UNDERSTANDING THE HISTORY OF A DIVERSE INVERTED FLUVIAL LANDSCAPE: 1:500K GEOLOGIC MAPPING OF THE AEOLIS DORSA REGION, MARS. D. M. Burr[1], R. E. Jacobsen[1], A. Lefort[1], R. M. Borden[1], S. E. Peel[1], [1]University of Tennessee, Knoxville, TN, 37996 USA (dburr1@utk.edu).

Introduction: This abstract summarizes our fifth and final year of work on a 1:500k USGS geologic map of the Aeolis Dorsa (AD) region, Mars [1-3]. The work plan presented in the Planetary Geologic Mappers Meeting of 2018 [4] for our first no-cost extension was accomplished, and the map has passed compliance review as described in section 6.5.2 of the Planetary Geologic Mapping Protocol – 2018 (PGMP) [5; see link]. This abstract summarizes the map and scientific findings, most of which preceded the past year's technical completion of the map and so were presented in 2018 [4].

The AD region is located north of the Highland-Lowland Boundary (HLB), ~800 km east of Gale Crater, and south of the Cerberus lavas [Fig. 1A]. The primary motivation and focus of the proposed work was to investigate thousands of sinuous ridges, interpreted to be inverted fluvial features [6,7 and refs. therein]. The great diversity of AD landforms led to additional investigations of lacustrine, tectonics/collapse processes [8], and aeolian features associated with the Medusae Fossae Formation (MFF) [e.g., 4,9].

Scientific results: As noted in the 2018 summary of the scientific results associated with the mapping effort [4], analysis of local-scale stratigraphy and estimates of paleodischarges and paleohydrology of the AD deposits elucidate the history of ancient fluvial activity in the region. The global Martian hydrologic timeline, as represented by the inferred transition from older widespread valley networks to younger alluvial fans within craters, is represented in the stratigraphy of Aeolis Dorsa. In particular, this global evolution is shown in the AD region in the transition from wide meandering fluvial deposits and channel fills to alluvial fans [10-11 and refs. therein]. Close examinations of AD features and comparisons with terrestrial analogs suggest features in southern AD formed in the presence of weathered sediments [11]. The apparent absence of such features in the northern areas suggests enhanced weathering in the south, possibly caused by orographic precipitation near the HLB [6,11]. Additional research associated with this map entailed comparisons of meandering deposit morphometries with those of terrestrial analogs, leading to improved accuracy and precision of empirical relationships for estimating paleodischarges on Mars [12]. Results from morphometric analyses and comparisons with terrestrial analogs suggest confounding factors in interpreting eroded fluvial landscapes [13]. Mapping in nighttime infrared data of a moderately bright unit located between the two plana suggests fluvial deposition by centripetal [14] and potentially southward flow.

Several large (>10km-diameter) craters in the trough between Aeolis and Zephyria plana preserve post-impact sedimentary deposits with branching ridges and layered outcrops [15]. Mapping and analysis suggest that these deposits are most consistent with deltaic and sedimentary deposition in lacustrine environments [15]. Local geologic mapping of these interplana crater deposits, along with analysis of their regional topographic setting, is focused on evaluating the possibility that these larger, lower-elevation craters hosted paleolakes and, if so, their potential water source(s).

The AD region exhibits numerous tectonic features [e.g., 8,10]. Aeolis Chaos, sitting ~1 km below the surrounding terrain and ~2 km below the southern highlands, separates AD from the highlands [Fig. 1B] and is interpreted to have formed by extension along the HLB [16]. Wrinkle ridges [10] have orientations that range between NW and NE, with this variability in orientation suggesting variability in the compressive stress field over the time of their formation [17]. Normal fault scarps are inferred locally on the interior (western side) of southern Zephyria Plana [18].

Mapping results: GIS files and the geologic map show six map unit groups with a total of 19 map units [Fig. 1]. Linear feature types were used to denote large crater, tectonic [e.g., 17], and fluvial features [11]; location feature types indicate small cones and craters.

These mapping results show Noachian to early Hesperian-age highlands moderately deformed by impact cratering, and, to their north, transitional units deformed by extensional tectonics [e.g., 16]. These units are interleaved with aeolian and volcaniclastic plana units (i.e., MFF). Fluvial deposition occurred with waning geomorphic effective during the Hesperian and Amazonian periods [4,14,18]. These fluvial deposits, and the potentially lacustrine interplana deposits, were repeatedly buried by widespread aeolian and/or volcaniclastic deposition (MFF), later exhumed by aeolian processes that formed yardangs and aeolian bedforms [e.g., 3,4,18].

Map package submission: A new basemap of blended CTX images was incorporated into the project [19], which required warping of GeoContacts and features to align with the new basemap. The map package, including the Description of Map Units and Correlation of Map Units [Fig. 1, right], is under technical review [18]. We look forward to responding to the reviews during the final few months of our No Cost Extension.

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References: [1] Burr & Jacobsen (2015) *Planet. Mappers Meet.*, Honolulu, HI. [2] Burr et al. (2016) *Planet. Mappers Meet.*, Flagstaff, AZ. [3] Burr et al. (2017) *Planet. Mappers Meet.*, Flagstaff, AZ. [4] Jacobsen et al. (2018) *Planet. Mappers Meet.*, Knoxville, TN. [5] Skinner et al. (2018) USGS. [6] Burr et al. (2009) *Icarus*, 200. [7] Burr et al. (2010) *JGR-Planets*, 115. [8] Lefort et al. (2012) *JGR-Planets*, 117. [9] Kerber and Head (2010) *Icarus*, 206. [10] Kite et al. (2015) *Icarus*, 253. [11] Jacobsen & Burr (2017) *Geosphere*, 13. [12] Jacobsen & Burr (2016) *GRL*, 43. [13] Jacobsen & Burr (2018) *Icarus*, 302. [14] Burr et al. (2016) *LPS XLVII*, #1392. [15] Peel & Burr (2018) *LPS XLIX*, #1006. [16] Lefort et al. (2015) *Geomorph.*, 240. [17] Borden (2018) Master's thesis, University of Tennessee. [18] Burr et al., (2019) *USGS Map Series*, submitted. [19] Dickson et al. (2018) *LPS XLIX*, #2480.

Figure 1: (A, below) Context image of MOLA topography. Black box north of southern highlands shows map area. (B, below) Aeolis Dorsa 1:500k map with geologic units (70% transparency) overlain on blended CTX mosaic [20]. Linear features, including scarp and crater crests and depression margins (in black with standard symbology), representative inverted fluvial and alluvial ridges (cretan blue with white diamonds; N=497 shown on map), and mapped wrinkle ridges (Mars red with black diamonds; N=35), are shown. For readability, location features, including pitted cones (N=93) and small craters (1-4 km dia.; N=19,677), are not shown in this figure, but are displayed on the accompanying poster, along with channels (N=35) and grooves (N=12). (right) Correlation of Map Units.