Geology of Aeolis Dorsa alluvial sedimentary basin, Mars

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Abstract: Aeolis Dorsa is a topographic depression, ~800 km east of Gale Crater, located along the Mars' dichotomy boundary (Figure 1). This area records an exceptional set of sedimentary features and deposits, either fluvial or alluvial, formed by interleaved hydrologic activity and concomitant sedimentation, preservation (via geochemical cementation), exposure and topographic inversion. The main aim of this work was, firstly, to provide a detailed cartographic base of the region proposing a 'two-scales analysis approach' (e.g. the association of a greater cartographic detail to a wide regional context analysis) and, secondly, to bind the geographic distribution, the stratigraphic relations and, ultimately, to elucidate the history of Aeolis Dorsa region. A geological map at the 1:430,000 scale was produced: 1) using multiple datasets including altimetry and visible images at various spatial resolutions (e.g. from 50 m pixel^{-1} to 25 cm pixel^{-1}) and 2) considering previous observations and interpretations of the Aeolis Dorsa features and their environments of formation with a complementary approach, based on morphological similarities to fluvial/alluvial environments and deposits on Earth. Regional mapping of the area revealed the presence of a large-scale fluvial system that points to a past long-term and extensive hydrological cycle and to the presence of a large amount of surface and/or subsurface water. We interpreted the plain as an ancient waterlogged environment, a sedimentary basin passing into distal depositional environments. The identification of the stratigraphy of the studied region is challenging owing to the difficulty in discriminating between multiple fluvial and alluvial events within heavily eroded surfaces (Figure 2). A significant wet period with changing environmental conditions in Hesperian occurred in the study area diverging from the present-day climate. These findings contribute to the understanding of past climatic conditions on Mars. Moreover, they provide an interesting perspective for future missions looking for evidence of present-day and/or past extraterrestrial organisms as the life as we know it needs liquid water.

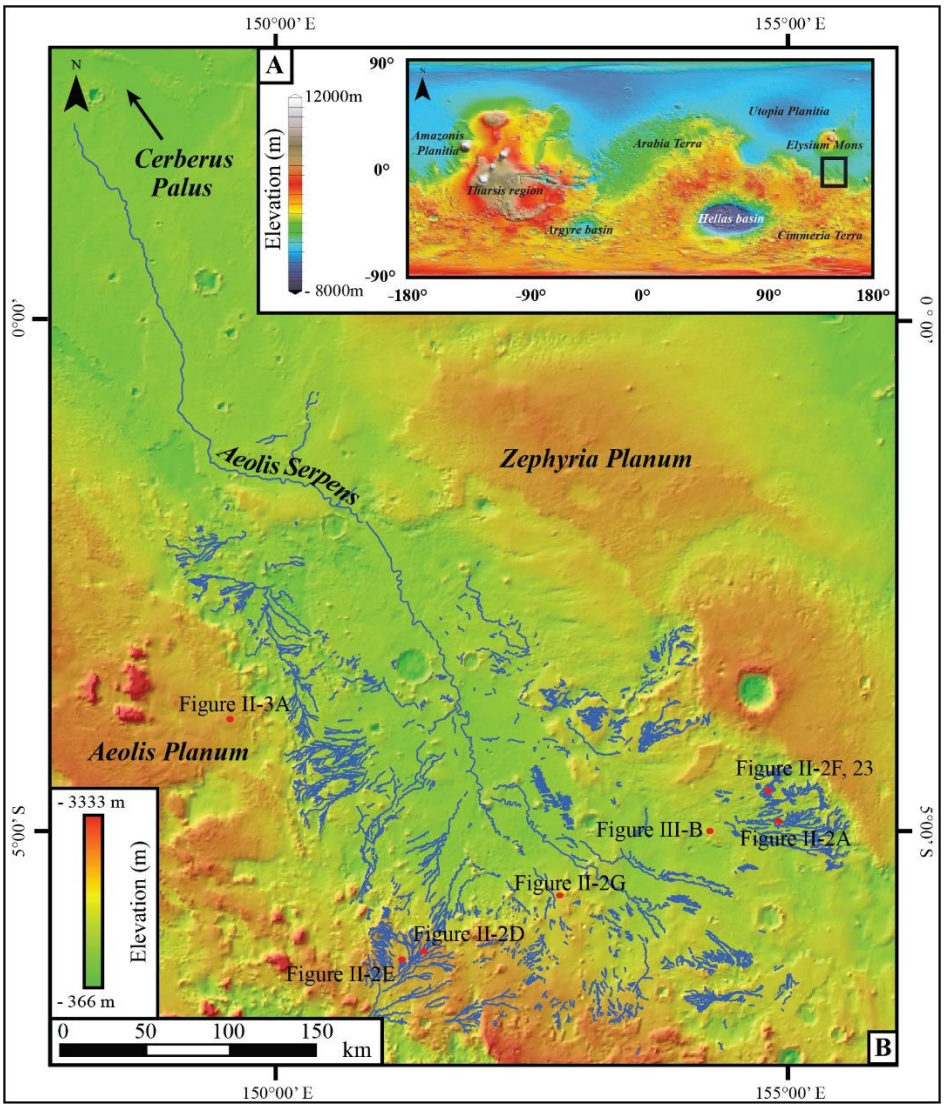

Figure 1.(A) Labeled topographic map based on colorized MOLA data. Study area is marked by black rectangle. (B)Extrapolated river network on colorized MOLA topography. Red dots mark locations of supplementary figures included in PhD dissertation of Ilaria Di Pietro. Scale 1:3,300,000. Courtesy of NASA/JPL/Univ. of Arizona.

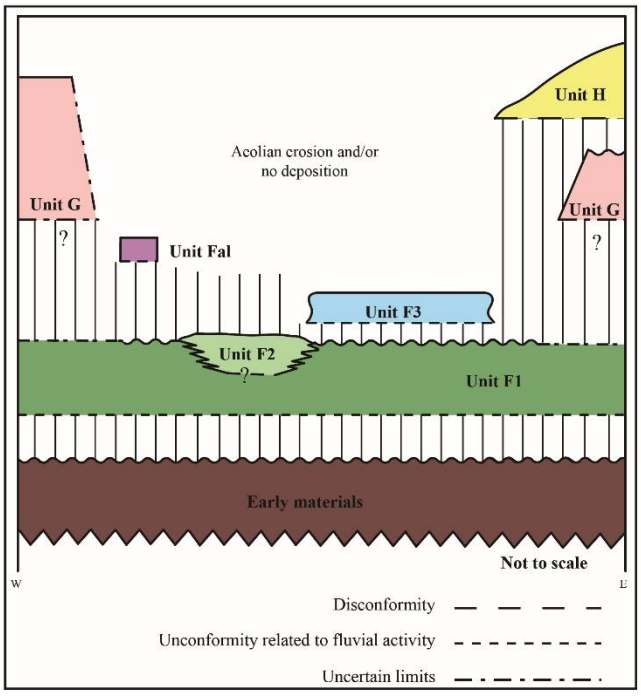

Figure 2. Time-space geological sketch of Aeolis Dorsa basin. Thicknesses of some units are exaggerated for a better understanding and view. Unit and colors are referred to the main map.