Layer Thickness Determination of the Interior Layered Deposit within Ganges Chasma, Mars. C. Ismailos[1], F. Fueten[1], R. Stesky[2], J. Flahaut[3], A. Rossi[4], E. Hauber[5], [1]Department of Earth Sciences, Brock University, St. Catharines, Ontario, Canada L2S 3A1 <ffueten@brocku.ca>; [2]Pangaea Scientific, Brockville, Ontario, Canada K6V 5T5; [3]Laboratoire de Géologie de Lyon, Ecole Normale Supérieure de Lyon, Lyon, Université Lyon 1, F-69622 Villeurbanne cedex, France; [4]Jacobs University Bremen, 28759 Bremen, Germany; [5]Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany

Introduction: The formation of the up-to-11 km deep chasmata of Valles Marineris is thought to have taken place during a two-stage process [1, 2] of early ancestral basin formation, followed by the linking of the basins into their current geometry during the opening of Valles Marineris [3, 1]. Interior layered deposits (ILDs) occur throughout the chasmata of Valles Marineris [1], yet their origin remains uncertain. Most theories propose that ILDs fill ancestral basins, however multiple infill mechanism have been proposed (see references in [4]).

Detailed examination of the layering can help to narrow the range of deposition mechanisms. A few studies [e.g 4, 5] have provided estimates of layer thicknesses. Here we measure layer thicknesses within one large ILD within Ganges Chasma. The aim of the study is to document stratigraphic relationships and compare layer thicknesses with other ILDs.

Ganges Chasma ILD: Ganges Chasma, the easternmost chasma within Valles Marineris and only a single narrow outflow channel, is a good candidate for having been an ancestral basin. A single large (~100 km x 50 km) ILD is located within the chasma (Fig. 1A, B). While no clear basement is exposed, the best estimate for the elevation floor of this part of the chasma is ~-4000 m (Fig. 1C) while the top elevation of the ILD is ~ 250 m. Within HiRISE images, measureable layering can be detected at elevations ranging from -3350 m to –450 m, representing a stratigraphic range of nearly 3 km.

Methodology: A CTX mosaic was constructed using HRSC data as the base where available and substituting MOLA and Themis VIS data where no HRSC data were available. HiRISE images were rescaled to 1 m/pixel and registered to HRSC images and corresponding DTM (Digital Terrain Models) derived from HRSC stereo images. Layer measurements were taken along multiple transects. Transect length and mid-elevation of the transect were obtained in ORION, and the number of layers was counted along each transect. The local slope of the topographic surface was measured using ORION to correct for the topographic section effect. Wherever possible multiple measurements were taken in the same location. Measurements of layering attitude using ORION suggests that all layering is nealy horizontal, hence layers were assumed to be horizontal.

Only layers that could be traced in the original HiRISE image for at least 75 m were counted. This qualification had to be added because in some locations what appeared to be an intermittently visible layer boundary was located between two layer boundaries that could clearly be traced continuously for more than 75 m. Hence our estimates most likely represent layer thickness that err on the high side. Measurements were made at locations identified by yellow dots in Fig.1B.

Results: A total of 43 transect layer measurements were made in 6 HiRISE images. Representative images of layering are presented in Figs. 1D, E, F, G. We were able to measure layering of a relatively continuous stratigraphic range of nearly 3 km (Fig. 1H). Layer thicknesses range from 0.04 m to 3.46 m with an average thickness of 1.26 m.

Visual Observations. The overall geometry of the ILD is dominated by several nearly horizontal benches which can be traced for tens of kilometers (Fig 1B, C). Examination of layers and layer measurements immeduiately above and below several benches suggest that they do not correlate with significant changes in layer morphology. Layering may be internally disrupted and exhibit polygons, but significant fracturing is only seen in a few locations.

Discussion: Layer thickness measurements indicate that at least 3 km of stratigraphy of the ILD are composed of layering on average 1.26 m thick, with a maximum layer thickness of 3.46 m. The fact that what is interpreted as intermittently visible layering appears to occur between traceable layering suggests that some of the layering in this ILD is at the limit of HIRISE resolution and is only visible under fortuitous lighting conditions.

These layer thickness measurements contrast with similar measurements made on layers in Candor Mensa [6]. There, most of the stratigraphy was composed of layers 4 m to 10 m in thickness with only a thinner upper unit with layering <1 m to 6 m in thickness. More work, including direct layer measurements using HiRISE DTMs and mineralogical observations will be aimed at investigating this apparent difference between these two large ILDs.

References: [1] Lucchitta, B.K., N.K. Isbell, and A. Howington-Kraus (1994), *J. Geophy. Res.*, *99*, 3783-3798. [2] Schultz, R. A. (1998), , *Planet. Space Sci*., 46, 827–829, doi:10.1016/S0032-0633(98)00030 -0. [3] Lucchitta, B. K., and M. L. Bertolini (1990), Lunar Planet. Sci., XX, 590–591. [4] Fueten, F. et al. (2010), *EPSL*, 294, 343-356, doi:10.1016/j.epsl.2009. 11.004. [5] Lewis, *et al.* (2008) *Science* 322, 1532; DOI:10.1126/science.1161870. [6] Fueten et al. 2011, LPSC XLII, Abstract # 1255.

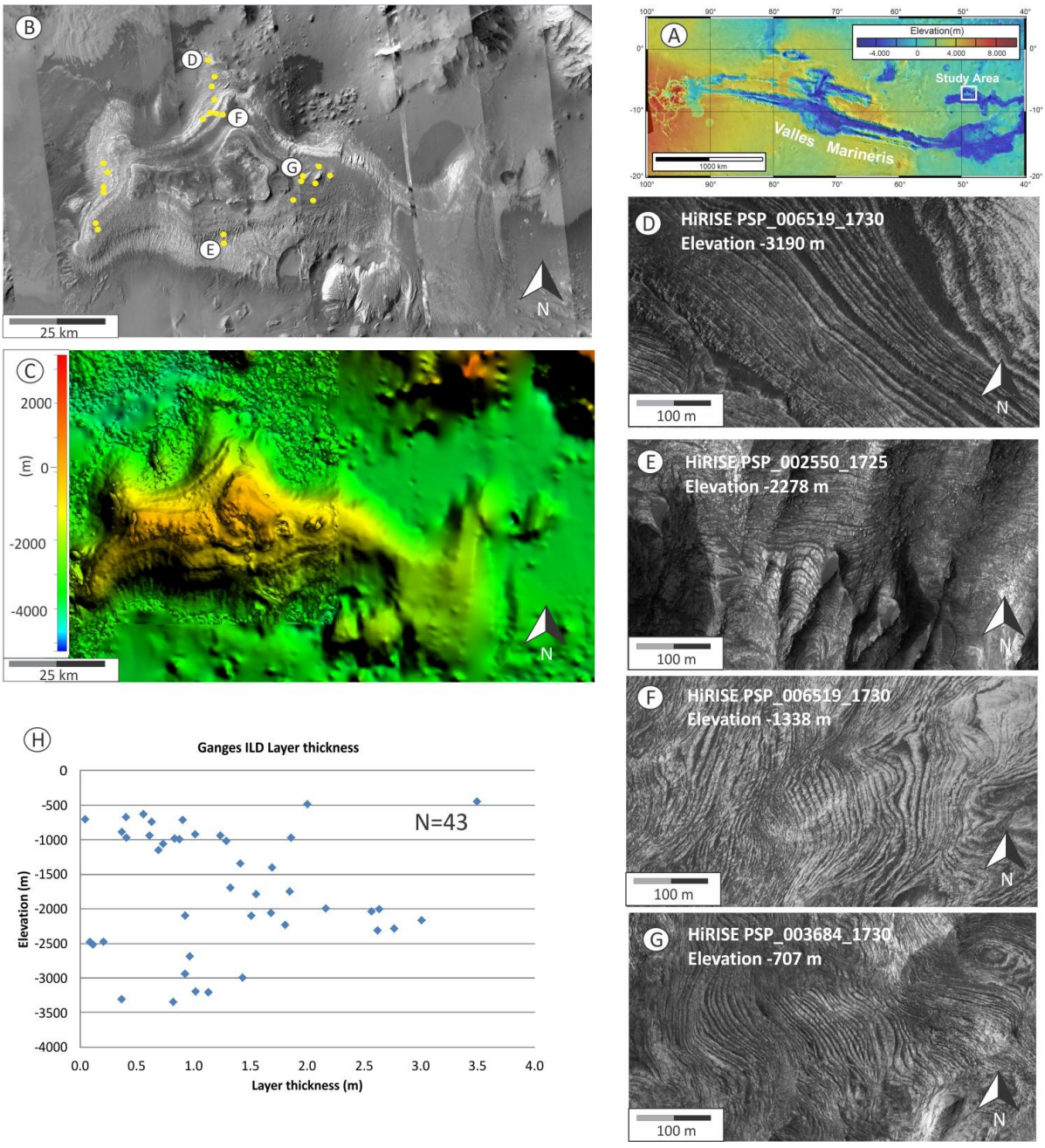

Figure 1: A) Location of study area. B) CTX composite of ILD within Ganges. Yellow dots indicate layer measurement site; markers D to G indicate locations of subfigures D – G. C) DTM composite of ILD using HRSC and Mola data. D-G) Examples of layers measured, including HiRISE image number and elevation. H) Layer thickness measurements vs elevation.