



Geomorphic evidence of lobate deposits in gullies on Mars – global survey using HiRISE images

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Gullies on Mars, found between 30°-75° in both the hemispheres, represent steep slope drainage systems comprising an alcove, a channel and a depositional apron [1]. Lobate deposits similar to those found in terrestrial debris-flow gullies have been observed in martian gullies, consequently researchers suggested that water-bearing debris-flows likely formed martian gullies. However, since there are only few sites on Mars where the evidence of lobate deposits is preserved, and recent observations have revealed present-day modifications in martian gullies that result in features akin to water-bearing debris-flows [2], sublimation of seasonal CO₂-frost has been suggested to drive gully formation [2]. Thus, water has been suggested to never have been involved in gully formation [2], thereby raising a question whether lobate deposits are from wet (water-bearing) or dry (CO₂-frost) flows.

To decipher whether the CO₂-frost driven mechanism has formed the entire suite of gullies, we have conducted geomorphic investigation utilizing the High Resolution Imaging Science Experiment (HiRISE) images of the craters emplaced between 30°-75° in both the northern and southern hemispheres to document evidence of overlapping lobate deposits. We primarily aim to infer whether the geomorphic evidence of overlapping lobate deposits are widespread and whether their presence reflects a global climate signal. Furthermore, we aim to understand the orientation preferences and slope ranges of crater walls on which lobate deposits are found and examine whether the age of the craters containing evidence of lobate deposits influence their formation and distribution.

We have found 20 new sites (on crater walls) on Mars (6 in the north and 14 in the south) in which unambiguous lobate deposits are preserved. Overlapping lobes are evident at all the sites, such as stacking of relatively small-sized individual lobes or laterally elongated lobes at the fan termini or at the fan surface. We use the most up-to-date global data on gully orientation [3] to compare the orientation of sites with gullies and those with lobate deposits. We measure the slope of surfaces dominated with overlapping lobes using digital terrain models (DTM) from Context camera (CTX) stereo images and compare them with previously reported values of slopes estimated for lobate deposits [4-5]. The crater age will be used to infer if there is a preference for a time-period during which the lobate deposits are emplaced. Together, we will use our observations to decipher the origin of lobate deposits, and examine the possible role of water to critically assess the hypothesis that present-day CO₂-frost driven processes can explain the formation and evolution of entire suite of martian gullies.

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