NEW GEOLOGIC MAP OF THE ARGYRE REGION OF MARS: DECIPHERING THE GEOLOGIC HISTORY THROUGH MARS GLOBAL SURVEYOR, MARS ODYSSEY, AND MARS EXPRESS DATA SETS. J.M. Dohm¹, M. Banks², D. Buczkowski³; ¹University of Arizona, Tucson, AZ (dohm@hwr.arizona.edu), ²Smithsonian Institution, Washington, D.C., ³John Hopkins University, Washington, D.C.

Introduction: The primary objective of the mapping effort is to produce a geologic map of the Argyre basin and surrounding region at 1:5,000,000 scale in both digital and print formats that will detail the stratigraphic and crosscutting relations among rock materials and landforms (30°S to 65°S, 290°E to 340°E) (Fig. 1). There has not been a detailed geologic map produced of the Argyre region since the Viking-era mapping investigation of [1]. The mapping tasks include stratigraphic mapping, crater counting, feature mapping, quantitative landform analysis, and spectroscopic/spectroscopic investigation. The 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, and the southeast margin of the Thaumasia plateau using important new data sets from the Mars Global Surveyor, Mars Odyssey, Mars Express, and Mars Reconnaissance Orbiter. The geologic information unfolded by this new mapping project will be useful to the community for constraining the regional geology, paleohydrology, and paleoclimate, which includes but is not limited to the assessment of: (1) whether the Argyre basin contained lakes, (2) the extent of reported flooding and glaciation, (3) existing interpretations of the origin of the narrow ridges located in the southeast part of the basin floor, and (4) the extent of Argyre-related tectonism and its influence on the surrounding regions.

Methodology: The mapping investigation will include stratigraphic mapping, crater counting, feature mapping, quantitative landform analyses, and stratigraphic/spectroscopic investigation.

Stratigraphic mapping. Identification, characterization, and relative-age analyses of map units with presently available data will be vastly improved over those based solely on Viking images. Using the new data, the stratigraphic and crosscutting relations among rock materials and landforms can be mapped, characterized, and interpreted. Geologic cross sections will cover mountainous impact crater rim materials (Charitum Montes and Nereidum Montes) and adjoining highland materials of Noachis Terra, valleys and elongated basins that are radial and concentric about the primary Argyre basin, and faults, sinuous rilles, lobate debris aprons, polygons, and valley networks. The mapping effort will also characterize the stratigraphic relations among basin infill materials (e.g., massive vs. layered vs. sequence stratigraphy). The mapping results will provide the planetary science community with better constraints on regional geology, paleohydrology, and paleoclimate.

Crater counting. Careful interpretation of crater density data is required due to the following factors: (a) crater density reflects a mean surface age (some grasp of potential relative-age range can be obtained by performing crater counts in multiple locations); for example, total crater counts of a map unit can help constrain its emplacement history, while counts of only superposed craters (pristine ejecta blankets that overlie the map unit and/or erosional, depositional, and/or tectonic structure) reflect an upper time limit for the resurfacing of that particular unit [e.g., 2]; (b) resurfacing activity causes degradation and/or embayment of craters as well as inflections and roll-offs in crater-size distributions due to crater obliteration [e.g., 3]; (c) possible secondary and non-impact craters, particularly at smaller diameters, which can alter crater size-frequency distributions [4]. Keeping the above mentioned factors in mind, 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.

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. Our regional 1:5,000,000-scale mapping investigation will include the Argyre basin floor and rim, transition zone, and the southeast margin of the Thaumasia plateau [2].

Structural and feature mapping. Tectonic, collapse, depositional, and erosional features will be mapped in detail including wrinkle ridges, lobate scarps, faults, fluvial channels, enigmatic ridges, lobate debris aprons, polygons, and valley networks, to help unfold the geological history (e.g., Fig. 3). Detailed crater statistics and MOLA-based cross-sectional information will assist in the determination of stratigraphic and crosscutting relations among rock materials and landforms. This includes Argyre basin infill materials (massive vs. layered vs. sequence stratigraphy), mountainous impact crater rim materials (Charitum Montes and Nereidum Montes) and adjoining highland materials of Noachis Terra, valleys and elongated basins that are radial and concentric about the primary Argyre basin, and faults, enigmatic ridges, lobate debris aprons, polygons, and valley networks.

Quantitative landform analyses: Multiple modern datasets will be used to identify landforms in the Argyre region, and various techniques will be implemented to quantitatively analyze these landforms to constrain the processes involved in their formation and to compare them with terres-
trial analogs (Fig. 2 based on [5]). Such analyses will provide important insight into possible formation mechanisms of the various landforms observed in the region and, based on the distribution and abundance of the landforms, indicate how active and widespread these formation processes are/were. In assessing different formation mechanisms, a “landsystems” approach will be used similar to [5]. In this approach, landforms will be considered in context and relation to each other, and the entire pattern and regional assemblage of landforms will be considered in regard to a typical terrestrial landscape. Altogether, this will provide important insight into the geologic history of the Argyre region.

**Spectroscopic/stratigraphic investigation.** Comparative analyses among the stratigraphic information based from this mapping investigation and the CRISM data will be performed to further unfold the geologic history of the Argyre region. Fig. 3 based from the work of [6], for example, shows a laterally-extensive, phyllosilicate-enriched deposit on the western wall of a shallow graben related to the seventh (of eight) ring structures associated with the Argyre basin, as mapped by [7].

**Summary:** The proposed investigation will have a direct bearing on the understanding of the geologic evolution of Mars. Furthermore, a new regional geologic map of the Argyre region of Mars will have wide-ranging significance and application, including: (1) the establishment of a spatial and temporal geologic context for local to regional geologic, geophysical, geochemical, hydrologic, and climatic studies, (2) the refinement of the regional stratigraphic scheme for establishing chronology and estimating rates of geologic activity, and (3) spatial and temporal information from which to assess whether the Argyre basin contained lakes [e.g., 8] and whether flooding and glaciation contributed significantly to the geologic and paleohydrologic records of the Argyre region [e.g., 7,9,10], as well as determining the extent of Argyre-related tectonism [2].