GEOMORPHOLOGICAL CHARACTERISTICS OF MASS-WASTING FEATURES IN IUS CHASMA, VALLES MARINERIS, MARS. K. T. Dębniak[1*] and O. Kromuszczyńska[1**], [1]Planetary Geology Lab, Institute of Geological Sciences, Polish Academy of Sciences, Research Centre in Wrocław ul. Podwale 75, 50-449 Wrocław, Poland; [*]krzysztof.debniak@twarda.pan.pl, [**]okromuszczynska@twarda.pan.pl

Introduction: Ius Chasma is an elongated trough constituting one of twelve depressions of Valles Marineris. The chasma displays evidences of various processes which enlarged, carved, and modified its walls and floors, including features of tectonic, water erosion, glacial erosion, ponding sedimentation, eolian, and mass-wasting origin. Geomorphological mapping performed on the basis of CTX image mosaics led to the development of detailed classifications of wall, floor, glacial, and mass-wasting units [1]. The abstract presents cartographic outcomes from investigation of landslide deposits and other mass-wasting features.

Ius Chasma: The largest western trough of Valles Marineris displays length of ~850 km, width up to 120 km, and depth locally exceeding 8 km. Ius Chasma is composed of two parallel, E-W trending valleys which are separated by Geryon Montes. This inner ridge is 270 km long, ~5 km high, and up to 26 km wide. It is a border between two grabens constituting northern and southern sub-basins. The most characteristic geomorphological features related to the chasma are extensive sapping channel systems (with the largest Louros Valles system), uphill-facing fault scarps along flanks of Geryon Montes [2], enormous landslides [3, 4], abundant walls of spur-and-gully morphology [5], and light-toned layered deposits on the plateau south of the trough [6].

Data and methods: The geomorphological map of Ius Chasma was prepared using 100 greyscale MRO Context Camera images (CTX), supplemented predominantly by MRO High Resolution Imaging Science Experiment images (HiRISE) and MGS Mars Orbiter Laser Altimeter data (MOLA). The map was produced in GCS Mars 2000 Sphere coordinate system and plate carrée projection (equirectangular projection). The process of map generation was divided into three steps, i.e. image gathering (JMARS), image processing and mosaicking (ISIS), and geomorphological mapping (ArcGIS). The spatial resolution of resultant CTX images was decreased from 6 to 12 m/pixel in order to ensure a fluent mapping procedure in ArcGIS software. Since the ISIS software exacts file size limitations, the introduced set of CTX images was divided into three mosaics (western, central, and eastern) covering the total area of over 375 000 km^2.

The proposed classification of landslide deposits was based on [7], expanded after detailed visual investigation of CTX images conducted in the scale of 1:10 000. Other mass-wasting features were mapped on the basis of comparative studies performed between terrerstial and martian landforms.

Results: The geomorphological map of Ius Chasma [1] contains 48 symbols, including large landslide units (scars and deposits), and other mass-wasting features (i.e. collapsed wall rocks, tongue-shaped feature, small landslides, major talus cones, bright material, and other outcomes of mass movements). The entire map covers an area of 86 048 km^2.

Large landslides. Ius Chasma is the host of 21 large landslide scars (labeled in Figure 1) and almost 23 000 km^2 of mass-wasting deposits divided into ten geomorphological types.

Large landslides are abundant along the northern chasma wall, where ten scars, including the enormous landslide complex in the western trough part (i.e. landslides no. *5-6* in Figure 1) and the Ius Labes complex

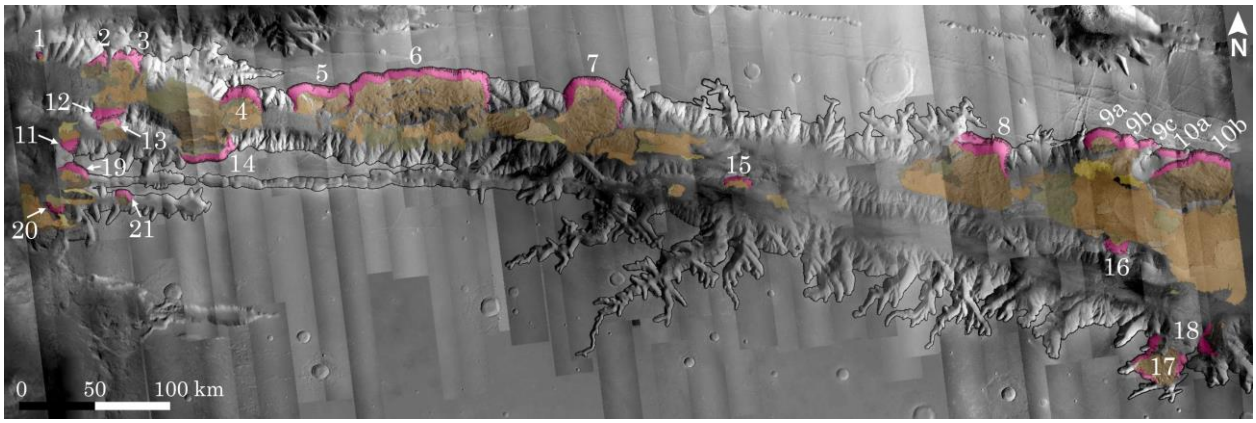

Figure 1. Locations of landslides in Ius Chasma, labeled *1-21*. *Pink* – landlisde scars, *brownish* – landslide deposits.

in the eastern area of chasma (no. *10*), are present. Eleven landslide scars are localized in other Ius Chasma regions, i.e. four on inner ridges, four on the southern chasma wall, and three in the western area associated with pit chains.

Large landslide scars are rotational and they are composed of two units: main slopes (active or grooved) and rocky wall tops. Active main slopes are vastly covered with talus cones, whereas the only grooved landslide scar area (in uphill section of landslide no. *2*) exhibits sandy, parallel waves of 100 m spacing. Rocky outcrops within topmost slope areas are arranged in rock falls of relatively constant lengths (~1-2 km). Locally, the outcrops display clearly visible wallrock layering.

The gigantic wallrock collapses led to the development of 22 969 km^2 of landslide deposits, constituting 27% of the entire area of Ius Chasma. They are particularly present in the northern Ius graben, covering most of the chasma floor. Large landslide materials have been classified into ten units displaying different morphological characteristics. (*1*) Undivided material (13 areas, 942 km^2) – unchanged mountainous rock blocks with preserved wall units, i.e. displaying main slopes and rocky wall tops. (*2*) Ridged material (13 areas, 1680 km^2) – mountainous deposits arranged in parallel to subparallel ridges, formed by directed rock sliding without evidence of chaotic movement. (*3*) Coarse material (52 areas, 8056 km^2) – the most widespread large landslide deposit unit composed of disordered, large-scale material displaying numerous scarps which imply secondary falls inside slided rocks. (*4*) Small coarse material (57 areas, 6067 km^2) – coarse deposits of smaller-scale lumps located further from scar than *coarse* material. (*5*) Grooved material (19 areas, 1688 km^2) – gentle lobate aprons of grooved or lineated deposits. Four large grooved deposits occur in the eastern part of chasma (within Ius Labes complex), and two smaller are present in the western landslides. (*6*) Gentle material (6 areas, 314 km^2) – rare type of landslide deposits, appearing as small-scale material of gentle surfaces, probably formed by water activity. (*7*) Rough material (38 areas, 2658 km^2) – small-scale deposits characterized by a high rate of degradation, occurring in various locations (including close and distant landslide areas). (*8*) Flat material (48 areas, 948 km^2) – smooth material, mainly located adjacent to landslide scars and between coarser lumps. (*9*) Remnant material (9 areas, 294 km^2) – highly degraded deposits located either in a distant landslide area as individual lumps or in an old debris apron as separated knobs. (*10*) Active material (5 areas, 323 km^2) – relatively thin covers of material displaying dynamic appearance, located on scarps and wall slopes in the eastern area of Ius Chasma.

Other mass-wasting features. (*A*) Collapsed wall rocks are the result of rock falls widespread in all major units of Ius Chasma. There are 463 collapsed wall rock areas covering 1918 km^2, of which the two largest are present within floors of sapping channels. They are coarse, highly cratered, old rocks that fell from adjacent walls and immediately settled. (*B*) Small landslide unit is a combination of several categories of mass-wasting landforms, i.e. rock avalanches, debris flows, and rock glacier-like features. There are 120 *small landslide* areas covering 579 km^2 in Ius Chasma. They are mostly associated with walls of spur-and-gully morphology. Ius Chasma is also the host of thousands of smaller landforms of mass-wasting origin. (*C*) Chasma wall slopes are covered with talus cones. There are 444 major talus cones in the trough, occupying the total area of 707 km^2 and displaying maximum lengths of 6-7 km. (*D*) Other mass-wasting features of small dimensions and less obvious morphologies are present predominantly on floor areas of major wall units. (*E*) In addition, the eastern part of Ius Chasma (centered at 8°52’S, 78°26’W) contains highly degraded light-toned deposits which could have been placed on the chasma floor in a mass movement event. The area is 33 km wide and 19 km long. The adjacent wall slopes are composed of light-toned, layered deposits which were a source for the landslide material.

Conclusions: Mass-wasting features mapped in Ius Chasma constitute the most abundant geologic units in the trough. The spatial relations between large landslides and other major units (i.e. walls of spur-and-gully morphology, sapping channels, basal escarpements of glacial origin) indicate the intense development of landslides in response to deglaciation which occurred during the terminal phase of increased geologic activity in Valles Marineris in Hesperian. Smaller mass-wasting features, especially talus cones, are still developing on chasma walls. Their abundance indicates the availability of source materials, predominantly on scars of large landslides.

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