TECTONIC-RELATED FRACTURES IN OXIA PLANUM (MARS) AND THEIR IMPLICATION FOR LIFE INVESTIGATION. A. Apuzzo[1], G.W. Schmidt[1], P. Cianfarra[2] , A. Frigeri[3] and F. Salvini[1], [1]Dip. Scienze, Università Roma Tre, L.go S.L. Murialdo 1, I-00146 Roma, Italy (andrea.apuzzo@uniroma3.it),[2]DISTAV, Università di Genova, Corso Europa 26, I-16132 Genova, Italy,[3] Istituto di Astrofisica e Planetologia Spaziali, INAF, Roma INAF Via del Fosso del Cavaliere,100

Introduction: The ExoMars mission developed by the European Space Agency (ESA) and the Russian Space Agency (Roscosmos) investigates traces of past and present life on Mars[1]. On November 2015, ESA announced the landing site of the ExoMars rover in 2022, Oxia Planum located southwest of Mawrth Vallis, to the east of the Chryse Planitia Lowlands (Fig. 1). Within the payload onboard the Rosalind Franklin rover, the Ma_MISS spectrometer will investigate the composition down to 2 m below the surface[1].

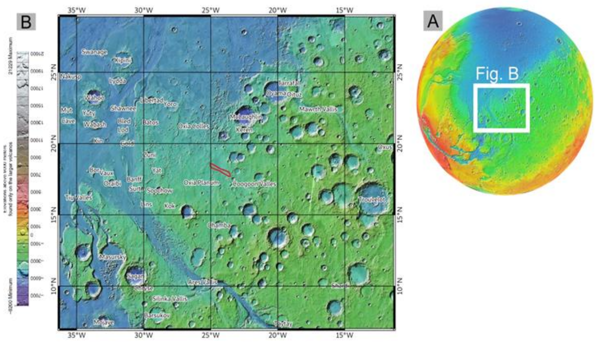

Figure 1: *(A) Location of Study Area. (B) Location of the landing-site.*

Ma_MISS is the Visible and Near-Infrared miniaturized spectrometer hosted in the shaft of the drill of ExoMars2020, developed by IAPS-INAF. The landing area is characterized by the presence of basalt and phyllosilicates rich in Fe/Mg, information provided by the spectral and hyperspectral data of OMEGA and CRISM. The clays are characterized by pervasive fractures identified by the high resolution images of HIRISE (30 cm/pixel). These fractures have been previously interpreted as a result of water loss, and therefore, desiccation [2]. We explore the possible tectonic origin of these fractures as related to lithostatic load and/or by overpressure. We mapped the fractures that characterize the clays soils of Oxia and we statistically analyzed them, both from a directional and a dimensional point of view. Tectonic-related fractures are of relevant importance for the presence of traces of life since due to their underground potential penetration and are preferential corridors for the uprising of deeper materials, including life relics.

Methodology: Two types of software were used in this work, QGIS version 3.10.1 and Daisy version 3_5.38. The use of QGIS made it possible to upload ten HiRISE images. Subsequently, ten Survey stations of 500m per side were created in each of the images (Fig. 2). Mapping has been done in QGIS by manual digitization at 1:2000 scale tracing over HiRISE imagery. Hence identified fractures where imported in Daisy for the statistical analyses.

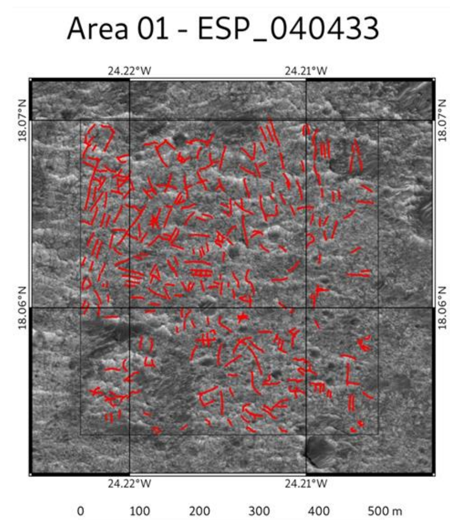

Figure 2: *Example of one of the ten survey stations (500x500m) observed in ESP_040433_1980. Red lines indicate fractures misured for the analysis presented in Figure 3.*

The Daisy software analyzes the possible preferential orientations of the fractures through azimuth-frequency or azimuth-length histograms(Fig. 3).

Results: A total of 2497 fractures were detected with an average length of 18 m. Each survey station it is characterized by two distributions of the orientation of the fractures: an isotropic orientation, indicated by the gray color in the Wind Rose graphs and an E-W trend, indicated by the colored in the Wind Rose graphs (Fig. 4).

Discussion: The desiccation polygons are of non-tectonic origin linked to the expulsion of fluids and the contraction of the sediment as well as thermoclastism-related ones, therefore generating fractures without a specific preferential direction and with different geometries linked to the heterogeneous stresses that occur [3]. For this reason the isotropic distribution could be- linked to a drying process. Given that the orientation of the fractures is related to the conjugate system of horizontal stress components σh1-σh3 (maximum and minimum horizontal stress), we can interpret the results of the structural analysis as a result of a stress field. Our study shows that the investigated ExoMars 2020 landing area has two fracturing trends.

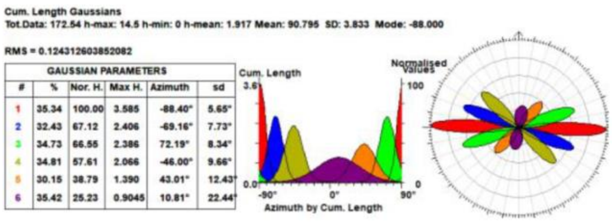

Figure 3: *Daisy statistical analysis of fractures from survey station presented in Figure 2.*

The first trend is isotropic, due to local processes, which can be interpreted as diagenetic fracturing resulting from the loss of water volume and possible thermoclastism. This conclusion is in agreement with studies on the polygonal fracture patterns that occur when clay-rich sediments lose volume [4] The second trend found has a regional character, and indicates a stress field in which the σh1 (maximum horizontal stress) is oriented around E-W. The presence and orientation of the compression structures (wrinkle ridges) in the vicinity of the study area is in accordance with the stress trajectories indicated by the results of the analysis. The approach used proved very effective and allowed us to understand the origin of the Oxia Planum fractured field. This survey, repeated systematically throughout the area, will support the preparation of evolutionary tectonic models of Oxia Planum. Our study therefore contributes to the knowledge of the area in which the ExoMars rover will search for evidence of past or present life on Mars.

References: [1] Vago et al.(2017), Astrobiology, Vol. 17, No. 6-7. [2] Bowen A.P. et al. (2019), *LPSC L*, Abstract# 2132. [3] Goehring L. (*2013)* Phil. Trans. R. Soc. A. 371: 20120353. [4] El-Maarry et al. (2013), JGR: Planets, vol. 118, 2263–2278.

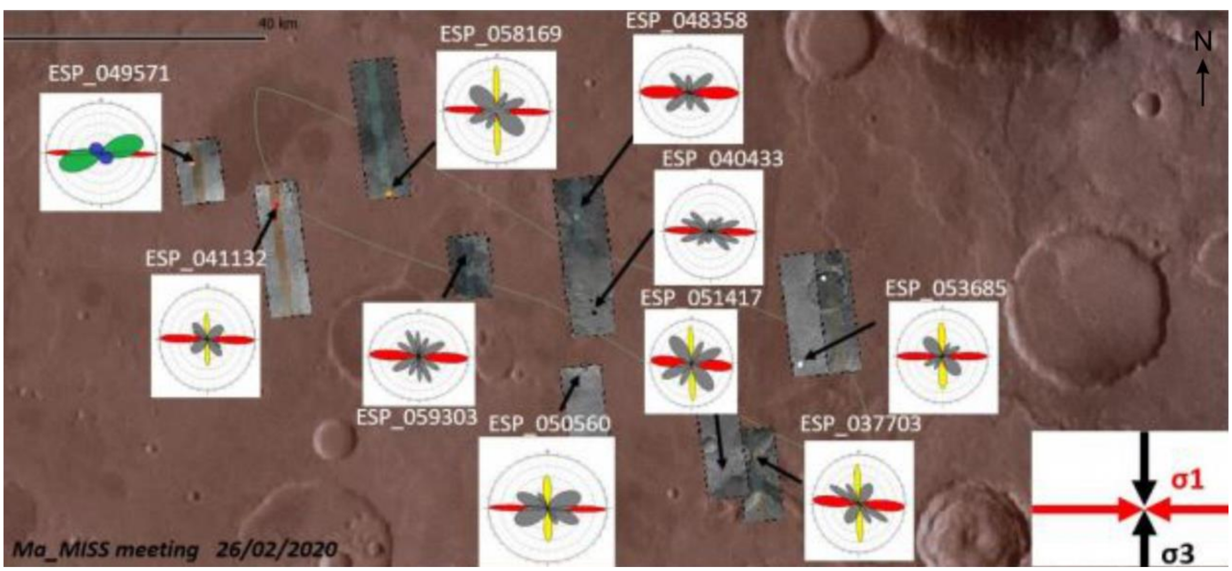

Figure 4: *Wind Rose Diagrams of the measured fractures within all ten survey stations.*