EVIDENCE FOR AN ANCIENT MULTI-RINGED BASIN IN MERIDIANI PLANUM AND ASSOCIATED CHANNELS AND BASINS: H.E. Newsom[1], V. Sutherland[1]C; . A. Barber[1], R. T. Schelble[2], T. M. Hare[3], A. Livingston[4], [1]University of New Mexico, Institute of Meteoritics and Dept. of Earth and Planetary Sciences, Albuquerque, NM 87131, newsom@unm.edu, [2]Dept. of Earth Sci., Univ. of Southern California, Los Angeles, CA 90089, [3]U.S. Geol. Survey, Flagstaff, AZ, 86001, [4]Southwestern Indian Polytechnic Institute, Albuquerque, NM 87184.

Introduction: Topographic evidence for the existence of an early multi-ringed impact structure (Fig. 1), has been identified by Newsom et al., [1] in Meridiani Planum. This structure is at least 800 km in diameter and an outer ring may be as large as 1600 km in diameter. The topography created by this structure has controlled the location of fluvial channels and lacustrine basins identified in the vicinity of Meridiani Planum. The origin of the hematite deposits [2] present in the region may be related to the topography created by the impact structure by providing an environment for early sedimentary deposition of the layered materials that are topped by the hematite, and by providing a later environment where the hematite deposits could be exposed to surface water.

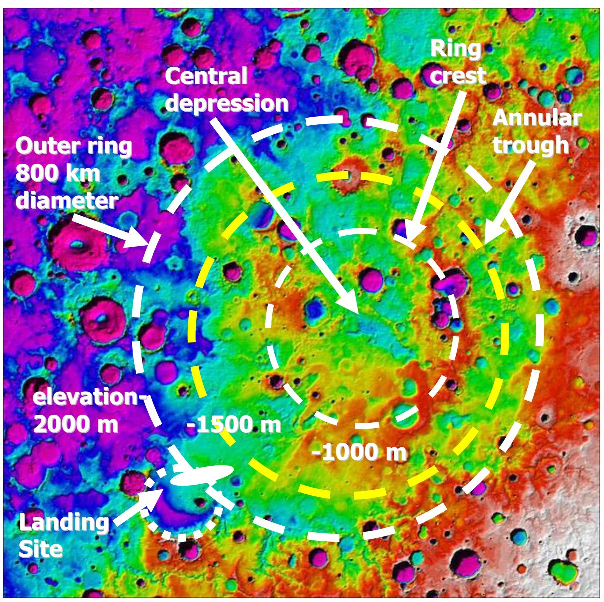

Fig. 1 Color coded MOLA topography showing concentric circular features in Meridiani Planum consistent with the presence of an 800 km diam. multi-ringed impact structure. The location of the MER landing site inside a 150 km diam. crater is also shown.

Discussion: Evidence for concentric circular structures in Meridiani Planum are seen in MOLA topographic maps and stacked radial profiles (Figs. 1, 2). This evidence includes a central basin, a 200 m high raised ring at a radius of 200 km (400 km diam.), and an annular trough at a maximum radius of about 400 km (800 km diam.). The western edge of the annular trough is missing, probably due to later erosion. This inner structure is very similar in size to the Cassini structure, which has a 400 km diameter rim and an 800 km diameter annular trough. In contrast to Cassini, the Meridiani structure is one of the very few possible impact structures that contains a magnetic anomaly (Fig. 3).

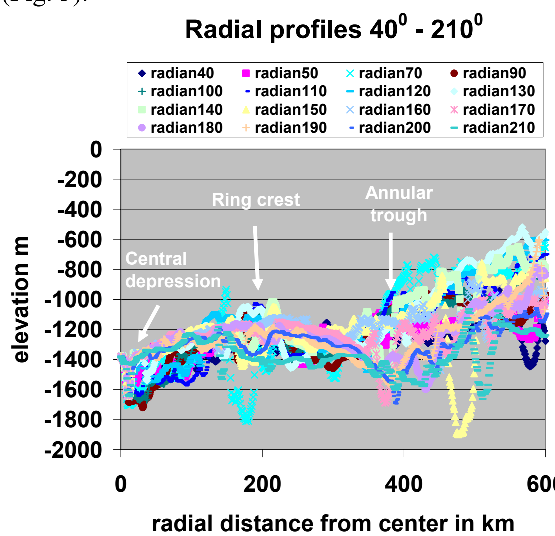

Fig. 2 Stacked radial profiles from the 40^0 azimuth to the 210^0 azimuth. Profiles are ten degree averages of one degree profiles, and show the central basin, the ring crest, and the annular trough at 400 km radius.

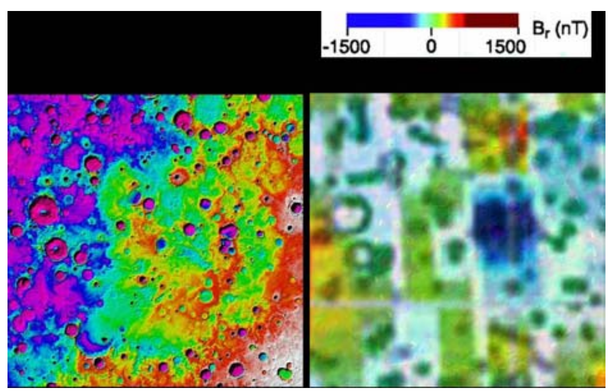

Fig. 3 Comparison between the Mola topography and the magnetic field anomalies reported by Acuña et al., [3].

Frey [4] at the 6th Mars conference reported on a much larger structure in this area he calls the “Ares” structure, which could be connected with the location of Ares Vallis. At his suggestion we constructed a detrended MOLA topographic map which shows evidence for a trough at a diameter of 1600 km (Fig. 4).

The overall relief of the structure is very small (<500m) and the low areas in the structure make up a series of basins. We have used topographic data and MOC and THEMIS images to show that the southern boundary of the hematite area (near the area containing the strongest hematite signature) was the site of a chain of paleo-lakes (Fig. 5). Our mapping shows that the paleo-lakes were fed by an extensive channel system covering a minimum of 580,000 km^2, the size of Texas, originating near the Schiaparelli basin.

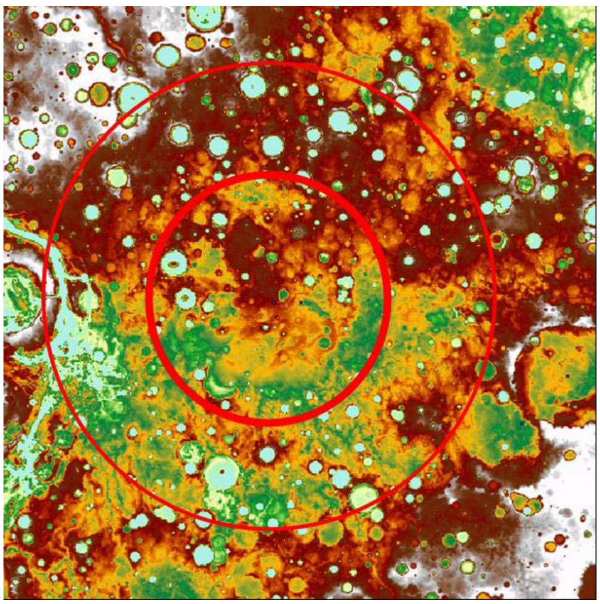

Fig. 4 Detrended MOLA topography map showing the pattern of channels outlining the troughs in the southern portion of the structure at 800 and 1600 km diameter.

The impact structure is unlikely to be directly connected with the origin of the hematite because recent THEMIS images [1] show evidence for a substantial interval of time between the crater formation and the deposition of the layered deposits containing the hematite, with the presence of channel systems being exhumed from under the layered deposits. A sedimentary origin of some of the layered materials in Meridiani Planum is possible because of the presence of early topographic barriers associated with the impact basin and the extensive erosion in the upstream region [1, 5].

However, the hematite could imply an iron enrichment process associated with aqueous processes that enhance or create the observed surficial hematite signature. The impact created the topographic setting where water would be abundant. Supporting the role of water is the presence of the strongest hematite signature in Meridiani (Fig. 5) on the topographic ridge that makes up the edge of the eastern basin at an elevation of 100 to 200 m above the present lake barrier A.

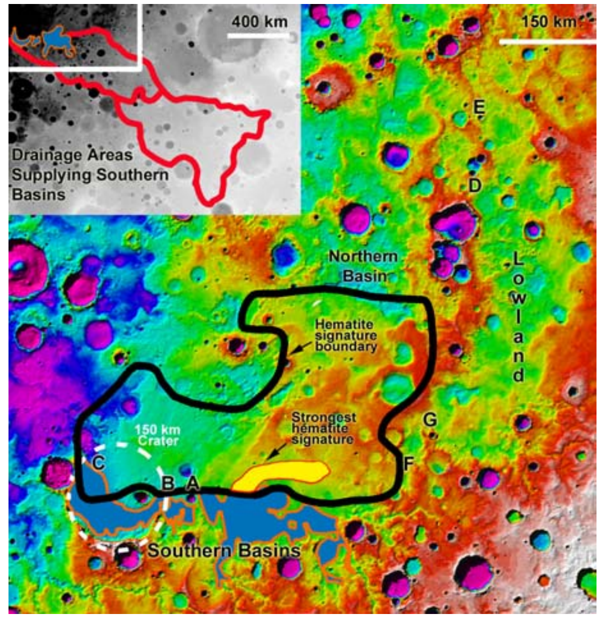

Fig. 5 Study area in Meridani Planum. MOLA topography map (Latitude 7 N to 5.6 S, Longitude 351.1 E to 5.5 E) showing the regional setting of the hematite-rich surface deposit labeled with areas and basin barriers [1]. The inset shows the drainage areas feeding the southern basins.

Conclusions: Topographic analysis using GIS based tools in connection with additional data has shown the existence of a large structure underlying the Meridiani region. This large multi-ringed basin is characterized by at least two annular troughs that have controlled the locations of channels and paleo-lake basins in the region. The hematite deposits in the region are at the top of a sequence of layered materials that could have been deposited as sediments in a very ancient paleo-lake whose western edges have been eroded. The hematite minerals could also have formed in connection with water from later paleo-lake basins along the southern edge of the hematite deposits. This study has shown the benefits of GIS-based analysis combined with the new high resolution imagery.

References: [1] Newsom et al., (2003) *JGR*, in press. [2] Christensen, et al. (2001), *JGR 106*, 23,873. [3] Acuña et al. (1999) *Science* 284, 790-793. [4] Frey (2003) *6th Int. Conf. on Mars*, # 3104, [5] Forsberg-Taylor & Howard (2003) *LPSC XXXIV*, # 1872.

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