NORTHERN XANTHE TERRA: A REFERENCE SITE TO TEST HYPOTHESES RELATED TO THE OXIA PLANUM LANDING SITE FOR EXOMARS 2022. T. Früh[1,2], E. Hauber[2], S. Adeli[2], D. Tirsch[2] and A. Nass[2]
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Introduction: ESA's ExoMars rover will land in the Oxia Planum (OP) region [1,2], which was chosen for its ancient age, evidence for the sustained presence of water, the presence of layered deposits, and the potential for biosignature preservation [2]. While some of the geological characteristics have been studied in detail [3-5], other aspects are less well understood. In particular, it is unclear if the situation in OP is a unique one, or if the geologic setting is representative for Mars on a regional, or even a global scale. Specifically, the stratigraphic relationship of the geologic units in OP to the nearby ancient impact basin, Chryse Planitia, requires further study. For example, a »bathtub«-like ring of Fe/Mg-rich phyllosilicates around Chryse [6] may indicate that the phyllosilicates at OP reflect aqueous processes that operated in a specific context at basin-scale.

To test the hypothesis that OP is representative for a circum-Chryse geologic setting, we selected a site in northern Xanthe Terra (XT) (~9-13.5°N/315-318.5°E) to investigate key geologic features and compare them to OP. This site displays several characteristics similar to OP, making it a suitable reference site: The presence of phyllosilicates [7], the proximity to fluvial features [8-10], and the abundance of remnant buttes that are indicative of widespread erosional processes [11]. Here we present preliminary results of our mapping and geologic analysis.

Data and Methods: We used CTX, HRSC, HiRISE, and THEMIS for morphological mapping. Additional topographic information was derived from HRSC and MOLA. All datasets were integrated into a GIS environment. For uniformity with other studies [12], the mapping was performed at a scale of 1:100,000.

Preliminary Results and Discussion: The study area is approximately 225 × 190 km in size. The general elevation increases in height from north to south from approximately -2,960 m to -1,800 m. The lowest elevation of -4,000 m is on the floor of the outflow channel Shalbatana Vallis to the east. Both at OP and XT, the lowland-highland boundary is expressed as a gradual slope rather than a sharp topographic step. The study site displays various geological features related to aqueous processes that are similar to OP.

In the northwestern study area, the Hypanis fan represents the arguably largest sedimentary fan deposit on Mars [8-10]. These deposits are finely layered and appear dark in THEMIS nighttime IR images (Fig. 1). The deposits are partly eroded, and their original full extent is unknown. Sedimentary fan deposits, while having a smaller extent, are also present in OP at the termination of the Coogoon Valles fluvial system [5,13,14]. Similar to the fan deposits in XT, these sediments in OP are layered [13] and appear dark in THEMIS nighttime infrared images. Both the sedimentary deposits in XT [8-10] and OP [14] are thought to have a fluvial origin.

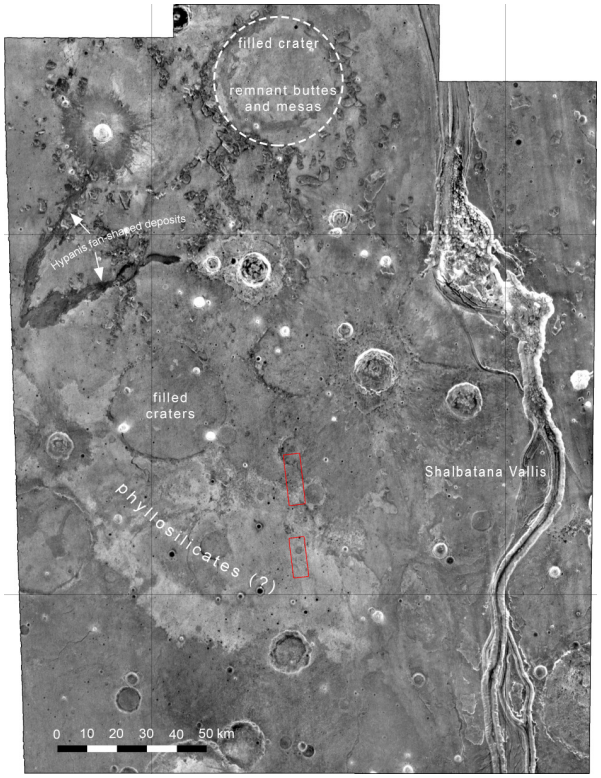

***Figure 1**. THEMIS nighttime IR image (~9-13.5°N; 315-318.5°E) of the northern XT study site. The red boxes mark locations of HiRISE images with polygonised texture.*

Phyllosilicates are widespread in OP [4-6] and are the main target of the ExoMars rover. Apart from their spectral signature, they are also characterized by a bright THEMIS nighttime IR signature and a polygonised texture at HiRISE scale. A global-scale search for chemical alteration signatures revealed the presence of Fe/Mg phyllosilicates in northern XT,

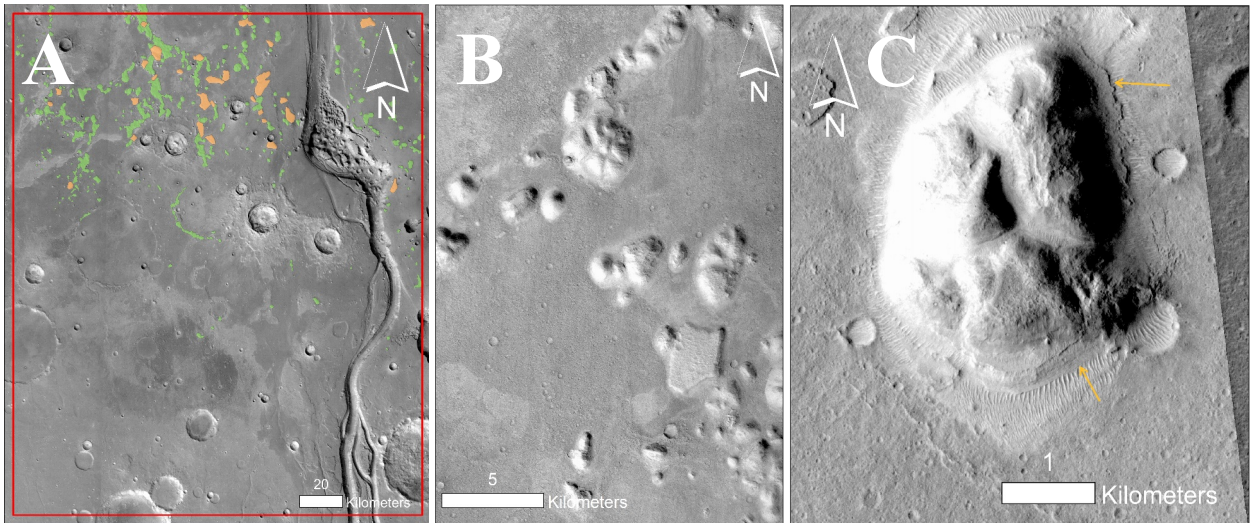

***Figure 2**. (A) Mapped mounds projected on HRSC image of the XT study site. Rounded buttes are shown in green and mesas in orange. (B) Variable morphologies of mounds. (C) A "bread-crust-like" mound with a layered basis (orange arrows).*

marginal to Chryse [4]. As in OP, the phyllosilicate-bearing plains appear bright in THEMIS nighttime IR images (Fig. 1). HiRISE coverage of this unit is rare, but –where available– the texture shows distinct polygonization. It also seems that periodic bedrock ridges, a type of aeolian erosional landforms which is ubiquitous in the clay-bearing plains of OP [15], are also present in northern XT.

In visible imagery, the surface in the southern part of the study area appears brighter than in the northern part (Fig. 2A). The oldest and largest craters (> 10 km) are completely infilled in the northern study area (Fig. 1). The extent of infilling decreases from the Chryse-basin towards south. A similar trend with a southeast orientation exists in OP. The presence of infilled craters suggests extensive sedimentation at northern XT and OP.

The rims of the ancient filled craters are outlined by rings of mounds. The diameters of these mounds range from tens of meters to several kilometers. Their appearance is variable and resembles mesas, rounded knobs/buttes, and "bread-crust-like features" (Fig. 2). These mounds are increasing in height and abundance towards north, i.e. towards Chryse. A similar trend of height and abundance was also observed in OP [16]. However, the height of these mounds varies individually. Rounded buttes, for example, can be higher than mesas in their immediate neighborhood. The ejecta of at least seven large craters (d > 5 km) cover mounds partly. A rough unit with low albedo seems to embay mounds in the northern study area. In some cases, wrinkle ridges are deforming overlying mounds, while in other cases mounds seem to be un-affected by wrinkle ridges. The correlation between the Hypanis deposits and the mounds is conflicting. Some mounds show a fine layering, and, in some cases, mounds stand on top of a finely layered basis (Fig. 2). The mounds appear dark in THEMIS nighttime infrared images (Fig. 1). Similar mounds are present along the eastern highland boundary of Chryse. The composition of the mounds and their erosional history are not yet clear. The low thermal inertia and the fine layering of some of the mounds, however, favor a sedimentary material. The timing of mound formation relative to other geological units is also still unknown since stratigraphic relationships between these units still seem conflicting.

Preliminary Conclusions: Northern XT and OP share various geological characteristics (e.g., sedimentary fans, phyllosilicates, remnant mounds) and a comparable location at the lowland-highland boundary at Chryse Planitia. These similarities enable a comparison between both sites and a testing of hypotheses related to the ExoMars rover landing site.

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