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Liquid Water on the Surface of Mars Today: Present Gully Activity Observed by the Mars Reconnaissance Orbiter (MRO) and Mars Global Surveyor (MGS) and Direction for Future Missions.

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Eight new flows in martian mid-latitude gullies have been found using the MRO Context Camera and MGS Mars Orbiter Camera. Each formed during 1999–2009. Using MRO HiRISE images, we find that the morphology and inferred emplacement behavior of these features is consistent with those of debris flows fluidized by a liquid medium and not by dry, granular flows. Evidence comes from the patterns of flow around obstacles, ponding in and subsequent overtopping of topographic depressions, and super-elevation of deposits on channel banks where the channels change direction, attributes consistent with a liquid but not with fluid-like granular flow. Additional evidence includes anastomoses in distal reaches and lobate terminations. Of the 8 flows, 3 have formation dates constrained to within a single Mars year (although not the same year); these 3 formed during autumn to early spring, demonstrating that summer warming is not participating in creating the liquid (i.e., that would melt snow or ice).

The new gully deposits indicate that some gullies are currently active, suggesting that Mars has liquid water today and it occasionally appears on the planet's surface. NASA's Mars Exploration Program has focused on the "follow the water" theme and is now shifting toward "habitability" and life detection. Places where liquid water comes to the Martian surface today warrant detailed investigation.

Martian astrobiology involves the search for evidence of extinct and extant life. Discovery of ancient sedimentary rocks shifted emphasis from the Viking-era pursuit of present-day microbial life to MSL's focus on habitable environments. Recent descriptions of contemporary methane production have renewed interest in searching for extant life. Missions to locations of potential present day life, whether indicated by methane or liquid water, must deal with the associated planetary protection issues (they are "special regions"). More information about such locations is critical. Present mission planning is focused on methane (a 2016 trace gas orbiter), while the on-going gully activity is not being subjected to the same level of examination. Active gully locations might represent the optimum landing site for the much-discussed astrobiology rover mission (2018), provided additional information can be developed (i.e., the occurrence and recurrence rates and locations, and further evidence of the role of water). Long-term orbital monitoring at high resolution plus lander deployment from orbit after activity is detected are key gully mission objectives, as are the development of vehicles that can negotiate steep slopes and instruments that can detect sub-surface ice and/or water. As an added benefit, rather than learning only about a specific landing site, the knowledge gained from a single landed mission at a gullied site would be applicable to thousands of other locations on Mars.

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