays the length of the furrows in dark terrain.

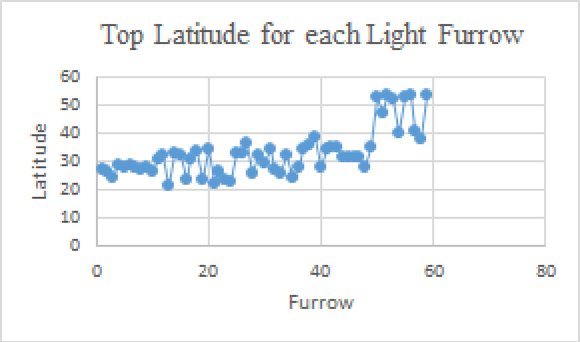

Figure 5. Displays the trends in top latitude for light furrows.

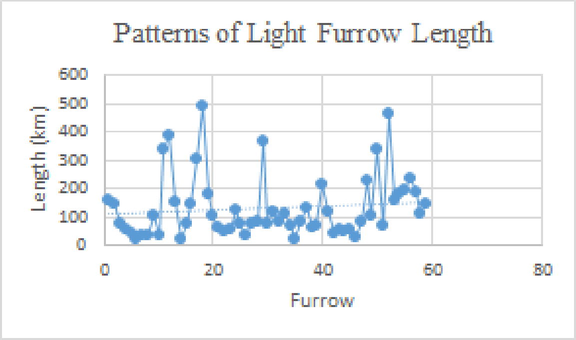

Figure 6. Displays the lengths of the furrows in light terrain.

References:

Our team would like to thank Dr. Kelsi Singer for lending her time and data to our research; we cannot appreciate it enough. [1] Singer K. et al. (2012) *43rd Lunar and Planetary Science Conference*: 2775. [2] Grasset O. (2014) *Workshop on the Habitability of Icy Worlds*: 4011. [3] Casacchia, R., and R. G. Strom (1984), Geologic evolution of Galileo Regio, Ganymede, J. Geophys. Res., 89(S02), B419–B428, doi:10.1029/JB089iS02p0B419. [4] http://www.jpl.nasa.gov/spaceimages/details.php?id=PIA18005