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Evidence for recent wet-based crater glaciation in Tempe Terra, Mars?

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Evidence for basal melting of putative debris-covered glaciers in Mars’ mid-latitudes is extremely rare.

- The glaciers are currently frozen to their beds, but has this always been the case?
- Eskers (Fig 1) emerging from two mid-latitude glaciers [1-2] indicate at least two localized melting events beneath existing glaciers ~110-150 Myr ago (Fig 2).

Eskers indicate past glacial melting.

Are glacier-linked sinuous ridges in Chukhung Crater eskers?


The two sinuous ridge populations are morphologically distinct, supporting different origins.

- The esker-like ridges are younger, more sinuous, and have sharper crests than the inverted channel-like ridges (Fig 5).
- However, the ridges have similar dimensions, so differences in crest morphology could be due to differences in degradation state rather than formation mechanism.

The esker-like ridges ascend valley walls.

- Esker-forming meltwater can ascend bed slopes under hydraulic pressure in subglacial tunnels [8]. Ascent of valley walls (Fig 6b) is inconsistent with deposition under gravity-driven flow in subaerial fluvial channels.
- However, ascent of slopes could be inherited from differential erosion under the alternative inverted channel hypothesis, rather than a primary feature.

There are challenges for the esker hypothesis.

- The esker-like ridges could be a second population of inverted channels.
- Glacial deposits (Vff, Gtr, Rpu) covering the southern crater floor hinder scrutiny of the relationship of the esker-like ridges to pre-glacial fluvial deposits.
- Eskers are ice-contact deposits but there is no additional evidence for past glaciation northward of the moraine-like deposits (Gtr & Rpu).
- There is one esker-like ridge system on the northern floor, where there is no evidence for glaciation.

Lessons from Chukhung Crater.

- Even where sinuous ridges emerge from existing glaciers, and where they have esker-like non-slope-conforming topographic signatures, conclusive identification as eskers is complicated by similarities in form between inverted channels and eskers [e.g. 8].
- Regional mapping and quantitative 3D morphometric analyses [e.g. 2,9] should always be performed before an esker origin can be concluded. Such analyses are ongoing for Chukhung Crater.

References:

Acknowledgements: We thank Caleb Fassof, Edwin Kier and David Mayer for drawing our attention to the study site (CF & ER), and providing DLMs (EK & DM). The Royal Astronomical Society and the British Society for Geomorphology funded FEGB to attend this conference. This work was funded by STFC grants ST/N50427X/1 (FEGB) and ST/L000771/1 (MR/M01993X/1). SJS is supported by the French Space Agency CNES.

The esker-like ridge [Ssr] superposing inverted channel-like ridge [Usp] (extent in Fig 3, CTX image P40_002577_2186_XN_38N072W), and (b) topographic profiles AA’ & BB’ from (a) extracted from digital elevation model generated from HiRISE images ESP_017477_2190 and ESP_018545_2190 [6].