BASIN-FILLING STRATA EXPOSED IN HADRIACUS CAVI, MARS RECORD COMPLEX TRANSITIONAL ENVIRONMENTS DURING THE MIDDLE NOACHIAN. J. A. Skinner, Jr.¹, C. M. Fortezzo¹, and M. L. Barton¹,² ¹Astrogeology Science Center, U. S. Geological Survey, 2255 N. Gemini Dr., Flagstaff, AZ 86001 (jskinner@usgs.gov), ²School of Earth Sciences and Environmental Sustainability, Northern Arizona University, Flagstaff, AZ 86011.

Introduction: We are completing a 1:24,000-scale geologic map of strata exposed along the northeastern margin of Hellas Planitia in the Martian cratered highlands. This map-based investigation was designed to identify and temporally and spatially constrain the basin-filling processes for a principally non-crater basin within a typical sequence of cratered highland materials. We previously reported details about the regional geologic setting and mapping rationale [1], relative and model absolute ages of these units and their bounding terrains [2], key unit-bounded textures and bedforms [3-5], and the potential of these types of basin-related strata for future robotic and human exploration [6]. Here, we summarize unit details and a geologic map-based history as the project nears completion.

Geologic Setting: The map region is defined by a HiRISE stereo-derived digital terrain model (DTM) that transects central Hadriacus Cavi, located in the cratered highland of southwest Tyrrhena Terra, along the northeastern rim of the Hellas basin. The cavi are a 65 km long, 15 km wide set of irregularly-shaped, east-west oriented depressions bound on the south by topographic promontories and eroded cratered terrains and on the north by Hadriacus Palus, a nearly horizontal plain (Fig. 1). The map region contains light- and dark-toned stratified and massive rocks that outcrop between -2506 and -2844 m elevation. It is dominated by a broad surface with an average 1° northward slope that is locally disrupted by up to 200 m tall mesas and hills and up to 350 meter deep depressions and canyons. The northern part of the study area is located ~530 m below the southern part and contains the southern, scarp-forming margin of Hadriacus Palus. The map region does not contain, but is located adjacent to, bounding topographic promontories.

Results: We identify, describe, and subdivide local strata based on dominant grayscale tone and texture and lateral continuity as observed in a stereo-derived HiRISE orthoimage (0.5 m/px) and DTM (1.5 m/post), supplemented by HiRISE grayscale images. CTX, HRSC, and THEMIS daytime and nighttime IR mosaics helped link local observations to surrounding terrains. Three unit groups form the volumetric bulk of Hadriacus Cavi and one group that constitutes the strata at the southern margin of Hadriacus Palus. Throughout, light-toned strata form steep (40°) slopes and scarps, implying increased erosional resistance compared to intervening dark-toned strata, which form shallower slopes and which source pervasively-occurring surficial cover. We identify no widespread angular unconformities within or between any of the mapped units, though disconformities may exist. Lineaments, interpreted as near-vertical joints and faults with minor offset, are mapped throughout the map area and parallel E-W and NE-SW regional trends. Stratigraphic orientations were determined via three-point solutions.

Figure 1. Context for Hadriacus Cavi map region. (A) HRSC DTM over CTX image mosaic shows 1500 m tall massifs bounding the rugged cratered and dissected plains and smooth basin plains of Hadriacus Palus. Napo and Huallaga Valles drain highland terrains and terminate in palus. (B) N-S cross-section depicts basic framework of the massif, highland, and palus units.

The basal group is topographically and stratigraphically the lowest group in the study region, covers 8.1 km² (6%) of the map area, and crops out between -2492 and -2838 m elevation. It consists of mostly massive, dark-toned material that is bounded (and subdi-
The occurrence of breccia-like units, columnar joints, broadly traceable light- and dark-tones, and sheer thickness and vertical continuity of local units lead us to postulate that the basal, cavi, and mons groups are predominantly volcanic in origin. The dominant dark-toned, slope-forming character of the lowermost basal group markedly contrasts the dominant light-toned, scarp-forming character of the uppermost mons group. Between these, the cavi group contains tonal and textural characteristics of both subjacent and suprajacent unit groups, which we interpret as recording a transitional depositional environment. If the bulk of these units are indeed volcanic in origin, the cavi group may represent a transitional phase of local volcanic eruptions. Volcanic activity was followed by fluvial activity from Napo and Huallaga Valles, forming Hadriacus Palus as accumulated clastic debris sourced from highland terrains located east and north.


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