



## **Earth-like aqueous debris-flow activity on Mars at high orbital obliquity in the last Ma**

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Mars is currently very cold and dry and its thin atmosphere makes liquid water at its surface exceptionally rare. However, climatic conditions differed during periods of high orbital obliquity in the last few millions of years, and liquid water was probably more abundant, as testified by the widespread occurrence of mid-latitude gullies: small catchment-fan system (Fig. 1). There are no direct estimates of the amount and frequency of liquid water generation during these periods. We determined debris-flow size, frequency and associated water volumes in Istok crater, and show that debris flows occurred at Earth-like frequencies during high-obliquity periods in the last million years. This implies that (1) local accumulations of snow/ice within catchments were much more voluminous than generally predicted; (2) melting must have yielded centimeters of liquid water in catchments; and (3) recent aqueous activity in some mid-latitude craters was much more frequent than previously anticipated.