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Evidences of Wet Climate on Early Mars from Analysis of HRSC Observations

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Both Geomorphological and mineralogical evidence point to the episodic availability of liquid water on the surface of early Mars. However, the distribution of water was not uniform over space and time. Considerable environmental and climate variations due to latitudinal or elevation effects combined with a diverse surface geology caused distinctively different of local conditions that influenced the planet‘s water content. The history of water on Mars has been constantly revised and refined during the past years. Landforms such as widespread valley networks, fluvial deposits and associated assemblages of hydrated clay minerals support the hypothesis that the Martian climate was to some extend warm and wet during the early history of Mars [e.g.,1,2]. At the boundary between the Late Noachian and the Early Hesperian, environmental and climate conditions changed significantly and resulted in a transition towards a colder and dryer climate. The intensity of aqueous activity decreased throughout the Hesperian, including a transition from long-term and repeated precipitation-induced fluvial activity towards reduced, short-term, spatially isolated and groundwater-dominated fluvial erosion [e.g.,3,4,5,6]. At the end of the Hesperian, fluvial erosion has mostly ceased and volcanic, aeolian and glacial processes are interpreted to be dominant on Mars. The Early Amazonian was characterized most likely by a cold and dry climate that was similar to the conditions on recent Mars. However, Mars’ climate and aqueous history, in particular the timing of the termination of fluvial activity and the transition from precipitation-induced toward groundwater-dominated erosion as well as the temperature with time, is still subject to debate. Modeling of flow transport processes revealed that the formation of deltas on Mars geologically requires only brief timespans [7] and, based on discharge estimates, the formation of erosional valleys also needs less than a few million years and seems to have occurred only episodically [4,8]. Recently formed gullies and alluvial fans might have experienced even shorter periods of liquid water (minutes to hours), as shown by the identification of debris flow deposits that were formed by short-lived high-energy mass-wasting events [9]. Even with no adequate global climatic conditions, such as a long lasting warm and wet Mars, water- and ice-related surface processes occurred on an episodic timescale. However, the duration of the episodically appropriate conditions seems to be restricted to geologically relatively short periods.
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