INVESTIGATION ON A PHYLLOSILICATE-BEARING CRATER IN THE NORTHERN PLAINS OF MARS. C. Gross[1], L. Wendt[1], J.-Ph. Combe[2], P. Jodlowski[1], G. A. Marzo[3], T. L. Roush[4], T. McCord[2], P. Halbach[1] and G. Neukum[1]. [1]Freie Universität Berlin, Inst. of Geological Sciences, Malteserstr. 74-100, 12249 Berlin, Germany, christoph.gross@fu-berlin.de. [2]Bear Fight Institute, P.O. Box 667, Winthrop WA 98862, USA. [3]ENEA, Rome, Italy, [4]NASA Ames Research Center, Moffett Field, CA, USA

Introduction: Various hydrated silicates were identified within impact craters in the northern plains of Mars [1]. Phyllosilicates are of particular interest, because they require long–lasting liquid water abundance in order to precipitate [2]. Such conditions existed in the early history of Mars, in the Noachian period. To date, phyllosilicate outcrops in the northern plains are exclusively found in impact craters. This leads to the conclusion that they must be excavation products of preexisting, buried deposits, exposed by impacting and erosion [1, 3, 4].

However, combined spectral and geomorphologic data [2, 5] have shown that the Hesperian–aged Toro crater bears evidence for impact–induced hydrothermal mineralizations. Since the formation of an impact structure is a high energy, high temperature event, introducing large amounts of energy into a limited area, the development of a hydrothermal system is inevitable if water is present. The resulting aqueous solutions and volatile components will interact with the hot and brecciated rocks, leading to effective alteration processes and hydrothermal overprint of the area and to the deposition of secondary minerals. Extensive modeling was carried out [6] to determine the hydrothermal circulation and discharge of waters after an impact, even under current martian conditions for crater sizes 45 km to 90 km. Here, we investigate a ~50 km wide, complex impact crater, located at 50°33'5,08"N 16°20'20,37"E, east of Acidalia Planitia for evidence of post impact hydrothermal activity. Since detailed maps are needed to correlate hyperspectral data obtained by the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) with geologic and geomorphologic units, a geologic and geomorphologic mapping of the unnamed crater was carried out at a scale of 1: 30.000 [7].

Data Sets and Methods: We used HRSC data from orbit 3304 with 12.5 m/px and CTX image B01_009997_2308_XN_50N343W with 6.1 m/px as our base images for mapping (Figure 1). In addition to this, HiRISE image ESP_016577_2310 was used for the identification of particular textural properties of the surface units. Image processing was conducted in ISIS3 environment and the mapping in ESRI's ArcGIS 9.3 .

We used CRISM high-spectral resolution data from the long-wavelenth detector (L) that covers the near-infrared radiation range (1.0-4.0 micrometers) with 438 channels. This is the most usefull product from CRISM for our investigation because phyllosilicates and other hydrated minerals are characterized by narrow absorbtion bands between 1.4 and 2.5 micrometers.

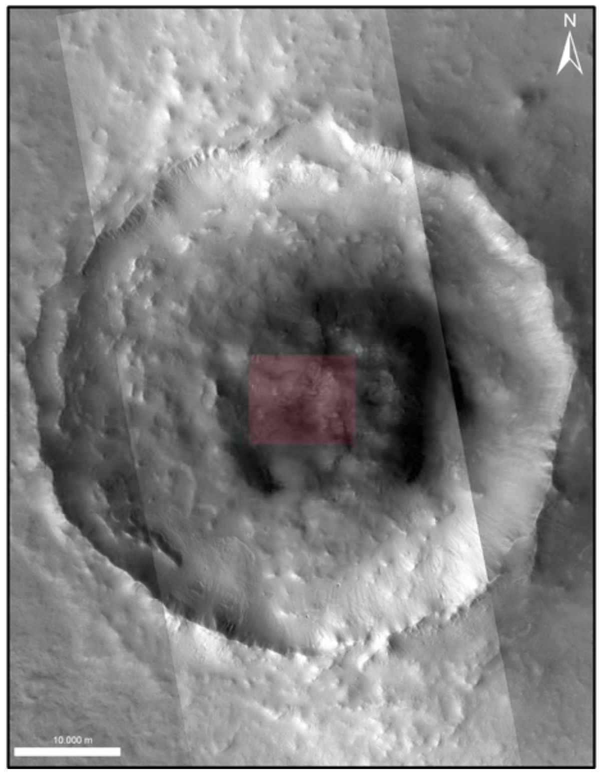

Figure 1: Overview of the selected unnamed crater. HRSC orbit 3304 with 12.5 m/px and CTX image B01_009997_2308_XN_50N343W with 6.1 m/px. Red box in the center shows approximate boundaries for oblique views (Figure 2).

CRISM full resolution target data (FRT0009C3C at ~20-30 m/pixel ~604 pixels wide) and half-resolution long data (HRL0000C75D at ~40-60 m/ pixel and 301 pixels wide) were used for this study. Spectral Mixing Analysis (SMA) was used for the mapping of mafic minerals olivine, clinopyroxene (CPx) and orthopyroxene (OPx). We performed SMA of CRISM data by using the Multiple-Endmember Linear Spectral Unmixing Model (MELSUM) [8, 9] (see Fig. 2B). The phyllosilicates were mapped performing an expert-system based spectral identification tool as [10, 5] including continuum removal on narrow ranges of wavelengths around each absorption band of interest.

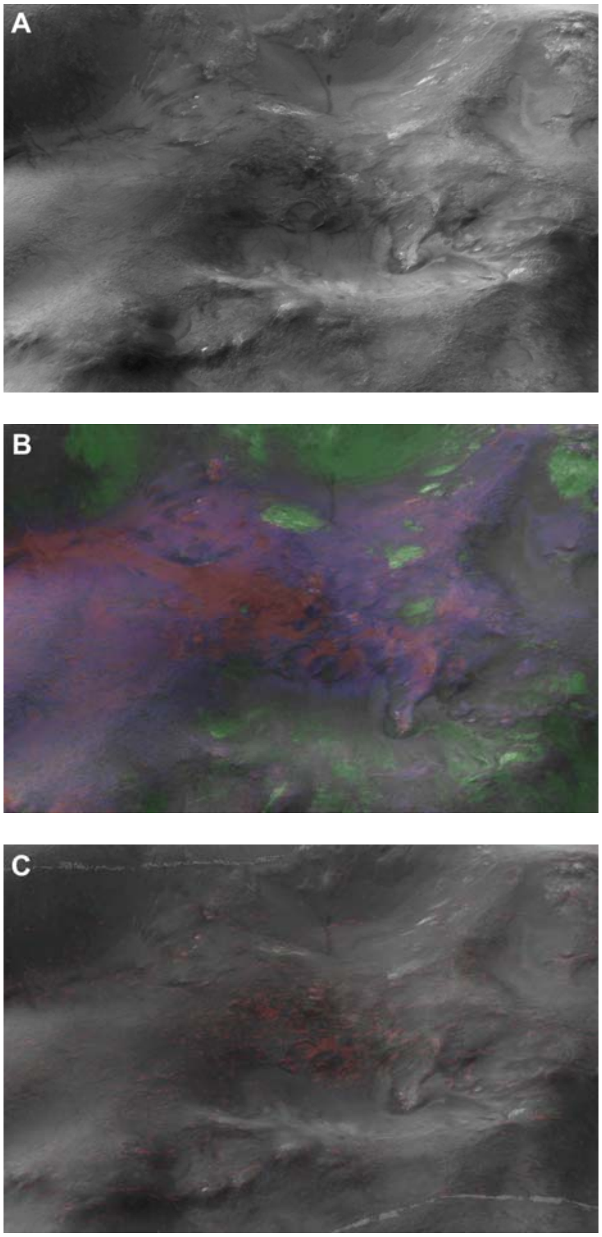

Figure 2: Oblique view in western direction on the central area of the impact crater (compare to figure 1). Width of the images ~8 km.
A: CTX image B01_009997_2308_XN_50N343W draped over HRSC-DTM. **B:** MELSUM processed mineral map of: olivine (red), OPx (green) and CPx (blue). The light-toned outcrops fit best with olivine and OPx detection. **C:** Chlorite detection represented in red.

Results: The investigated crater shows a high abundance of mafic minerals. The modeled mafic mineral maps fit very well with observed outcrops and geomorphologic units. Fe/Mg-rich clays were also found. Important phyllosilicate detections are located in the central area of the impact crater, embayed by the central peak ring structure and often in association with sublimation pits and/or small depressions. The presence of distinctive (volatile-rich) surface mantling in various erosional stages, must be taken into account by further investigations. Chlorite detections show a close spacial association to the olivine, suggesting an alteration process as genetic source. Prehnite was also detected within the crater. Positive prehnite detections cover only a few pixels but can be correlated with faint, dark material, cropping out in several locations close to the center of the crater. The mantling deposits and sublimation artifacts make a clear localization of faults difficult [7]. Another important observation is the presence of gullies and fan deposits in the northern and eastern part of the peak ring area. The gullies show various stages of degradation, some northward facing ones look fresh suggesting they are recent features and may provide evidence for recent aqueous activity [11].

Outlook: As a next step, the determination of spectral parameters of other minerals of interest will follow and more phyllosilicate–bearing impact craters, located in the Martian Northern Plains will be mapped.

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