EXAMINING POTENTIAL FOR SIMILAR SUBSURFACE CONDITIONS ON EUROPA AND CALLISTO BY COMPARING AND CONTRASTING RING STRUCTURES. A. Manchester, G. Byers, V. Chang, V. Do, X. Fontenot, S. McGrath, C. Sanchez, J. Smith, K. Sutherland, and J. Tran. Klein High School, Spring, TX

Introduction: In previous years, the Klein High Europa and Callisto Student Imaging Project (ECSIP) Team has studied Enceladus and Ganymede and recently we have become interested in the subsurface oceans and ring structures on Europa. According to the California Institute of Technology, the ring structures on Europa may have been created by large impacts. The troughs and ridges left behind are significant because they form concentric circles, which may be evidence of fluid underneath the surface. We decided to study the possibility of subsurface oceans on Callisto, another one of Jupiter's moons, by comparing and contrasting ring structures on the surfaces of both Europa and Callisto.

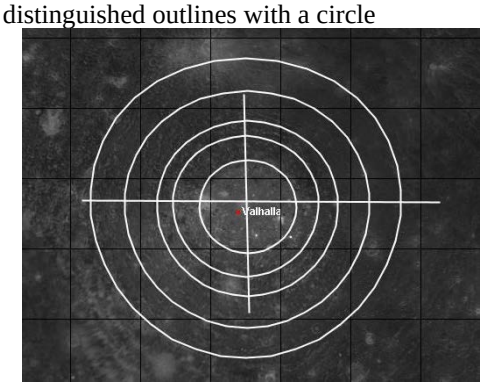
Using JMARS (Java Mission-planning and Analysis for Remote Sensing) and all existing known ring structures on both celestial bodies – Callanish, Tyre, Adlinda, Asgard, Valhalla, and Utgard– we measured center longitude, center latitude, and average distance between the rings. Through examination of the physical properties of Large Ringed Structures on the surfaces of Europa and Callisto, we hope to find correlations that could give further insight to support the hypothesis that the subsurface conditions on both bodies may relate.

Experimental Setup: We used all available high-resolution images provided by JMARS of the ringed structures on Europa and Callisto. We decided that we would only take data from the structures that fit the following criteria:

1) Circular or nearly circular
2) Raised/lowered topography
3) Different albedo
4) Different segments in at least two quadrants

We discussed and decided on the exact process to measure and calculate the average distance between the rings and record the data. Next, we split our team into smaller groups and assigned each one with a different ring structure. Each team followed the following experimental setup to ensure consistency in data collection:

1) Identify the center ring and label as ring #1
2) Identify consecutive rings outward, numbering them upwards from 1
3) Using the custom shape layer on JMARS, trace the rings as closely as possible to their distinguished outlines with a circle



Layout of rings on Valhalla (Callisto)

4) Once the outermost ring has been traced, record the number of rings, center latitude & longitude, and area to acquire general information about the ringed structure itself.

Results and Discussion: We found interesting patterns in the ringed basins regarding their general size, number of rings, and location. An analysis of the radii of each individual ringed structure, without separating the moons, yielded a clear division between Callisto and Europa through the data:

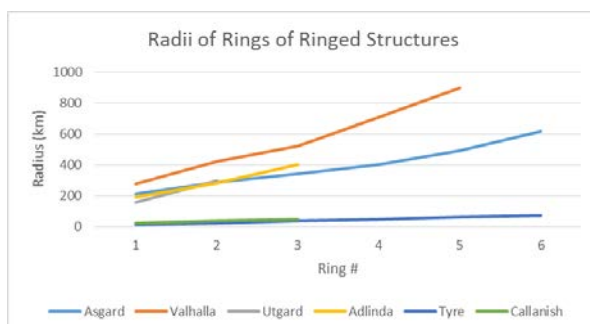


***Fig. 1** – The data from Callisto shows a clear separation from that of Europa*

Results comparing the number of rings of each structure to its latitude indicated an increase in the number of rings closer to a possible certain latitude on both Callisto and Europa* [Fig. 2A, 2B].

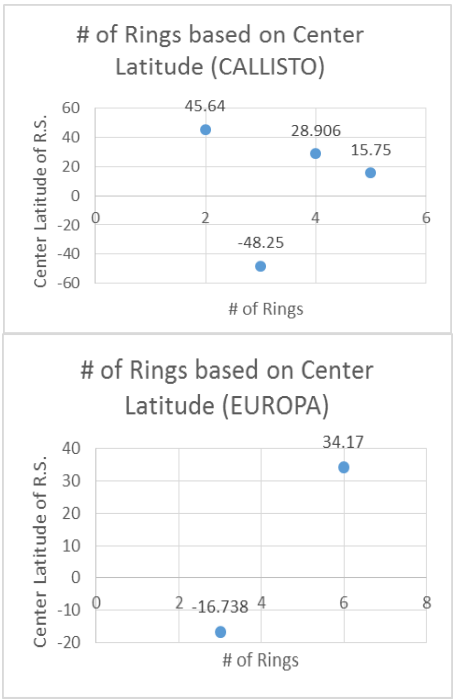


Fig. 2A and 2B – *indicate latitudes in which a structure has more or less rings*

*Because of the small number of data points, we observed surface conditions at the locations of the two ringed structures on Europa to help connect results with those found on Callisto, in which the surface region around Tyre appears more active compared to the relatively inactive region around Callanish.

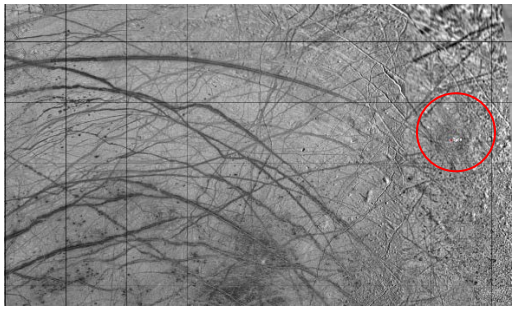


Fig. 3A – *Surrounding region of Tyre, Europa*

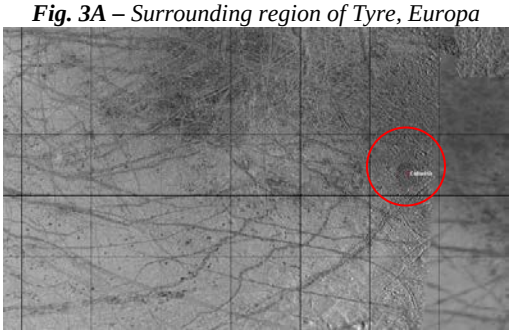


Fig. 3B – *Surrounding region of Callanish, Europa*

This is further supported by a comparison of the relative increase in size of each ring. As the difference in latitude decreases, the relative increase in size becomes very similar, as shown by Asgard and Valhalla:

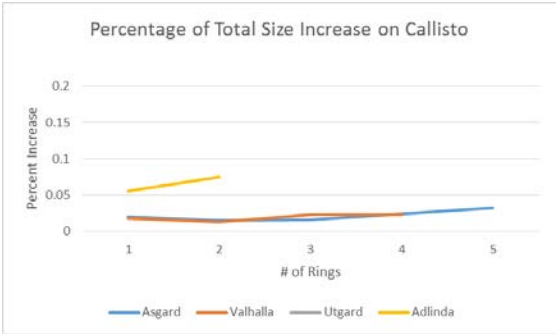


Fig. 4 – *The relative increases in size of Asgard and Valhalla are very similar.*

The results of our research indicate that patterns in the particular features of the large ringed structures could be used to predict the subsurface conditions at their locations. Additionally, they point toward an ideal latitude for the creation of Large Ringed Structures, and an impact in this latitude could form a hypothetical ringed structure with an even greater area and number of rings. Upon further analysis, it could be possible to use these structures to find points in the surface that are thinner and to find more prime candidates for exploring possible subsurface oceans on both of these moons.

References:

[1] Klemaszewski, J.A.; Greeley, R. (2001). "Geological Evidence for an Ocean on Callisto" (pdf). Lunar and Planetary Science XXXI. p. 1818.

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[3] Chang, Kenneth (March 12, 2015). "Suddenly, It Seems, Water Is Everywhere in Solar System". New York Times. Retrieved March 12, 2015.