A preliminary assessment of the role of impact craters in forming hydrous minerals on the surface of Mars M. R. El Maarry[1] O. Gasnault[2], [1]MPI für Sonnensystemforschung, in 37191Katlenburg-Lindau, Germany, [2]Université de Toulouse [UPS]. Centre d'Etude Spatiale des Rayonnements, 9 avenue Colonel Roche, B.P. 44346, 31028 Toulouse cedex 4, France.

Introduction: Hydrous minerals such as phyllosilicates and zeolites have been reported before in the mid latitudes on Mars[1-4]. In many cases, these hydrous minerals are found associated with impact craters either in the ejectal lobes, crater walls, or central peaks. Large impacts events in water rich terrains such as those on Mars are known to generate hydrothermal systems with long enough lifetimes, even under current Martian conditions, to form hydrothermal alteration products such as clay minerals, zeolites and carbonates[5]. In addition, neutron and gamma-ray elemental maps show that the surface of Mars is rich in the midlatitiudes with chemically bound Hydrogen[6,7] since water ice is not expected to be stable at such low latitudes[8]. This works aims at correlating the GRS hydrogen maps for the midlatitudes, i.e. areas with high probability of chemically bound Hydrogen, with another map depicting crater density in bins similar to those of the GRS maps (5°x5° bins).

Maps used: A simple method of crater counting was used for constructing a 5°x5° gridded map. Each bin was given a "score" that is reflective of the number of craters larger than 20 km in diameter inside the grid, since craters smaller than this size are not expected to form large enough hydrothermal systems that would yield considerable amounts of hydrous minerals. Moreover, the grid score is indicative of the total area of the grid that is covered by craters. This map was limited only to the mid-latitudes to have the same dimensions of the gamma-ray elemental map of Hydrogen. For obvious reasons, the neutron map of Hydrogen that covers almost the entire planet was not used since in the higher latitudes, most of the Hydrogen should be more strongly indicative of water ice that is stable near the surface. Finally, the "crater density" map was correlated with the most recent hydrogen elemental map from the GRS suite which is mapped as equivalent water.

Results and discussion: Since more elaborate correlation schemes are currently being prepared, only a visual correlation is presented here. Nevertheless, even a rough visual correlation shows that the two maps are in good agreement. On Mars, impacts have long been recognized as triggers to water-related events such as hydrothermal alteration of melt sheets and small outflow channels. Furthermore, craters that are large enough (>20 km in diameter) are expected to have sustained long-life hydrothermal systems, and even carter lakes [9]. The resulting products from such systems are commonly hydrous rich and altered minerals such as clay minerals (most notably nontronites and montmorillonites), zeolites, quartz, and even carbonates. In addition, areas with low crater counts (volcanic in nature) correlate strongly with areas of poor hydrogen. Notably, the Tharsis rise, Elysium, and Tyrehena. It is noteworthy to add that a similar work has been done before to correlate the GRS data with age units on Mars [10], where the authors report that H-rich areas in the mid-latitudes lie mainly within Noachian terrain. This work aims at giving a geological and geochemical reasoning to this correlation. The most notable geomorphic feature that is currently visible in the Noachian terrains is impact craters and basins. The strong correlation between areas of high crater density and H-rich regions and the corresponding trends in Amazonian and low-H regions imply that hydrothermal systems formed by impact crater events could be major players in forming the hydrous minerals that are apparent on the surface of Mars today.

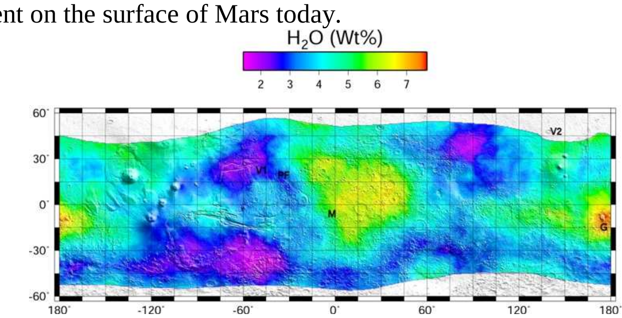

Fig.1 Gamma-Ray elemental map of Hydrogen from the GRS instrument on Mars Odyssey mapped as equivalent water in the mid-latitudes of Mars. The map is superimposed on a MOLA terrain map of Mars

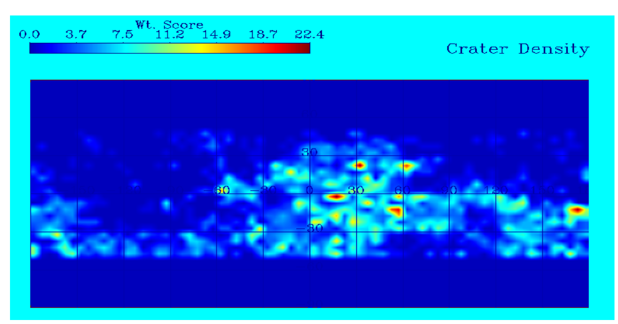

Fig. 2. Map of crater densities in the mid latitudes of Mars (±50°). The weighting score is directly proportional to the number of craters in a given bin that has a

diameter of more than 20 km. The map is smoothed to give make a visual interpretation easier.

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