FLUVIAL FEATURES AT PERIDIER CRATER, SYRTIS MAJOR, MARS: EVIDENCE FOR HESPERIAN WARM EJECTA INDUCED SHALLOW ICE MELTING. J. D. Wagner[1], S. Tuhi[2],, K.B. Kimi[2], N. Harish[2] and S. Vijayan[2], [1]RWTH Aachen University (jan.david.wagner@rwth-aachen.de), [2]Planetary Science Division, Physical Research Laboratory (vijayan@prl.res.in).

Introduction: During the late Hesperian to early Amazonian (~3.5-2.8 Ga) Isidis basin and its rim were dominated by fluvial and glacial processes. North-northwest of the rim at Arena Colles, where massive glaciations are thought to have occurred during this period, fluvial features are widespread [1].

Here, populations of ridges and channels in Peridier crater (25.7°N, 276.2°W) and its immediate surrounding are described based on observations from geomorphic mapping. The crater has a diameter of ~94 km and is located in the Syrtis Major quadrangle (Fig. 1A). Furthermore the hypothesis of the ridges being inverted fluvial channels created through shallow ice melted by warm ejecta deposition is discussed.

Methods: Landforms around and within the Peridier crater were mapped in QGIS by analysing Context Camera (CTX) [2] images with a resolution of ~6 m/pixel, supplemented by 0.25-0.5 m/pixel High Resolution Imaging Science Experiment (HiRISE) [3] images. The topography of the mapped area was studied using data from the Mars Orbiter Laser Altimeter (MOLA) [4]. To estimate an approximate age of Peridier crater, size-frequency distributions of impact craters in a radius of 100 km around Peridier crater were measured using the CraterTools add-in for ArcGIS and Craterstats II.

Observation: *Channels:* Inside the Peridier crater, channels can be found primarily in the northern part of the crater, with larger channel networks forming especially in the northwest. The N-W channels appear to originate from the crater wall and extend up to 10 km along an elevation that extends from the north to the west of the crater, before reaching the crater floor. On reaching the crater floor, these channels then transition into fans, as observed in the N-W of the crater, or ridges, as seen in the west (Fig. 1B). On the ejecta blanket, channels are found with a higher abundance in the north-east of the crater, where they follow the local topography towards the Utopia Planitia basin and are broadly superimposed by smaller craters (Fig. 3). Even further N-W of Peridier crater, next to an unnamed crater (28.5°N, 276,8W)(Fig. 2), with a radius of about 54 km, a large network of braided channels can be seen. These braided channels extend to lengths of over 100 km and are partially 3-4 km wide. Unlike the other channels around Peridier crater, which seem to originate from the crater slope, these channels appear to be outflow channels extending from Nili Fossae.

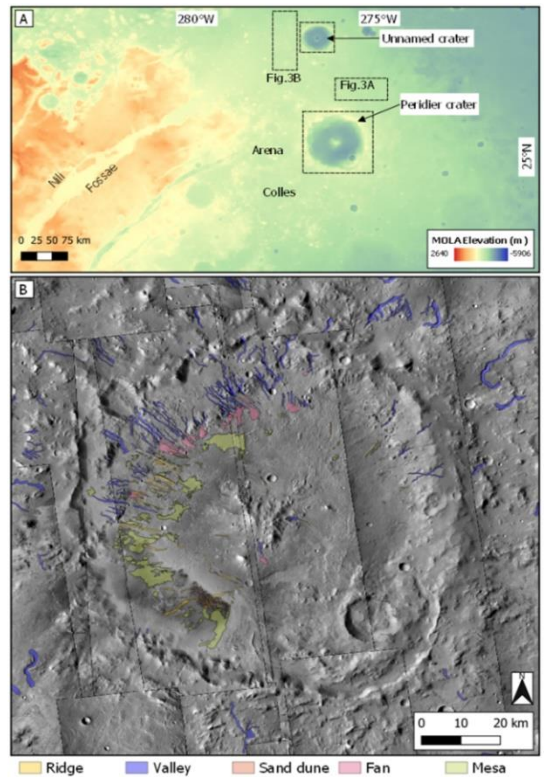

Fig 1. *A) Colorized MOLA [4] elevation map showing the location of Peridier crater, an unnamed crater north of it, as well as the location of Fig.3A & B. B) Geomorphic map of Peridier crater based on CTX image mosaic.*

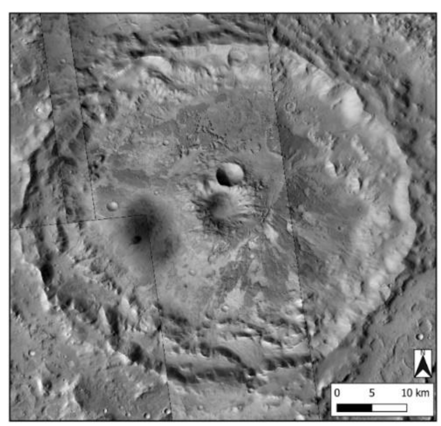

Fig 2. *CTX image mosaic showing the unnamed crater in the north*

North-West ridges: The ridge population hosted inside the crater can be distinguished into 'north-western' and 'southern' population. The N-W ridges emerge where the valleys flow from the elevation into the crater floor. They are between 4-6 km long, 50-300 m wide, and follow the slope of the crater while showing nearly

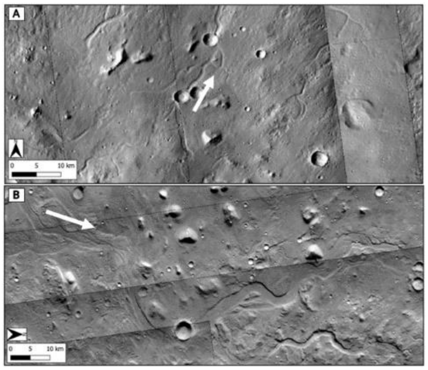

Fig 3. *A) CTX view of channels north of Peridier crater. B) CTX view of channels west of the unnamed crater. Arrow indicating flow direction.*

no sinuosity. The ridges appear to exhibit flat, round, and partly sharp crests. Furthermore, a distinct layering of the ridges is recognizable using the HiRISE images (Fig. 4).

Southern ridges: The southern ridge population appears to be morphologically distinct from the N-W ridges. 1-8 km long and 50-200 m wide ridges form an approximately 20 km long sinuous branching network with some sections ascending the topographic gradient. Additionally, a clear origin of the ridges can't be identified. With HiRISE images being limited and CTX images having a lower resolution, layering of the southern ridges can't be identified but also not be ruled out The crests of the southern ridges appear to be sharp, however the DEM resolution doesn't allow for a more detailed analysis.

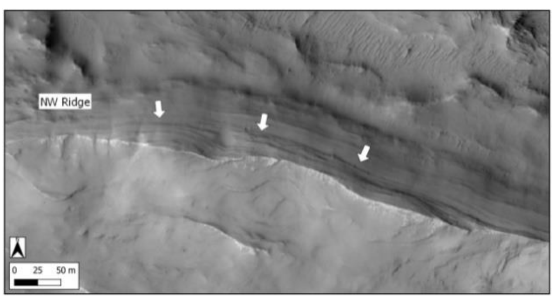

Fig 4. *HiRISE image ESP_028838_2060_RED showing layering of the N-W ridges.*

Age estimation of the Peridier crater: As no clear edge of the ejecta blanket could be identified from the CTX images, the size-frequency distribution of impact craters was instead measured in a 100 km radius around Peridier crater. In total, 1569 impact craters with a diameter ranging from 500 m – 14.5 km were measured. Using the chronology function defined by Hartmann and Neukum (2001) [5], a maximum best-fit estimate of 3.5 +0.009/-0.001 Ga was derived for D (500 m – 1 km) with 1361 impact craters following the isochron (Fig 5). Peridier crater therefore is assumed to have formed during the early Hesperian.

Discussion: The increase in topographic gradient observed in the southern ridges, as well as the linear/low-sinuous ridges in the N-W of the crater, lead to

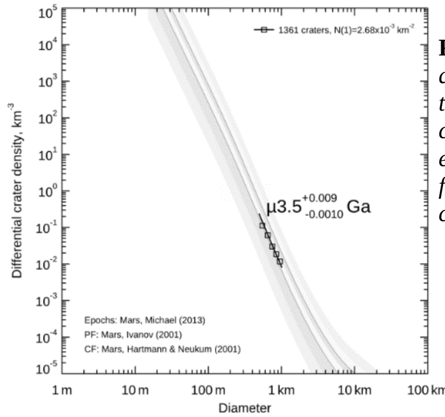

Fig 5. *Size-frequency distribution of impact craters for the ejecta blanket for the Peridier crater.*

the hypothesis that they could have formed under esker-like conditions. However, the lack of glacial features in the study area suggests otherwise. Instead, we hypothesize the ridges to be topographically inverted fluvial channels. In this case water would have drained from the crater walls, which would also explain the connection of the ridges to the channels inside the crater. Layering of the ridges would also imply episodes of transient activity. Furthermore, considering that the channels on the ejecta blanket are broadly superimposed by smaller craters, it is assumed that the time period between ejecta emplacement and the formation of the channels must have been short. A possible explanation for these observations could be the presence of shallow ice that melted below the warm ejecta, as regional mapping shows a link between fluvial features on ejecta at mid-latitudes and the presence of shallow ice deposits [6]. The liquid water would have reached the surface through fractures or local points of weakness. The distribution of the channels on the ejecta blanket would indicate that these shallow ice deposits only existed only locally.

In summary the features observed at the Peridier crater are most likely fluvial in origin and were formed shortly after the crater itself was formed. According to this, the most plausible hypothesis suggests that shallow ice deposits melted beneath the warm ejecta, resulting in localized outbursts of water required for the fluvial erosion that created the features we see today. Regarding the channels N-W of Peridier crater, further studies have yet to be conducted. Our study reveals that the Peridier crater and the surrounding region witnessed significant fluvial activities and adds another location to the dichotomy region of Mars with past water activity.

References: [1] Ivanov M. A. et al. (2012) Icarus, 218.1, 24-26 [2] Malin M. et al. (2007) J. Geophys. Res. 112, E05S04 [3] McEwen et al. (2007) J. Geophys. Res. 112, E05S02 [4] Fergason R. L. et al. (2018) U. S. Geological Survey [5] Hartmann W.K. and Neukum G. (2001) Space Sci. Rew., 96, 165-194 [6] Mangold N. (2012) Planetary and Space Science, 62.1, 69-85.