**LARGE ERODED VOLCANO COMPLEX AND BURIED GLACIER ICE IN EASTERN NOCTIS LABYRINTHUS: EVIDENCE FOR RECENT VOLCANISM AND GLACIATION NEAR MARS' EQUATOR.**

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**Summary:** A large eroded volcano complex and buried shallow glacier ice are reported in Eastern Noctis Labyrinthus, providing evidence for recent volcanism and glaciation near Mars' equator.

**Introduction:** We report identifying on Mars, at 7.40°S, 94.60°W, a set of large tilted blocks reaching +9028 m, forming a crescent-shaped regional topographic high in the central portion of the vast (~300+ km wide) sub-circular transition region (TR) between Noctis Labyrinthus and Valles Marineris, which we interpret as the summital erosional remnants of a large, ~250 km-wide, shield volcano complex, provisionally named "Noctis Mons" **(Figs.1-6)**. We also report new features in the same area indicative of relatively recent volcano-$H_2O$ (ice) interactions, in particular areas of "blistered terrain" which we interpret as fields of rootless cones likely indicative of shallow buried $H_2O$ ice even at present.

**Approach:** We analyzed NASA Mars Reconnaissance Orbiter (MRO) High Resolution Imaging Science Experiment (HiRISE), Mars Orbiter Laser Altimeter (MOLA), and Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) data via Arizona State University's Mars Quickmap data visualization tool, and Johns Hopkins University's CRISM website.

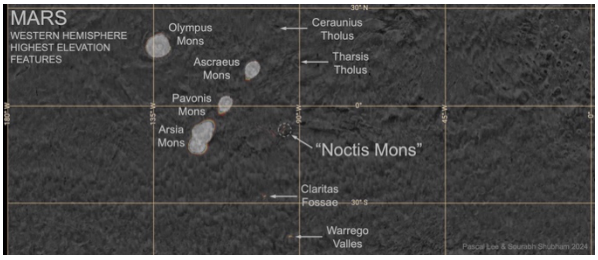


**Figure 1: "Noctis Mons" Location Map and Topographic Prominence.** The feature designated as "Noctis Mons" in this study, identified by the dotted circle, appears prominently in a map of the highest elevation features in Mars' western hemisphere. Peaking at +9028m, "Noctis Mons" is the 7th highest elevation feature on Mars behind Olympus (21.9 km), Ascraeus (18.0 km), Arsia (16.1 km), Pavonis (14.0 km) and Elysium (12.6 km) Montes (the latter in the Eastern hemisphere and not shown), and the highest part of Claritas Fossae near crater Llanesco (9.2 km). "Noctis Mons" is higher than Tharsis Tholus (9008 m), Warrego Valles (8972 m) and Ceraunis Tholus (8.5 km) (NASA MRO MOLA).

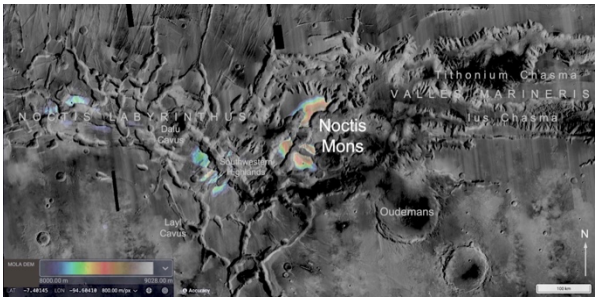


**Figure 2: "Noctis Mons" in Relation to Noctis Labyrinthus and Valles Marineris.** Areas in color in this scene range from 8000 m to 9028 m, the summit elevation of Noctis Mons. All areas in gray are below 8000 m. Noctis Mons occupies the central portion of the TR defined by its broad, roughly circular, largely depressed topography, located between Noctis Labyrinthus to the West and Valles Marineris to the East. The TR is defined by prominent concentric and radial depressions readily interpreted as concentric and radial fault zones. Noctis Mons' summit area components form a distinct, outward sloping broken crescent, hinting at the possibility of a once wider, more fully circular summit area. "Southwestern Highlands", might represent remnants of distal volcanic deposits from Noctis Mons.

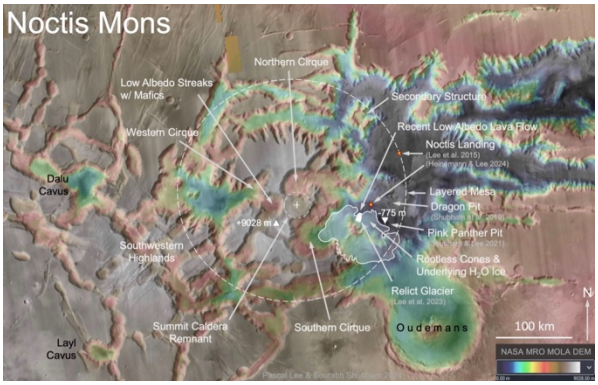


**Figure 3: Noctis Mons: An Eroded Shield Volcano.** Noctis Mons and immediate surroundings present key features leading to its interpretation as an eroded shield volcano approximately 250 km in diameter: a) concentric symmetry of summit elevations and slopes, and of circular mesa and trough systems in the broader transitional region (TR); b) sub-circular terraced summit depressions readily interpreted as caldera remnants; c) discrete low albedo features in near central and high elevation locations, including flow features with dis-

tinct lava flow morphologies and textures, and streaks in closed summital depressions; d) widespread occurrences of relatively fresh mafic materials (high Ca pyroxenes). In addition, there is a wide range of evidence, both locally and regionally, for volcano-$H_2O$ interactions: e) large summital cirques with down-valley flow textures characteristic of glacial foliation and moraines; f) large areas of blistered terrain interpreted as fields of rootless cones, implying surface volcanic deposits interacting with shallow subsurface $H_2O$; g) a relict glacier presenting fine scale characteristic features such as crevasse fields and thrust moraine bands [1]; h) a wide range of hydrothermal materials, in particular in nearby Layl Cavus, the "nutshell" in which most Mars minerals are found together in a single local setting [2]; i) light-toned deposits (LTDs) and their many forms of associated hydrated minerals [3,6]; and j) the light-toned deposits (LTDs) in Dragon Pit, Pink Panther Pit, and around the relict glacier and rootless cones fields which are dominated by jarosite (a hydroxylated sulfate) likely a product of acidic mafic material interaction with $H_2O$.

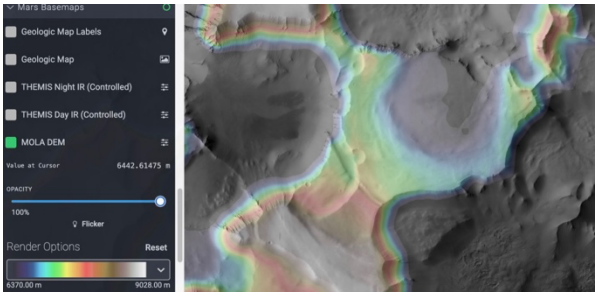


**Figure 4: Noctis Mons Summit Caldera Remnant.** Note terraced walls and flat floor in the summit caldera at center right, and also discrete, low albedo streaks in basin (possibly another summit caldera) at center left. CRISM data indicate that the dark material, which is most likely locally derived given the closed basin and the elevation, contains high Ca pyroxene (e.g., augite), supporting the volcano interpretation for Noctis Mons.

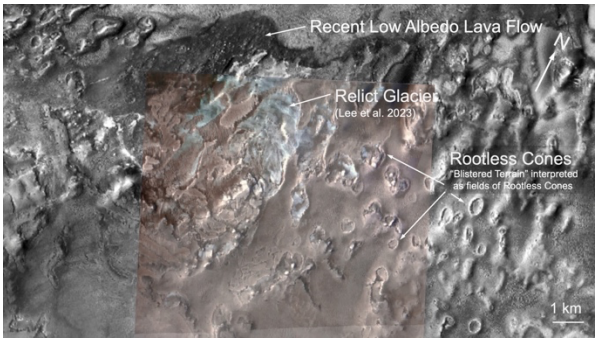


**Figure 5: Noctis Mons Volcano-Ice Interactions.** A low albedo flow feature with morphologic and textural characteristics of a lava flow is evident at the top of this figure, near the "Relict Glacier" reported by Lee et al. 2023 [1]. "Blistered Terrain" encountered throughout this area is interpreted, on the basis of morphometric and distribution similarities with pitted and gutted mound fields in Alaska, Iceland, and elsewhere on Mars, as fields of rootless cones. CRISM data confirm that the low albedo, black-brown lava flow materials and lighter-colored red-brown materials in the scene are mafic (high Ca pyroxenes, e.g., augite). LTDs exposed in breached mounds of the "blistered terrain", and over the "relict glacier", are dominated by jarosite. We interpret the red-brown surface materials as likely a thin (~ 1- 3 m) volcanic pyroclastic deposit overlying an $H_2O$ ice-rich substrate, recent enough and protective enough (diffusively and thermally) to preserve extant shallow subsurface $H_2O$ ice [1]. The extent of the rootless cones field, and thus of the $H_2O$-rich substrate, is shown at lower right in Fig. 3.

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**References:** [1] Lee et al. LPSC-2023. [2] Thollot et al. 2014. *8th Int'l Conf. Mars.* #1314. [3] Weitz et al. 2016. *Ann. Planet. Geol. Mappers Meet.,* #7029. [4] Rodriguez et al. 2016. *Planet. Space Sci.* 124, 1-14. [5] Bussey & Davis 2015. rb.gy/xiruww. [6] Shubham, & Lee 2021. 52nd LPSC, #2591.