



Sedimentological evidence for debris-flow formation of Martian gullies

Tjalling de Haas (1), Ernst Hauber (2), Dario Ventra (1), Susan Conway (3), and Maarten Kleinhans (1)

(1) Faculty of Geosciences, Utrecht University, Utrecht, Netherlands (t.dehaas@uu.nl), (2) DLR-Institut für Planetenforschung, Berlin, Germany, (3) Department of Physical Sciences, Open University, Milton Keynes, UK.

Gullies are among the youngest landforms formed by liquid water on Mars, and therefore of critical importance in resolving the planet's recent hydrologic and climatic history. The key to estimating the amount of liquid water involved in gully formation is their formative mechanism. Water-free sediment flows, debris flows and fluvial flows, which all require very different amounts of liquid water, contributed to gully formation but their abundance and effectiveness differs greatly between sites. We show that many gullies dominantly formed by debris flows, based on sedimentological analysis of outcrops in gully-fans rather than surficial debris-flow features, which are often degraded beyond recognition by weathering and wind erosion or masked by ice-dust mantling. This resolves the controversy between previously published morphometric analyses implying debris-flow formation and observations of modified fan surfaces often interpreted to have formed by fluvial flows. Furthermore, it shows that deriving formative processes on gullies from surface characteristics can be highly misleading, which should therefore be inferred from multiple approaches, including sedimentological outcrop and morphometric analyses.