Distribution and Classification of Thumbprint Terrain in Isidis Planitia, Mars. F. J. Hielscher[1], H. Hiesinger[1], G. Erkeling[1], M. A. Ivanov[2], D. Reiss[1], [1]Institut f. Planetologie, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany (f.hielscher@uni-muenster.de), [2]Vernadsky Inst. RAS, Moscow, Russia.

Introduction: Isidis Planitia is a large impact basin just north of the equator of Mars. Centered at 12.9°N 87.0°E, it is located almost on the dichotomy boundary. The large volcanic province of Syrtis Major is immediately to the west of Isidis Planitia. Unique to this region is a large number of pitted mounds and cones distributed across the floor of the basin. These features are arranged in short and long chains, the pattern of which resembles thumbprints [e.g., 1-8]. In order to investigate the possible correlation between the length of the chains and their location, we mapped the characteristic structures of the Thumbprint Terrain (TPT) across the entire floor of the basin using HRSC images.

Data and Methods: Available HRSC-images cover about 60% of the TPT. For mapping, we defined eight categories of structures. The first five categories represent chains of increasing numbers of cones (Table 1.). There are an additional three categories: No Cone Ridges (NCR), Graben (GRA), and Craters (CRA). The craters of the CRA unit are all younger than the surrounding TPT. In addition to mapping the distribution of cones and related structures, we also used Mars Orbiter Laser Altimeter (MOLA) data to estimate the heights of the mapped features.

Table 1: Classification of mapped structures and their abundances within Isidis Planitia.

Category	Color	Object	# of Objects
I		Single cones	15718 (55%)
II		2-3 cones	8956 (32%)
III		4-6 cones	2622 (9%)
IV		7-10 cones	726 (3%)
V		>10 cones	378 (1%)
NCR		No cone ridges	18125
GRA		Graben	174
CRA		Craters	114

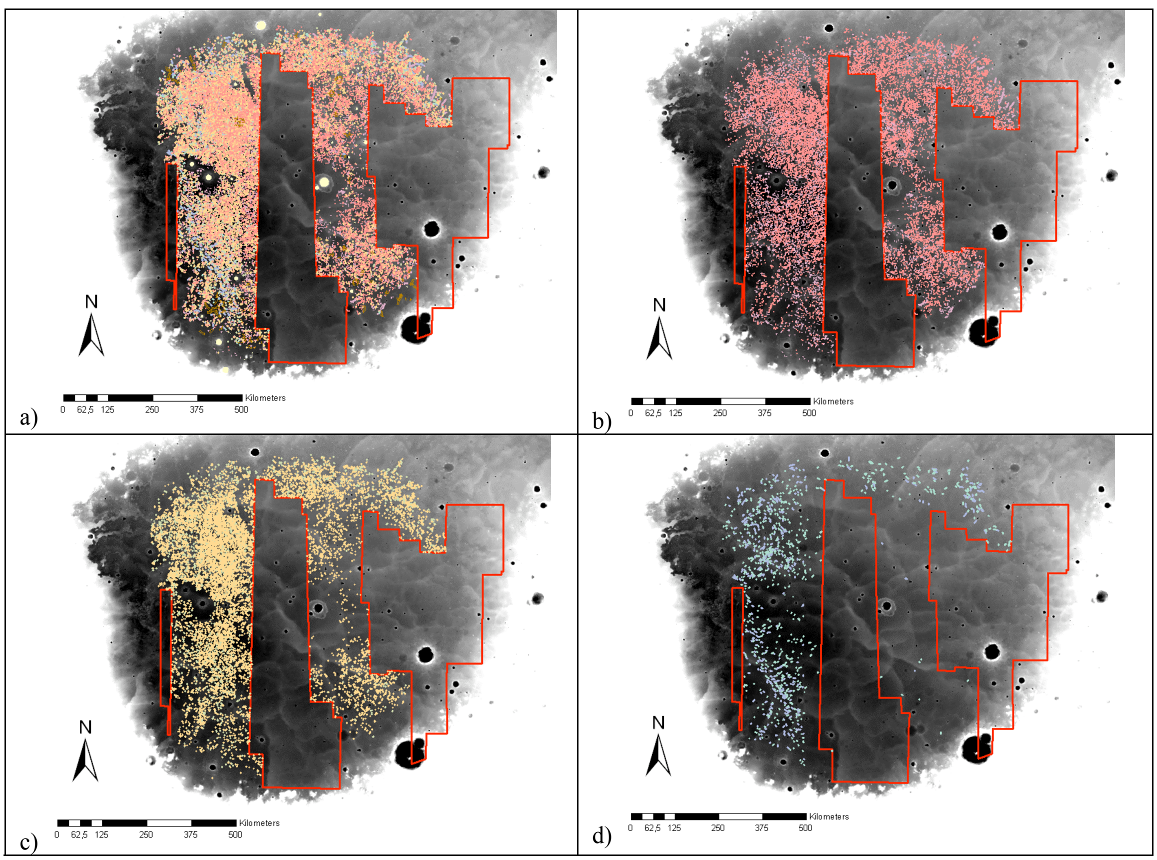

Figure 1: TPT of Isidis Planitia (MOLA DTM base layer): a) Distribution of TPT Category I-V, NCR, GRA and CRA, b) Category I and NCR, c) Category II and III, d) Category IV and V (outlined areas are not currently covered by HRSC data).

Results: We have produced the most detailed map of thumbprint terrain in the Isidis basin currently available. This map is complementary to a new geologic map of the Isidis floor [9]. In this companion paper, we have re-mapped the entire floor of the Isidis basin and have performed extensive crater counts in order to investigate the timing of the formation of the thumbprint terrain [9]. On the basis of our new map of the distribution of TPT, we see that most of the long ridges of cones seem to be located in a relative narrow zone at the periphery of the TPT, particularly in the western and northern parts of the basin floor (Fig. 1d). Also remarkable are the different distributions of long chains in the eastern and western parts of the TPT. The long chains of the TPT are more abundant in the western regions than elsewhere in Isidis. The central portion of the Isidis Basin is characterized by a large number of single cones/mounds or Cat. II-structures (Fig. 1b, c). NCR-structures are found throughout the basin (Fig. 1b). The gaps in the HRSC coverage (Fig. 1) complicates the accurate assessment of the distribution of the longer ridges. However, the absence of ridges in the southeastern part of the basin (Fig. 1d) suggests that their real distribution may be asymmetric relative to the center of the basin.

Natural gaps in the distribution of mapped structures around craters are caused by overprinting by ejecta blankets. Some gaps in the eastern part of the map are caused by wide fields of secondary craters. The TPT in these areas is presumably completely destroyed by impact events and it is not possible anymore to observe cones or chains of cones there. Because MOLA data show that the characteristic heights of the TPT cones are ~10 to 50 meters, it is relatively easy to cover the TPT with ejecta material or destroy them by secondary impacts. The heights seem only to depend on the diameter of the object, but not on the length of the TPT chains/ridges.

Discussion: Overall, we mapped 46813 objects, of which 55% are single cone structures, 32% are ridges of Cat. II, 9% are ridges of Cat. III, 3% are ridges of Cat. IV, and only 1% of the ridges consist of more than 10 coalesced cones (Cat. V). From this we conclude that any hypothesis for the origin of the TPT must be able to primarily explain the formation of cones and only secondarily the formation of cone ridges. The results of the mapping show that the distribution of long chains within the TPT is not random, and that the distribution of single cones and short chains of cones (Cats. I and II) is homogenous. In the center of the Isidis basin an absence of long chains is evident, whereas single cone objects are abundant. Also, a relatively sharp boundary of the distribution of long chains is visible in the western portion of our mapped area.

In many cases graben structures are formed on the rims of ancient buried craters (Fig. 2 red arrow). It is notable that the buried craters do not control the distribution of TPT structures. We conclude that the formation of the cones must be linked to the uppermost layer(s) of material.

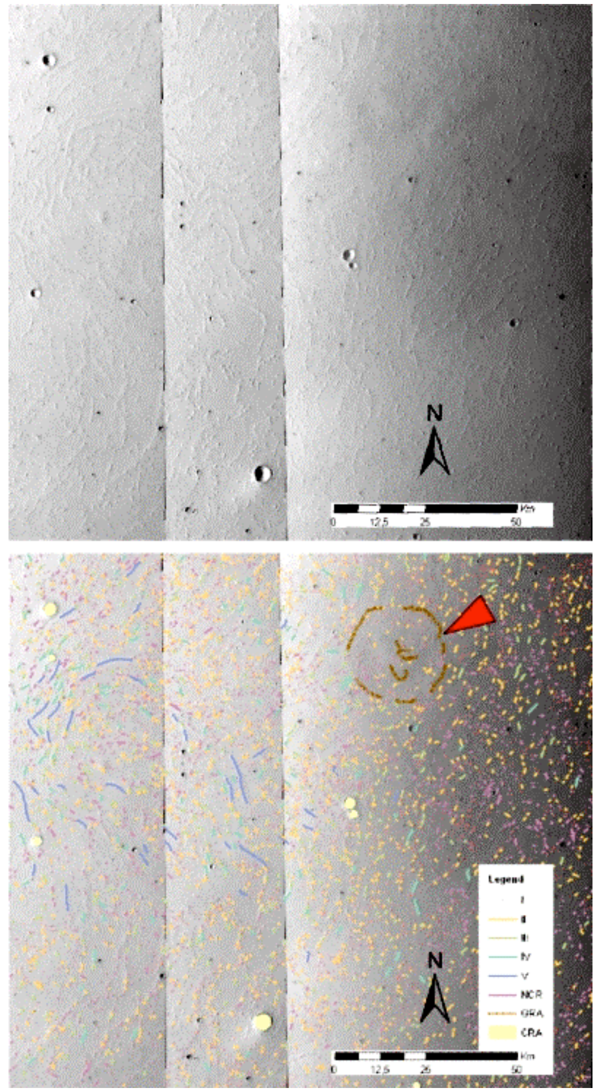

Figure 2: TPT morphology and mapping overlay.

Outlook and Future Work: We will continue mapping the Isisdis basin floor and the associated features as HRSC coverage for the presently unmapped areas becomes available. Meanwhile, we will focus on the detailed statistics of elevation variations across the region and how they influence the distribution of the TPT throughout the basin.

References: [1] Grizzaffi and Schultz, (1989), Icarus 77. [2] Hiesinger et al., (2009) LPS XL, Abstract #1953. [3] Hiesinger and Head (2004) LPS XXXV, Abstract #1167. [4] Tanaka et al. (2005), USGS SIM 2888. [5] Pithawala and Ghent, (2008), LPS XXXIX. [6] Pithawala and Ghent, (2008), EPSC 3. [7] Bridges et al. (2003), J. Geophy. Res. 108. [8] Pomerantz and Head, (2003) LPS XXXIV. [9] Ivanov et al., (2010) LPS XLI