A COMPARATIVE STUDY OF LUNAR AND MARTIAN WRINKLE RIDGES. A. Y. Blasizzo, Department of Geosciences, Texas Tech University, Lubbock, TX, 79409 (ablasizzo@yahoo.com)

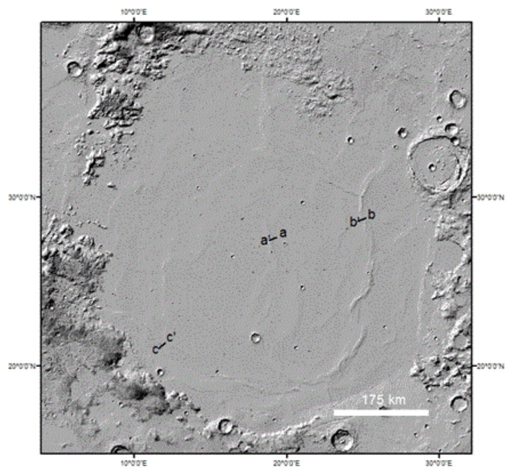
Introduction: The purpose of this study is to compare lunar and martian wrinkle ridges with the use of Digital Elevation Model (DEM) data. These features are characterized by having a low, broad relieved arch with a narrow superimposed ridge [1; 2], alternately defined as the broad ridge and echelon crenulations respectively [3]. The focus of this comparison will be in the connected lunar basins Mare Serenitatis (Map 1) and Mare Imbrium and the martian basins of Isidis Planitia (Map 2) and Utopia Planitia. What is particularly striking about wrinkle ridges is their lack of terrestrial analogs despite their presence on the other terrestrial bodies [4]. Their mechanisms of formation are not entirely known, and thus two major hypotheses have been proposed.

One hypothesis is creation from volcanic or isostatic loading processes, specifically in the context of Isidis and Utopia Planitia [5-7]. The alternate hypothesis is creation from horizontal shortening [1; 3; 8-10] through means of planetary cooling [11] or other tectonic processes sourcing from Syrtis Major Planum and Isidis Planitia and the Elysium Volcanic Region, [9]. Such forces lead the underlying geology to form blind thrust faults protruding in concentric and radial patterns [1; 3; 8-10].

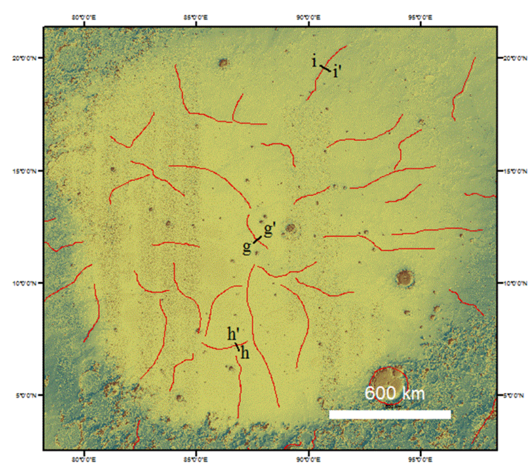
Due to the lack of terrestrial analogs and the inability to conduct field work, understanding the formation of these features is challenging. If this study confirms the morphologic similarities of the wrinkle ridges, another incentive to conduct further field based research on the Moon would be introduced.

Methods: The Lunar Orbiter Laser Altimeter (LOLA) Digital Elevation data was accessed through Jet Propulsion Laboratory's Moon Trek. Similarly, the elevation data from the Mars Orbiter Laser Altimeter (MOLA) was accessed through the Jet Propulsion Laboratory's Mars Trek. Both programs were useful due to their ability to instantly produce topographic profiles and georeferenced topographic data that could be manipulated to have 10x vertical exaggeration. A compilation of twelve geographically analogous profiles were collected (a, b, g, h sample profiles, locations seen in Map 1 and Map 2), three per basin. The profiles and map data is summarized into Table 1 for convenience. The data for map creation of Lunar LOLA Color Hillshade 128 ppd in Mercator projection for Mare Imbrium and Serenitatis were found through USGS Astrogeology Cloud Processing Map a Planet 2. The datum to create the map of Isidis and Utopia Planitia was found in [12]. Additionally, the datum were used along with Yue et al., 2015 [2] to confidently collect data in areas where wrinkle features were mapped.

Map 1: A Digital Elevation Model (DEM) map of Mare Serenitatis in Mercator projection of the lunar surface displaying locations of topographic profiles a-c.



Map 2: A DEM map of Isidis Planitia in GCS Mars 2000 Sphere Projection on the martian surface displaying locations of topographic profiles g-i. Outlined in red are wrinkle ridge features [12].



Results: The topographic profiles are taken perpendicular to the long axis of the ridges in order to isolate the topographic morphology from the overall ridge orientation. The basins of Mare Serenitatis (Map 1) and Mare Imbrium primarily contain wrinkle ridges in concentric rings with smaller, topographically lower radial ridges cutting through them. As seen in Isidis Planitia (Map 2), the wrinkle ridges here are weakly radial, with segments seemingly concentric, with little similarity to those of the lunar surface. However, Utopia Basin's ridges share more similarities with its lunar counterparts. Concentric ridges are seen upon the northern half of the region, yet are primarily radial further towards the middle of the basin. However, the ridges do not interweave with the concentric ridges as seen in the lunar basins.

The lunar ridge topographic profiles (a-f) typically display a pronounced superimposed ridge, creating a sharp rise of the ridge that then slopes downwards and back up again with a shallow slope. It is because of this echelon crenulation that some of the elevation rises have steep slopes. Contrastingly, martian wrinkle ridges (g-l) in Isidis and Utopia Planitia show little evidence of a superimposed ridge and generally increase in elevation over moderate slopes. Additionally, the elevation change is much smaller than those on the lunar surface.

Conclusion and Future Work: The limited knowledge of sub-surface geology in Utopia and Isidis Planitia coupled with uncertainties of its geologic history leads the topographic comparisons to remain inconclusive. Looking at the topographic profiles, the ridges are analogous to each other; however one cannot simply rely on the outer morphology of the ridges to confirm analogy when the methods of formation are unconfirmed. While the topography might indicate a similarity of underlying structures of blind thrust faults, there is not enough field information to confirm this.

Additional research can be done between the four basins, where comparative analyses of major ridge system orientations are applied with quantitative strike data of the long axis of the broad ridge segments in conjunction with the orientations of the superimposed ridges. Additionally, another consideration would be to conduct another morphology comparison between lunar ridges with other areas of wrinkle ridge presence on the martian surface, such as on Lunae Planum, Amazonis Planitia, or Solis Planum.

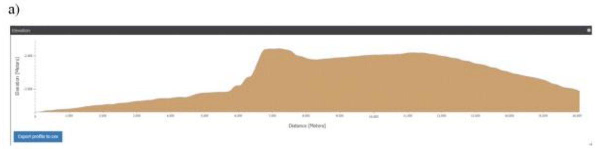
The further study of these wrinkle ridge structures is highly applicable and useful for the study of other terrestrial bodies and gives opportunity to promote future field work to be conducted on the lunar surface.

References: [1] Watters, T. R. (2004). *Icarus*, *171*(2), 284-294. [2] Yue, Z., Li, W., Di, K., Liu, Z., & Liu, J. (2015). *JGR*, *120*(5), 978-994. [3] Schultz, R. A. (2000). *JGR*, *105*(E5), 12035-12052. [4] Watters, T. R. (1988). *JGR*, *93*(B9), 10236-10254. [5] Thomson, B. J., & Head, J. W. (2001). *JGR*, *106*(E10), 23209-23230. [6] Head, J. W., Kreslavsky, M. A., & Pratt, S. (2002). *JGR*, *107*. [7] Ivanov, M. A., Hiesinger, H., Erkeling, G., Hielscher, F. J., & Reiss, D. (2012). *Icarus*, *218*(1), 24-46. [8] Golombek, M. P., Anderson, F. S., & Zuber, M. T. (2001). *JGR*, *106*(E10), 23811-23821. [9] Anderson, R. C., Dohm, J. M., Haldemann, A. F. C., Pounders, E., Golombek, M., & Castano, A. (2008). *Icarus*, *195*(2), 537-546. [10] Daket, Y., Yamaji, A., Sato, K., Haruyama, J., Morota, T., Ohtake, M., & Matsunaga, T. (2016). *EPS*, *68*(1), 157. [11] Walsh LS, Watters TR, Banks ME, Solomon SC (2013). XLIV LPS, abstract #2937, Houston [12] Tanaka, K. L., James A. Skinner, J., Dohm, J. M., Rossman P. Irwin, I., Kolb, E. J., Fortezzo, C. M., . . . Hare, T. M. (Cartographer). (2014).

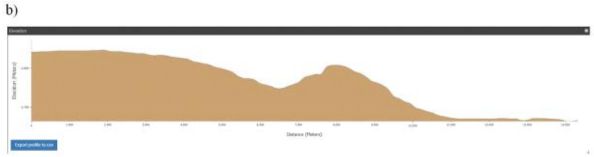
Table 1: Data displaying location of endpoints for topographic profiles, along with the vertical exaggeration displayed in the profiles.

	latitude 1	longitude 1	latitude 2	longitude 2	VE	Location
a	27° 43' 21.792" N	19° 15' 50.04" E	27° 30' 30.996" N	18° 42' 48.024" E	10	Mare Serenitatis
b	28° 50' 49.308" N	25° 8' 27.276" E	28° 37' 46.272" N	24° 39' 43.416" E	10	Mare Serenitatis
c	21° 7' 24.024" N	11° 30' 33.912" E	21° 26' 20.652" N	11° 55' 3.288" E	10	Mare Serenitatis
d	41° 34' 51.996" N	13° 49' 11.64" W	41° 23' 0.24" N	14° 23' 5.28" W	10	Mare Imbrium
e	40° 30' 6.084" N	7° 37' 11.712" W	40° 13' 36.696" N	8° 10' 11.676" W	10	Mare Imbrium
f	31° 55' 32.484" N	30° 1' 37.56" W	32° 2' 23.136" N	29° 26' 50.28" W	10	Mare Imbrium
g	11° 53' 2.472" N	87° 35' 29.04" E	12° 5' 59.064" N	87° 51' 43.92" E	10	Isidis Planitia
h	19° 39' 57.744" N	90° 32' 0.708" E	19° 25' 53.544" N	90° 53' 49.812" E	10	Isidis Planitia
i	7° 4' 4.026" N	87° 5' 42.684" E	7° 26' 39.0264" N	86° 53' 13.776" E	10	Isidis Planitia
j	37° 31' 54.732" N	94° 9' 52.236" E	37° 50' 1.176" N	93° 48' 27.576" E	10	Utopia Planitia
k	59° 29' 7.08" N	89° 48' 55.08" E	59° 0' 22.608" N	90° 9' 1.224" E	10	Utopia Planitia
l	54° 54' 24.912" N	128° 20' 10.68" E	54° 27' 13.428" N	128° 44' 41.64" E	10	Utopia Planitia

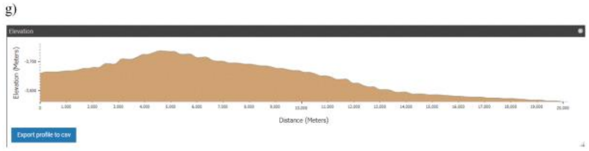
a)



b)



g)



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