GEOLOGY OF CRATERS WITH PITS AND DUNE FIELDS IN NOACHIS TERRA, MARS. K. Cairns, H. Hiesinger, and W. Iqbal, Institut für Planetologie, Westfälische Wilhelms-Universität, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany (k.cairns@uni-muenster.de).

Introduction: The Noachis Terra region on Mars, exhibits several craters with distinctive pits and dune fields of which the origin is yet not fully understood. In order to examine these craters, we produced preliminary detailed geologic maps of Rabe crater, Proctor crater, and five additional unnamed craters. We labelled the five craters, crater A (185 km southeast of Proctor), crater B (240 km southwest of Proctor), crater C (384 km northwest of Proctor), crater D (557 km northwest of Proctor), crater E (405 km north of Proctor), and Rabe crater (326 km northeast of Proctor). The geologic settings of crater A, crater B, and Proctor crater have been previously discussed [1]. The mapping is expanded to understand the unique co-occurrence of pits and the widely distributed dune fields in craters of the Noachis Terra quadrangle. By investigating the stratigraphy of each crater, we gained insight into the geomorphological differences between the craters, as well as estimates of the time scale on which the geological processes operated in the craters.

Methods: To better constrain the geomorphological processes that took place in the craters, we mapped them in ArcGIS by using CTX images that were selected from MUTED (Multi-Temporal Database) [2]. The CTX images with 6 m per pixel allow a detailed unit classification. We identified several units that were based on their distinct surface appearance (e.g., color, surface smoothness, and resurfacing condition).

Geologic Setting: Noachis Terra is located west of the Hellas basin in the southern highlands of Mars. The selected area is known for its widespread dune fields [3], with craters exhibiting pits on their floors (Fig.1). The studied area mainly consists of heavily degraded Middle and Late Noachian highland units, together with Hesperian and Amazonian impact units [4].

Geological Units: The maps are divided into three major groups: 1. Rim Units, 2. Crater Floor Units, and 3. Pit Units. In Fig. 1, the rim is represented by dark blue colors (*NHrf* Noachian-Hesperian furrowed material). This unit shows a smooth surface with furrows that traverse into the inner part of the crater wall. Each crater floor is unique in its configuration. All craters exhibit units *NHrf*, *Am* (Amazonian mantling material), *Amd* (degraded unit of *Am*), and mostly *Adtd* (Amazonian dark transversal dune fields). Based on its smooth, featureless terrain, the lack of impact craters, and its draped morphology, *Am* is interpreted as an ice-dust mantle. We propose that it is related to the accumulation of atmospheric particles in furrows and local depressions due to recent climate changes [5]. *Amd* is considered to be a degraded unit of *Am* (Fig.1). *Adtd* is regarded as mostly mafic material [6], with its origin likely to be volcanic from underlying volcanic deposits in the intercrater plains or the pits [7].

Pits and Dune Fields: *Pits* are exposed in all mapped craters. In most cases, the pits are located to the west of the crater floor. The shape of the pit in Proctor is unique, as it extends somewhat along the rim of the crater. The pit in crater C extends almost completely across of the crater floor. The pit in crater D is located in the East of the crater floor. The Rabe crater pit stretches over a large part of the crater floor, along with a large dune field that covers an extensive area of the pit. *Dune fields* are located on the crater floors, either directly in the pits, or adjacent to them. They are the most distinct features in the craters, as they exhibit a large volume of material of dark color.

Discussion: The studied craters are heavily degraded [8] and have smooth crater infills. Together with the accumulation of the large dune fields, there is strong evidence for depositional processes operating on a regional scale. The mafic dune deposits [8] are also located in the intercrater plains, which is indicative of local and regional aeolian events [9]. Additionally, the pit-forming mechanisms may have also led to the supply of material to form the dune fields. Thus, pits may represent the local sources of dune-forming sediments [9]. Nevertheless, as the total volume of the combined pits seems to be significantly smaller than the depositional volume of the dune fields and, moreover, as the albedo of the dunes is lower compared to that of the pits, the pit deposits can only account for a minor quantity of the dune sediments. Region-wide depositional processes must have been the dominant dune-forming processes. The mafic material of the dunes may originate from volcanic, glacial, or impact processes [3]. Based on our detailed geologic maps, several pit-forming mechanisms in the craters appear plausible, including aeolian erosion and exhumation processes. Finally, as pits are post-impact depressions [10] and because of the depositional layering and exhumation processes we see in our maps, pits act as possible windows into the geologic history of the crater infill depositions.

References: [1] Cairns et al. (2020) LPSC 51 1929; [2] Heyer et al. (2018) PSS 159; [3] Fenton (2005) JGR 110; [4] Tanaka et al. (2014) USGS IMAP 3292; [5] Wilmes et al. (2012) Planet. Space Sci. 60; [6] Tirsch et al. (2018) EGU, 19598; [7] Fenton et al. (2005) JGR 110; [8] Fenton et al. (2003) JGR 108 (E12); [9] Hiesinger et al. (2018) LPSC 49, 2001; [10] Korteniemi et al. (2003) Microsymposium 38, MS048.

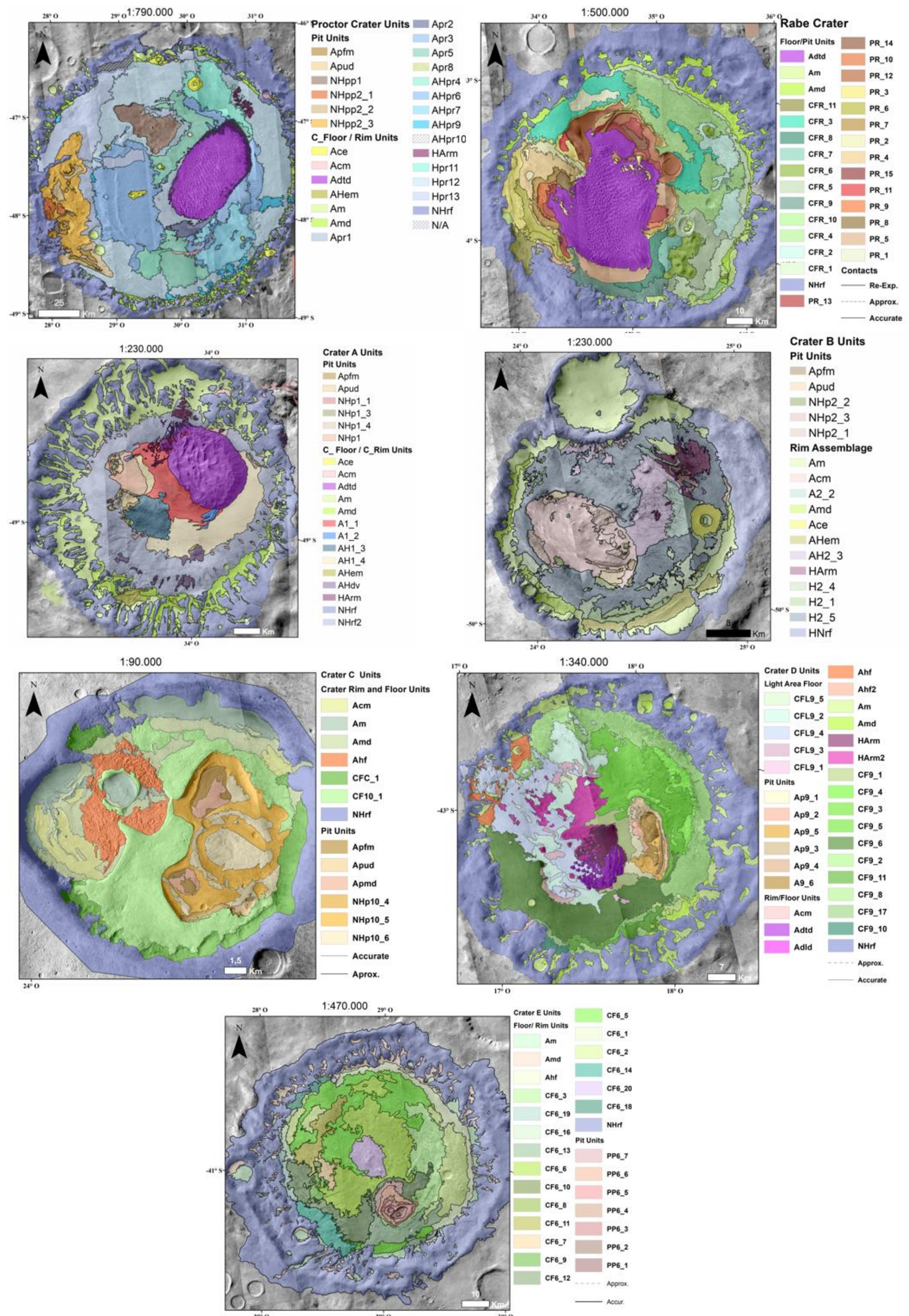

Figure 1: Seven detailed geologic maps, including Proctor crater and Rabe crater, located in Noachis Terra Mars, with the prominent co-occurrences of dune fields and pits.