MORPHOFACIES ANALYSIS OF THE EBERSWALDE CRATER (MARS). M. Pondrelli[1], A.P. Rossi[2], L. Marinangeli[1], G.G. Ori[1], S. Di Lorenzo[1], A. Baliva[1], E. Hauber[3], G. Neukum[4] and the HRSC team, [1]IRSPS, Università d'Annunzio, viale Pindaro 42, 65127, Pescara, Italy, monica@irsps.unich.it, [2]RSSD of ESA, ESTEC, The Netherlands, [3]Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany, [4]Institut für Geologische Wissenschaften, Freie Universität Berlin, Germany.

Introduction: The delta-like morphology located in the Eberswalde crater (centered 33W-24S) [1, 2, 3, 4] close to the Holden crater [5] represents the most spectacular evidence of a persistent water related activity discovered on Mars so far.

The understanding of the complex interplay between fluvial input, possible wave reworking and fluctuating level of water inside the basin could provide excellent information in order to detect the possible climatic control.

New DEM and images coming from the HRSC experiment on board of Mars Express used in combination with high resolution MOC images allow not only very detailed observations, but also to observe the outcrops with an earth-like approach.

Data analysis and discussion: In order to relate the delta-like morphology to the rest of the basin, a detailed geological map of the Eberswalde crater and its drainage basin has been realized (fig. 1) associated with a stratigraphic survey to detect the mutual relationships of the sedimentary units.

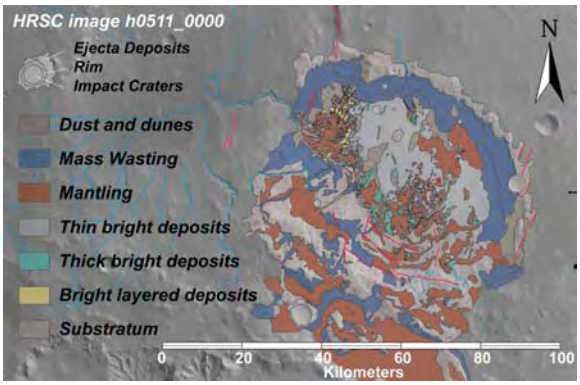

Fig. 1 - Geological map of the study area.

A brief description of the recognized sedimentary units follows.

Bright layered deposits. This unit consists of bright and dark interlayered deposits. Their thickness ranges from some tenth of meters to more than 100 m estimated on the base of the HRSC DEM (h2013). Each bright-dark couplets can be estimated few meters thick. Bright layers are clearly more resistant to weathering and erosion than darker ones.

Inferences about the depositional environments and formation processes of this unit can be made on the base of the correspondent morphologies. Of course it must be taken in account that we can describe in terms of morphology only the most recent episode of the evolution of this feature because the older history is covered under younger sediments [4]. In particular, these deposits crop out in correspondence of the delta-like feature which consists of three major lobes (figs. 1, 2). This morphology has been interpreted either as a fan delta [4, 6] or alluvial fan [3].

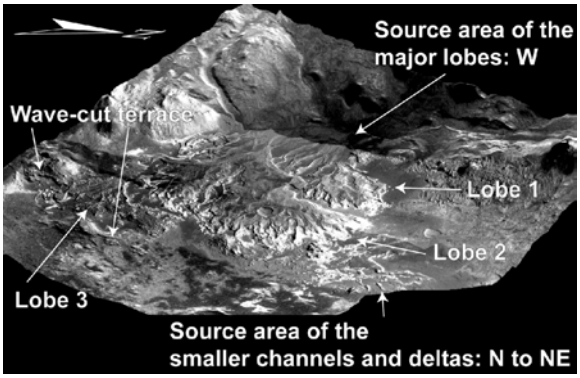

Fig. 2 - 3D view of the Eberswalde delta. HRSC-MOC NA mosaic draped on HRSC h2013 DEM. Vertical exageration: 5.

The alluvial fan hypothesis is consistent with the presence of bright deposits beyond the fan which could represent the original extension of the fan before wind erosion [3]. Nevertheless, to a closer look these bright deposits can be interpreted as formed by smaller channels and deltas (figs. 2, 3) which source area is totally different from the one of the main lobes (fig. 2).

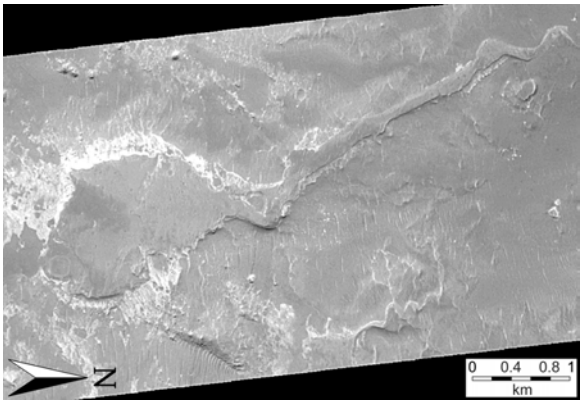

Fig. 3 - Channel and delta with source area approxinately located to the NW. MOC NA R0701352, res. 4.46 m/pix.

The surface of the major lobes consist mainly of coalescent point bars on top of which sometimes chute bars develop (fig. 4). A spectacular chute cut-off has been also documented [4]. Avulsions are

extremely common [1, 2, 3, 4], often developing from crevasse splays (fig. 4).

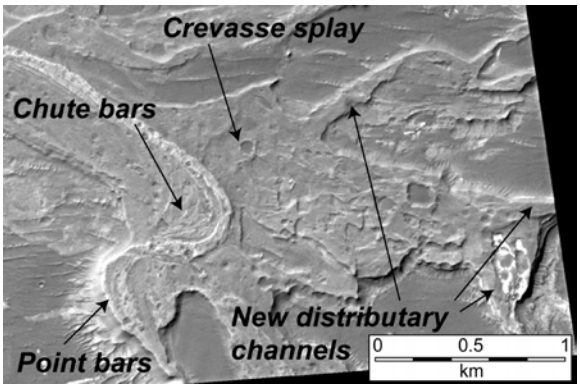

Fig. 4 - Subenvironments characterizing the delta plain. Meandering channels mainly build distributary areas. Crevasse splays develop in the interdistributary areas favouring avulsions and the formation of new distributary channels. MOC NA R1902022, res. 1.64 m/pix.

In the frontal part of the lobes the layers incline toward the basin while at the toe of the slope they become again sub-horizontal (fig. 5). This suggests interaction with a standing body of water.

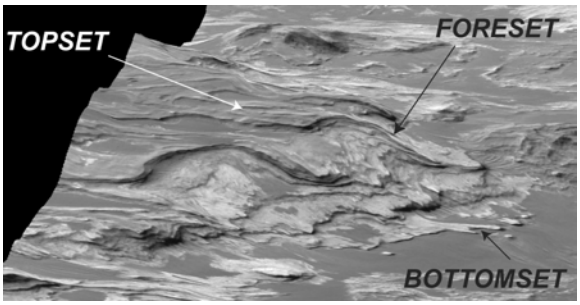

Fig. 5 - The delta front is characterized by an escarpment in which layers incline 6˚ to 10˚ toward the basin. MOC NA R0801104 (Res. 3.35 m/pix) draped on HRSC DEM. Vertical exaggeration: 5.

These elements, together with the presence of wave-cut terraces are consistent with a formation of this feature as fan delta in correspondence of a standing body of water.

We distinguish delta plain (fig. 4) and delta front facies (fig. 5) passing distally to prodelta bottomsets (fig. 5). In the delta plain two subenvironments can be distinguished, distributary channels, consisting mostly of coalescent point bars, and interdistributary areas, consisting of crevasse splays and plains in which fine material was probably deposited during flooding. This material was then probably eroded by wind [1] thus originated the inverted topography pattern. In the delta front, mouth bar and interdistributary bay facies can be distinguished (fig. 5). Meandering channels and frequent avulsions are consistent with a long-lived crater lake, persisting at least 150000 yrs [4]. Delta plain layers (topset) are gently inclined toward the basin (1˚ to 2˚) while the delta front foresets incline 6˚ to 10˚ and the prodelta bottomsets are subhorizontal. The occurring morphologies suggest a deposition of mixed sand-clay deposits in the distributary channel and mouth bar facies and mainly clay in the interdistributary areas.

The depositional architecture of the lobes ranges from aggradational to slightly progradational (fig. 5), suggesting equilibrium between level of the water table in the lake and sedimentary input.

The lobate morphology of the fan delta suggests formation by input-dominated processes [2, 4], but some wave reworking appears to be locally present.

Thick bright deposits. This unit consists of bright deposits with no evident stratification. Its thickness can be estimated in few tenth of meters using HRSC DEM. It crops out in the outermost part of the crater, close to the crater walls.

These deposits can be found in correspondence of small channels and delta (fig. 3), or draping and onlapping the older Substratum. They appear to gradually pass laterally to the Bright layered deposits (bottomsets in fig. 5). Most probably the lower sedimentary input originated layers too thin to be resolvable with the data currently available.

We interpret this unit as fluvio-deltaic and coastal deposits.

Thin bright deposits. This unit consists of very thin bright deposits heavily disturbed by younger periglacial processes and eroded by wind. Its thickness can be estimated in few meters using HRSC DEM. It crops out in the central part of the crater draping the Substratum.

We interpret this unit as lacustrine facies. Evaporitic deposition cannot be ruled out as forming process.

Conclusion: The sedimentary deposits and morphologies recognized in the Eberswalde crater are consistent with a formation in a lacustrine system. The fan delta can be divided in delta plain, delta front and possibly prodelta facies passing distally to deeper facies. Input processes dominate this feature but locally reworking by waves appear to be present.

Its evolution is partly driven by autogenic processes, such as avulsions, but the major lobes appear to have been formed in correspondence of different levels of the water table, suggesting the importance of an allogenic control as well.

References: [1] Malin, M.C. and K.S. Edgett, (2003) *Science, 302,* 1931-1934. [2] Moore, J.M. et al. (2003) *GRL, 30,* 24, 2292. [3] Jerolmack, D.J. et al. (2004) *GRL, 31*, L21701. [4] Bhattacharya, J.P. et al. (2005) *GRL, 32*, L10201. [5] Pondrelli, M. et al. (2005) *JGR, 110*, E04016. [6] Irwin III, R.P. et al. (2005) *JGR, 110*, E12S14.