GEOLOGICAL CARTOGRAPHY OF INNER MATERIALS OF AN IMPACT CRATER ON NEPENTHES MENSAE, MARS. A. Valenciano[1] and M.A. de Pablo[2]. [1] Dpto de Paleobiología, Museo Nacional de Ciencias Naturales- CSIC, 28006, Madrid, Spain, (alb3rtovv@gmail.com); [2] Dpto. de Geología. Universidad de Alcalá. 28871 Madrid, Spain. (miguelangel.depablo@uah.es).

Introduction: Nepenthes Mensae, on the martian Lowlands near the dichotomy in the equator was recently studied due to the important role of water has played throught its geological history. Shorelines, deltas or lakes are some of the features described in this area (e.g., [1, 2, 3, 4, 5]). The interest of this region of Mars is reflected on the landing site of the Mars Science Laboratory mission of NASA, what will take land on Gale Crater (e.g., [6, 7, 8, 9,10]) , in the edge of Nepenthes Mensae. We focused our attention on the sedimentary materials located into an unnamed impact crater, about 42 km in diameter, near Gale Crater (Figure 1). We conduct a geological cartography and a preliminary geochemical analisys of some of the materials filling the crater. Here we present the geological map and a brief description of the materials and its geological history, as well as an approach to their astrobiological and exopaleontological implications.

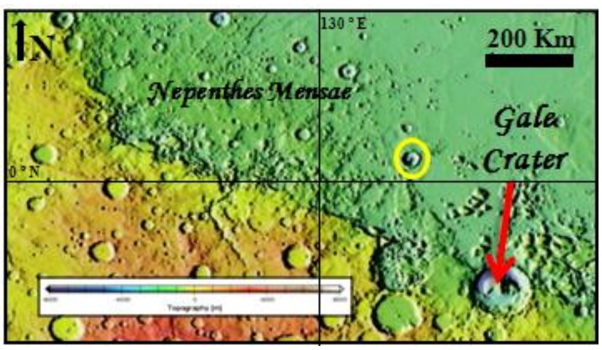

Fig. 1: Geographical location of the cráter study (yellow circle) (1,2ºN- 134,0º E). Note the proximity to the Gale Crate (4,4ºS–137,4ºE)*, the landing site of MSL NASA's mission.*

Data and Methods: We analyzed high and medium resolution satellite images of different missions, including: THEMIS-Vis (18 m/pixel) [Images: V04951006; V07922019; V27590034; V14786013; V10493018; V18168015], CTX (6 m/pixel) [Images: P20_008714_1791; P15_006921_1820] and HiRISE (0,30-0,60 m/pixel) [Images: PSP_007923_1810; PSP_008714_1815; PSP_013751_1810]. We also used geochemical product from CRISM instrument covering only the southern part of the study area [image: FRT0001374A_07_IF165S_TRR3.LBL) to obtain geochemical data to help interpret the origin and nature of some of the materials inside the impact crater. Geological cartography was based on P15_006921_1820 CTX image.

Sediments inside the impact crater: The mapped crater is 42.5 km in diameter with a complex inner morphology, including a central peak and eroded inner terraces formed during the impact [11]. Satellite images show the existence of important sedimentary deposits, what we mapped into 12 units (and their 24 subunits) based on their morphology, physiography, texture, albedo, and stratigraphic position (Figure 2).

Geology: Moreover the sediments from the erosion of the inner crater flanks, sediments from aluvial fans are the most frequent sedimentary deposits on the inner slopes, as well as possible paleolake sediments filling its floor. We consider important to remark the presence of some periglacial features at the SE on the crater (possibly also in the NW, but there are no high resolution data of this area), because their presence imply periglacial conditions in the area and, subsequently, cold conditions. Landslide deposits were also observed on the slopes, marking the important role of water in the geological evolution of this crater. Desiccation markers (polygonal pattern, as proposed previously by other authors [12]) on different sites of the crater floor also support climatic changes in the area from a wetter to drier conditions. Then, mapped materials allow us to deduce that 1) this impact crater was an endorheic basin, filled by fluvial sediments, 2) two possible lakes, formed by accumulated water coming from this channels could exist on the floor of the crater, 3) local climate changed from wetter and warm to drier and cold, as revealed by the desiccation marks and periglacial features.

Geochemistry: Geochemical products from CRISM instrument data confirm the presence of water on the ground as well as phyllosilicates and hydrated sulfates. This minerals are related to the desiccation marks as well as with the paleolake sediments (Figure 2). This observations support the hipothesis about the presence of water in the area, and its important role in the geological evolution of this region. Presence of Phylosilicates and Sulfates, based on the mineralogical time scale for Mars [13, 14], allow us to date the geological sediments of this impact crater on Lower Noachian and Upper Hesperian, about 3800-3600 My ago.

Astrobiological and exopaleontological implications: Numerous studies invent potentially habitable environments on Mars (e.g. [15, 16, 17, 18, 19]). In this crater stand out: (1) paleolake basin (with layered materials), (2) paleolakes terminals and (3) frozen grounds (periglacial features). Likewise the presence of water, phyllosilicates and hydrated sulfates on Earth sediments facilite the preservation of the fossil or biosignatures [15, 16, 17, 18, 19], so these areas inside the mapped crater could be potential areas to search for signs of extant and extinct life among sediments.

Implications for the MSL mission: This impact crater is located approximately on the same region as the Gale Crater (Figure 1), at only 437.5 km far away; for that reasons, they could have similar climatic (and may be also geological) evolutions (Noachian lower and Hesperian upper 3800-3600 My [9]). Then, a detailed study of this unnamed impact crater could provide an adequate example to understand the geological setting of Gale Crater [6, 7, 8, 9,10], and reciprocally, the data what will provide MSL mission will help to understand the geology of the impact crater here studied. Such as in Gale Crater, the here studied unnamed impact crater has: (1) layered materials, (2) phyllosilicates and hydrated sulfates, (3) sediments of fluvial and lacustrine origin, (4) possible presence of permafrost and (5) a similar relative age of formation. Therefore, this crater is an ideal place to compare both crater data and to advance the geological, astrobiological and climate knowledge of the Nepentes Mensae región because they could had very similar paleoenvironments throughout their geological history.

Finally, it is necessary to emphasize that this crater has never been studied in depth and represents a new astrobiological and exopaleontological point of interest to consider. Future work will present a detailed study of the interior of the crater together with a complete cartography and a detailed study of the astrobiological and exopaleontological implications.

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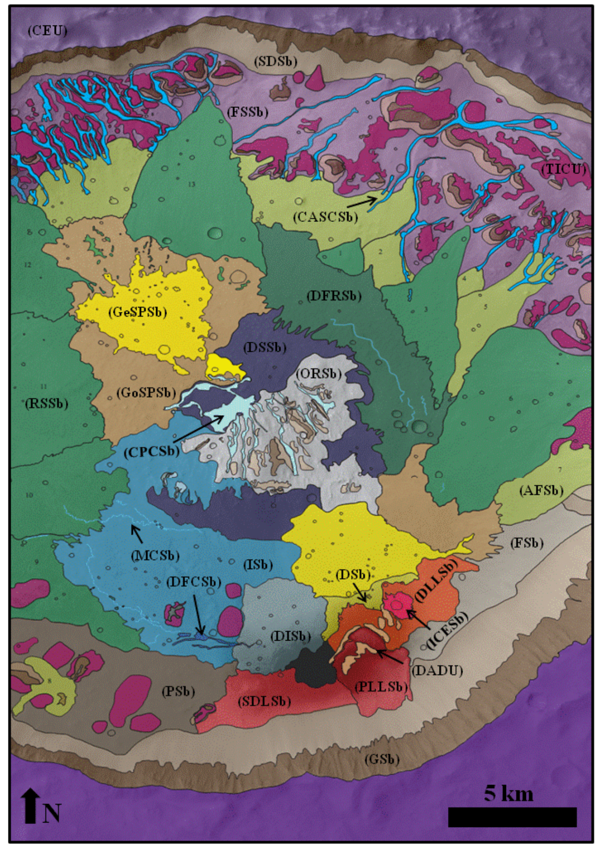

Fig. 2: Preliminary cartography inside the impact crater. Legend: CEU (Crater Eyecta Unit); TICU (Terraces Impact Crater Unit);Slope Material Unit includes: GSb (Gullies Subunit); SDSb (Slope Deposit Subunit); FSb (Foothills Subunit); PSb (Paleoslides subunit); FSSb (Fluvial Desiments Subunit); Central Peak Unit include: ORSb (Outcrops Rocks Subunit); DSSb (Distal Sediments subunit); Alluvial Fan Unit include: AFSb (Ancient Fan Subunit); RFSb (Recent Fan Subunit);DFRSb (Distal Fan Recent Subunit); Lacustrine Unit include: CoSPSb (Coastal Sediments of Paleolake Subunit); CeSPSb (Central Sediments of Paleolake Subunit); Transition Unit include: ISb (Intermediate Subunit); DISb (Distal Subunit); Channels Unit include: CASCSb (Channels Associated Slope Crater subunit); MCSb (Meandering Channels Subunit); DFCSb (Distal Flood Channels Subunit); CPCSb (Central Peak Channels Subunit); Impact Crater Unit include: ICESb (Impact Crater Eecta Subunit); Circles drawn (Impact Crater Subunit); Landslide Unit include: SDLSb (Sedimentary Deposits Landslide Subunit);Dsb (Dessication Subunit); PLLSb (Proximal Lobe Landslide Subunit); DLLSb (Distal Lobe Landslide subunit); DADU (Dark Aeolian Deposits Unit); Black (Indeterminate Unit).