STRUCTURAL REMAPPING AND RECENT FINDINGS IN VALLES MARINERIS, MARS. D. Mège[1], J. Gurgurewicz[1] and P.-A. Tesson[1], [1]Space Research Centre PAS, Warsaw, Poland (dmege@cbk.waw.pl, jgur@cbk.waw.pl, pt@cbk.pan.wroc.pl).

Background: Valles Marineris is a key element of the Tharsis dome and as such, understanding its formation and evolution constrains the evolution of the dome. It has become accepted over the years that most of Valles Marineris formed as a mechanically coherent extensional system [1-5] following dikes and faults [1,2,6-9], frequently named a "rift", whatever the term may mean in the lack of plate tectonics. This view dates back to the Viking era, and little structural analysis has been conducted since that time. Using post-Viking datasets, observational evidence of regional tectonic deformation has been nuanced, with some of the normal faults reinterpreted as either of gravity origin (or as reactivated regional tectonics faults) or subglacial scarps [10-14]; at the same time, low intensity deformation of Interior Layered Deposits (ILD) has been found (e.g., [15-17]). However, the understanding of the earliest stages of Valles Marineris evolution has little improved.

Comprehensive detailed structural mapping of Valles Marineris and the surrounding plateaus has been undertaken (Figure 1) at CTX and HiRISE scale (depending on HiRISE image availability), highlighting outstandingly rich Valles Marineris tectonic evolution. Currently, mapping of the central and eastern Valles Marineris chasmata and their surroundings is in progress.

Findings:

Tectonic extension and crustal dilation. Evidence of tectonic extension and crustal dilation perpendicular to the main chasmata is supported, but both normal faults and dykes point to additional directions, including very significantly, perpendicular to the main chasmata [18].

Shear tectonics. NE-SW dextral brittle-ductile shear zones exposed within the northern chasmata indicate that extension was also achieved through large-scale, oblique shearing [19-21] parallel to the oblique chasma-bounding fault lines investigated earlier [5]. In the Echus Chasma area, strike-slip tectonics indicates that shearing continued after the deposition of the Lunae Planum top stratigraphic unit [22].

Chasma megageomorphology. The interior of Ophir Chasma exhibits a dense swarm of dykes, the thickness of which indicates a significant role of erosion in chasma formation prior to lower ILD deposition, in addition to crustal dilation. The intruded rock includes light-toned basement as well as possible pseudotachylite [21]. Glacial erosion is the most appropriate process of chasma erosion [23], and also probably controlled the passageway between the Ophir and Candor chasmata [21].

Inverse tectonics. Some wrinkle ridges in Lunae Planum are aligned with grabens and dykes, implying that they formed by inversion tectonics.

Volcanic construction vs. crustal folding. On the west, Ophir Planum has been intensely stretched by narrow graben formation [24], and on the east, displays 1 km-high mountains interpreted as crustal folds from the southeast Tharsis ridge belt [25-26]. No evidence of tectonic deformation has been observed in the mountains; instead, some are affected by normal faulting, they are parallel with dikes, and display radiating valleys. They are also consistently linear and parallel, in contrast with the curvilinear ridges of the ridge belt. A volcanic construction origin appears a viable alternative to crustal folding.

Perspectives: Structural mapping clearly indicates that the tectonic evolution of Valles Marineris and surroundings needs reevaluation, being far more complex than the N-S stretching that has given the chasma system its current morphology and the E-W contraction that generated wrinkle ridges. This complexity has implications for the evolution of the Tharsis dome, which below the most recent lava flows, is long known to have been amazingly complex (e.g., [27]). Mapping is continuing, the mapped area is growing toward Syria Planum and Noctis Labyrinthus, Juventae Chasma, and Thaumasia Planum.

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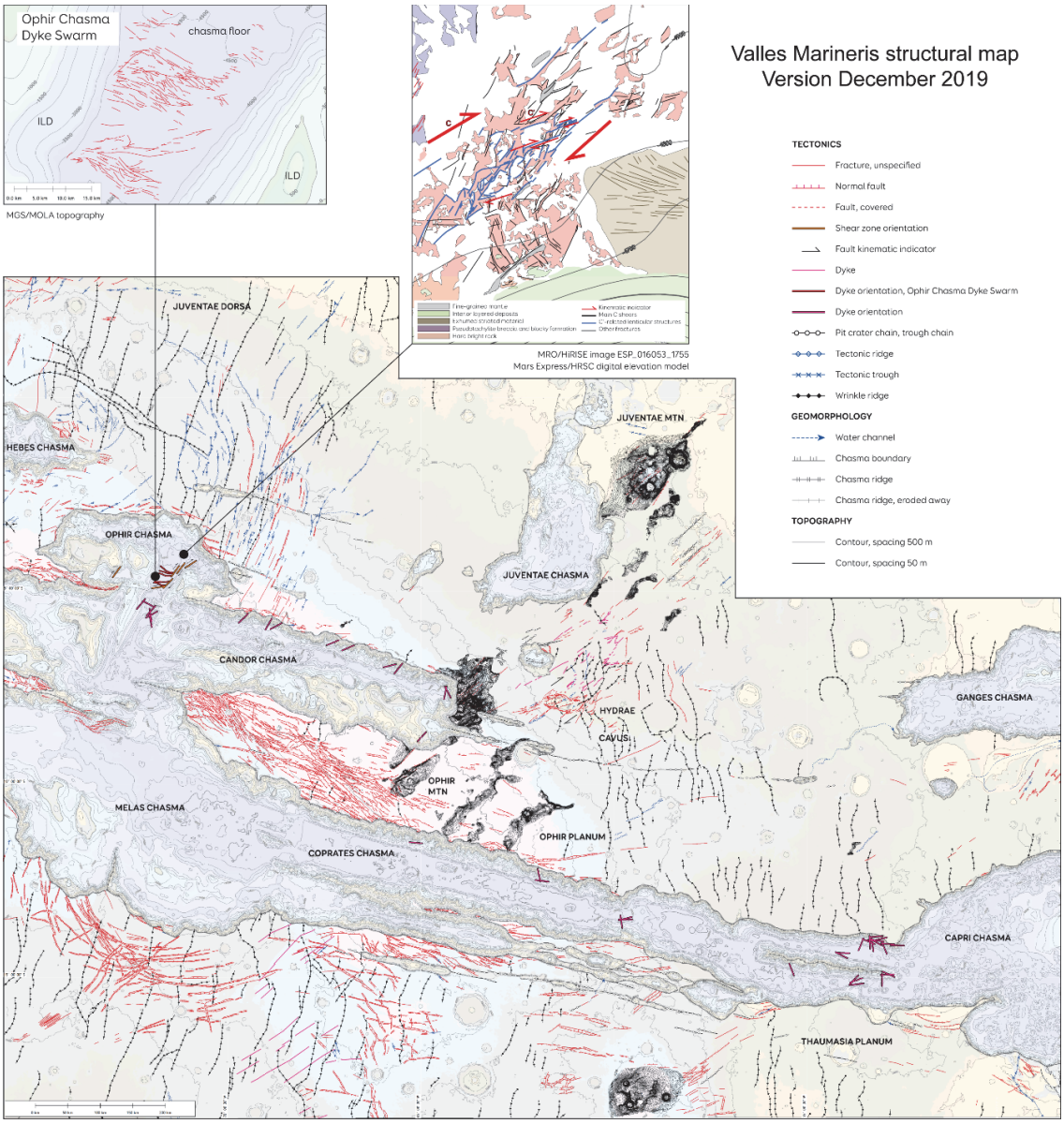

Figure 1 – Valles Marineris structural map, current stage (December 2019)