GEOLOGIC MAP OF THE DEUTERONILUS MENSAE REGION: INSIGHTS INTO THE HISTORY OF MARS. L. Pauw, L. Wüller and H. Hiesinger, Institut für Planetologie, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany, (l.pauw@wwu.de)

Introduction: The northern mid-latitudes of Mars contain a wide range of fluvial and (peri-) glacial landforms as well as geologic units that are diagnostic for both a cold and dry and a warm and wet environment [1]. Deuteronilus Mensae lies inside the northern mid-latitudes of Mars and is a transitional zone at the dichotomy boundary that covers relatively old highland terrain, planar lowland units and the previously mentioned landforms, containing a record of mid-latitude glaciation and extensive mantling during the Amazonian [2, 3]. Glacial and periglacial landforms, e.g., viscous flow materials, like lobate debris aprons, lineated valley fill, and concentric crater fill, can be used as key instruments in elucidating the fluctuations of past and recent climatic conditions on Mars' surface [e.g., 2, 4 - 6]. Orbital radar sounding of these features confirms relatively pure ice under a protective lag deposit of debris [7]. Large- and small-scale geologic mapping of areas that exhibit such features as well as geomorphic indicators of ground ice, help us investigating the evolutionary history of Mars. Some large-scale studies have already interpreted this region as a complex array of geologic processes, including eolian, fluvial and glacial activity, coastal erosion, marine deposition, mass wasting, tectonic faulting, and effusive volcanism. In addition, evidence for significant modification of the ancient highland plateau and resurfacing of the lowland regions was found [e.g., 8, 9]. Our research area represents a volatile-rich and diverse exploration zone that spans large parts of the Martian chronology starting from Noachian-aged highlands up to Amazonian mantling material that might indicate relatively recent geologic activity. We present a geologic map that covers parts of the Arabia Terra bench as well as parts of the southern Deuteronilus Mensae region. Extending from E008/N36 to E024/N44, our map also contains a diverse suite of units that are related to Okavango Valles, Mamers Valles and Deuteronilus Colles. Additionally, the complexity of geomorphological features is represented by large valleys, prominent channel systems, little to highly degraded surfaces, and a high abundance of wrinkle ridges, especially in the highland terrain. Our goal was to create a geologic map by using multiple datasets to study the climatic conditions and geological processes throughout the history of Mars.

Methods: Our map is centered at 40° N, 16° E, covers an area of approximately 365,000 km², and is using the Lambert-Conformal-Conic map projection. The mapping was conducted at a scale of 1:500,000, a scale at which no geologic map exists for this region. Using ESRI's ArcMap with multiple individual datasets allowed us to produce a high-resolution map of this area. The following data sets were utilized: (1) THEMIS daytime data for first visual and topographic assessments; (2) THEMIS nighttime data to analyze the thermal heat conductivity of various surface materials; (3) CTX mosaics obtained from the Murray Lab website as a basis for mapping at a pixel-resolution of ~5 m - 7 m/pixel; (4) HRSC data blended with MOLA information to provide a digital elevation model that has a resolution of ~10-30m/pixel, and (5) HiRISE images to investigate small-scale textures and morphologies at ~0.5 m/pixel.

Units: Here, a comprehensive overview of our major preliminary units, i.e., plateau material, plains material, superimposing surficial material, and crater material, illustrate the broad geological context of this area.

Plateau Material: Appears as cratered highlands with channels, elongated depressions and secondary crater fields. Hosts rimless and infilled craters, sub-circular basins and well-preserved rampart craters. Crater density and elevation, decrease towards north to north-east, whereas the abundance of surface collapse features, dissected highland blocks, mesas and remnant knobs located in the lower plains increase. High density of wrinkle ridges at the western highland terrain and large variations of the surface with regard to textural characteristics, e.g., patches with highly variable albedo. These patches might be related to the processes that led to the formation of the extensive channel system Okavango Valles.

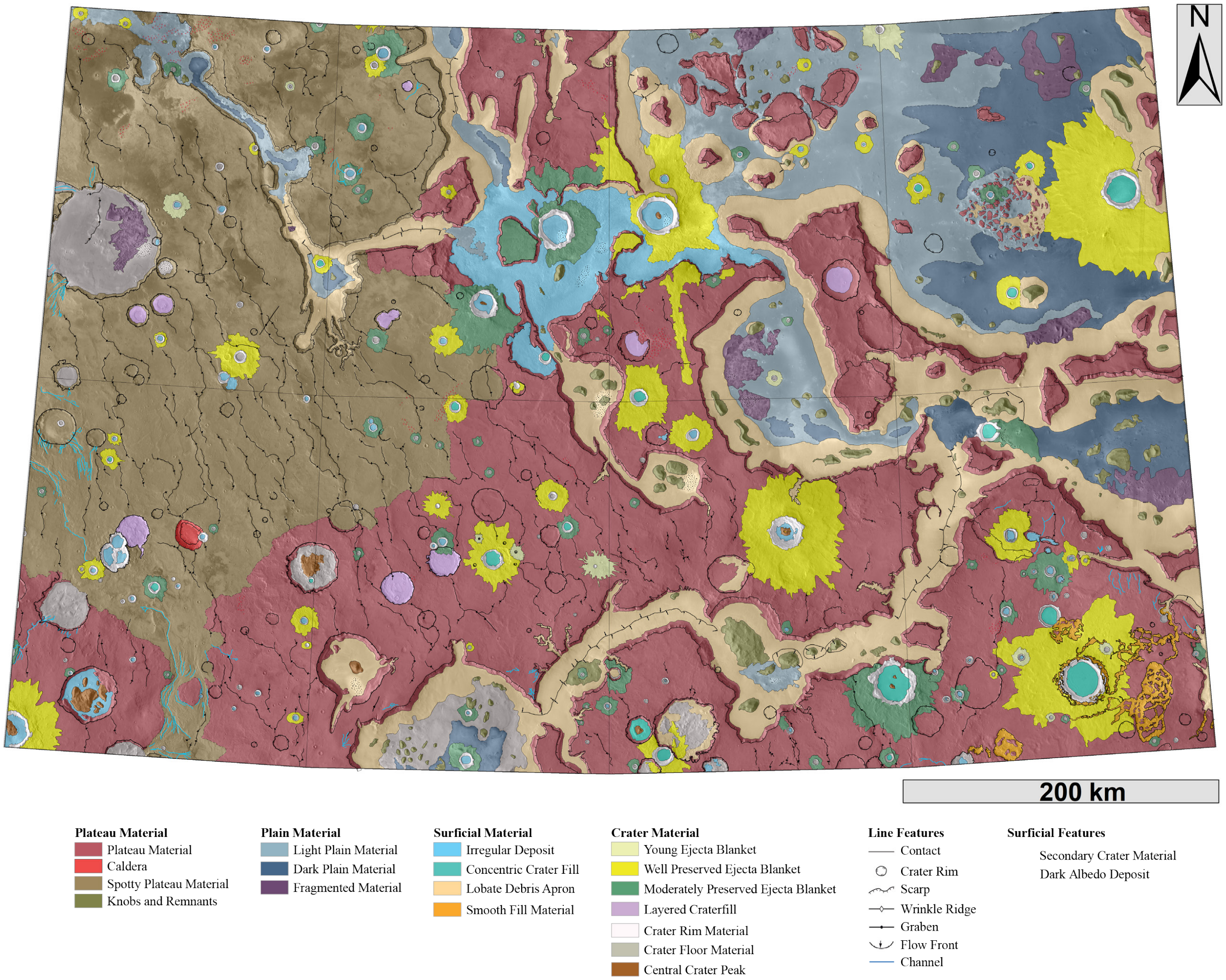

Fig.1: Geologic Map of our research area that extends from E008/N36 to E024/N44 and is centered at E016/N40.

Plains Material: Relatively smooth plains occurring in the northern lowlands. Crater densities are lower compared to the highland terrain. The plains host clusters of dissected fragments. Wind streaks create dark albedo areas that are covered by a light and thin dust mantle, indicating the effect of eolian processes.

Superimposing Surficial Material: Lineated valley fill and lobate debris aprons surrounding mesas, knobs and extending from the bases of plateaus into valleys or lowlands. Eroded and mass-wasted deposits with small grain-sizes are embedded between blocks, knobs and channel systems as smooth fill material.

Crater Material: Various types of ejecta blankets are divided into young units with an extremely sharp contact to the underlying material, a well-preserved unit that displays pronounced lobes and blankets but not as sharp as the young unit, and moderately to highly degraded blankets that are partly superposed by younger craters. Crater interiors are commonly covered with fill material or concentric crater fill.

Conclusion and Outlook: Our map displays a diverse region that represents large parts of the Martian history. Establishing a detailed chronology might improve our understanding of the geological context and key processes that led to the formation of this area.

References: [1] Galofre et al. (2020) *Nat. Geosci*. 13, 663-668. [2] Morgan et al. (2009) *Icarus 202*, 22-38. [3] Baker and Head (2015) *Icarus 260*, 269-288. [4] Sharp (1973) *JGR 78*, 4073-4083. [5] Kargel and Strom (1992) *Geology 20*, 3-7. [6] Fastook et al. (2008) *Icarus 216*, 23-39. [7] Petersen et al. (2018) *Geophys. Res. Lett. 45*, 11.595-11,604. [8] Chuang and Crown (2009) *USGS*, Map#3079. [9] Tanaka et al. (2014) *Planet. Space Sci*. 95, 11-24.