The Nature of Remnant Mounds on the Margin of Chryse Planitia

INTRODUCTION

- There are thousands of kilometre-scale mounds distributed around the southern margin of Chryse Planitia, a ~1090 km diameter quasi-circular basin that lies north of the dichotomy boundary (Parnell, 2019, Figure 6A-C).
- Large numbers of mounds are present in Oxia Colles/Oxia Planum (Figure 1A), Hypanis Vallis (Figure 1B), and atop the Simud Valles/Area Vallis channel islands (Figure 1C).
- Despite being a widespread geomorphological feature in this important highland-lowland transitional region, their origin and stratigraphic position are poorly understood.
- This study has investigated the morphology and distribution of these landforms in order to understand their place in the stratigraphy and their role in the geological history of the area.
- Mounds have been identified and digitised using a combination of CTX, HiRISE, and MOLA data, and classified based on their morphologies. Heights have been determined from the intersection of their high and low points with individual MOLA shot data.
- Mounds were categorised based on the morphology of their highest points, which are either smooth peak-topped (Mls), flat-topped (Mesa), or any combination of these (compound mounds, Figure 2). The distribution of these types is visualised in Figure 1A, and their populations are graphed in the statistics section.
- In total, 14,368 mounds were digitised and categorised using the above classification scheme.

BURRED CRATERS

- Mounds are often associated with surficial wrinkle ridges. These features sometimes demarcate the rims of buried impact craters, suggesting that mounds could be related to an underlying surface or structure.
- Wrinkle ridges typically do not cut through mounds (Figure 5A). Nonetheless, in some areas they can be seen to truncate mounds, suggesting that the most recent tectonic episode post-dates the deposition and erosion of the mounds (Figure 10).
- All three sub-study areas yield an approximate age of 4.1 Ga, the maximum depositional age of the mound-forming material.
- This age likely represents a pre-Noachian surface, upon which the mounds were deposited. Subsequent erosion, likely in the mid-to-late Noachian, created the isolated mounds we see today.
- This surface must be younger than the Chryse-forming impact, suggesting this impact occurred ~4.1 Ga in the Noachian.

PRELIMINARY CONCLUSIONS

- The different morphologies of mounds are likely to represent different erosional states. Hills are likely to be derived from compound mounds, which in turn are likely to be derived from flat-topped mounds.
- Mound morphologies are diverse, and their heights converge towards elevations of ~500 m above the surrounding plains, suggesting they were the thick deposits of material above large enough craters, causing these areas to be preferentially shifted into mound forming during periods of erosion.

REFERENCES


MOUNT CLASSIFICATION

- Mounds were divided into three main categories: (1) hills, (2) mesas, (3) compound mounds
- Hills are defined as mounds with smooth, peak-topped surfaces (Figure 2A) and are often associated with surficial wrinkle ridges
- Mesas are flat-topped mounds (Figure 2B) and are characterized by a uniform surface texture and lack of internal stratigraphy
- Compound mounds are a combination of hills and mesas (Figure 2C)

STATISTICS

- The elevations of 2236 mounds were calculated using MOLA shot data
- Mound height increases with area, up to a maximum of ~500 m, where they plateau (Figure 8), suggesting that 500 m was the maximum thickness of the layer from which the mounds are derived.

MORPHOMETRICS

- Mounds and buried mounds are typically the tallest and most extensive, with compound mounds intermediate, and hills usually being the smallest example. This suggests that hills are a more recent erosional surface, likely derived from the underlying mounds.

STRATIGRAPHY

- The nature of the relationship between mounds and the surrounding plains is ambiguous due to the presence of a regional lowland layer (RL)
- Despite this, a few examples throughout the Oxia Study Area (Figure 1A) reveal that at least some of the mounds are embedded by the dark plains material (Figure 7).
- Mounds show intense fractures (Figure 6A, B) that do not appear to propagate into the surrounding plains, suggesting that the mounds predate the plains, although this could be due to extensive regolith cover.
- High albedo layers (e.g., Figure 7C) can be traced between mounds up to 100 km away, suggesting that the mounds were once part of a more contiguous unit.
- Mound-like stratigraphy is common in the top tier of tiered mounds in the northern section of the Oxia Study Area (Figure 6A, B), implying that the Mawrth phyllosilicates extended into the northern lowlands early in Mars' history.