PRELIMINARY MAPPING OF DIKE SYSTEMS IN NORTHERN ELYSIUM PLANITIA. S. Rivas[1,2], J. Ruiz[1], I. Romeo[1], [1]Departamento de Geodinámica, Estratigrafía y Paleontología, Universidad Complutense de Madrid, José Antonio Novais, 12, 28040, Madrid. [2]samuelrivas@ucm.es.

Introduction: Many areas of Mars have been focus of the search for dikes, mostly in the Tharsis region; Arsia [1], Pavonis [2] and Olympus Montes [3], Alba Patera [4], Valles Marineris [5] and eastern Thaumasia [6]. However, the other prominent volcanic province, Elysium, remains largely unexplored for this purpose. Here we present the first results of a survey for dike detection in northern Elysium Planitia. A total of 262 individual structures identified as exposed dikes have been mapped in high resolution images. We have placed them in a broad geological context, proposed possible time relationships, and speculated about the stresses that may have generated them. This portrait will allow to continue looking for dikes in the area, and eventually construct a consistent history for their emplacement in relationship with regional volcanic and tectonic histories.

Area of study, data and methods: The region of Elysium Planitia explored is located approximately 1200km SE of Elysium Mons, and consists of low (-2600 to -2800 m) plains bounded to the NW by the Tartarus Montes, and crossed by the NW-SE fracture system of Cerberus Fossae, extending 200km to the S into the plains (Fig. 1). The area of study has been interpreted mostly as Late Amazonian volcanic plains with sparse shield edifices, whilst the Tartarus Montes consist of Hesperian and Noachian transition units with impact breccias, volcanic deposits, sediments and mass-waste deposits [7].

Topographic data from the Mars Orbiter Laser Altimeter (MOLA, MEGDR dataset, 463 m/pixel resolution), and imagery from Context Imager (CTX, 6 m/pixel res.) and HiRISE (High Resolution Imaging Science Experiment, 0.26-0.5 m/pixel res.) have been used to identify and characterize possible dike systems in northern Elysium Planitia. Global and local geological maps, MOLA data and CTX images have been used to provide geographic and geologic context to the interpreted dikes, which in turn have been mapped in the high-resolution images. Mapping has been carried out entirely in the Quantum GIS software package.

Exposed dikes are identified as long, narrow linear features, usually several hundred meters in length, formed by hard, blocky materials which are resistant to erosion, act as barriers for dunes, sometimes create tiny plateaus around the lineaments, and usually have lower albedo than its surroundings. In all cases, these structures are associated with similar features in the same directions, and are interpreted collectively as dike swarms.

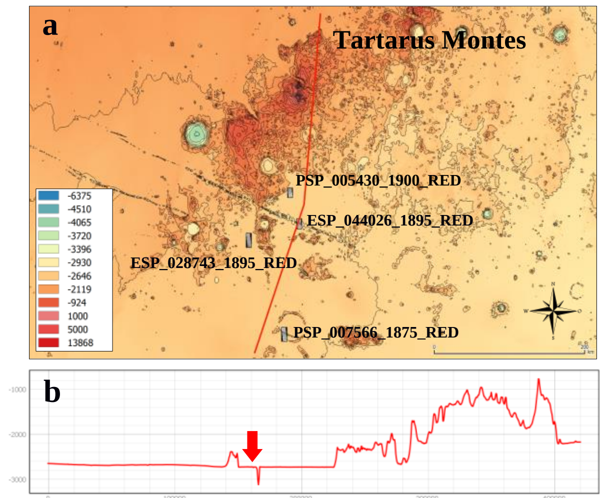

Figure 1. **a)** MOLA topography for the study area, showing the location of the HiRISE images used. Contour spacing is 200 m. Legend is elevation in meters. Scale bar at the bottom left is 200 km. **b)** Topography profile through the solid red line show in a). Location of ESP_044026_1895_RED is indicated with a red arrow. Vertical and horizontal scales are in meters.

Results: 262 individual dikes have been mapped in several HiRISE images, with two major trends identified; NW-SE (hereafter A) and NE-SW oriented (hereafter B), with some isolated N-S oriented structures which tend to merge with either of the two main systems. Both sets of dikes show a similar number of structures, but the NW-SE system is generally easier to map and, as its dikes are clearer and more continuous. For both trends, the smallest individual dikes have minimum lengths of approximately 100 m, whilst the longest continuous structures reach to 3500 m, all showing apparent thicknesses of 2-5 m.

Geology and geomorphology. All the dikes are in terrains identified as Late Amazonian volcanic units in the last geological maps available [7]. The mapped dikes are situated in remarkably plain regions at low elevations between -2650–2750m, and are frequently associated to relatively high-albedo rugose terrains, or relatively low albedo chicken-wire-like surfaces of undetermined nature (Fig. 2). In many cases, dikes are observed to block dune movement and act as barriers for the propagation of large dune fields, highlighting their

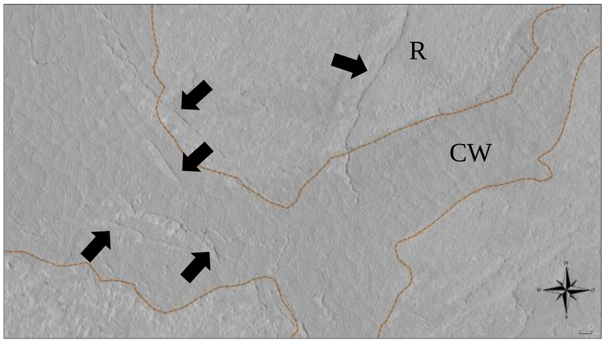

Figure 2. Detail of HiRISE image ESP_028743_1895_RED. Note the low-albedo nodular terrain described as chicken-wire (CW) within the dashed brown line, surrounded by high-albedo rugose areas (R). Possible dikes are indicated by the arrows, and cross-cut both types of surfaces. Scale bar on bottom right of the image is 30 m.

resistance to at least present day erosive forces. How the dikes express at surface varies from one location to another. In image PSP_005430_1900_RED, B dikes are concentrated in a discrete and well-defined 100-400 m wide NE-SW corridor (as in Fig. 3), whilst in ESP_028743_1895_RED_GR they are, though following specific directions, spread across an area several kilometers wide (in the style shown in Fig. 2).

Dike stratigraphy. Cross-cutting relationships show that the B system likely post-dates the A dikes. Figure 3 shows that the B dikes are associated to a dextral strike-slip zone, as indicated by the right-lateral displacement of the A dikes at both sides of the fracture zone. The B dykes may have been initially emplaced via mode I fracturing of the host rock, then acted as a weak zone to accommodate the observed lateral movement. Additionally, the nodular terrain seems to have developed abundant lineaments oblique to B, in a N-S trend. The principal Riedel (R) shears in a dextral system would be expected to develop at a low angle relative to the fracture zone, around 10-20º clockwise, but these oblique lineaments to the B dikes do not show this orientation, and instead have angles of 180-200º clockwise from the fracture zone. Therefore, they are not consistent with R shears, and we interpret them as some sort of drag features associated with the movement of the fracture zone. This strike-slip zone is the only structure of its kind found so far, but allows to establish a clear chronology between possible dike systems.

Associated stresses. The presence of the two dike systems and the observed strike-slip zone, implies the succession of two distinct extensional phases almost perpendicular to each other and coeval with extrusive episodes, plus a phase of lateral movement. According to the ages assigned to the terrains in which the dikes are emplaced, a succession of post-Late Amazonian tectono-volcanic episodes would be required to produce the sequence of events described, and thus a recent and intense activity in the region.

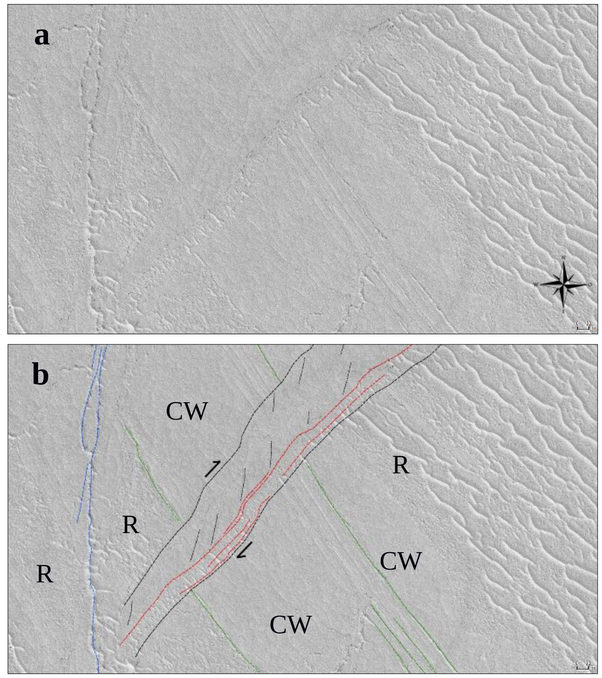

Figure 3. Detail of HiRISE image PSP_005430_1900_RED. **a)** Uninterpreted and **b)** interpreted image. A dikes are displaced approximately 60 m by a fracture zone which runs roughly parallel to the B dikes. Dashed green: A dikes. Dashed red: B dikes. Dashed blue: N-S dikes. Dotted black: oblique lineaments. Fracture zone delineated by the dashed black lines. Scale bar on bottom right of both images is 30 m.

Conclusions: We have identified two possible dike systems in northern Elysium Planitia; one NW-SE, another NE-SW, with the latter post-dating the former. This time relationship is based on simple geological criteria from a single large structure (the strike-slip zone), but could be confirmed at other locations from same, larger or smaller scale structures. More high-resolution and regional images will be surveyed for search of dikes and indicators of timing and kinematics of the structures associated to them, in order to building a consistent history for dike emplacement in Elysium Planitia.

References:

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