Windows of Mars: *Impact Craters Along the Martian Dichotomy as Markers for Planetary Evolution*

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ABSTRACT

Impact cratering has been a prominent reconstructor of the Martian Surface. Every impact creates a window into the subsurface of Mars when it excavates and modifies the surface. It is most observable in the southern hemisphere, consisting of old, cratered bedrock. The southern and northern hemispheres are separated by a crustal dichotomy. There are different theories for how the dichotomy boundary formed (Citron, 2021; Robert, 2021) but what is known is that there are notable differences in material composition, but also the amount of water found in subsurface ice, permafrost and water bearing minerals. Previous research has focus on exterior crater morphology, called ejecta, which has served as proxies to understand volatile content thus, trying to understand how Mars has evolved over time (Osinski et al., 2011). However if other structures can be analysed for the same reason has not been researched to the same extent and therefore the aim of the study is to see if:

- Interior morphological structures of impact crater (such as central uplifts and terraces) can be used to understand Mars's evolution – Why should other structures be investigated, and could they be used as a complement to previous research?
- There any significant differences between craters in the northern and southern hemisphere, respectively – Do they differ from each other, why or why not? What would be the cause of that and could that exlpain how Mars has evolved?

In This study, three complex craters across the dichotomy boundary were therefore explored, to observe similarities and difference which could reveal attributes of southern highlands and northern lowlands, respectively.

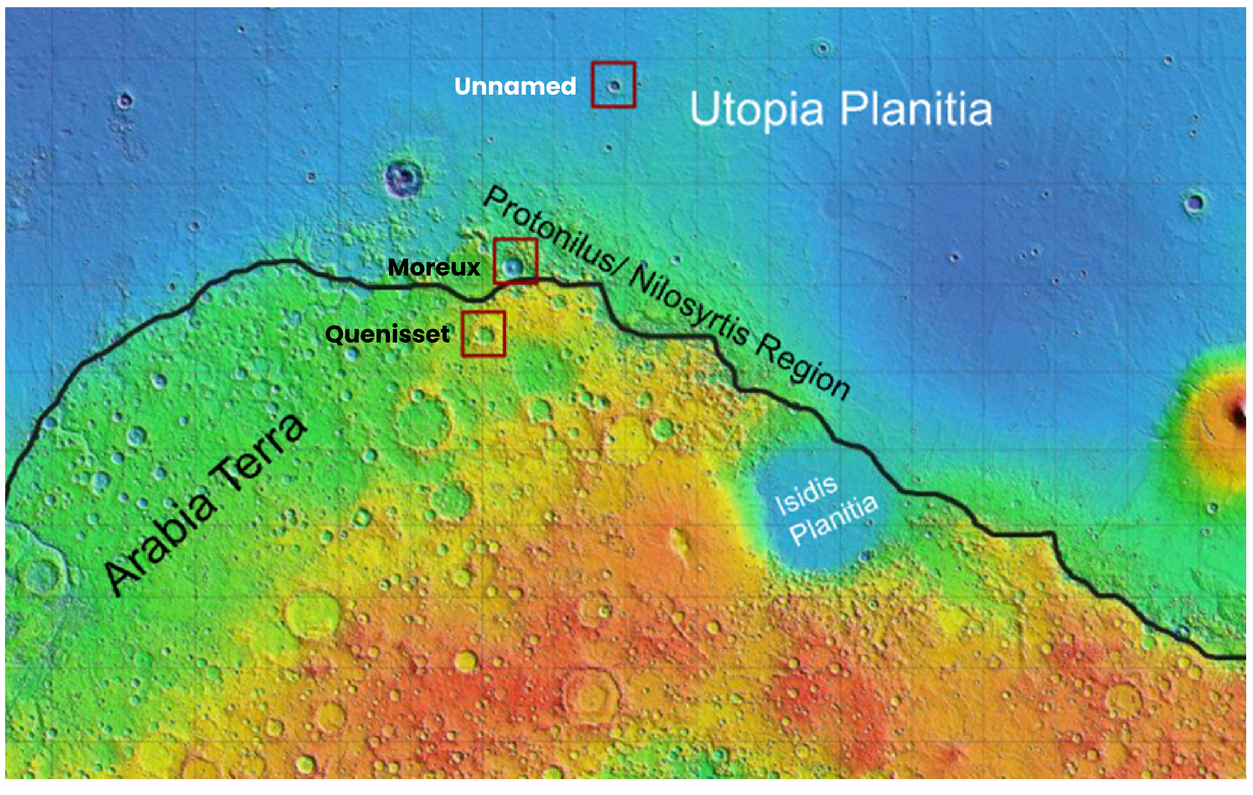

Fig. 1. Map over the area of interest on Mars, with the three craters, chosen for investigation, marked out, NASA/JPL-Caltech/Arizona State University

METHODOLOGY

Investigated area was analysed with the help of High Resolution Imaging Science Experiment (HiRISE) and Java Mission-planning Analysis for Remote Sensing (JMARS). Three craters were chosen for investigation:

- Quenisset crater situated in the southern Highlands, in the Arabia Terra region
- Moreux situated in the Protonilus/Nilosyrtis region along the Martian dichotomy
- Unnamed crater situated in the Northern Plains, close to Utopia Planitia

Profile lines were drawn across each crater in different directions in order gain a 3D-view of the craters. HiRISE-imaging of morphological structures within each crater, were analysed, which laid the foundation for the discussion and interpretation

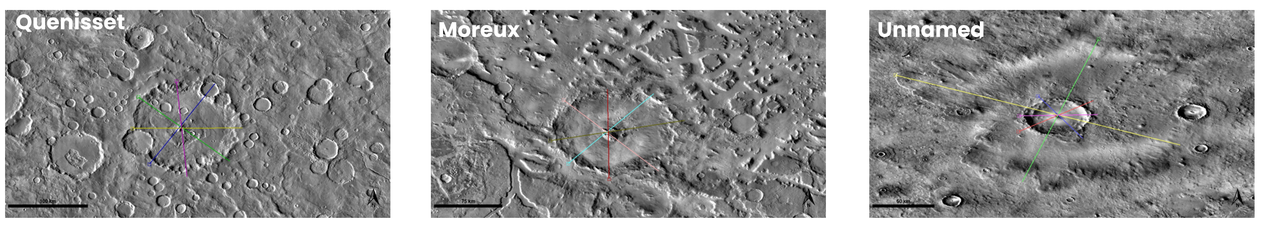

Fig. 2. JMARS imagas of the three craters, NASA/JPL-Caltech/Arizona State University

RESULTS

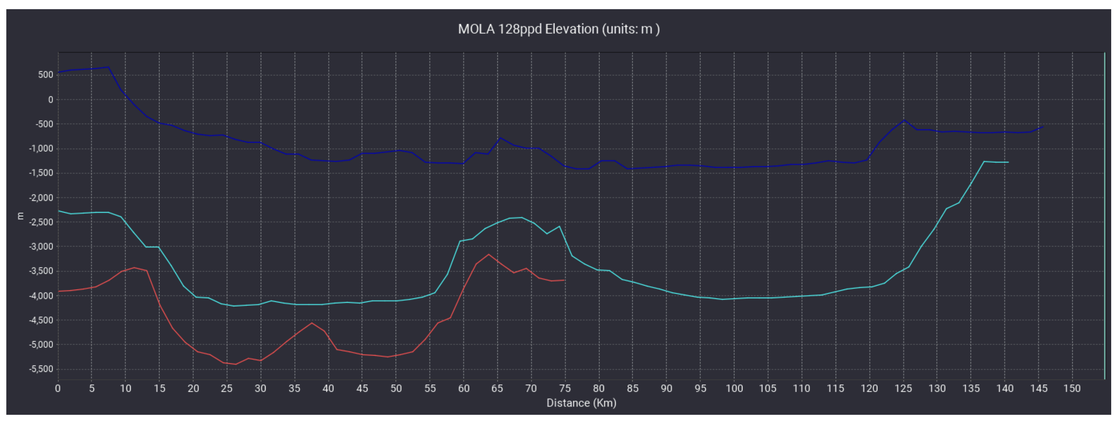

Fig. 3. Comparison chart over elevation profiles: dark blue = Quenisset, turquoise = Moreux, red = unnamed.

Comparison chart over the craters in NE-SW direction. The Depth-to-diameter ratio is clearly shown, indicating that the depth decreases as the crater grows larger. A distinct peak is seen in both Moreux and unnamed crater, whereas Quenisset appaears much flatter. The size difference is also plainly visulised, showing that the unnamed crater is about halft the size compared to the other two, somtheing thath could be the result of the target matierla of the impact crater

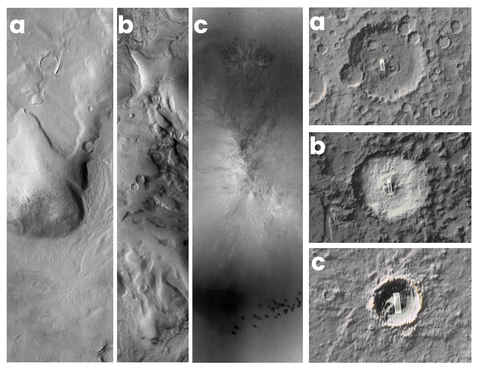

Fig. 4. Central peak of each crater NASA/JPL-Caltech/UArizona

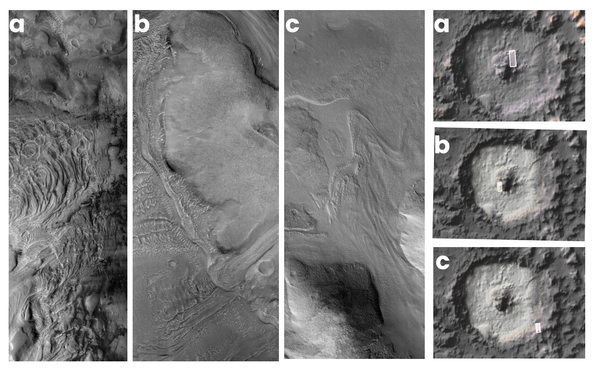

Fig. 5. Flow features in Moreux crater NASA/JPL-Caltech/UArizona

Modification grade of the three central peak varies, the unnamed crater shows a pristine central peak whereas central peak of the Moreux crater has been extensivly modified by some type of flow.

Flow features are also seen around the central peak of Moreux as well as on the southern rim which is aligned with the crsutal dichotomy boundary. Sinah & Murty (2015) have previously described the Moreux crater being modified by glaciation, seen on the flow featuers and surroundring terrain

CONCLUSION

Seen throughout the project is that impact craters are useful to understand how the Martian surface has evolved. Results show that water is intricately linked to surface properties and involvement of volatiles have shaped the craters in different ways. Furthermore does crater size also play a role in how a crater develop, hence revealing target material characteristics. What is found, in conection to the aims is:

- Interior morphological structures
  - Can be used as proxies as to understnad how mars has evolved
  - Modification of central peaks can be used understand water distribution on Mars
  - Characteristics consistent with geological units and time periods can be observed and linked to surface evolution

- Differences between the hemispheres:
  - Size the main difference between craters
  - Differences could be used to understand the formation of the lowlands/highlands
  - Size differnce can also reveal material composition in the Higlands and lowlands, respectivly

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