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1 Outburst Flood from the Martian north polar Ice Cap constrained from streamlined Volcanoes

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The margins of the Martian polar ice caps are irregular, with shallow embayments and deep chasms exhibiting steep, semi-circular scarps at their headwalls. Two possible mechanisms have been proposed for scarp formation, wind erosion (Edgett et al., Geomorphology, 2003) or meltwater outflows (Fishbaugh & Head, J. Geophys. Res., 2002).

In this study, we look at a smaller, recent outflow region, more suitable for studying the active dynamics of the ice cap than the older chasms. The presence of streamlined volcanoes is sited as evidence of an outflow mechanism. By analysing the alteration of cone shape with respect to a gaussian model derived from unaffected volcanoes nearby, we can conclude that material has been eroded from the volcanoes themselves. Experiments suggest that scour pools in the polar deposits behind the volcanoes have formed as a result of flow past a conical obstruction and the dimensions of the scour are clearly related to flow properties.

The scour pools give us a firm constraint on the minimum flow depth and by comparison with typical jökulhlaup hydrographs, scaled for Martian conditions, a discharge estimate in the order of 10^8 m^3s^{-1} is obtained. We use these constraints on discharge to evaluate the likely sourcing mechanism, observing that the upstream area is characterised by subglacial volcanicity and regional ice cap subsidence.

We believe that a catastrophic release of meltwater was channelised and followed a path that was influenced by paleotopography. Small, sustained flows from the same source incised other small channels and larger outflow events led to the formation of

large scarps, which were subsequently modified on a smaller scale by wind erosion.