Argyre Mons and other volcanic features within Argyre Basin, Mars

J.-P. Williams[1], J. M. Dohm[2], R. J. Soare[3], J. Flahaut[4], R. M. C. Lopes[5], A. V. Pathare[6], A. G. Fairén[7,8], D. Schulze-Makuch[9,10], and D. L. Buczkowski[11], [1]Earth, Planetary, and Space Sciences, University of California, Los Angeles, CA, USA (jpierre@mars.ucla.edu), [2]Earth-Life Science Inst., Tokyo Institute of Technology, Tokyo, Japan, [3]Dept. Geography, Dawson College, Montreal, Canada, [4]IRAP, University of Tolouse, France, [5]Jet Propulsion Laboratory, Caltech., Pasadena, CA, USA, [6]Planetary Science Inst., Tucson, AZ, USA, [7]Dept. Planetology and Habitability, Centro de Astrobiología, Madrid, Spain, [8]Dept. Astronomy, Cornell, Ithica, NY, USA, [9]Center of Astronomy and Astrophysics, Technical University Berlin, Germany, [10]School of the Environment, Washington State University, Pullman, WA, USA, [11]Johns Hopkins University, Applied Physics Lab, Laurel MD, USA.

Introduction: The Argyre impact basin has been a sink for volatiles and other material through time, and experienced partial infilling with water and episodes of glaciation evident from stratigraphic sequences, crater statistics, topography, and geomorphology [1][2]. We now have identified widespread volcanic and tectonic activity within the floor of the basin including Argyre Mons, a ~ 50 km wide volcanic-structure first reported by Williams et al. [3]. Crater counts on Argyre Mons yield an absolute model age of ~ 3 Ga [4]. Additional cones, vents, mounds, dikes and cavi, many of which are associated with extensional tectonic features, are observed within the region. Many of these features appear to disrupt largely uncratered terrain indicating a relatively young, Late Amazonian age for some of these features. Argyre Mons, along with the additional endogenic modification of the basin floor, indicates the region has experienced episodes of volcanism over a protracted period of time, representing a component of the basin's history that until recently, remained unrecognized [5].

Observations: A suite of spatially-related volcanic and tectonic features are observed in the northwest portion of the basin floor that includes Argyre Mons, a heavily degraded construct of likely volcanic origin [3][4][5]. The structure extends ~ 1 km above the basin floor with a central, caldera-like depression ~ 25 km wide (Fig 1a). A smaller ~ 5 km cone is observed at the base of the northern flank (Fig 1b).

Further examples of volcanic features observed in the region are shown in Figs 1c-f. Linear features south of Argyre Mons consist of aligned mounds, ridges, and elongated depressions. Some mounds possess summit depressions and morphologically resemble volcanic cones indicating that fissure eruptions may have occurred forming spatter cones and ramparts along fractures over distances tens of km (Fig 1c).

North of Argyre Mons, numerous elongated and irregular depressions, or cavi, are observed ranging in size from sub-km to tens of km in length (Fig 1d). In many cases they are aligned with extensional faults and fractures that extend across the region, demonstrating an element of structural control in their formation; some fault segments extend up to ~ 100 km in length. Broad, low-rimmed, quasi-circular depressions (e.g. bottom of Fig 1d), resemble terrestrial maars, craters resulting from the explosive interaction of magma and water or ice. These craters lack the distinct raised rims and ejecta blankets of impact craters and appear to have fluidized deposits or channels along their flanks.

Evidence for extrusive volcanism includes a lava flow deposit observed within the floor of a channel. The emplacement of at least two flows is evident as an underlying flow extends farther along the channel floor (Fig 1e). Several small mounds and cones are superposed on the upper unit. Additionally, hundreds of circular and elliptical mounds, pitted cones, and rings are observed in the region and may represent rootless cones (pseudocraters) indicative of lava emplacement atop a water-rich or ice-rich surface (Fig 1f). Additional features and details are described in [5].

Discussion: Collectively, these observations indicate volcanic activity has occurred within the basin. The volcanism has had to compete with deposition, glaciations, and other geologic processes, explaining why such volcanic activity had previously gone unrecognized.

References

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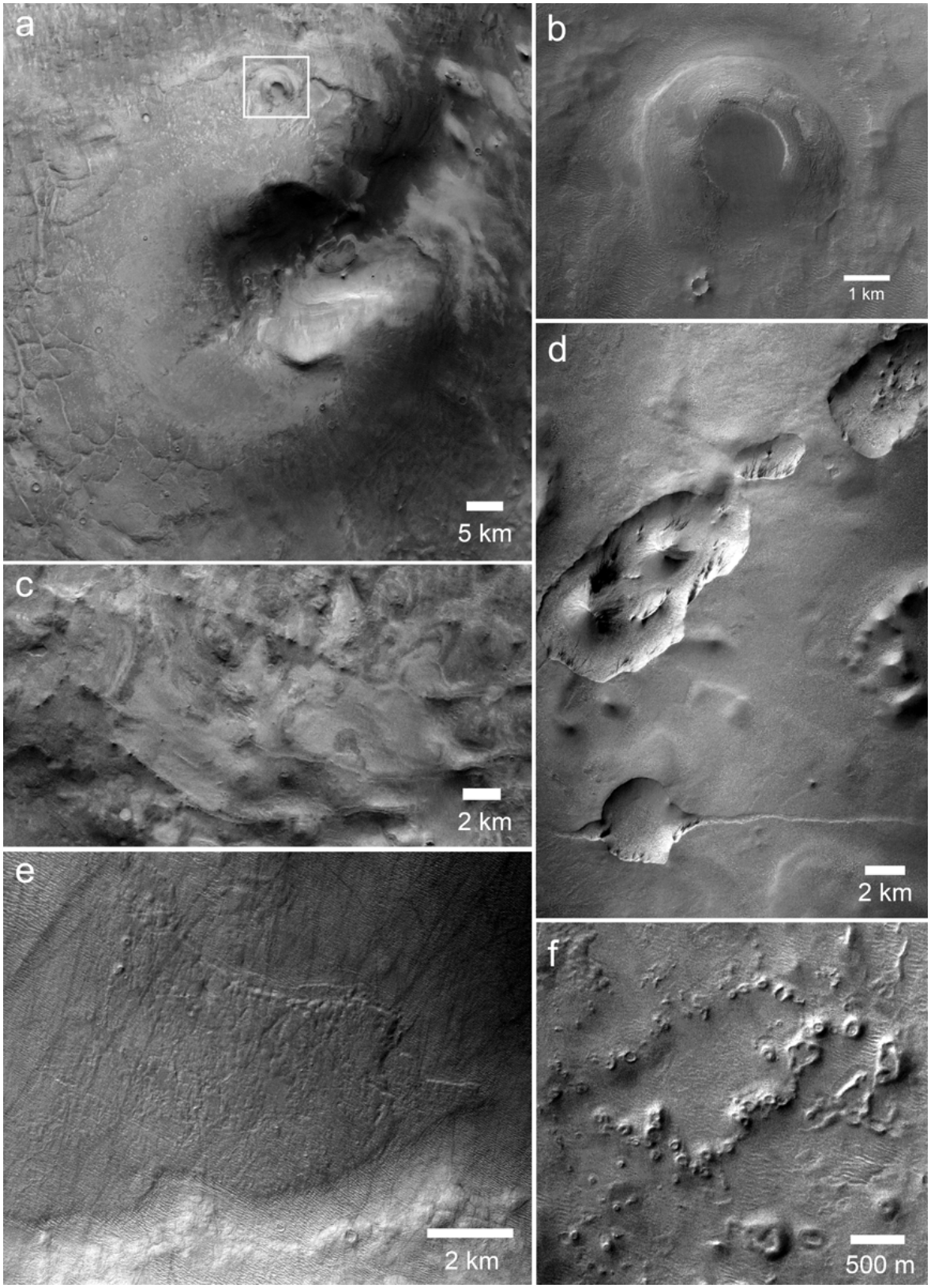

Figure 1: Examples of volcanic features on the Argyre basin floor: (a) Argyre Mons and (b) a smaller cone on the northern flank, (c) ridges, elongated depressions, and mounds aligned over tens of km resulting from intrusive dikes, (d) cavi, maar-like craters, and graben, (e) lava flows within a depression with small cones superposed, and (f) possible rootless cones (pseudocraters).