HRSC/MEX ANALYSIS OF VALLEY NETWORKS ON ECHUS CHASMA PLATEAU AND IN AEOLIS REGION

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**Introduction:** Since visible images have been acquired by Viking orbiter in 1976, valley networks have been mainly identified in the heavily cratered uplands dated Noachian (>3.5 Gyr). Valley networks on Mars have been the subject of considerable debates about their formation processes since three decades [1-5]. They have been first attributed to fluvial processes under conditions 3.5 Gyr ago that were warmer than the present cold climate. However, many other hypothesis like geothermal activity, subglacial melting or sapping processes have been proposed because of the low organisation. The Mars Express High Resolution Stereo Camera (HRSC) data give a wide range of tools to study fluvial valleys on Mars both using high resolution images and DTM extracted from stereoscopic images [6]. We determined the organisation of valleys in relationships with regional topography and structural geology. We analysed quantitatively the valley morphology and the valley network morphometry in order to determine process(es) which is(are) at the origin of valleys. We focussed our study on two locations: Echus Chasma plateau and Aeolis region.

**Valley networks in Echus region:** This region is located at the North of Valles Marineris. On the plateau at the west of Echus Chasma canyon (278-281°E, 0-5°N), valley networks show similar fluvial dendritic pattern visible on the Earth (Fig. 2). These valleys were identified from their difference of thermal properties on THEMIS images [10]. HRSC provides the possibility to look in detail to their morphology and geometry with the spatial resolution at ~20 m/pixel (Fig. 2). Valleys in Echus area are thus not restricted to the locations where they have been observed through THEMIS images [10]. They extend over more than 200 km along Echus Chasma western plateau. On the colored HRSC image (Fig. 2), the valley networks appear in yellow in contrast to brown substratum because of the dust filling by wind (some dunes are visible on HRSC images). This landscape is similar to that observed in the Sahara where valley networks formed during wet Pleistocene are now partially buried by sand dunes. These valley networks display a mature dendritic pattern with high bifurcation ratio [11, 12] ranging from 2 to 5. The drainage density, i.e. the ratio between the total length of valleys and the area of the watershed [11], allows to evaluate the level of maturity. The highest drainage system reaches a density of 1.4 km$^{-1}$ mapped at 13 m/pixel resolution. This is the second highest drainage density on Mars after Alba Patera volcano and it is similar to terrestrial values of valleys on Hawaiian volcanoes [13]. Only few valleys are detected on the 200 m/pixel resolution HRSC DTM. This shows that they are shallow pristine landforms even if they could have been originally deeper and filled later by sand. They can be dated to the Late Hesperian epoch from chronological relationships. All of the characteristics of the dendritic valleys are similar to terrestrial features of surface run-off due to atmospheric precipitations.

**Conclusion:** Valley networks both observed in Echus and Aeolis regions display dendritic shape and morphometric characteristics of terrestrial fluvial networks. They may have formed by precipitations during a wetter and warmer climate than the present-day climate on Mars surface.
Figure 1. Extract of HRSC image (orbit 228) located in Aeolis region. Numerous dendritic valley networks incised Noachian densely cratered terrains.

References:

Fig. 2: HRSC color image (orbit 97) of West Echus Chasma plateau. Numerous dendritic valley networks incised the Hesperian terrains.