TRIBUTARY CANYON AND ASSOCIATED MASS WASTING FEATURES IN THE VALLES MARINERIS REGION. P. Singh[1], R. Sarkar[1], A. Porwal[1], [1]Geology and Mineral Resources Group, CSRE, Indian Institute of Technology, Bombay, (pragya.singh@iitb.ac.in).

Introduction: Tributary canyons on Mars are deeply incised features carved by aqueous processes. These are short, stubby with U-shaped cross sections, generally considered to have been formed by groundwater [1, 2]. However similar morphology can also be formed by overland flows, flash flooding or plunge pool erosion [3, 4]. Luo and Howard (2008) [5] show seepage weathering combine with fluvial run-off may be efficient enough to carve these amphitheater headed features.

Study area: We studied four locations in Valles Marineris region where there is a high density of tributary canyons, namely, Louros, Echus, Juventae and Ganges Chasma. Further, we discuss eastern part of tributary canyons in detail.

Data and Methods: Elevation data from MOLA 463m global data and THEMIS daytime IR datasets in a GIS environment were used to calculate aspect ratio of tributary canyons in four chasmata, namely, Ganges, Juventae, Echus and Louros with Valles Marineris.. Aspect ratio is calculated by dividing length of a tributary channel by its width at the mouth. Figure 2 shows length vs width at the mouth of a tributary canyon. Context Camera (CTX) [6] images are used for further detailed studies.

Tributary canyons on the western side of Valles Matineris: Tributary canyons on the west of the Valles Marineris region are densely branched and considered to have been formed by structurally controled groundwater flow [7, 8, 9].

Tributary canyons on the eastern side of Valles Marineris: Tributary canyons on the east Valles Marineris region are (i.e. Juventae and Ganges) are sparse, more stubby and and shorter than those on the western side of Valles Marineris. Apart from morphological differences, we also observe mass wasting features on the mouth of these tributary canyons, which are not seen on the western part. Multiple overlapping of lobes indicate multiple episodes of debris flows on both the chasmata (Fig. 3).

In Juventae Chasma we do not see any sign of overland flows. There are some inverted channels over the plateau area; they are directed away from the tributary canyons. In Ganges Chasma there are signs of overland flow.

Discussion: The presence of debris flows at the mouths of tributary canyons indicate their formation is associated with aqueous processes. The exact nature of the aqueous process that lead to the formation of tributary canyons could vary from groundwater sapping, flash floods, to waterfall erosion. However, the presence of debris flows at the mouth suggest that these tributary canyons have formed by sudden, catastrophic collapse. This requires a mechanism that is more complicated than currently known. Our future work would be to understand the possible formative mechanism which combine catastrophic debris flow process with tributary canyon formation.

References:

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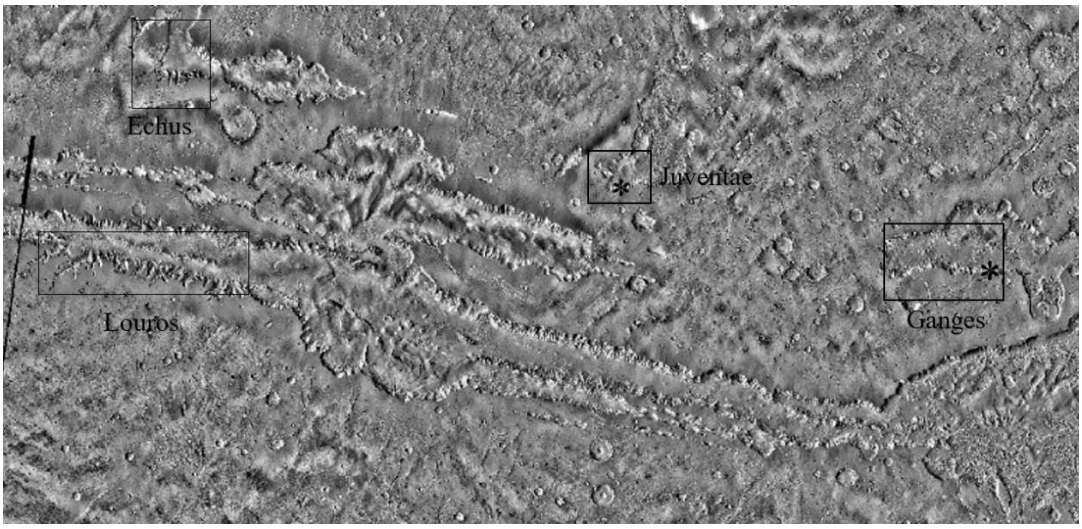

Fig.1. Valles Marineris region , black boxes show study area. (Image source: THEMIS daytime IR global mosaic). Asteric shows the location of Fig.3.

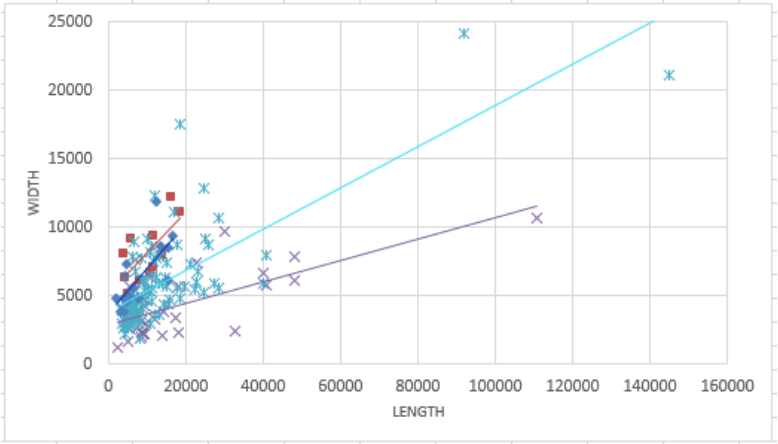

Fig. 2. Length vs width graph. (Trendline color: Red-Juventae blue-Ganges, cyan-Louros, purple-Echus, units are in meter)

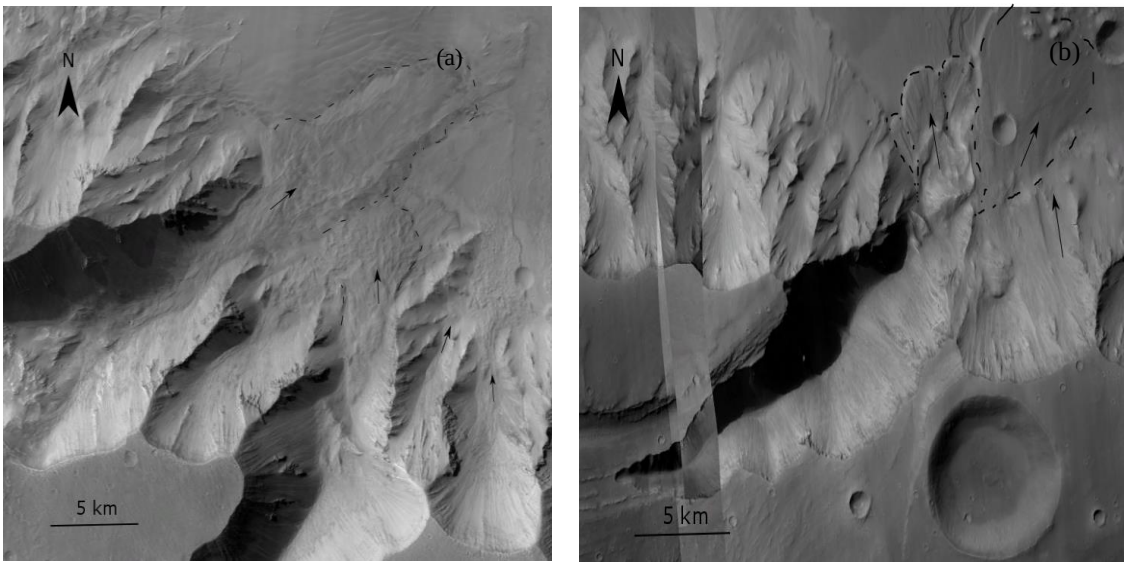

Fig. 3. Debris on the mouth of a tributary canyon on (a) Juventae Chasma (b) Ganges Chasma. Dashed lines show outline of debris while black arrows show flow direction. (image source: CTX images)