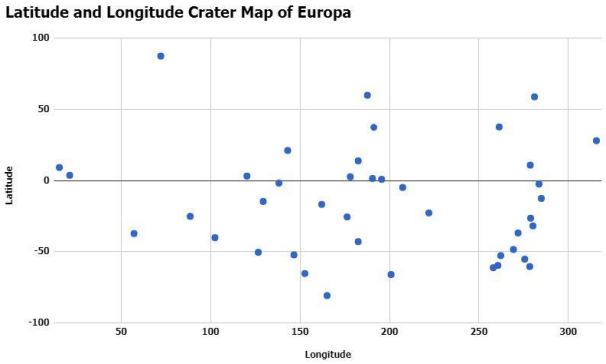
Examining Potential Evidence of Warmer Ice on Leading Hemispheres by Examining Surface Features on Icy Moons of Jupiter and Saturn. Gabriel Byers, James E. Miller. Klein High School, Spring, TX

Introduction: In previous years, the Klein High School Astronomy Research Team has studied Jovian moons, but recently we have become interested in the potential of warmer or thinner ice on the moons of Jupiter and Saturn. We decided to study the possibility of warmer ice on leading hemispheres on these moons and how this could correlate to the appearance of plumes. Using JMARS (Java Mission-planning and Analysis for Remote Sensing) and the Planetary Names from the USGA and IAU, we collected lists of craters, linea, and sulcus. Through examination of the physical properties of these structures we are looking for evidence that these along with other factors make leading hemispheres of icy moons more active, and possibly thinner above the subsurface oceans.

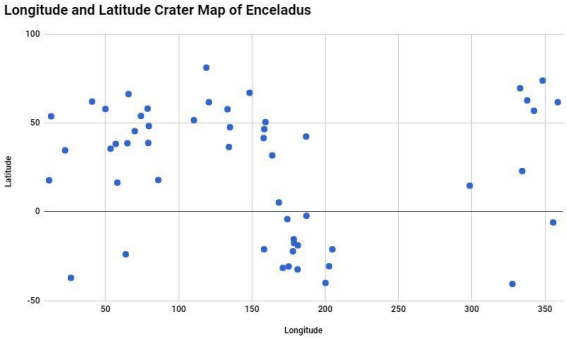
Experimental Setup: The finding of evidence to research our hypothesis was based primarily on data collected from the USGS Planetary database and JMARS was used to visually confirm locations of specific hemispheres and structures. We used the data we collected on Europa, Enceladus, Ganymede, and Callisto to work towards finding a correlation between each moon's craters, linea, or sulcus relative to leading and trailing hemispheres. The use of abstracts from previoius years assisted us in locating the leading hemispheres and major structures for each of the sattelites.

Discussion and Results: There were some interesting findings that supported our hypothesis, but also some unique information that came out of our data which contradicted our initial thoughts.

Surface features and craters found on Europa are primarily on the leading hemisphere, which assists in supporting our hypothesis. The increased number of linea, roughly 42,500 km in total length to the roughly 22,000 km on the trailing hemisphere, on Europa's surface clearly points towards a more active ice lithosphere, making it warmer and more suitable for the appearance of plumes. Europa's leading hemisphere is centered on exactly 180° E (the hemishphere ranges from 90° to 270°).

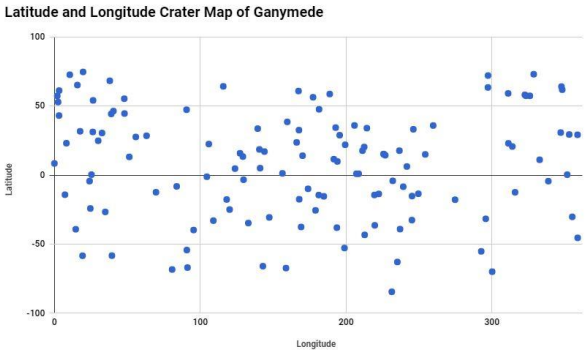


Enceladus' trailing hemisphere surface impact concentration is somewhat higher than that of Europa's leading with thirty eight craters and 2,140 km of sulcus on the trailing hemisphere and only fifteen craters and 944 km of sulcus on the leading hemisphere. Contradicting our hypothesis, the leading hemisphere of Enceladus shows much less activity than any other moon we researched. The leading hemisphere of Enceladus is centered on 320° E (starting at 230° and reaching around to 50°).



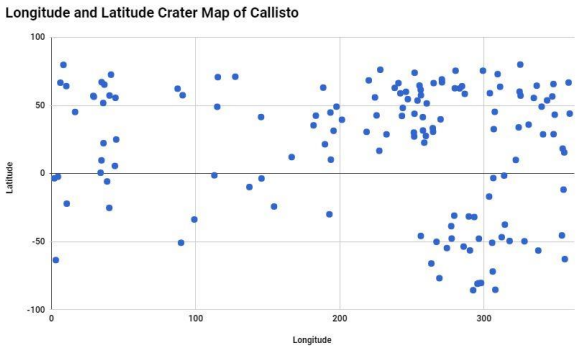
Ganymede is the same as Enceladus in that it didn't support our hypothesis, but different in that it wasn't contradicting either. The amount of craters on the leading and trailing hemispheres of Ganymede are even at sixty four on both sides, while the total sulcus length on the leading hemisphere is roughly 30,000 km and on the trailing hemisphere the length is roughly 37,500 km. Ganymede has similarities to the moons on both sides of it, Europa and Callisto. Its very broken surface has visual similarities to Europa's lithosphere, but the massive amount of craters is an extreme similarity to Callisto. The surfaces of its two neighboring moons exemplify the different surface features of Ganymede. Ganymede's leading hemi-

sphere is centered on 234° E (with the hemisphere



ranging from 144° to 324°).

Callisto's unusual amount of craters and lack of plate tectonics is very different from Europa, the other moon that supports our hypothesis. Callisto has eighty one craters on the leading hemisphere and fifty nine on the trailing hemisphere. The largest of the four large ringed structures on Callisto, Valhalla, is also on the leading hemisphere. The ripple formation of these ringed features on Callisto could further provide clues to a warmer surface temperature. Callisto's leading hemisphere is centered on 221° E (ranging from 131° to 311°)



With only half of the studied moons supporting our hypothesis, it was neither proven nor disproven that hemisphere affects the appearance of plumes, while still learning some valuable and interesting information. With Europa and Callisto both most likely having a subsurface ocean, and a majority of their features on the leading hemisphere, it is peculiar for them to be so different in appearance. The findings from these two moons though do not necessicarily guarantee or preclude plumes from being formed on any certain body.

References:

[1] Rothery, David A. Satellites of the Outer Planets: Worlds in Their Own Right. Oxford University Press, 1999. [2] Xu L. et al. (2017) *48th Lunar and Planetary Science Conference:* 1774. [3] Maue, Anthony & Patthoff, D & Pappalardo, R. (2015). Mapping and analysis of tectonic structures on Enceladus's Leading Hemisphere Terrain. [4] http://hubblesite.org/images/news/release/2017-17