CHLORIDE - FE/MG CLAYS DEPOSITS ON MARS: MORPHOLOGIC AND AGE CONSTRAINTS FROM A SELECTED SITE. O. Ruesch[1], F. Poulet[2], M. Vincendon[2], D. Reiss[1], G. Erkeling[1] and H. Hiesinger[1], [1]Institut für Planetologie, Westfälische Wilhelms-Univerität Münster, Germany (ottaviano.ruesch@uni-muenster.de), [2]Institut d´Astrophysique Spatiale, Université Paris-Sud, Orsay, France.

Introduction and background: The secondary minerals found on Mars give insights into alteration processes that have occurred in specific environments and periods in the history of the planet. Secondary minerals include phyllosilicates and salts and might testify for surface weathering, detritic deposition, evaporation, hydrothermal alteration and possible low metamorphism. The diversity of the phyllosilicates group, with more than 10 families of hydrated minerals, has been recognized on Mars and is similar to the one present on Earth [1]. The main salts found on Mars are sulphates [e.g., 2, 3] and possibly anhydrous chlorides [4]. Anhydrous chloride salt deposits have been proposed in more than 600 spots in highland terrain [4]. The anhydrous nature of chlorides precludes, however, its unambiguous detection by remote sensing [5]. Supporting the chloride salts composition of these deposits are contiguous material bearing Fe/Mg clays [6, 7]. The chloride salts deposits could be related to a past evaporating or freezing/sublimating brine [4, 8]. A brine might have formed from ponding of surface runoff or groundwater upwelling [4]. For the ~600 sites, the formation period is poorly constrained and seems to span from the Late Noachian to the Early Hesperian [4]. In one site, a large intracrater basin in which the deposits are found has been constrained to the Late Noachian (3.9 Ga) [9].

A survey of most of the ~600 sites of putative chloride with the Observatoire pour la Minéralogie, l´Eau, les Glaces et l´Activité (OMEGA) imaging spectrometer has revealed that their near infrared spectrum is free from absorption bands and displays a red slope [8], consistent with laboratory spectra of anhydrous chloride [10]. Ultramafic material close to putative chloride bearing deposits has not been found, further confirming that a sulfide composition of the deposits, as alternative to chloride [5], is less likely. Fe/Mg clays have been detected adjacent to the putative chlorides only in relatively few locations, mostly in northwestern Terra Sirenum [8]. In these locations the assemblage suggests an aqueous related origin of chloride deposits, possibly with involvement of groundwater upwelling. However, stratigraphic observations seem to suggest that the two materials formed at distinct period of time [8]. To further investigate the formation processes and the time of emplacement we are focusing on selected sites presented in [8], where mineralogy and morphology provide insights into the origin of the deposits. Here we present one of these locations.

Data and Methods: For morphologic analyses and age determinations we used Context camera (CTX) images with a resolution of 6 m/pixel [11] and High Resolution Stereo Camera (HRSC) with a resolution of 12 m/pixel as well as HRSC digital elevation models of about 50 m/pixel [12]. For absolute model age determinations the chronology function of [13] and the production function of [14] are used.

Results:

Geologic context. In the Noachian dissected terrains, at the boundary between the highlands and lowlands, a 35 km large basin hosts deposits of chloride and Fe/Mg clays rich material (Fig. 1). The basin is located at 6°S/132°E, near Knobel crater. Dendritic and longitudinal valley networks drain into the basin from the south and south-west. Another longitudinal valley originates at the outlet of the basin. The basin presents a dark- toned cap unit, which is mainly exhumed, revealing deposits rich in Fe/Mg clays [8]. In some locations the Fe/Mg clays bearing material forms inverted channels. These are probably formed by detritic infilling of a channel during fluvial activity. Subsequent erosion has created the inverted morphology. Juxtaposed to these deposits, chloride-bearing materials occur as patches [4].

Stratigraphy. The basin floor is superposed by Fe/Mg clays rich material, which forms knobs scattered on the floor (Fig. 1). Putative chloride material is also stratigraphically higher than the basin floor. The stratigraphic contact between Fe/Mg clays and chloride is covered by fine, possible eolian material. Their location suggests however that the detritic material rich in Fe/Mg clays and chloride bearing material deposited within the same time period. A stratigraphically higher unit is represented by the dark-toned cap unit. Its edges show evidence for erosion and indicate that the unit once covered a larger area.

Age constraints. The exhumation process has destroyed craters, oblitering smaller craters more efficiently than larger ones. It has also partly exhumed large craters, for which the diameter cannot be precisely determined. In addition, the exhumation is not homogeneous: some areas in the basin are more exhumed than others. These observations are taken into account for the interpretation of the crater size frequency distribution (CSFD) as well as for the determination of the age of the units.

The CSFD of the dark-toned cap unit could be best fitted at 3.5 Ga, which would correspond to an upper limit formation age for the stratigraphically lower Fe/Mg clays and chlorides. The CSFD for the basin floor can be best fitted at ~3.75 Ga. This value is an upper (younger) limit for the age of the basin floor, because of its exhumed nature. The age of the Fe/Mg clays rich material and the chloride bearing material is constrained by the upper limit ages of the stratigraphically lower and upper units.

Discussion: The morphologic context in which the assemblage of chloride-Fe/Mg clays is found can be diverse on a global scale. Near Knobel crater, the context suggests that the minerals formed during fluvial activity. Fe/Mg clays bearing material is probably a detritic deposit and chloride bearing material might have formed due to brine evaporation. In other locations, noteworthy in northwestern Terra Sirenum, morphologies suggest a relation with groundwater upwelling [8]. Locations showing assemblages of chloride-Fe/Mg clays are strongly affected by exhumation. CSFD measurements are thus limited on these terrains. The CSFD measurements indicate, however, that the deposits probably formed during the Late Noachian. We will study the regional stratigraphy and the CSFD of non-exhumed areas to provide more precise constraints on the formation age. This will help to understand whether chloride material formed also during the Early Hesperian, as suggested by [4] or only during the Noachian.

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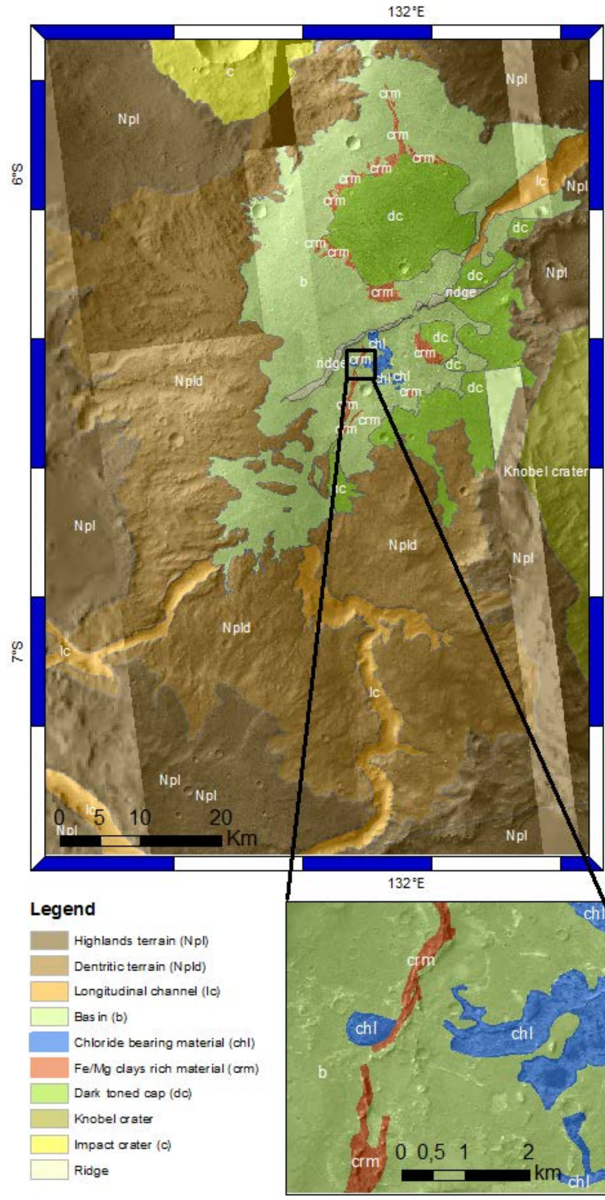

Figure 1. Morphologic map adjacent to Knobel crater. Chlorides (blue) and Fe/Mg clays (red) are found within an exhumed basin (green), surrounded by dendritic valley terrain (light brown). Longitudinal valleys (orange) drain into the basin from south and south-west and also appear at the north-east oulet.