**GEOLOGICAL HISTORY OF A LIGHT-TONED FORMATION DRAPING THE PLATEAUS IN THE REGION OF VALLES MARINERIS, MARS.** L. Le Deit[1,2], O. Bourgeois[2], D. Mège[2], S. Le Mouélic[2], M. Massé[2], E. Hauber[1], R. Jaumann[1], J.-P. Bibring[3], [1] Institute of Planetary Research, German Aerospace Center (DLR), Rutherfordstr.2, 12489 Berlin, Germany (Laetitia.Ledeit@dlr.de), [2] Laboratoire de Planétologie et Géodynamique UMR 6112, CNRS, Université de Nantes, 2 chemin de la Houssinière, 44322 Nantes, France, [3] Institut d'Astrophysique Spatiale, Université Paris 11, Bâtiment 121, 91405 Orsay Campus, France.

**Introduction:** A light-toned formation crops out on the plateaus around Valles Marineris [1, 2, 3, 4, 5]. These layered deposits (LDs) are present north of Tithonium Chasma, south of Ius Chasma, Melas Chasma and Candor Chasma, southwest of Juventae Chasma and west of Ganges Chasma [5]. We analyzed the spatial distribution, the morphology, the stratigraphy and the mineralogical composition of these LDs in order to constrain their possible origin.

**Morphology, spatial distribution and stratigraphy:** LDs correspond to finely layered material, with a total thickness not exceeding a hundred meters on average. Mainly from the analysis of CTX and HiRISE data, we mapped the LDs cropping out on the plateaus in the region [5]. The estimated area covered by LDs is ~ 48550 $km^2$, which corresponds to ~1/4 of the area of layered deposits in Meridiani Planum (2 x $10^5$ $km^2$) [6]. The largest LD outcrops are located south of Ius Chasma and Melas Chasma, and occupy ~ 37180 $km^2$ and represent ~ 75 % of the total mapped surface of LDs. The LDs near Ganges Chasma and Juventae Chasma cover ~310 $km^2$ and ~2270 $km^2$ respectively. However, these estimated values correspond to minimum values because LDs are frequently mantled by a dark superficial material, which may prevent from the observation of many outcrops. We mapped many remnant buttes of LDs that are located up to several tens of kilometers from the main outcrops. This demonstrates that LDs covered larger areas in the past.

LDs consist of subparallel strata dated Hesperian or younger according to stratigraphic relationships. For instance, LDs near Ganges Chasma were deposited after the formation of the Hesperian [7] Allegheny Vallis outflow channel (***Figure 1***). Most LDs mapped so far are located along the borders of Valles Marineris chasmata. The rims of the outcrops are usually parallel to the rims of the chasmata and are located up to several hundreds of meters far from them. This suggest that the LDs, which are weaker than the chasma wall material, were deposited before the erosion in spurs and gullies of the chasma walls and may be before the opening of some of them. Consequently, the LDs may have been deposited in shallow depressions (≤ 100 m) formed by limited subsidence during one of the earliest stages of Valles Marineris formation (predating chasma opening). Except for LDs located south of Melas Chasma, at the outlet of valley networks in a hanging depression [8] and in a pit west of Juventae Chasma, we doubt that deposition in a plateau-wide lacustrine environment is possible at such elevations (≥ 1800 m). Therefore, because of the large spatial extent of the LDs and of their location ontop of high plateaus, we favor the hypothese that LDs were deposited in an aerial environment and may correspond to dust or volcanic ash.

**Role of water:** The morphological and mineralogical characteristics of the LDs indicate that water played a significant role in their geological history however.

*Pedestal craters and lobate ejecta.* The presence of pedestal craters and lobate ejecta in the LDs suggests that volatiles (liquid water, ice) were present in the LDs after their deposition and during the impacts.

*Hydrated minerals.* The analysis of CRISM data reveals the presence of $H_2O$ and SiOH bearing phases in the LDs near Juventae Chasma [2, 3], Ius Chasma, Melas Chasma, and Candor Chasma [2]. We also have detected a hydrated layer at the base of LDs near Ganges Chasma (***Figure 2***). The corresponding CRISM spectra display a small absorption band at ~1.4 µm, ~1.94 µm and a large band between ~2.2 µm and ~2.27 µm, which may correspond to hydrated silica and/or Al-OH phyllosilicates possibly mixed with other phases such as Fe-rich sulfates [9]. One pixel of the OMEGA cube 0394-2 located on the LDs shows similar spectral properties (***Figure 2***), which reinforces the confidence in the detection of these alteration minerals in the LDs.

*Sinuous ridges and valleys.* The presence of sinuous ridges interpreted as inverted channels in Juventae Chasma [4, 5, 10] and Ganges Chasma [11] suggests a fluvial erosion of the LDs in these areas. Sinuous valleys near Juventae Chasma and Ius Chasma may also be ancient fluvial channels.

**Possible formation scenario:**

(1) Limited plateau subsidence prior to Valles Marineris chasma opening.

(2) Widespread deposition of dust or volcanic ash on the plateaus in an aerial environment during the Hesperian.

(3) Imbibition of these deposits by water ice or liquid water (possibly coming from precipitations such as rain or snow) after their deposition.

(4) Formation of secondary hydrated minerals in response to aqueous alteration.

(5) Local fluvial erosion during and / or after LD deposition and alteration.

(6) Opening of the Valles Marineris chasmata and wall erosion in spurs and gullies.

(7) Possible alteration and local LD deposition. South of Ius Chasma, fluvial erosion perhaps associated to chasma wall sapping.

**References:** [1] Lucchitta B. K. (2005) LPSC XXXVI, Abstract #1500. [2] Milliken R. E. et al. (2008) Geology, 36, 847-850. [3] Bishop J. L. et al. (2008) LPSC XXXIX, Abstract #2334. [4] Weitz C. M. et al. (2008) GRL, 35, L19202, doi:10.1029/2008GL035317. [5] Le Deit L. et al. (2008) EPSC 3th, Abstract #0327. [6] Hynek B. M. et al. (2004) Nature, 156-159. [7] Coleman N. M. (2007) Icarus, 189, 344-361. [8] Quantin C. et al. (2005) JGR, VOL. 110, E12S19, doi:10.1029/2005JE002440. [9] Le Deit L. et al. (2008) Martian Phyllosilicates: Recorders of Aqueous Processes workshop, Abstract #7016. [10] Mangold N. et al. (2008) JGR, 113.

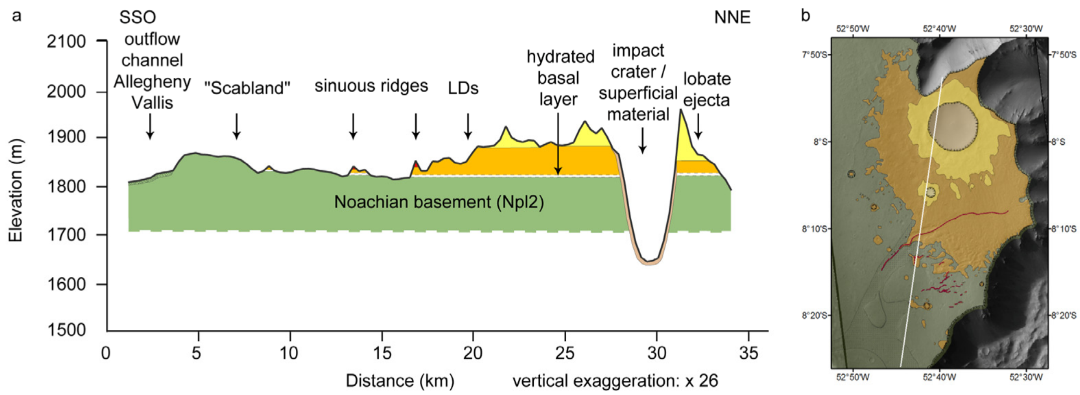


***Figure 1*** *Stratigraphy and spatial distribution of LDs near Ganges Chasma. (a) Interpretative cross-section of the region displaying Noachian basement (green), a basal hydrated layer (white), LDs (orange), sinuous ridges (red), impact crater ejecta (yellow), and superficial material filling the impact craters (light brown). MOLA PEDR topographic profile (ap20211). (b) Morphological map of the region. The location of the cross-section (a) is indicated. The hydrated basal layer is not represented.*

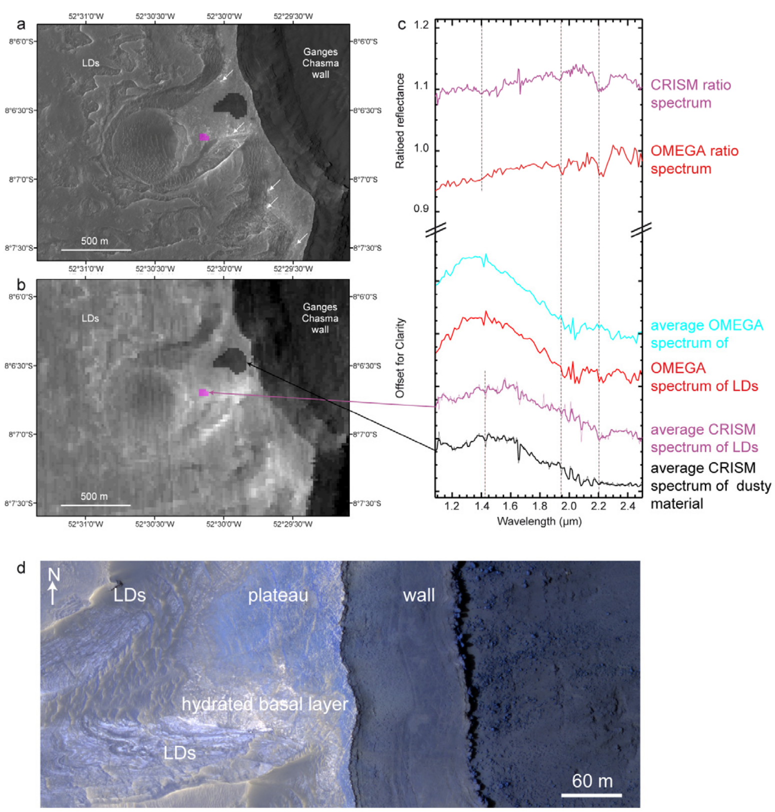


***Figure 2*** *Spectral properties and location of an hydrated layer near Ganges Chasma. (a) Subset of HiRISE image PSP_005939_1720. Bright outcrops with hydrated signatures are shown (white arrows). (b) Subset of CRISM image FRT 8949 of the LDs. Colored pixels correspond to the location of averaged spectra shown in (c). (c) Spectrum, average spectra overlain by smoothed spectra for CRISM spectra (colored areas) and ratio spectra (division by an average spectrum of spectrally featureless surfaces) of the LDs. (d) Portion of HiRISE IRB color image (PSP_005939_1720, centre of the image: 52.2°W - 8°S) displaying the hydrated basal layer.*