



Geologically recent small-scale surface features in Meridiani Planum, Mars

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Leveed fissures and gutters, small scale (<1m) depositional and erosional features that have been imaged at several locations in the equatorial Meridiani Planum region by the Mars Exploration Rover Opportunity, occur in loose, dark basaltic sands that partly cover exposures of light-toned bedrock. Leveed fissures appear to have been formed by venting from beneath; possible explanations include wind creating blowholes near crater margins, volcanic fumarole activity, or gas/vapour escape resulting from the decomposition of small pockets of ground ice, methane clathrates or hydrated sulphate minerals. Some leveed fissures cross-cut and are therefore younger than aeolian ripples which are thought to have last been active c. 50,000 years ago. Some gutters are sharply defined and fresh, internally terraced, have a hole or hollow at or near one end, and in one case seem to give way to small depositional fans downslope; they have the appearance of having been formed by liquid flow rather than by wind erosion. There is evidence elsewhere that contemporary ground-ice thaw and consequent transient surface runoff may occur occasionally under present conditions in low, near-equatorial latitudes on Mars; short-lived (even for just a few minutes) meltwater emission and flow at the surface could erode gutters before evaporating. The decomposition of buried pockets of methane clathrates, which theoretical considerations suggest might be present and stable even in equatorial regions, could give rise to both methane venting (leveed fissures) and transient surface water (gutters). Yet another possibility is the decomposition, in response to local changes in thermal conditions, of hydrated magnesium sulphate minerals in the bedrock, which could release liquid water to the surface. Whatever their explanation, these features hint at previously unrecognized, young (perhaps even contemporary) martian surface processes.