USING HRSC AND HiRISE FOR THE STUDY OF MARTIAN DEPOSITIONAL ENVIRONMENTS: AN EXAMPLE FROM OPHIR PLANUM. G. Di Achille and G. Komatsu, International Research School of Planetary Sciences, Università "G. D'Annunzio", Pescara, Italy.

Introduction: HRSC and HiRISE datasets provide the ideal high resolution combination required to study in details the morphology and morphometry of small martian sedimentary deposits and determine whether past standing bodies of water were present during their formation [1, 2]. Combined use of these datasets can contribute to expand the database of martian depositional systems and paleolakes, and thus help to reconstruct the hydrological and climatic evolution of the planet.

In this study we present evidence for a new possible 40-km-diameter crater lake (Fig. 1) detected, at Ophir Planum, southward of Ganges Chasma. The occurrence of a small Gilbert fan-delta and the evidence for shorelines and sedimentary infilling of the crater floor strongly suggest the past presence of a standing body of water or ice-covered lake [2]. Likewise, the elevation of the main delta front (1300 m above the MOLA datum) coincides with that of the sharp termini of several hanging channels flowing toward the crater floor, indicating the main standing levels of the water within the paleolake.

Observations: The complex crater (53°40' W, 10°9' S) is located 100 km southward of the western margin of Ganges Chasma, in a plateau area that has been dated to the Noachian [3]. Significant hydrological activity has been described in this area during the Hesperian [4, 5], when catastrophic discharges, mainly supplied by the regional groundwater system, sculpted the local hydrography, which is largely dominated by the northeast oriented Allegheny and Elaver valleys [4, 5]. A 20-km-long and sinuous valley (V in fig. 1) is also visible close to the eastern rim of the study crater. This valley opens into a flat basin (B in fig. 1) confined by the northern crater rim and the *Hilly unit*.

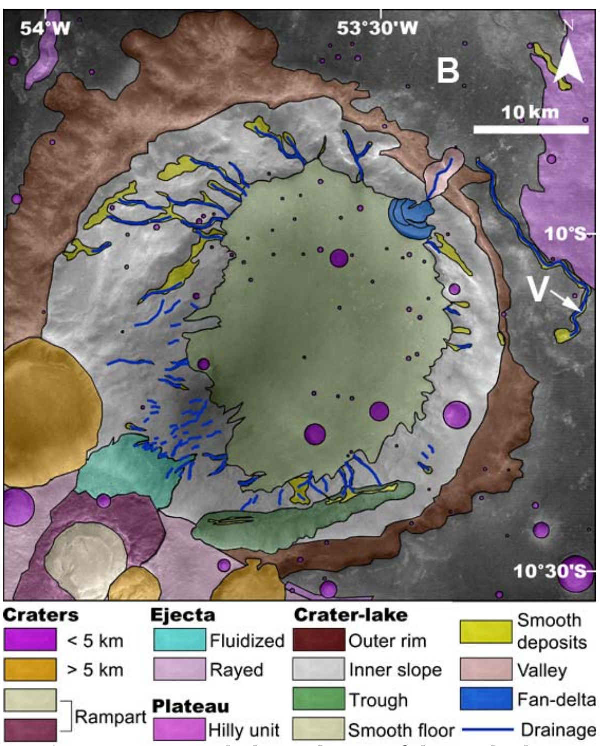

Fig. 1 – Geomorphological map of the studied crater.

Basin: The crater has a maximum depth of 1.5 km and is characterized by an asymmetric inner slope, which is wider and less steep in the western sector. Also the crater rim is more pronounced along its northwestern portion, whereas the northeastern part is breached by a small valley adjacent to the fan-delta (Fig. 2). The southwestern area is affected by several smaller craters superimposed over rayed ejecta depos-

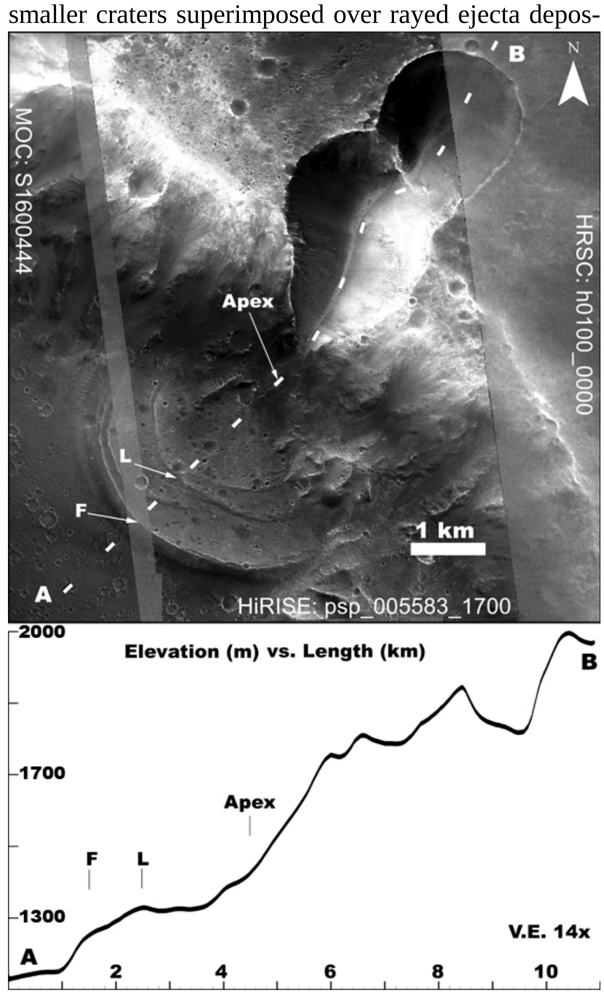

Fig. 2 – The Gilbert fan-delta as seen by MOC, HIRISE and HRSC images. AB is the topographic profile from HRSC stereo-derived DTM (F – delta front, L – secondary depositional lobe).

its. One of the youngest impacts is a well-preserved rampart crater whose fluidized ejecta flow downslope over the inner slope of the main crater [6] (Fig. 1). The latter shows a floor slightly dipping to the east and characterized by a smooth texture with respect to the surrounding units. Themis-IR nighttime and visible images also evidenced the presence of small craters almost completely buried and filled on the crater floor (Fig. 3). An elongate trough is present on the southern crater slope. Its deepest portions are covered by smooth materials. Smooth deposits are also extensively found along the entire inner crater slope, but especially to the south, in coincidence with the trough, and to the northwest, where deposits start almost from the upper rim and reach the crater floor (Fig. 1). The smooth deposits are mostly found in association with small ravines that form a well-developed centripetal drainage system, showing sharp channel terminations nearly aligned along same contour lines (Fig. 1 and 3).

Fan-delta: The deposit is located at the mouth of a 5-km-long and up to 2.2-km-wide valley (Fig. 2). The fan has a maximum radial length of 3.5 km and covers an area of about 10 km^2 for a total volume of about 2.4 km^3 (vs. 2.8 km^3 of the valley). Its maximum height is 250 m with an average slope gradient of about 4°. HRSC topography of the fan shows an almost flat proximal portion and a distal steep slope which occurs at about 3 km from the fan apex and wanes towards the crater floor (Fig. 2). The deposit is comprised of a main lower body, which overlies directly the crater floor and is overlaid by at least three additional and smaller lobate features (L in Fig. 2). The surface of the fan imaged by MOC and HiRISE appears pitted by multiple small craters, whereas the steep delta front shows alternate internal layers with a maximum thickness of a few tens of meters.

Interpretation: The sedimentary deposit is interpreted to be a Gilbert-type delta. It shows the distinctive morphometry of terrestrial Gilbert fan deltas,

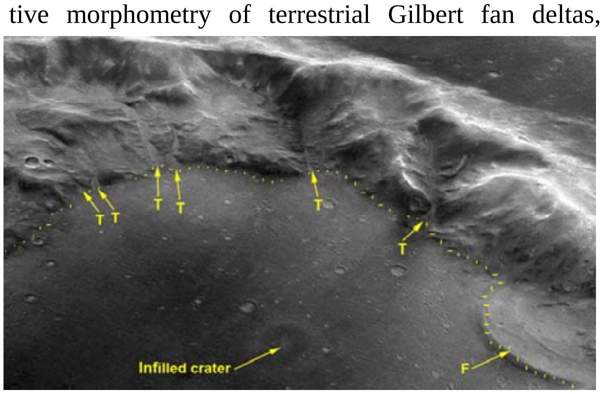

Fig. 3 – HRSC 3D view of the northern crater rim, showing the match between the 1300 m contour (yellow line), delta front (F), centripetal channel termini (T), and beginning of the crater floor infilling.

which typically have an almost flat delta plain and a steep slope at shoreline. The sharp channel termini of the centripetal drainage system are interpreted as the result of a sudden lost of energy along their courses. The presence of a standing body of water could have determined such energy drop and the fact that this occured at common elevations for several channels seems to confirm this hypothesis. Also the smooth morphology of the crater floor is consistent with the lacustrine hypothesis and infilling of the crater. Moreover, the elevation of the delta front (1300 m), which marks the shoreline, coincides with that of the channel termini, indicating the presence of a main standing level of water (or ice-covered water [2]) at this elevation, and encompasses also the downslope beginning of the smooth deposits of the crater floor (Fig. 3).

Water sources: Water supply to the system was mainly provided by (i) the small valley breaching the crater rim, (ii) the centripetal drainage system, and (iii) spilling from the trough located at the southern crater slope (Fig. 1 and 2). Previous studies about the area [4, 5] and the lack of significant evidence for precipitation and overland flow suggest that groundwater activity was the main source of water for the valley and the trough, whereas, in addition to the groundwater drainage of local aquifers, several mechanisms can be envisaged to take into account for the ravines developed along the inner crater slope. These include melting of snow or ground ice/permafrost, impact-related hydrothermal activity and spring formation, or water emanating from surroundings fluidized ejecta of rampart craters (Fig. 1) [6, 7, 8, 9].

Summary: An ancient crater lake (up to 350 m deep) has been detected at Ophir Planum. HRSC and HiRISE data were fundamental for the investigation of the deltaic deposit and the paleohydrogeological reconstruction of the host basin. The occurrence of the paleolake confirms that past groundwater activity around Ganges Chasma area was rather significant [4, 5] and supportive of local persistent flow and ponding of water. High-resolution data like HiRISE, HRSC, and CRISM adequately support detailed geological and hydrological observations of martian depositional environments. Further investigations across diverse areas and their correlation will help to better constrain the overall geomorphologic-climatic history of Mars.

References: [1] Di Achille et al., (2007) *J. Geophys. Res.*, 112; [2] Di Achille and Ori, *this conference*; [3] Scott and Tanaka (1986), *USGS Map*, I-1802-A; [4] Komatsu et al. (in prep.); [5] Coleman et al., (2007), *Icarus, 189*; [6] Komatsu et al., (2007) *J. Geophys. Res.*, 112; [7] Brakenridge et al. (1985) *Geology*, 13; [8] Newsom et al. (1996), *J. Geophys. Res., 101*; [9] Carr and Malin (2000) *Icarus, 146*.