CHAOTIC TERRAIN IN THE XANTHE TERRA AND HYDRAOTES CHAOS AREAS OF EASTERN VALLES MARINERIS AS SEEN BY THE HIGH RESOLUTION STEREO CAMERA (HRSC): EVOLUTIONARY CHARACTERISTICS, EROSIONAL PROCESSES, AND TIME-STRATIGRAPHIC RELATIONSHIPS.

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Introduction: From HRSC observations of image data of orbit 18 near eastern Valles Marineris, a wide range of high- and lowland morphologies have been observed and analyzed in detail. The rugged morphology of the features resembles that of terrestrial landforms dissected and eroded by water. Characteristic morphologies are defined by small buttes, angular mesas and debris aprons at varying elevation levels. The valley floors are situated at an elevation level of approximately -5100 m, whereas the relief of mesas varies between several hundred to a maximum value of more than 2500 m. The smooth surface texture and colour properties of the flat-topped mesas and surrounding highlands suggest similar ages. It has to be verified whether the different elevation levels of the mesas are (1) due to surface removal and subsequent abrasion, or whether (2) they are due to removal of subsurface material, block tilting or lowering of the remnant rocks. We carried out measurements to obtain crater size-frequency distributions in order to determine crater retention ages for corresponding areas. Furthermore, small scale height measurements were carried out by the use of a stereo comparator. The colour characteristics of varying geological and geomorphological units will be analyzed.

In particular, the bright material on the debris aprons of the mountains, on the rims of several mesas, and on the valley floors will be analyzed in terms of spectral characteristics and lateral distribution.The major goal of this procedure is to constrain the main erosional processes and the evolution of the characteristic terrains, and to understand the subsurface structure of the area.

Method: Heights of distinct mesas have been obtained from measuring parallaxes between HRSC's high resolution nadir and a stereo channel with a stereo comparator. This method allows to find height values for small features which are below the spatial resolution limit of the digital terrain model derived from HRSC processing. In order to derive height information, parallax shifts have been calibrated using the MOLA DTM. Heights range from -5100 m to 2500 m . Crater size-frequency distributions have been measured at three different height levels in Hydraotes Chaos. Then, the cratering chronology model by Hartmann & Neukum [1] was applied in order to obtain absolute cratering model ages.

Results: In top level mesa and highland plains of Xanthe Terra the cratering measurements reveal a long-lasting process of erosion which may have ceased 1.7 Ga ago or has slowed down considerably but continued maybe thereafter at a much lower level. Nevertheless it is not clear how long this second episode of erosion was going on due to lack of image resolution.

In what is now the Hydraotes Chaos area, the erosional process was much more effective and eroded the top level Xanthe Terra basaltic plains unit down to different levels in several episodes, thus creating mesa tops at several different intermediate levels.

The process of degradation slowed down considerably 400-200 Ma ago, and most of the former mesas and highland units had by then been eroded more or less down to the valley floor level.

These findings most likely mean that over a long period starting 3.7 Ga ago and ending sometime between 400 and 200 Ma ago, the valley area of Hydraotes Chaos first was formed by the action of flowing water because the morphology as now seen in the images at high resolution, colour and 3D, cannot be explained by any other process. Then, subsequent erosional processes do not seem to have been absolutely continuous, but the different mesa levels and erosional epochs showing up in the age measurements suggest that we deal with at least three extended episodes of erosional activity.

References: [1] Hartmann, W. K. and Neukum, G. (2001) Sci. Rev. 96, 165-194.