THE HOLDEN AND EBERSWALDE DELTAIC SYSTEMS: LITHOFACIES AND DEPOSITIONAL ENVIRONMENTS. M. Pondrelli[1], A. P. Rossi[2], L. Marinangeli[1] and A. Baliva[1], [1]IRSPS, Università d'Annunzio, viale Pindaro 42, 65127 Pescara, Italy, monica@irsps.unich.it, [2]ISSI, Hallerstrasse 6, CH-3012 Bern, Switzerland.

Introduction: The Holden and Eberswalde craters (centered 34°W/25°S and 33°W/24°S respectively) include two of the most spectacular water-related landforms discovered on Mars so far [1,2,3,4,5] which make these craters suitable as potential landing sites for the next robotic Mars Science Laboratory mission.

'Normal' turbulent fluvio-lacustrine processes have been hypothesized to occur in fluvial, fan deltas and shorelines systems [1,2,3,4,5]. However, some authors argued against this interpretation [6,7,8], and suggested debris-flow as dominant depositional process [7,8].

Our aim is to recognize and map the lithostratigraphic units, try to correlate such units among the craters, in order to infer the depositional processes and evolution and contribute to the discussion on the landing site value and characterization.

Lithofacies and Morphofacies analysis: The two putative deltaic systems show similar stratigraphies, complicated in the Holden crater by a catastrophic flow postdating the delta emplacement [4,5]. The flood partially eroded the existing succession, preventing a detailed analysis of the pristine morphological elements.

Eberswalde crater. A detailed morphofacies analysis of the fan delta has been performed by [4]. Lithostratigraphic units consists of Bright layered deposits and Thick bright deposits [4] (Fig. 1).

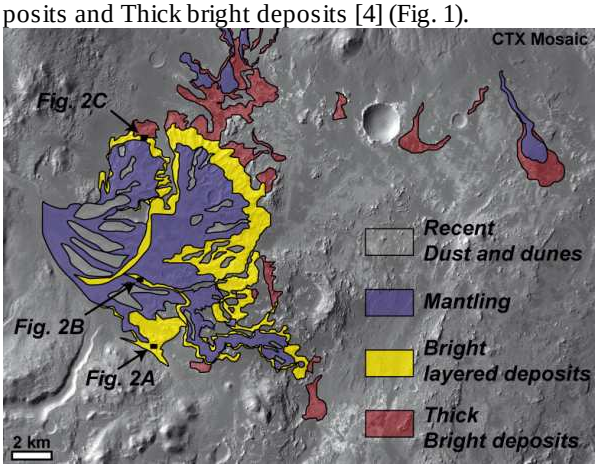

Fig. 1 - Geological map of the Eberswalde fan delta.

Bright layered deposits consist of intercalation between dark and bright layers where bright layers occur as: 1. relatively smooth levels showing sedimentary structures (Fig. 2A); 2. breccia (Fig. 2B); 3. polygonal patterned layers (Fig. 2C).

Thick bright deposits consist of faintly bedded bright deposits at places disrupted in polygons.

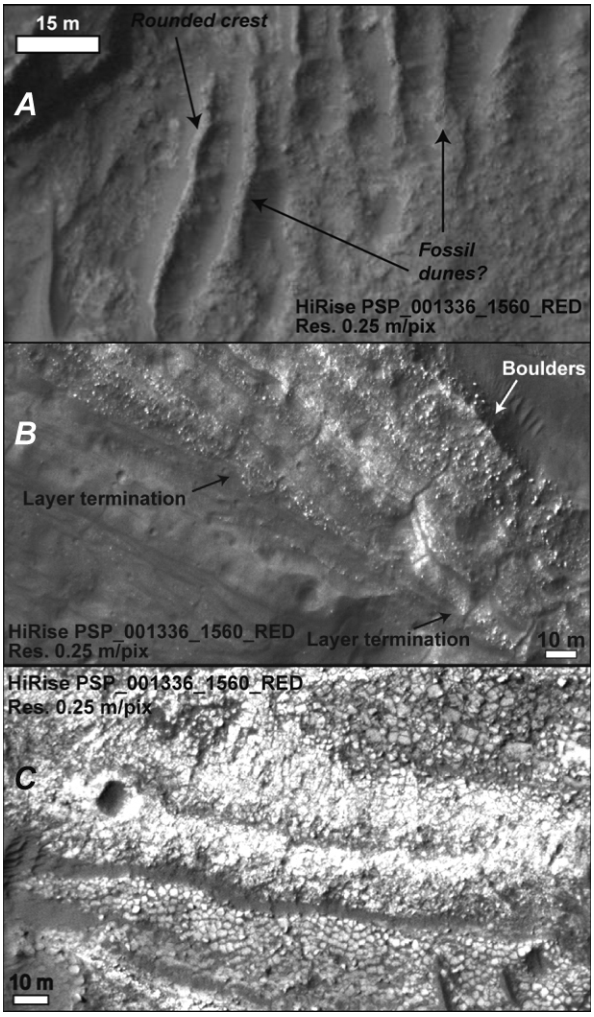

Fig. 2 - Lithofacies occurring in the Bright layered deposits.

The Bright layered deposits are partly superposed and partly eteropic with the Thick bright deposits (Fig. 3). The contact is sharp, usually conformable, even if at places the Bright layered deposits downlap on top of the Thick bright deposits.

Delta plain, delta front and prodelta have been recognized and mapped and a cyclic depositional architecture has been recognized by [4]. Objections to this interpretation have been raised because of the presence of blocks up to some meters of diameter [7] and of the interpretations of the point bar assemblages [6,7,8], in particular because they appear to be horizontally layered and the cut-bank side is topographically higher than the inner side of the meander bends [6]. [7,8] proposed debris flow as depositional process consequently neglecting the possibility that a lake occurred in the crater.

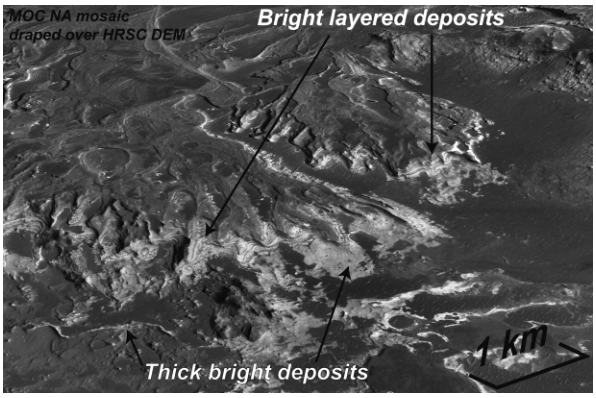

Fig. 3 - Stratigraphic relation between the units.

Breccia mostly occur in correspondence of low-sinuosity channels and display well evident layering with finer darker material, clast-supported texture and, at places, a erosional base (Fig. 2B). Erosional surfaces clearly argue against a debris-flow interpretation since debris-flows, as laminar processes, do not erode.

Moreover, the present morphology of the point bar assemblage do not represent the morphology at the time of the deposition, but after billions of years of weathering and erosion. The horizontal layering in correspondence of the point bar assemblage most probably do not represent true stratification, but apparent layering, originating because coarse material is confined in the lowermost part of the adjacent point bars. Unlike in Jazero crater [9], the resolution does not allow to observe the sedimentary structures.

The cohesion necessary to the meanders to form must have been provided by clays. Clays were probably the most common sediments deposited in the interdistributary areas. Then these sediments dried up and were subjected to erosion by aeolian processes, thus originating the channel positive geometry [2]. This is most probably the reason for the lack of strong clay signature in the upper portion of the delta [10].

Moreover, the dimension of the feature (about 93 km^2) on Earth would be not typical of debris flow dominated alluvial fans, as well as the variability of morphological elements [2,4].

Holden crater. The Holden delta is about 100 m thicker and almost as twice as large as the Eberswalde fan delta. A detailed lithostratigraphic analysis of the putative fan delta has been performed by [5], who distinguished a formation with three members corresponding to the delta formation phase. The lower member is uniformly bedded and dark toned, the middle member is similar but light toned, while the upper member consist of interbedded dark tone and bright tone deposits [5].

These deposits have been generally interpreted as deltaic [3,5], but the lack of morphological elements (which have been severely eroded by the following catastrophic flow) prevents from a detailed reconstruction of the depositional sub-environments. Nevertheless, some considerations can be done. Layers are, as in Eberswalde, mostly horizontally bedded. Middle and upper members are very similar respectively to the Bright layered deposits and Thick bright deposits mapped in Eberswalde. The stratigraphic relation is also very similar, the contact being sharp and conformable [5]. Sometimes the upper member onlaps (or laterally downlaps) against older deposits, suggesting basin infill (Fig. 4A). Syn-sedimentary extensional faults filled with sediments have been recognized cutting all the units (Fig. 4B).

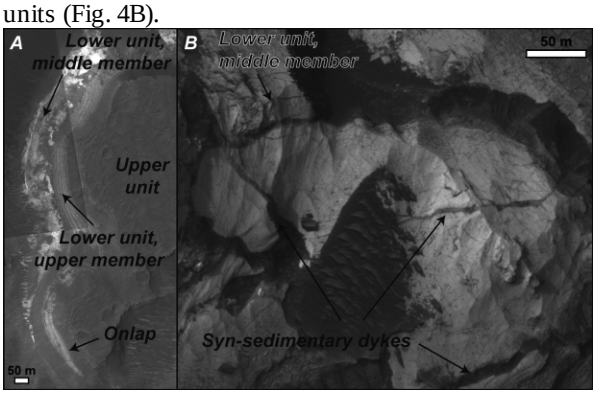

Fig. 4 - A. Upper member showing onlap. B. Synsedimentary dykes.

These features seem to represent growth faults, very typical of deltaic settings, which form as a result of sedimentary load.

Conclusions: The Holden and Eberswalde deltas share similar lithofacies assemblage and depositional architecture. Of course lithofacies only can not allow either temporal correlation or a perfect analogy in terms of depositional evolution, but, at the currently observed scales, the depositional processes appear to have been the same. The Holden delta is probably more complex, because of its larger dimensions, as it is confirmed by the presence of syn-sedimenatry dykes which presumably reflect an higher and more rapid sedimentary input.

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