A Large Vent Structure within Argyre Basin, Mars

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Overview

- A vent structure is identified on the floor of Argyre Basin
- Size: Diameter ~50 km, Height ~0.5-1 km
- The size and morphology suggest a volcanic origin.
- Represents the first volcanic structure identified within the Argyre Basin.
- IAU approved the name ***Argyre Mons*** Feb 2014.

1. Introduction

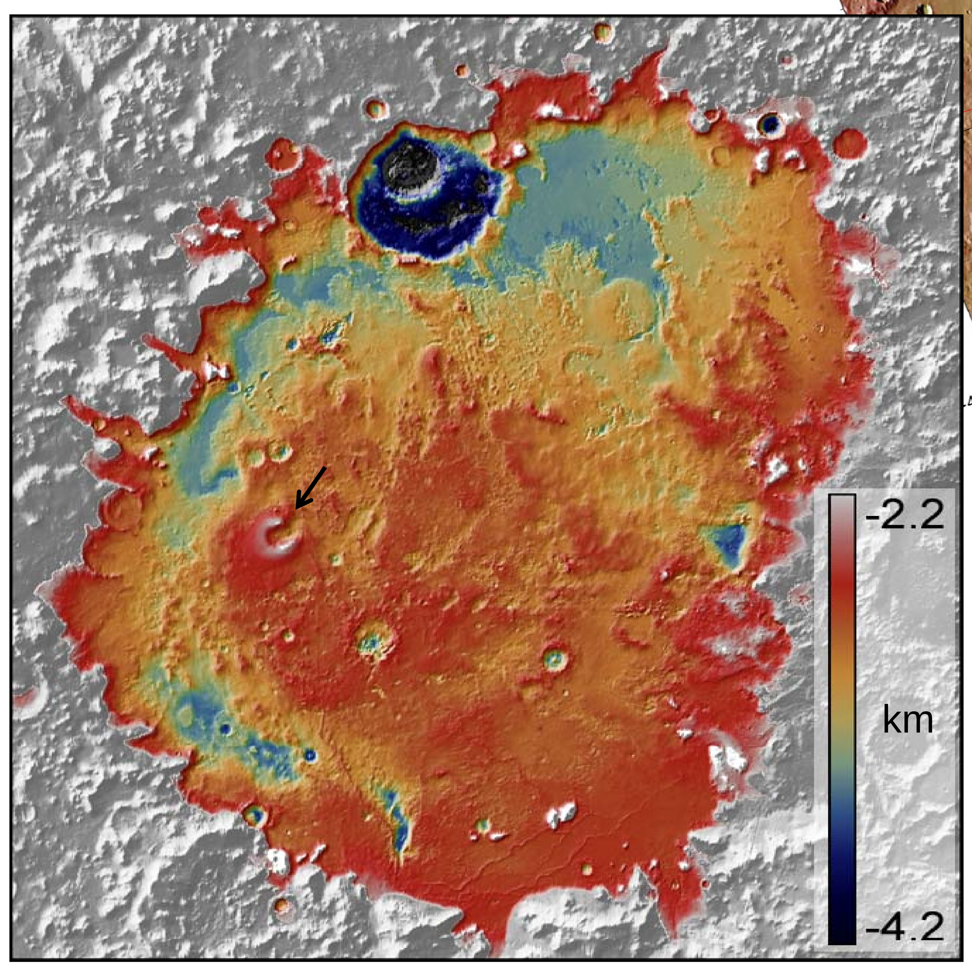
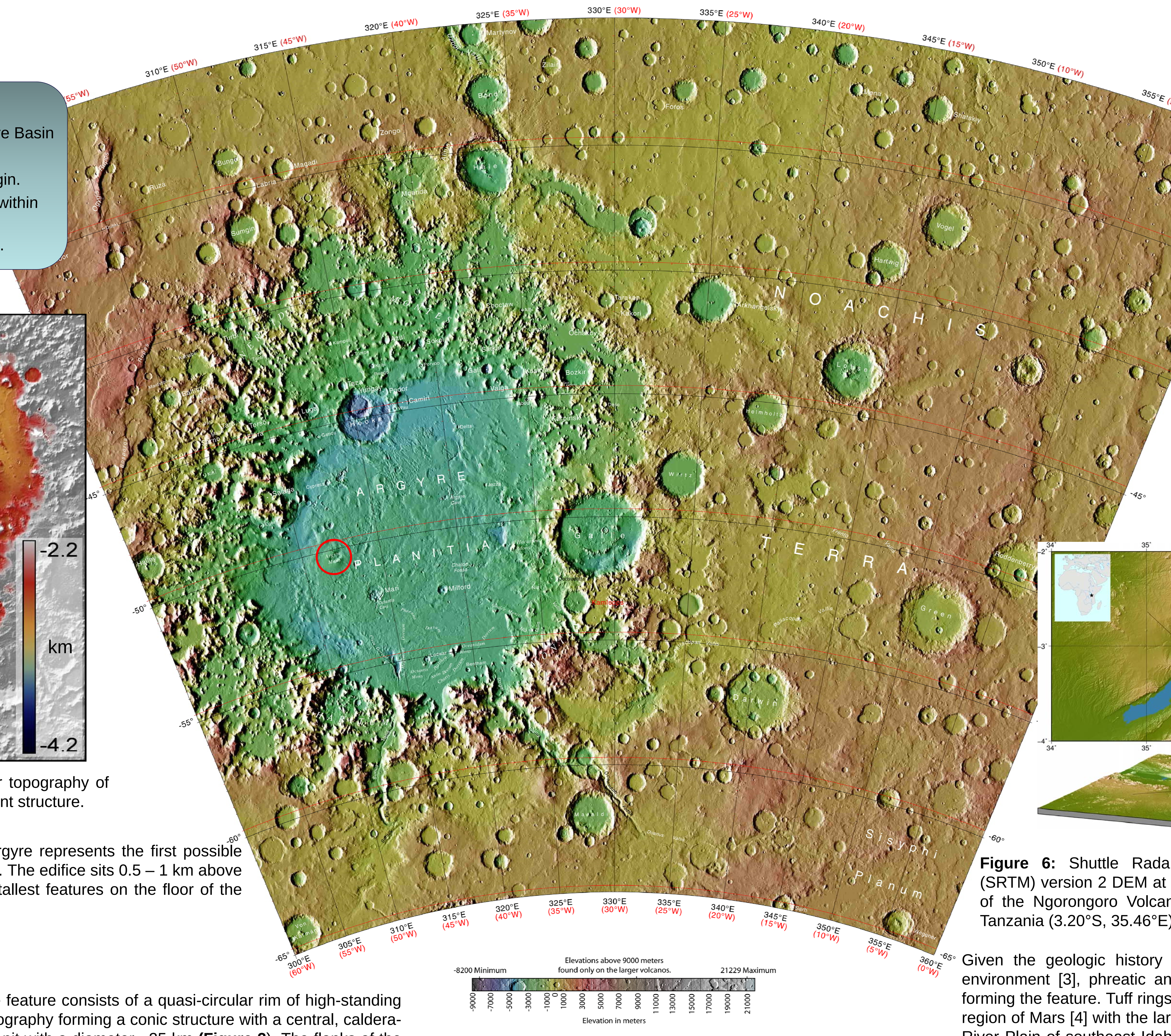


Figure 1: MOLA topography highlighting the floor topography of Argyre Basin. Black arrow shows location of the vent structure.

The discovery of a vent feature on the floor of Argyre represents the first possible volcanic structure identified within the Argyre Basin. The edifice sits 0.5 – 1 km above the surrounding basin floor making it one of the tallest features on the floor of the basin.



Argyre, MC-26
Lambert Conformal Conic Projection

2. Description

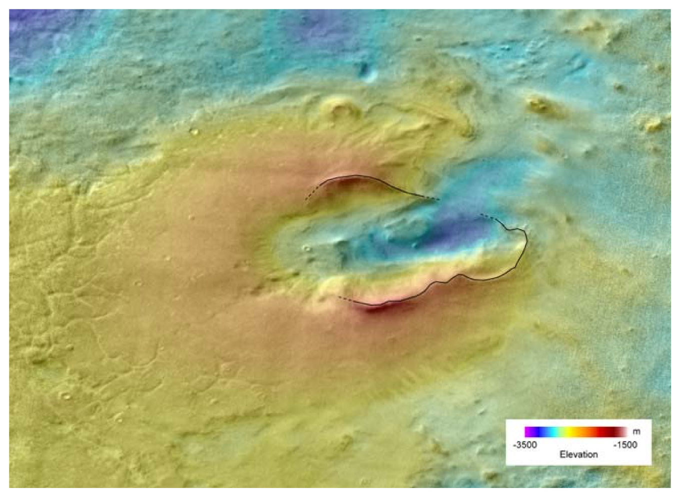


Figure 2: THEMIS IR daytime mosaic color shaded with MOLA. Black lines outline topographic ridges, possible remnants of crater rim structures.

The feature consists of a quasi-circular rim of high-standing topography forming a conic structure with a central, caldera-like pit with a diameter ~25 km **(Figure 2)**. The flanks of the feature extend 10 - 20 km from the rim.

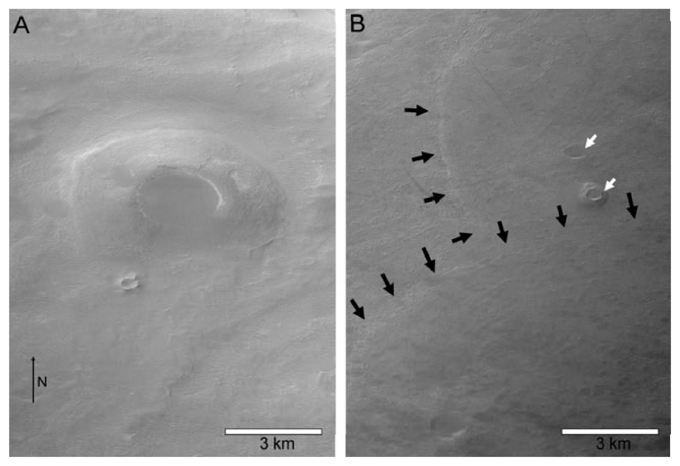


Figure: 3 (A) A smaller ~5 km diameter vent structure, possibly a parasitic cone, is observed on the northern flank. (B) Flow morphologies are also observed on the flanks (black arrows).

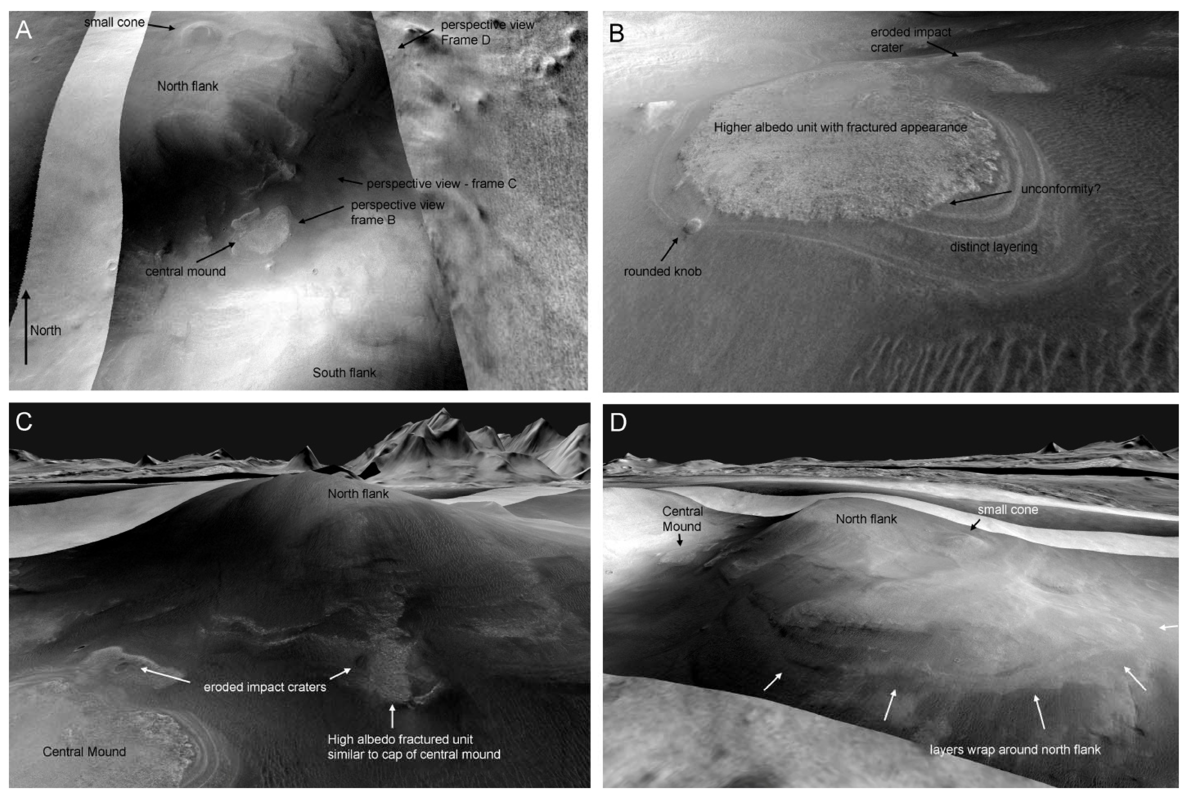


Figure 4: Perspective views of THEMIS IR daytime and CTX images overlaying MOLA 128 ppd topography. (A) Image looking near-nadir. Arrows indicate locations and viewing directions of frames (B), (C), and (D). (B) Perspective view looking west at the central mount comprised of a fractured, light-toned rock unit and underlying layered material. (C) North inner wall and flank. (D) Layers in the wall rock can be traced around the northern flank.

3. Formation

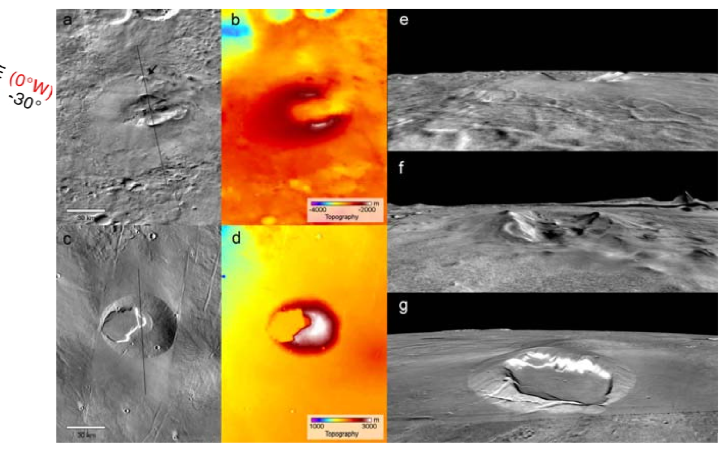


Figure 5: THEMIS IR daytime mosaic and MOLA topography of (top row) Argyre Mons and (bottom row) Jovis Tholus.

Jovis Tholus (18:41 N, 242:59 E) [1] provides an example of a shield structure of comparable vertical and horizontal dimensions with a complex caldera similar in scale to the central depression of Argyre Mons **(Figure 5).** The Ngorongoro Crater of northern Tanzania provides a terrestrial example of a volcanic shield structure and caldera of comparable size [2] **(Figure 6).**

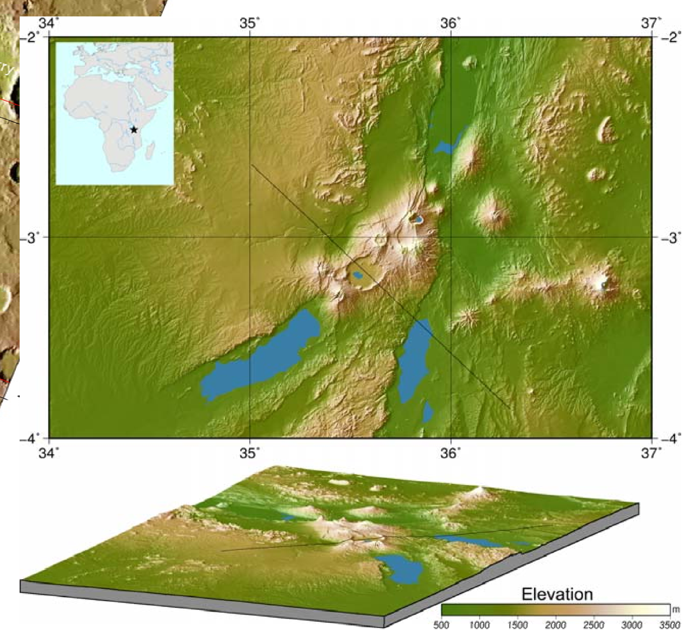


Figure 6: Shuttle Radar Topography Mission (SRTM) version 2 DEM at 3 arc second resolution of the Ngorongoro Volcanic Highlands complex, Tanzania (3.20°S, 35.46°E) [2].

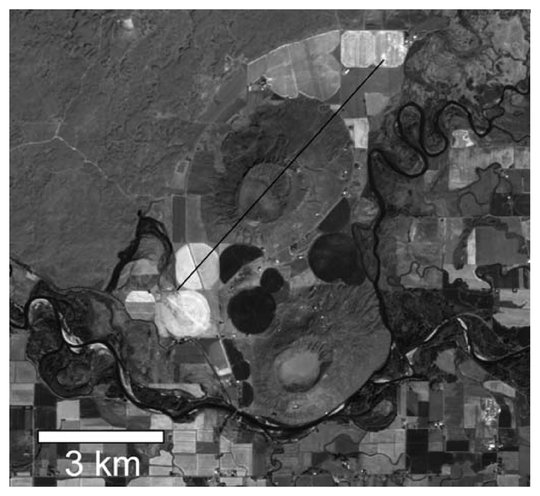


Figure 7: Portion of Earth Observing One (EO-1) image of Menan Buttes tuff cones.

Given the geologic history of the Argyre basin involving an aqueous and ice rich environment [3], phreatic and phreatomagmatic eruptions may have played a role in forming the feature. Tuff rings and cones have been tentatively identified in the Amenthes region of Mars [4] with the larger cones of similar scale to the Menan Buttes in the Snake River Plain of southeast Idaho **(Figure 7)**, part of a late-Pleistocene complex of basaltic tuff cones [5], formed by a basaltic dike intruding into shallow water-saturated alluvium. The Menen buttes are much smaller in scale however **(Figure 10)**.

Fluid expulsion in compacting deposits can form volcano-like structures (mud volcanoes) in terrestrial sedimentary basins **(Figure 8)**. Mud volcanoes have been identified in the lowlands of Mars (e.g. [6]). The Touragai Mud volcano in eastern Azerbaijan is one of the biggest terrestrial mud volcanoes [7]. Argyre Mons is much larger than any mud volcano identified on Earth or Mars **(Figure 10)**.

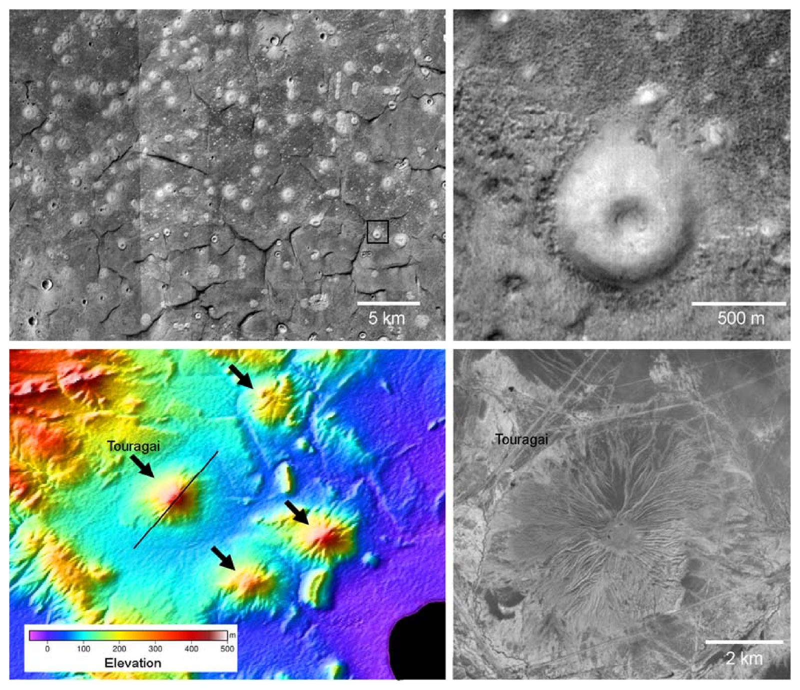


Figure 8: Examples of mud volcanoes in Acidalia Planitia, Mars (a-b) and Azerbaijan, Earth (c-d).

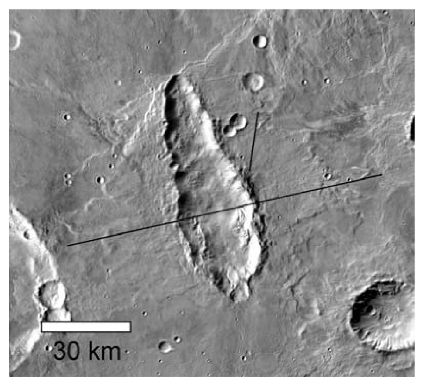


Figure 9: Unnamed elliptical crater (21.1°S, 54.7°E).

Alternately Argyre Mons is a remnant impact feature (e.g. **Figure 9**). This would require deflation of the surrounding basin floor of >500 m to explain the elevation of the rim. Eolian activity on the basin floor is evident with deflation and the accumulation of dunes modifying the basin floor. If the rim of the feature represents the original elevation of the basin floor at the time of an impact this would require a removal of ~$3.8{\times}10^{14}$ m^3 of material from the basin interior.

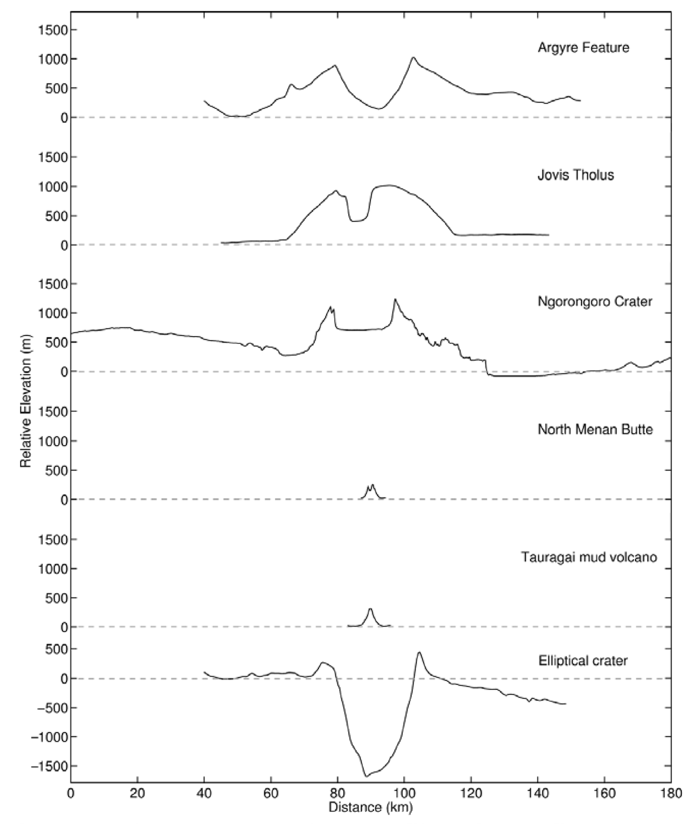


Figure 10: Topography profiles from figures 5-9.

References: [1] Plescia (1994) *Icarus*, 111. [2] Mollel et al. (2008) *EPSL*, 271. [3] Dohm et al. (2011) *LPSC XXXIII*. [4] Brož and Hauber (2012) *Icarus* 218. [5] Hughes et al. (1999). [6] Oehler and Allen (2010) *Icarus* 2010. [7] Bonini (2012) *Earth Sci. Rev.* 115.