NEW GEOLOGIC MAP OF THE ARGYRE REGION OF MARS.

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Introduction: The new generation of Mars orbital topographic and imaging data justifies a new mapping effort of the Argyre impact basin and surroundings (-30.0° to -65.0° lat., -20.0° to -70.0° long; Fig.1). Our primary objective is to produce a geologic map of the Argyre region at 1:5,000,000 scale in both digital and print formats. The map will detail the stratigraphic and crosscutting relations among rock materials and landforms. These include Argyre basin infill, impact crater rim materials and adjoining highland materials of Noachis Terra, valleys and elongated basins that are radial and concentric about the primary Argyre basin, faults, enigmatic ridges, lobate debris aprons, and valley networks. Such information will be useful to the planetary science community for constraining the regional geology, paleohydrology, and paleoclimate. This includes the assessment of: (a) whether the Argyre basin contained lakes [1], (b) the extent of reported flooding and glaciation, which includes ancient flows of volatiles into the impact basin [2-4], (c) existing interpretations of the origin of the narrow ridges located in the southeast part of the basin floor [2,5], and (d) the extent of Argyre-related tectonism and its influence on the surrounding regions. Whereas the geologic mapping investigation of Timothy Parker focuses on the Argyre floor materials at 1:1,000,000 (MTMs -50036, -50043, -55036, -55043; see Fig. 1 for approximate corners of the area), our regional geologic mapping investigation includes the Argyre basin floor and rim materials, the transition zone that straddles the Thaumasia plateau, which includes Argyre impact-related modification [6], and the southeast margin of the Thaumasia plateau using important new data sets (Fig. 1). Our mapping effort will incorporate the map information of Parker if it is made available during the project.

This mapping effort, which has received seed money during the first year, will complement the new global mapping effort spearheaded by K.L. Tanaka. As a state-of-the-art digital, GIS-based product, the map will be easily archived, distributed, and ingested into various research and mission-planning efforts and can be readily updated by us or by others when the need arises. Skinner et al. [7] renovated and GIS-formatted the Scott et al. [8] Viking-based global geologic map in a global projection with the MOLA DEM, and this has already been distributed widely. In addition to delivering a digital map, we hope to publish the map at 1:5,000,000 scale as a printed USGS map.

Science Objectives and Approach: The primary science objective will be to update our Viking-era understanding of the geologic history of the Argyre region [e.g., 8], which will include many new findings since the previous Viking-based maps [e.g. 8] were published, as well as other discoveries that will be made during the course of the mapping using the new data sets. As more data continue to pour in from Mars, the complexity of this planet becomes better appreciated. Interactions between volcanism, tectonism, cratering, hydrology, climate, and atmosphere in a variety of topographical, latitudinal, and other settings are the subjects of investigation by a large host of researchers. We intend to compile detailed geologic information for a first-order regional assessment by us and other investigators pertaining to stratigraphy and structural, impact, hydrologic, aeolian, and climate histories and reconstructions.

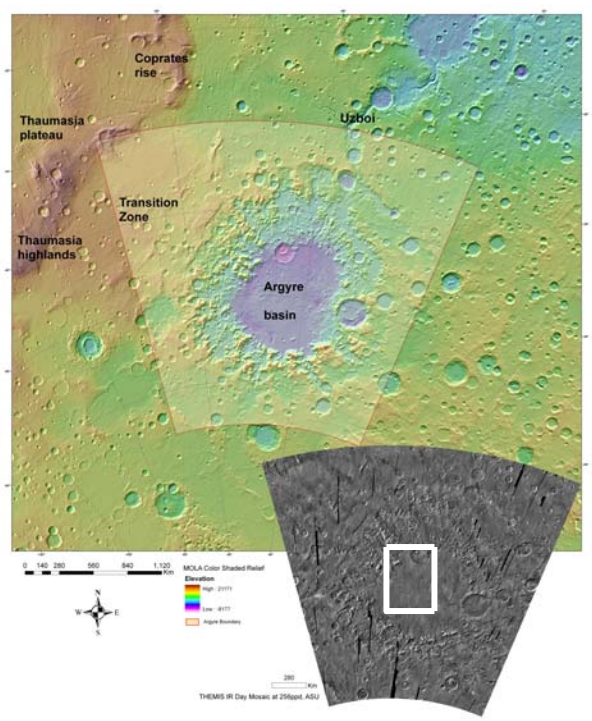

Fig. 1. MOLA color shaded relief map centered on the Argyre region (transparent outline). The image on the bottom right shows a 256 pixels/degree THEMIS IR day mosaic, to show the coverage available for mapping. Also shown is the approximate boundary (white box) of the 1:1,000,000-scale mapping investigation of Timothy Parker (MTMs -50036, -50043, -55036, -55043) originally funded to use Viking data to map mainly floor materials. Our regional 1:5,000,000-scale mapping investigation will include the Argyre floor and rim, transition zone, and the southeast margin of the Thaumasia plateau [6].

Stratigraphic mapping: We intend to apply various methods, including use of geologic and stratigraphic terminologies that will effectively communicate mapping results to the research community. We will follow the lead of Tanaka et al. [9] in mapping complex units as allostratigraphic units [10], also known as unconformity-bounded units [11-12]. These units include rocks and sediments of multiple, intimately mixed lithologies, a geologic scenario common to the Martian surface. Our strategy thus inherently avoids the splitting of lithologically similar materials without strong evidence for a hiatus in material emplacement activity. Stratigraphic units will be differentiated chiefly on the basis of both stratigraphic (crosscutting, overlap, and embayment) and contact relations and primary (that is, when the unit formed), morphologic characteristics.

Crater counting: Comprehensive crater counts for Martian geologic units in the Argyre region have not been obtained since the Mariner 9- and Viking-based geologic mapping [6, 13-19]. MOC, THEMIS, HRSC, CTX, and HiRISE images allow a major improvement. Careful interpretation of crater density data is required due to the following factors: (a) resurfacing activity causes degraded and/or embayed craters as well as inflections and roll-offs in crater-size distributions due to crater obliteration [e.g., 14, 20-21]; (b) possible secondary and non-impact craters, particularly at smaller diameters, which can alter crater size-frequency distributions [22]. We intend to produce detailed summary crater counts for all map units, as well as multiple counts for more broadly occurring units. These should help establish ranges and spatial variability of ages of surface and near-surface units, as well as resurfacing ages.

Structural and feature mapping: Features associated with unit formation will be mapped, including Argyre impact-induced, structurally-controlled valleys and basins, as well as impact crater rims. However, we intend to avoid the common practice of delineating degraded craters from other Noachian units, whose materials are already considered to include crater ejecta [e.g., 8]. We will restrict our mapping of a crater unit to those having well-preserved ejecta blankets extending >50 km (>1 cm on a 1:5M scale map), following the approach of Tanaka et al. [18]. We will also map features such as wrinkle ridges, lobate scarps, faults, fluvial channels, enigmatic ridges, lobate debris aprons, polygons, and valley networks to help unfold the geological history. Detailed structural mapping of the Thaumasia region, for example, which included producing paleotectonic and paleoerosional maps, as well as determining fault, fault-length, channel, and channel-length densities, was significant to describing and interpreting its geological evolution [6]. Thaumasia rift structures were also correlated spatially and temporally with the heads of fluvial channels in the region [23]. Using the newly available data will lead to improved mapping, characterization, and interpretation. For example, reassessing Viking-based published geologic information of parts of the Thaumasia region using MGS and MO data [24-25] has yielded several determinations, including: (a) an increase in the total number of mapped structures, (b) improved differentiation of fault segments and fault scarps of complex rift systems, (c) more structural trends and enhanced structural detail, and (d) a greater geologic perspective using multiple data types based largely on factors such as structural orientation, look direction of the acquired image, sun angle, and atmospheric conditions.

We will be conservative in feature interpretation. We will constrain the ages of structural and modification features where possible using crosscutting relationships and crater counts. Our structural mapping approach will be consistent with that of Dohm et al. [6], which provided a comprehensive digital paleotectonic and paleoerosional data set of the Thaumasia region, enhancing other geologic investigations [e.g., 26-27].

Summary: The primary objective of the mapping effort is to produce a geologic map of the Argyre region at 1:5,000,000 scale in both digital and print formats. We will present the progress and preliminary mapping information at the meeting.

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