GEOMORPHIC PROCESSES AND ORIGIN OF CUSUS VALLES ON MARS. S. Anbazhagan and M. Chinnamuthu, Centre for Geoinformatics and Planetary Studies, Periyar University, Salem-636011, Tamil Nadu, India. (anbu02@gmail.com,chinnamtech@gmail.com).

Introduction: The planetary geoscientist are interested to know about the origin of valley networks and climatic conditions at the time of fluvial activities on the Martian surface. The presence of water and fluvial activity in the past on Martian surface was supported by several evidences [1, 2]. It has two contrast fluvial landforms such as channel networks developed by precipitation and outflow channels. The precipitation driven valley networks on Martian surface are almost similar to the drainage pattern and networks in the terrestrial environment. Quite a good number of studies focused on fluvial activity, atmospheric precipitation, origin of valley network formation [3,4,5 & 6]. Though number of studies were conducted, still the formation of Valley networks remains divisive and it needs further studies. In the present study we try to understand the geomorphic processes and origin of Cusus Valles on Mars.

Study Area: Cusus Valles located in the south east of Cassini crater at 14.34^0 N 50.5^0 E on Mars (Figure 1). Cusus valles and its channel branches were probably carved out along structural discontinuities by flooding during the Noachian period. The channel length extends about 249 km from the possible source area in North Arbia Terra to the lowland plains in Antoniadi crater. The channel system originated from the south western part of Antoniadi crater.

Methodology: The geomorphological features, topography, slope and channel geometry of Cusus Valles were studied with help of Martian remotely sensed data with different spatial resolutions. The Mars Odyssey Thermal Emission Imaging System (THEMIS) data were used for mapping of drainage and morphological features. THEMIS has day and night time image covered under visible and infrared spectrum. MGS Mars Orbiter Laser Altimeter (MOLA) data in 463m spatial resolution is used for plotting of channel profiles in association with THEMIS image. ArcGIS 10.4 and ENVI 5.2 software were used for mapping.

Geomorphic processes: The Cusus Valles developed with moderate relief topography. The longitudinal profile drawn with help of MOLA data along the main channel indicate the concave depression of drainage basin (Figure 2). In which numbers of tributaries are arranged on both side of the main Valleys. The basin elevation ranges from 1100m in the catchment and 200m in the downstream with relief difference of 900m. The width of the main channel ranges from 2km to 5km with an average value of 3.65km.The depth of channel ranges from 70m to 150m over the length of 250km (Table 1). In most part of channel developed in V-shaped valley and at some downstream sections broad U-shaped valley formation. The Cusus Valles developed dendritic valley networks with coarse texture (Figure 1 & 2). The topography, river profile and valley networks are indicate the basin evolved through erosion due to running water.

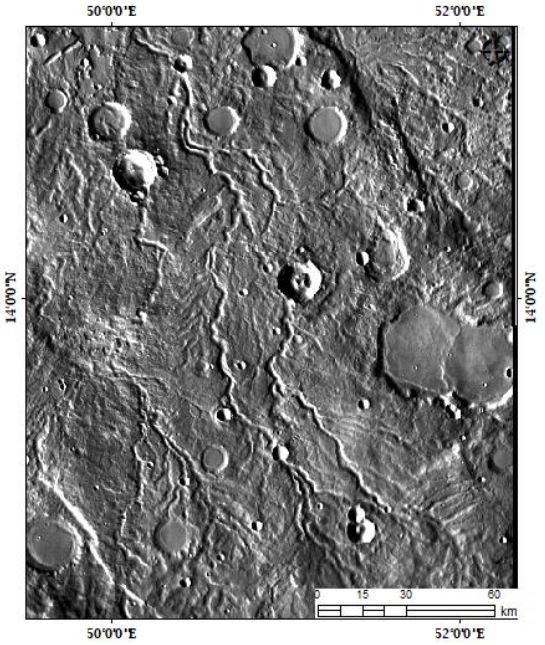

Figure 1 THEMIS IR day image show the valley networks and craters of Cusus Valles

Results and discussion: The order of streams segments are clearly interpreted from THEMIS IR image (Figure 1) and watershed map extracted from MOLA data (Figure 2). The source areas of finger prints or 1st order streams at different elevations in the basin area do not support groundwater sapping process. However, it indicates that an atmospheric process combining precipitation and surface runoff was responsible for development of valley networks. Most of the valleys in Cusus Valles are significantly wide, deep and V- shaped valleys. The average width and depth of the valley are respectively 3.65km and 100m. These geometry of channel network invariably devel-

oped due to the mechanism of erosion of running water. In general, the valleys developed by surface runoff are characterized by narrow, deep and V-shaped configuration in the upstream and U-shaped cross-section with increase of discharge in the downstream [7]. Similar condition observed in the downstream section of the Cusus Valles. Mostly, they are arranged in a tree-like dendritic drainage pattern with large drainage density. Though the valley networks have geomorphic characteristics consistent with runoff, the origin of network by surface runoff is frequently not considered because of their low drainage density [8]. However, there is no valley in the Cusus show theatre-like termination, the development of valley network by ground water sapping is ruled out. The beginning of narrow and shallow valleys are mostly characterized by a cone shape, which suggests formation of valleys by precipitation and surface runoff. At few locations, the valleys are filled with dust mantle. Based on our observation, the Cusus Valles might have developed due to combination of surface runoff, infiltration, seepage and groundwater flow. The valley network of Cusus Valles is comparable to a terrestrial network in semi-arid to arid region [4]. Most of valley networks developed on slope lesser than 5^0. The distribution of such valley networks is consistent with rainfalls that eroded the Cusus Valles. Overall, our observation supports that the valley networks developed by fluvial processes controlled by an atmospheric water cycle during late Noachian to middle Hesperian time period.

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References:

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Table 1 Channel geometry of Cusus Valles

Distance from catchment point (km)	Width (Km)	Depth (m)	Shape	Elevation (m)
27.0	4.0	150	V	1100
55.0	1.5-2	110	V	900
71.0	5.0	100	U	800
94.0	4.0	70	U	700
116.0	3.5	90	V	500
132.0	2.5	100	V	500
153.0	2.0	70	U	400
184.0	4.0	120	U	400
220.0	3.0	100	V	300

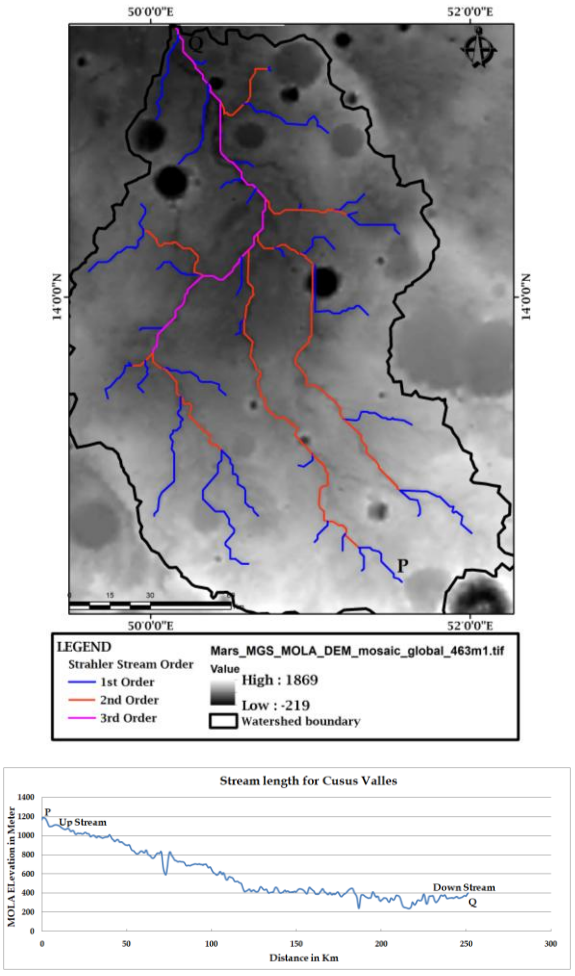

Figure 2 MGS MOLA image show the elevation and watershed boundary of Cusus Valles. The longitudinal profile show the development of valleys in concave slope.