TRACKING LAYERED DEPOSITS ACROSS THE DICHOTOMY BOUNDARY INTO THE NORTHERN LOWLANDS OF MARS. C. Gross[1] and J. L. Bishop[2]. [1]Institute of Geological Sciences, Planetary Sciences and Remote Sensing Group, Freie Universität Berlin, Germany (christoph.gross@fu-berlin.de); [2]SETI Institute & NASA-ARC, Mountain View, CA, USA.

Introduction: The evolution and environment of early Mars is still far from being understood. Especially the relationship of the morphologically and spectrally distinct Southern Highlands and the Northern Lowlands, also referred to as the Martian crustal dichotomy, remains a constant matter of debate. Hyperspectral data from orbiting instruments have greatly advanced knowledge on composition of the Martian crust however, extensive mantling deposits, hundreds of meters to kilometers thick cover the ancient crust of the Northern Lowlands making the determination of its composition difficult. Fortunately, impact craters can excavate materials and allow an insight into greater depth. Several craters along the dichotomy north of Mawrth Vallis have revealed phyllosilicate assemblages beneath the dust that are similar to those seen in neighboring highlands regions. Layered materials are also of particular interest as they are able to record and retain environments and environmental changes such as depositional- and climate history.

Approach: In order to track specific horizons over hundreds or thousands of kilometers we have to assume that these horizons were deposited uniformly over a large area. Not many processes are able to deliver such conditions. On Earth for example, volcanic air-fall deposits show an exponential thinning of precipitation within the first 150 km distance from the eruption center. Then, a secondary thickening of the deposits is observed, all paired with a fining of grain size with increasing distance [1]. In contrast, marine or lacustrine sediments are highly influenced by local topographic factors like slopes or basins and therefore not suitable for the determination of specific marker horizons. Also a discordance or a hiatus in such a scale has not been found on Mars yet and, if present, would be difficult to determine from orbit. These considerations lead us to investigation of alteration horizons which could provide the prerequisites if the alteration process was either global or at least extensive, like for example a climate change, rain or a considerable discharge of acidic waters, et cetera. These changes in the geochemical environment can be observed in the mineralogical record and have been identified in the Mawrth Valles region [2].

Besides Mawrth Vallis, we also investigated two large impact craters, capable of excavating rocks from 3-5 km depth consequently with diameters >50 km and located at different latitudes (Fig. 1).

Geologic Setting and Observations: *Mawrth Vallis* is an ancient flood channel located at ~24°N and 341.5°E and an intensly investigated region, making it ideal as a starting point. Here, layered deposits display near-infrared spectral characteristics consistent with multiple clay minerals [3-14], which are also observed in numerous outcrops across the western Arabia Terra region. These clay-rich deposits are interpreted as a sedimentary sequence [4, 10]. The Mawrth Vallis region is characterized by a complex geologic history dating back to the Early Noachian with long-lasting water activity that lead to multiple depositional settings. *Bamberg* is a ~55 km-diameter impact crater located at the dichotomy boundary, in the southern Acidalia Planitia region, close to the transition to the Arabia Terra region. This crater shows relatively well preserved terraced walls and a distinct ejecta blanket. A prominent feature of the crater is the central uplift, displaying an asymmetrical central pit. Outcrops of megabreccia can be found on the northern wall of the pit. HiRISE imagery reveal irregular layering within these isolated blocks a few 100s of meters in size, with layers as thin as 1-2 meters cropping out at the -4600 m level. Using high resolution targeted CRISM data, spectral signatures consistent with olivine, low-calcium pyroxene (LCP) and Fe/Mg-phyllosilicates are found in the bedrock and deposits protruding through the spectrally neutral mantling material at the central uplift of Bamberg crater. The signatures of the Fe/Mg phyllosilicate-bearing units are similar to those observed elsewhere on Mars [5, 15, 16]. *Micoud* is a complex impact crater, displaying an asymmetric central uplift and a terraced crater rim. The crater is located east of Acidalia Planitia, 350 km northwest of the Deuteronilus Mensae, centered at 50.5°N and 16.°E and has a diameter of 52 km. The major axis of the asymmetrical central uplift is ~20 km long and the minor axis ~18 km. Due to thick mantling, many features within the crater appear smoothened. The closest characterization of Micoud is a description as a peak-ring crater. Also here, phyllosilicates were detected by CRISM within the central uplift, as well as excavated stratified materials were found in HiRISE observations. Unfortunately CRISM data could not be extracted directly from the layered, uplifted blocks.

Conclusion: A plausible scenario for the provenance of the stratified phyllosilicate deposits in both impact craters could be the ancient deposition of regional or global clays taking place simultaneously in

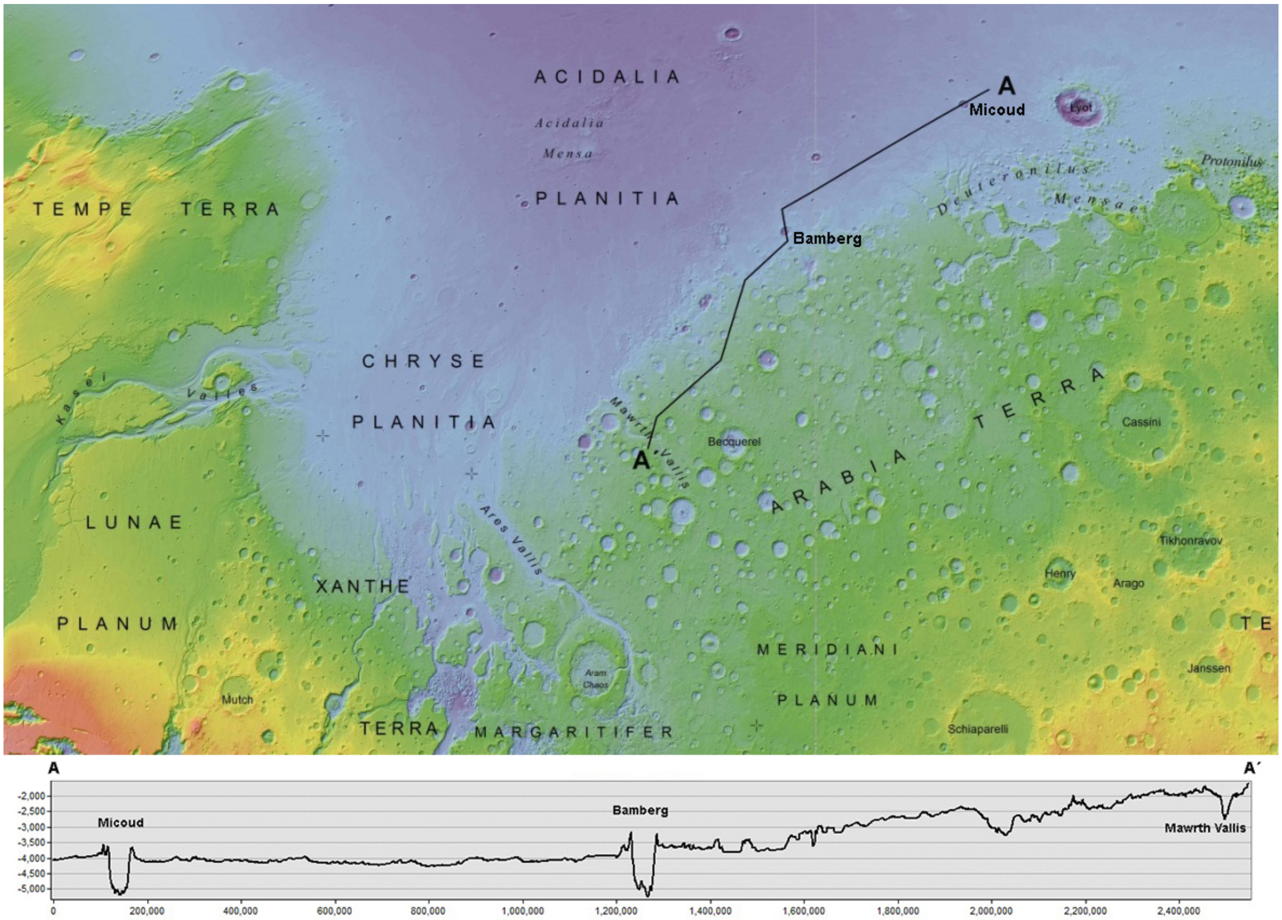

Figure 1: MOLA map showing investigated regions. Topographic profile from Micoud crater (A), crossing Bamberg crater and cutting through Mawrth Vallis (A').

the northern and southern hemisphere of the planet. Stratified meter-scale deposits imply a depositional cycle not much different from the one observed in the southern highlands. However, compared to the Mawrth Vallis deposits, a >200 m thick stack of layered sediments cannot be confirmed. The nontronite-rich sediments in Bamberg crater show at least 56 m of alternating layers and were buried by 3 to 5 km of material before excavation. Alternatively, the layered smectites observed at Bamberg could be related to materials similar to the Fe/Mg-smectite observed in the lower strata of the Mawrth Vallis sedimentary deposits toward the west. They could also be composed of remobilized clays from the highlands that have accumulated in sinks close to the dichotomy. An alteration horizon as observed in Mawrth Vallis could not be found within the limited outcrops of uplifted materials in the impact craters. In summary, the stratified blocks are either sedimentary deposits of pre-existing clays, or clays that formed in syn-deposition at the ancient surface and in an aqueous environment. The latter scenario appears to be supported by the detection of smectites in the circum-Chryse region [17].

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