EQUATORIAL LAYERED DEPOSITS IN ARABIA TERRA, MARS: FACIES AND PROCESS VARIABILITY. M. Pondrelli[1], A. P. Rossi[2], S. van Gasselt[3], L. Le Deit[4], F. Fueten[5], E. Hauber[4] and T. Zegers[6]. [1]IRSPS, Ud'A, Pescara, Italy, monica@irsps.unich.it, [2]Dep. Earth and Space Sci., JUB, Bremen, Germany. [3]Inst. für Geol. Wissenschaften, FU Berlin, Germany. [4]Inst. of Planetary Research, DLR, Berlin, Germany, [5]Dep. Earth Sci., Brock University, Ontario, Canada. [6]Fac. Earth Sci., University of Utrecht, Utrecht, The Netherlands.

Introduction: The depositional processes proposed to explain Equatorial Layered Deposits (ELDs) formation invoke very different systems such as sub-glacial volcanism [1], aeolian/airfall [2], lacustrine [3], lacustrine/volcanic [4] and spring-fed deposition [5]. In order to investigate the ELDs genesis and evolution, we have selected an area in the vicinity of the Firsoff crater - centered 2.6°N-350.8E (Fig. 1A)-, where ELDs are present within and outside of the craters.

Geological Setting: The stratigraphic succession of the study area begins with the Cratered unit of the Plateau Sequence of Noachian age [6] (Fig. 1B).

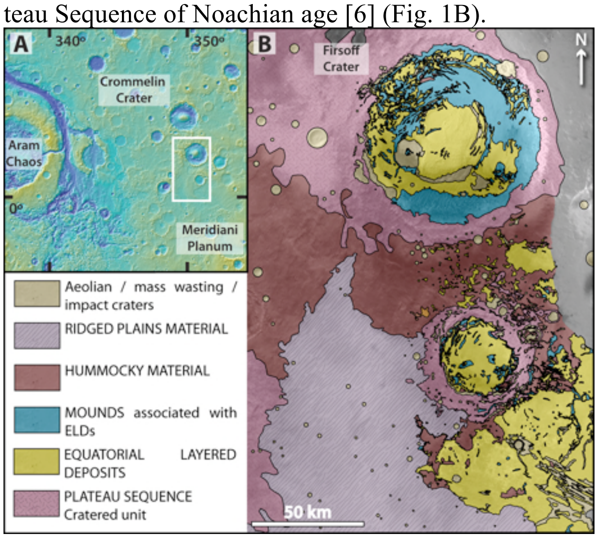

Fig. 1 – A. Location Map (on MOLA-based shaded relief). B. Geological Map of the studied area (on HRSC base).

The Cratered unit is nonconformably covered by the ELDs. Locally – in particular although not exclusively close to the rim bordering fractures – ELDs are associated with mound to cone shaped subcircular features which stays disconformably on top of the ELDs [7]. Both ELDs and mounds are locally unconformably capped by a dark-toned and hummocky-looking unit (Fig. 1B), possibly of volcanoclastic origin (Hummocky terrain). The Ridged Plains Material of Hesperian age [6] unconformably covers the Hummocky terrains, the mounds and the ELDs, thus providing an upper constrain for the age of their formation.

Description of ELDs: ELDs consist of well-bedded light-tone deposits locally interlayered with darker-tone material. Such deposits have been mapped within and outside of the craters with different morphologies and depositional architecture.

ELDs within the craters. The Firsoff impact crater is approximately 90 km in diameter and has an exposed depth of about 1500 m measured from crater floor to crater rim. ELDs form a bulge in the center of the crater that can be estimated between 200 m and 500 m thick. ELD layers gently drape the Plateau Sequence deposits at the impact-crater floors and onlap against that unit at the crater rims.

At places, the light-toned layers appear to be gently folded, even if the regional attitude remains sub-horizontal. These deposits - whose grain size is not detectable at the available scale - are disrupted in up to 6 m wide polygons (Fig. 2). Locally, they seem to be organized in a cyclic depositional pattern [e.g., 8].

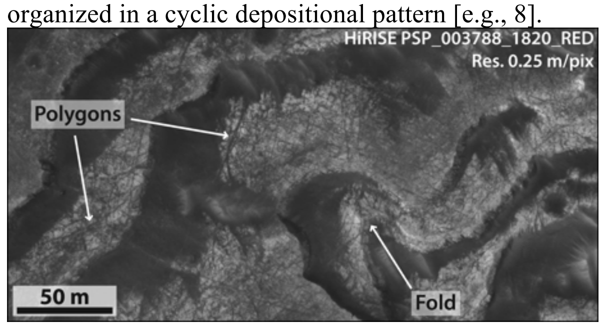

Fig. 2 – Texture of the ELDs in the Firsoff crater.

These deposits form a pattern similar to etched terrains (Fig. 3). At places, ELDs appear to be more resistant to weathering and erosion in correspondence of tectonically controlled lineaments (Fig. 3). This could imply either that ELDs source from the lineaments or that subsurface flow circulation favored differential cementation [9]. Often, the ELDs exhibit rims bounding the beds (Fig. 3).

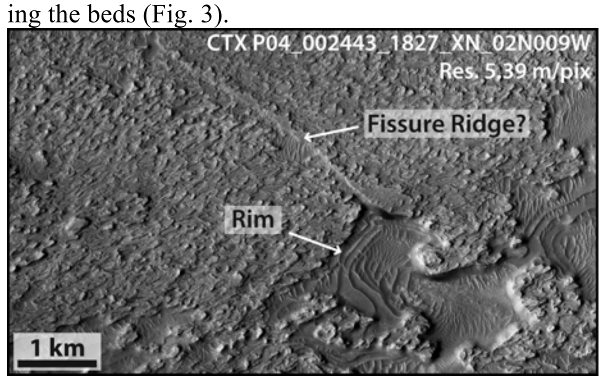

Fig. 3 – Possible fissure ridge and rim-bounded ELDs.

At places 100 to 500 meters large cone-shaped mounds stay on top of ELDs (Fig. 4A, B). They consist of boulders embedded in a block-free matrix, and about one-third of them possess an orifice at the top of the edifice (Fig. 4B) [7]. Locally, the mounds are associated with block-free medium albedo material which seems to source from the mounds themselves and that covers the ELDs layers (Fig. 4A).

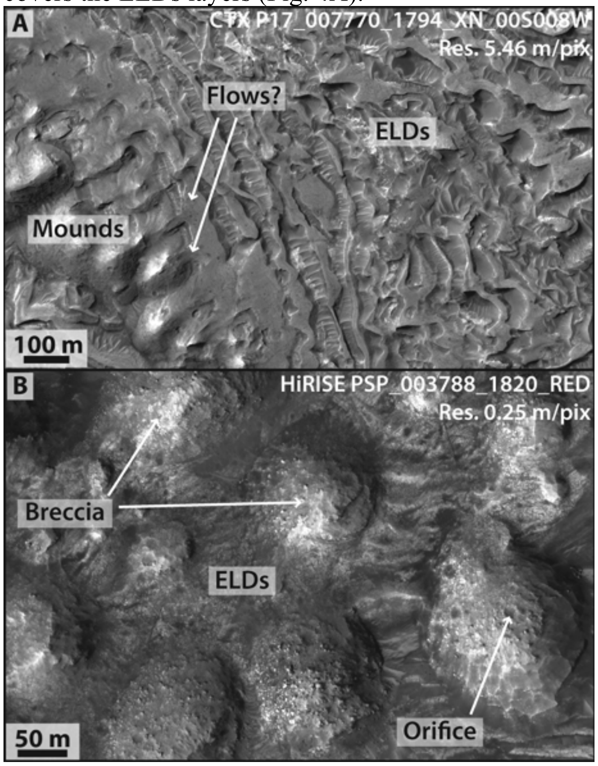

Fig. 4 – A. Mounds and floods which seem to source from them on top of ELDs.. B. Textural and morphological characteristics of mounds.

ELDs outside of the craters. In the southernmost part of the study area ELDs have been mapped outside of the craters (Fig. 1). Their texture is similar to the ELDs within the craters, with high albedo deposits disrupted in post-depositional polygons, but their large-scale depositional architecture is different. They form in fact flat lying deposits at a kilometric scale (i.e., not forming bulges) but undulated at a hundreds of meters scale (Fig. 5). Locally the ELDs show a sedimentary structure which bear resemblance to large scale cross stratification (Fig. 5).

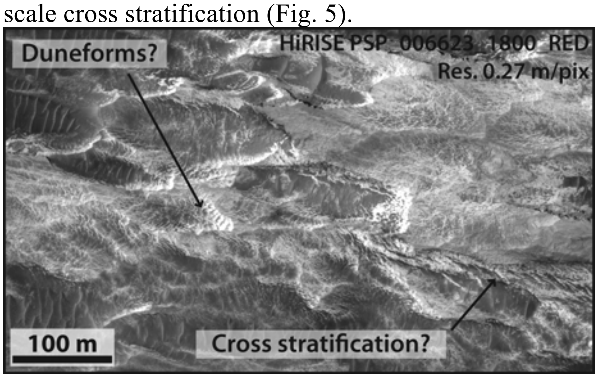

Fig. 5 – ELDs outside of the craters showing large scale cross stratification.

Interpretative scenario: ELDs within and outside of the craters show different texture, morphologies and depositional architecture, which we interpret as the result of different formation processes.

We interpret the ELDs within the craters as the product of fluid escape and evaporite precipitation and the younger mounds as mud volcanoes.

The ELDs are in fact associated with structures suggesting fluid escape (Fig. 3). The bulges are in the center of the craters, and the deposits lack any evidence of cross stratification. These features make aeolian processes improbable. The rims often bounding the layers with their twisty shape (Figs. 3, 4A) seem at least in part depositional features. Such morphologies are consistent with spring processes. On the other hand, the absence of fluvial and volcanic features tends to exclude such formational mechanism. The mounds on top of the ELDs share morphological (cone shape) and textural (high albedo blocks reworked from ELDs in a block-free matrix interpreted as mudbreccia in the cone edifices, and block-free medium albedo material in the flows) features with terrestrial mud volcanoes.

We interpret the ELDs outside of the craters as the result of aeolian reworking, transport and deposition.

Their large-scale morphology and most of all the presence of large scale cross stratification support an aeolian depositional system. Moreover, the cross-stratified layers are not associated to water-related landforms such as fluvial channels.

Accordingly, we distinguish between 'fluid escape' dominated ELDs forming within the crater and 'aeolian'-dominated ones, located outside of the craters and resulting from aeolian reworking and deposition of the 'fluid escape' type ELDs (Fig. 6).

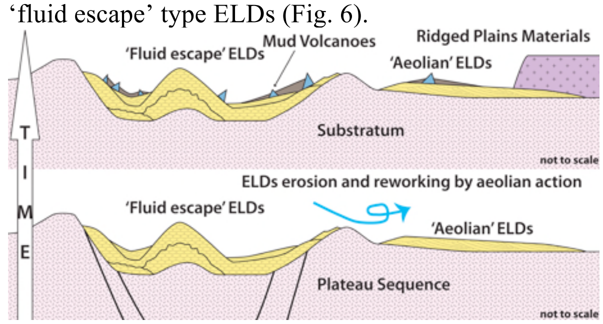

Fig. 6 – Interpretative scenario of the depositional evolution of the study area.

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