GEOLOGICAL MAP OF THE HOLDEN AND EBERSWALDE CRATERS AREA. M. Pondrelli[1], A. P. Rossi[2], L. Marinangeli[1], E. Hauber[3], G. G. Ori[1] and G. Neukum[4], [1]IRSPS, Università d'Annunzio, viale Pindaro 42, 65127 Pescara, 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: New data coming from the most recent scientific missions to Mars increased dramatically our knowledge on the geology of the red planet. At the same time such a huge volume of information coming from different instruments allow, at least in particular areas, extremely detailed geological maps which constitute the basis for any further geological analysis.

We present a geological map of the Holden and Eberswalde craters area, probably one of the most challenging areas in term of cartography of sedimentary deposits (Figure 1). Part of this map in a simplified version has been already published [1, 2] but the aim was mostly to understand the depositional environments and their evolution.

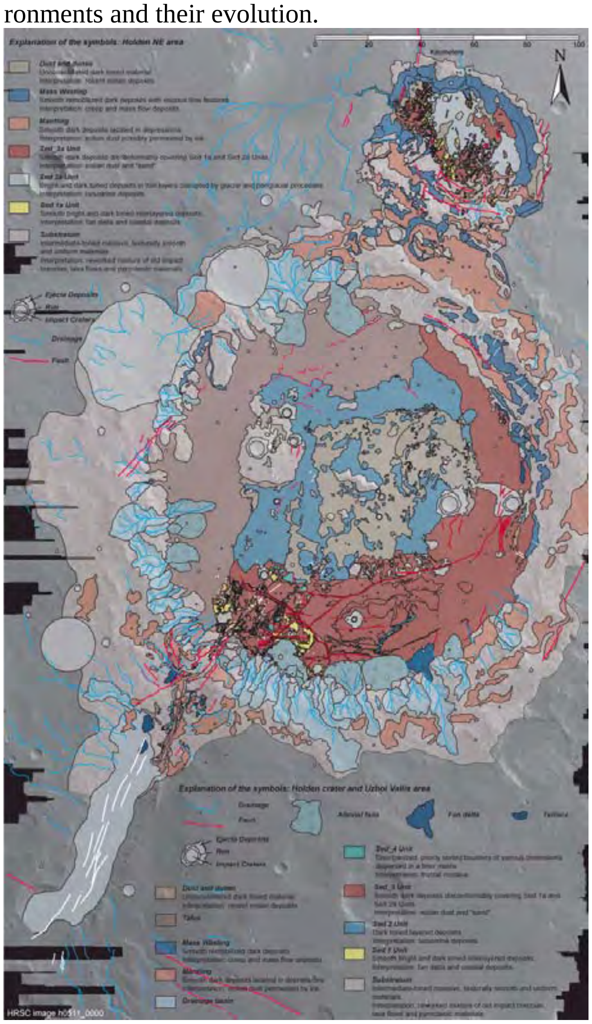

Figure 1 – Geological map of the Holden and Eberswalde areas.

Geological units: The most important mapped geological units are described here.

Substratum. The Substratum represents the oldest unit recognized in the study area, on which the younger putative sedimentary units were later deposited. It crops out along the entire study area and consists of massive light-toned texturally smooth material. This unit has been extensively reworked by impact episodes and form reliefs with jagged peaks and sharp ridges suggesting very coherent and compact rocks to be the main component. This is consistent with the interpretation as volcanic rocks proposed by [3].

Holden bright layered deposits. This unit has been discovered by [4] and its environmental significance discussed by [5] and [1: Sed 1 Unit]. It crops out in the southern part of the Holden crater (Figure 1).

It consists of interlayered bright and dark layers displaying a cyclic depositional pattern in which each bright-dark cycle can be estimated up to few meters thick [1]. They unconformably rest on top of the Substratum. Toward the outermost part of the crater they laterally pass to the Substratum through onlap geometries [1] while toward the center of the crater they appear to shift to the dark layered deposits (see below) but the contact is masked by eolian dust.

The overall thickness of this unit ranges from few meters up to at least 100 meters.

This unit has been interpreted by [4, 5, 1] as a sedimentary unit possibly deposited in deltaic and coastal depositional environments [1].

Eberswalde bright layered deposits. This unit has been observed and described by several authors [2 *cum bibl.*: Bright layered deposits]. It crops out in the western and southern part of the Eberswalde crater (Figures 1, 2).

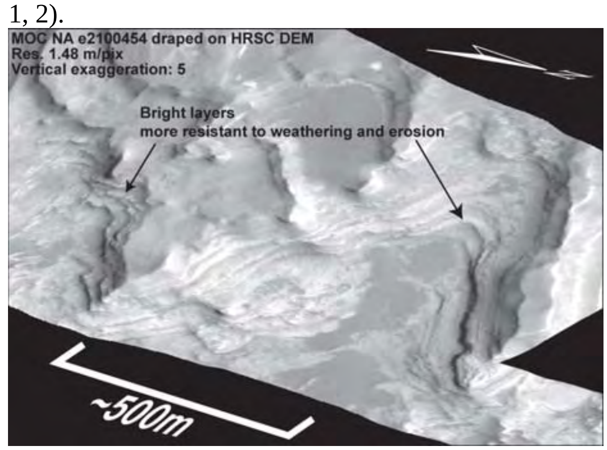

Figure 2 - The Eberswalde bright layered deposits in correspondence of the Eberswalde fan delta.

This unit displays a character very similar to the Holden bright layered deposits, consisting of up to few meter alternating bright-dark layers. Bright levels are always more resistant to weathering than the darker ones [6] (Figure 2).

The dark layers appear to consist, at the scale of our observation, of well-sorted and relatively fine material. They are in fact after erosion transported by eolian dunes [2] which, on Earth, would roughly suggest a granulometric range comprised between middle sands and granules. The bright layers consist at least of two distinguishable facies. Some levels display very poorly sorted deposits in which boulders up to 10 m of diameter are present (Figure 3), while in other levels the material appear finer, even if coarser than the dark deposits (Figure 3) [6].

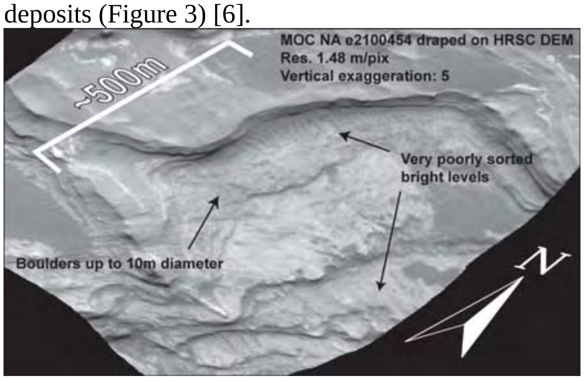

Figure 3 - Possible mass flow level in the Eberswalde bright layer deposits with boulders up to 10 m of diameter floating in a finer matrix.

They unconformably rest on top of the Substratum. Toward the center of the crater they laterally shift to the thin bright deposits. The maximum thickness of this unit can be estimated up to 100 meters.

According to [6] the Eberswalde bright layered deposits have been deposited in deltaic and coastal depositional environments controlled by fluctuations of the water table.

Dark layered deposits. This unit crops out in the central part of the Holden crater (Figure 1: Sed 2 Unit in [1]). It consists of dark-toned and layered deposits, with smooth surface texture. The eolian cover is extensive, inhibiting precise characterization of this unit. These deposits rest unconformably on top of the Substratum. Its thickness can be estimated only though geological section to up to 200 meters [1]. This unit has been tentatively interpreted as formed in lacustrine depositional environment [1].

Thin bright deposits. This unit crops out in the central part of the Eberswalde crater (Figure 1). It consists of very thin bright deposits eroded by wind. Its thickness can be estimated to reach a maximum of a few meters. This unit has been tentatively interpreted as formed in lacustrine depositional environment [2].

Uzboi mouth breccia. This unit crops out where the Uzboi Vallis debouches in the Holden crater (Figure 1: Sed 4 Unit in [1]).

It consists of patches of boulders with angular fragments floating in a finer matrix. They rest unconformably on top of the Holden bright layered deposits [1]. Laterally they appear to pass to the Mantling which also unconformably covers the Uzboi mouth breccia.

The formation of this unit has been tentatively interpreted in a context of terminal moraine [1].

Mantling. This unit crops out along all the study area (Figure 1). It consists of dark deposits. Bedding is very faint. Because eolian dunes from reworked Mantling sediments are often recognizable on top of this unit, we infer the grain size to be mostly sand and/or silt [1]. Along topographic scarps, this unit is reworked forming possible mud flows which suggest that at least part of this unit is ice-rich.

The characteristics of the Mantling are consistent with a deposition related to eolian processes.

Erosional features. The Uzboi vallis up to where it debouches in the Holden crater is characterized by the presence of erosional grooves, stoss and lee geometries and striations which cut the Holden bright layered deposits thus postdating them. These features are then postdated by the Mantling. None of these features have been observed in the Eberswalde crater.

The erosional features have been interpreted as related either to glacial or to catastrophic flooding erosion [1].

Tectonics. Extensional fractures roughly NNE and WNW trending have been mapped. These fractures are coeval with deposition of the Eberswalde bright layered deposits and Holden bright layered deposits. Bright layered deposits are in fact sometimes cut by the tectonic features while sometimes appear to be unaffected [6].

Stratigraphic correlation: stratigraphic relationships among the different units have been estimated through their cross cutting relationships. Absolute dating by crater counting is in progress.

Disconformably on top of the Substratum, units related to fluvial, deltaic and lacustrine activity appear to have been deposited at the same time in the Holden and Eberswalde craters. A second water-related episode appear to have affected only the Holden crater, either due to a glacial tongue or to catastrophic flooding.

References: [1] Pondrelli, M. et al. (2005) *JGR, 110,* E04016. [2] Pondrelli, M. et al. (2006) *LPSC XXXVII,* Abstract #1555. [3] Scott D. H. and Tanaka K. L. (1986) *U.S.G.S. Misc. Inv. Series*, Map I-1802-A. [4] Malin M. C. and Edgett K. S. (2000) *Science, 290,* 1927–1937. [5] Grant, J. A., and T. J. Parker (2002), *JGR*, 107, E95066. [6] Pondrelli, M. et al. (2006) *Eos Trans.AGU, 87*(52), Fall Meet. Suppl., Abstract P23D-0092.