NEW EVIDENCES FOR ICE RICH SEDIMENTS ON THE NORTHERN PLAINS FROM MGS DATA. F. Costard[1] and J. Kargel[2]. [1]UMR 8616, CNRS, Laboratoire de Géologie Dynamique de la Terre et des Planètes, 91405 Orsay, France, fcostard@geol.u-psud.fr. [2]US Geological Survey, Astrogeological Team, Flagstaff, AZ 86001.

Introduction : Recent studies indicate a quite good correlation between the hypothetical oceanic shorelines (contact 2 of Parker et al., 1989) and an equipotential surface parallel to the present geoid, corresponding to an ancient north polar ocean [1, 2]. A quite good correlation was discussed by Head et al. [2] between the limit of the contact 2 and some periglacial features. Polygonally fractured terrains and pseudocraters also occur at low elevations near the mouths of outflow channels supporting the hypothesis of volatile-rich layers of sediments [3,4]. These small cratered cones interpreted as pseudocraters are usually found north of fractured ground in Acidalia Planitia between 80° and 330°W and 45° to 67°N and in Utopia Planitia between 170° to 260°W and 53° to 67°N. In these two areas, large concentrations of rampart craters are found.

In order to quantify the spatial distribution of martian ground ice, a global study of rampart craters was undertaken to determine their temporal and spatial relations with the surrounding morphostructural units. Rampart craters all over planet Mars have been systematically measured and mapped using a GIS database of geologic and topographic information [5]. We used the MOLA data to correlate the profiles with our data from rampart craters. In addition, we used some MOC images to define the structure of the Martian ground ice.

Rampart craters : Data were collected for 2561 rampart craters in the size range 1-40 km from 1:2,000,000-scale Viking photomosaics. The resolution of imagery used and retained in these photomosaics generally varies from about 50 to 300 m/pixel. The carter rims and the distal edges of the ejecta blankets can be discerned for craters as small as 1 km in diameter. Note that this study simply requires a detection of the distal edge of the ejecta blanket, but not the fine morphologic details of the ejecta blankets. However, for the smaller craters, detection of the distal edge of the ejecta may in some cases be resolution limited.

Barlow and Bradley [6] found that different rampart morphologies dominate in differente locations on Mars and proposed that the different morphologies may result from impact into subsurface volatile reservoirs with different physical properties [7]. We have examined the global and regional distribution of rampart craters with a simple subdivision into three types. Type 1 exhibits a single continuous and multilobate ejecta with peripheral ridges. Type 2 ejecta includes a double continuous ejecta deposit. The first inner annulus has a convex distal edge with a more circular parameter. Outside this annulus a thin lobate sheet describes a more sinuous perimeter.

Ejecta mobility ratio : The evaluation of the volatile content may hold information useful to the characterization of the Martian ground ice. We therefore have undertaken a detailed study of the lateral extent of these ejecta for the whole planet. We assume that the observed variability in ejecta mobility reflect variations in the total ice content of the excavated material. Our analysis includes the farthest lateral extent attained by type 1 and 2 fluidized ejecta. Ejecta deposits resemble mud flows and debris flows. We assume that entrainment of water and/or water vapor derived from ground water or ice is responsible for flow. An increase of water content should increase the fluidity or the mobility of the ejecta. This is supported by laboratory experiments [8].

Ejecta mobility can be expressed by the EM ratio, of the maximum diameter of ejecta deposits divided by the diameter of the parent crater. This ratio, termed the ejecta mobility (EM ratio) is assumed to correlate with the quantity of volatiles involved during emplacement [5, 9]. In this study, the diameter of the crater is considered rather than the crater depth. The entire surface area of the ejecta deposits should be measured, but the very good correlation between the maximal diameter of the ejecta and its surface even for type 1 ou type 2 rampart craters allow us to simplify the determination of the EM ratio. EM ratio appears to be a good measure to evaluate the ejecta mobility.

Correlation between MOLA data and volatile content within the Martian ground ice: Figure 1 shows the relationship between the highest concentration of high mobility ejecta and areas near the terminations of outflow channels. The depths derived from the MOLA data coincide with the highest ejecta mobility ratio. Type 2 rampart craters (double continuous ejecta) deposit with high mobility, occur at a latitude higher than 40°N (where ground-ice remains stable) in Utopia and Acidalia Planitiae. The highest mobility ratio of rampart craters occur in large topographic basins near and below –4000 m, especially in areas that are close to the convergent terminations of outflow channels [10]. These two areas appear to exhibit the greatest concentrations of volatile materials.

The explanations are the following : Large lakes, seas, or glaciers may have existed in these basins [1, 2, 10, 11]. Rampart craters, especially one having high EM ratios, may be concentrated where sediments and floodwaters accumulated in the norhthern plains, especially in Acidalia

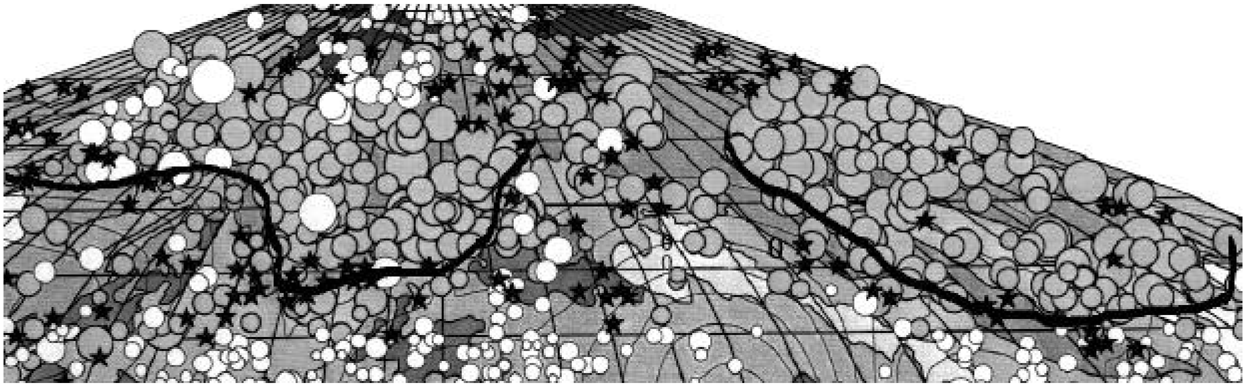

Figure 1: Sinusoidal projection of the northern lowland plains. GIS of ejecta mobility in Acidalia Planitia (left part) and Utopia Planitia (right part). The diameter of the circle is in relation with the volatile content within the Martianground ice. Gray circles: type 2 rampart craters. White circles: type 1 rampart craters. Stars: eroded rampart craters. Black solid line is the -4000 m elevation derived from MOLA data.

and Utopia Planitiae. Discharge water presumably then froze as pore ice or massive icy beds. These concentrations of high mobility ejecta are consistent with a boundary interpreted as possible ancient shorelines [1]. An another possibility is to suppose an outwash plain with a volatile rich sediments deposited directly from outflow channels [10]. The present data from MOLA indicate a much better correlation with the higest EM ratio. This new topographic map fits much better with our data than the previous topographic map from Viking mission, which had high errors (typically ±1500 m).

Thermoharstic depressions. In the northern plains, especially in Utopia Planitia, a few hundred small pits occur around 27O°W and 40°N. They are between 40 m to 100 m in length and are flat floored with some stratified deposits. They were previously described as thermokarstic depressions by Costard and Kargel [10]. On the Earth, these kinds of pits are mostly found in periglacial areas where ground ice is widespread. With the MOC images, these pits seems to be much more widespread and include some much smaller than had been recognized on the basis of lower resolution Viking Orbiter images. The morphology of these pits are consistent with the melting or sublimation and the subsequent collapse of a stratified ice-rich sediments. These features tends to demonstrate the presence of ice rich sediments with possible massive icy beds in the subsurface Martian megaregolith. These pits occured in large topographic depressions where rampart craters with high mobility ejecta deposits also occur.

Conclusion. This study supports some previous studies, but also gives some new observations about the regional concentrations of rampart craters anf their relationships to elevation, latitude, geology and periglacial features. We look forward to a continuing elucidation of these relationships.

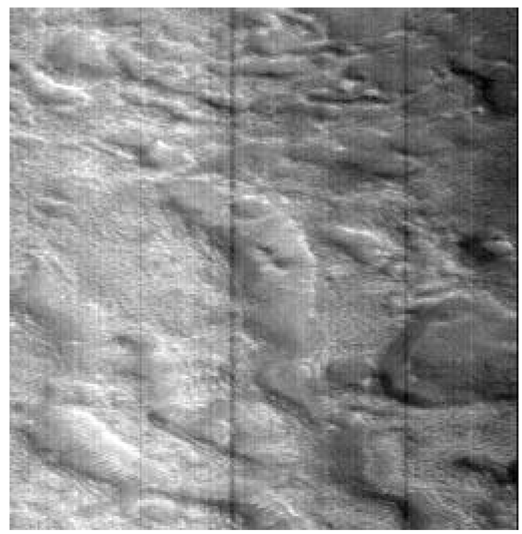

Figure 2: Pits less than 150 m in length in Utopia Planitia. 24904 MOC image. 274,03°W and 40,84°N, resolution 1.51 m/p, scene width: 1.5 km.

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