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A Morphological and Morphometric Comparison of Sapping Valley Networks on Earth and Mars

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A system of inferred sapping canyons located along the southern margin of Valles Marineris, have been identified from the High Resolution Stereo Camera (HRSC) on board ESA's Mars Express mission. The geomorphic characteristics of these valleys bear a strong resemblance to terrestrial valleys attributed to formation by spring sapping with typical features such as theatre-headed terminations and low drainage density. Here we analyse the geomorphology of a set of sapping valleys located south of the San Juan Basin in New Mexico, USA. Analysis of this terrestrial analogue may provide a model for developing geomorphic criteria useful in the recognition of features generated by groundwater sapping on Mars.

Morphological and morphometric analysis on 10-m -resolution digital elevation models of the New Mexico valleys show that they have low drainage density, amphitheatre heads, short stubby tributaries, relatively constant valley widths, step-like longitudinal profiles, U- to box-shaped cross sectional profiles and strong evidence of structural and stratigraphic control on valley patterns. Quantitative analysis of valley morphology was conducted using ArcGIS and Rivertools. We show that valley morphology is a strong function of the bedrock stratigraphy into which they are incised. The morphological features of the New Mexico valleys are compared quantitatively with examples from Valles Marineris. Our results are also compared with valleys formed by fluvial overland flow processes, which typically exhibit high drainage density, increasing valley widths downstream, tapered valley heads and V-shaped cross sections.