GEOLOGIC AND GEOMORPHOLOGIC MAP OF IANI CHAOS (MARS). L. Guallini[1], M. S. Gilmore[2], L. Marinangeli[1], [1]IRSPS, Università d'Annunzio, Pescara, Italy, guallini@irsps.unich.it; [2]Wesleyan University, Middletown, CT, USA.

Introduction: Iani Chaos is a ~30,000 km^2 region that lies at the mouth of and is presumably the source for the Hesperian age Ares Vallis outflow channel system [e.g., 1, 2]. Mapping of Ares Vallis reveals multiple episodes of erosion [3, 4]. Multiple discharge and recharge events have been proposed in the Iani Chaos aquifer system based on geophysical grounds [e.g. 5, 6], causing collapses of the region. Detailed geologic and topographic characterization of the Iani Chaos has been developed by [12, 13, 14]. In particular, Light-toned Layered Deposits (LLD) have been partially mapped and described within it [7, 8], and are found to be comprised of sulfates [9, 10, 11] consistent with their formation by evaporation of water.

In the present work is presented the first high-resolution geologic and geomorphologic map of the region (Fig. 1a-o).

Methodology: The region has been analyzed using high-resolution visible images acquired by cameras on the ESA Mars Express (HRSC orthoimages, 12.5 and 25.0 m/pix) and on the NASA MRO (CTX, 6.0 m/pix and HiRISE, 0.25 m/pix). Topographic basemaps are from MGS MOLA 128 pix/degree (460 m grid spacing) and from HRSC DEMs Da4 (75 m and 125 m grid spacing). Imageries have been processed using the USGS Integrated Software for Imagers and Spectrometers (ISIS 3) and georeferenced into ArcGIS 9.x software environment. CTX and HiRISE images are overlaid onto HRSC DTMs in ArcScene.

Geologic Units (LLD). At visible-light wavelenghts, LLD terrains (Fig. 1d) are clearly distinguished by a marked light-toned albedo and their morphology. At CTX and HiRISE resolution they usually show a polygonal texture down to the limit of resolution (Fig. 1e) and a meter scale "stair-stepped" layering (Fig. 1d). Karst-like landforms (i.e. doline-like fields) are also exposed on their surface (Fig. 1f, g). The main dome-shaped bodies fill the basins made by the collapsed chaotic terrains (Fig. 1o), occupying the valleys between them. LLDs also overlap the mounds or are themselves eroded into mounds after deposition (point A in Fig. 1o). The LLDs are mostly modified by eolian processes (to form yardangs; Fig. 1h) and craters are rare or absent on their surface, indicating that these materials are eroded rapidly.

Geomorphologic Units: Regional geomorphologic units has been mapped at HRSC and CTX resolution and are defined by depositional textures and/or erosional patterns and albedo.

Chaotic Terrains (CsT). These units are characterized by kilometer scale irregular block morphologies including both Noachian bedrock and LLD deposits. Five units have been distinguished with varying severity of modification (primarily by erosion and fracturing) starting from a common terrain (Noachian highlands). 1) *Hummocky Terrain (Hy)*: unit characterized by an irregular hummocky topography (Fig. 1i). At CTX scale, the unit displays a high-density pattern of smooth and small knobs, mounds and mesas at the tens of meter to kilometer, spaced out by minor order and shallow fracturing systems, smoothed by the erosion; 2) *Mesas (Ms)*: broad and flat plateaus bordered by wide and deep extensional fracturing and faulting systems (grabens; Fig. 1l); 3) *Mesas & Knobs (MK)*: broad plateaus bordered by wide and deep extensional fracturing and faulting systems spaced out and/or overlapped by mounds (Fig. 1m); 4) *Knobs (Kb)*: groups of dome-shaped hills spaced out by marked valleys (tectonic and/or erosional) and continuous to the *Ms* and *MK* terrains; 5) *Knobby Terrain (Ky)*: small and diffuse mounds showing a smooth morphology and defining a regional rough topography (Fig. 1n).

Fluvial Channels Remnants (ChR). Potential fluvial morphologies (channels, streamlined islands, terraces, grooved surfaces; cfr. Ch1 and Ch2 in Fig. 1o) are locally exposed on the surface of the LLDs. Fluvial features are of similar orientation and elevation to channels at the mouth of the Ares Vallis; we interepret them to have once been a semi-continuous floodplain, later interrupted by local chaos formation.

Outflow Channels (ChS). Five main erosional surfaces have been defined in Ares Vallis at the mouth of Iani Chaos on the basis of their altitude and relative stratigraphic relationships (Fig. 1b, S5-S1 from youngest to oldest), and are in agreement with previous studies [3, 4]. The channel floors appear regionally flat but include several outflow erosional morphologies as streamlined islands, grooved terrains, terraces and cataracts. Their shape and topography indicates dominant ~S to ~N flow direction.

Topography: A detailed statistical topographic and morphometric analysis has been developed using HRSC DEM elevations.

CsT Units. We observe a general progressive decrease of mean elevation from the *Hy*, *MS* and *MK* terrains (average of about -2200 m) to the *Kb* and *Ky* morphologies (average of about -2900 m). This trend is consistent with a greater initial collapse of the original surface and an increase of the fracturing and/or of the erosional degree of terrains**.**

LLD and ChR Units. LLD N are characterized by the lowest elevation (-3300 - -3500 m in average) of the

mapped LLD deposits within Iani Chaos, being entirely within a basin. At the same time, it is also inferred to be characterized by a relatively thinner sequence and a volume of ~1300 km^3. The LLD C have an higher weighted mean elevation (~-2700 m), almost covering all the values comprised between the basins and the chaotic interbasin highlands. Their maximum inferable volume is of ~6000 km^3. In terms of volume, the LLD S are the third of the Iani Chaos basin (~900 km^3). Their weighted mean elevation is of -2500 - -2700 m, almost close to the central LLD region. ChR elevations are consistent with those of respective LLD region. Also, LLDs are completely enclosed by higher topographic relief, formed by the chaotic terrains.

Stratigraphy. A relative stratigraphic relationship between ChS in Ares Vallis, the LLD and the ChR has been derived from HRSC DEMs [13, 14]. From it, we suggest that ChS outflows events controlled the LLD and ChR elevations and, thus, LLD was contemporaneous to Iani and Ares Vallis formation. In addiction, the LLDs regionally overlap the CsT unit with a non-conformity contact. We interpret this stratigraphy to show that some LLD as remnants of an ancient body partially filling the tectonic valleys between the interbasin terrains. A likely involvement of the LLD in the chaos basins formation is testified by the presence of fractures intersecting their surface continuity, their partial erosion into mounds (that are locally underneath younger and darker layers of LLD, entailing multiple episodes of deposition) and their partial tectonic tilting.

Discussion and Conclusions: We have, for the first time, mapped and described in detail geologic and geomorphologic units composing Iani Chaos. In particular, we have defined LLDs physiography and chronology and we have identified likely fluvial features within Iani Chaos, consistent with the topographic elevations of Ares Vallis outflow channels. These systems eroded LLDs and controlled their elevation. We map at least two major episodes of LLD deposition that we suggest occurred in lakes that were the surface manifestation of periodic recharging aquifer within Iani.

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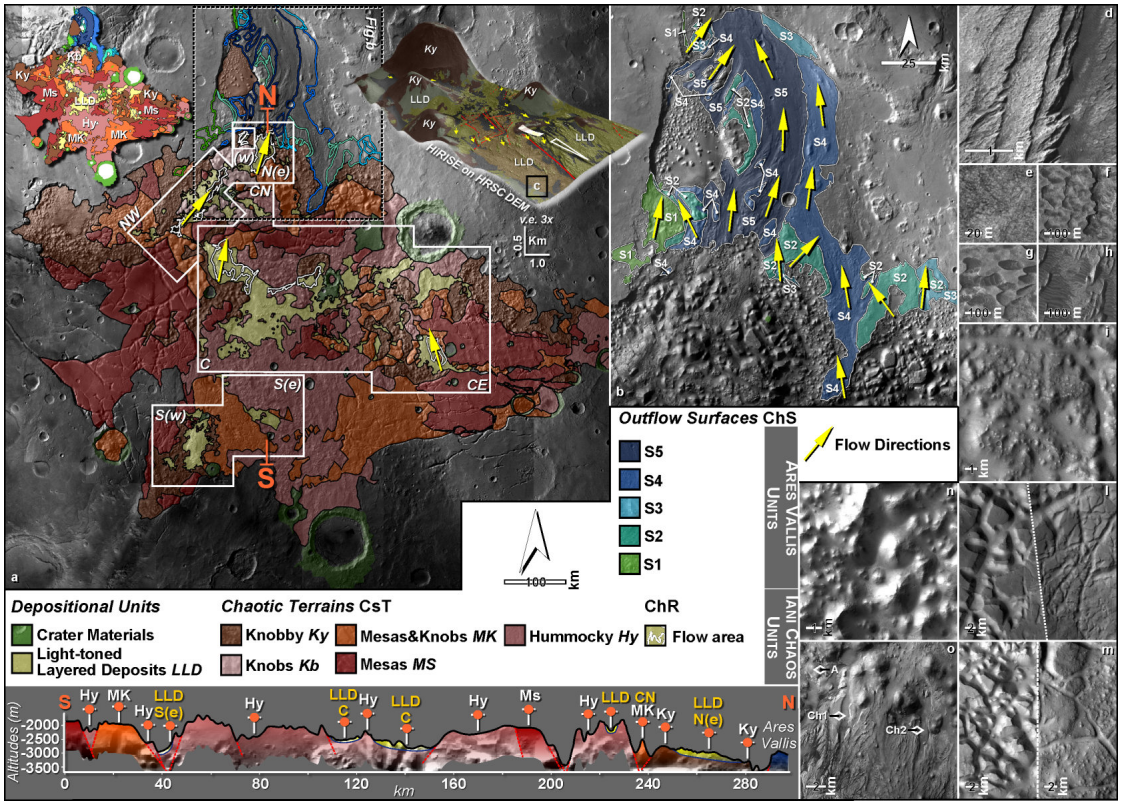

Fig. 1 a) Iani Chaos geologic and geomorphologic map. The white insets represent the three main depositional regions of the LLD (northern, central and southern); b) Ares Vallis outflow channels at the mouth of Iani Chaos; c) Perspective view of Iani units. Red lines represent fracturing systems crosscutting the LLD; d-o) Focusing on mapped units. See text for description and details.