Morphometric Characterisation of Eskers Associated with an Extant Mid-Latitude Glacier on Mars

How to cite:

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Version: Poster

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https://www.hou.usra.edu/meetings/lpsc2017/pdf/1238.pdf

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Evidence for basal melting of modern putative debris-covered glaciers (DCGs) on Mars is extremely rare.

- Modern DCGs are likely frozen to their beds, but has this always been the case?
- Gallagher and Balme [1] identified sinuous ridges in the foreland of a late-Amazonian-aged (~150 Ma) DCG in Phlegra Montes (Figs 1-3).
- They interpreted these ridges as young eskers (Fig 4) – the first of their kind identified in association with a modern DCG on Mars.

Eskers are diagnostic of glacial melting.

- Eskers are ridges of sediment deposited by meltwater in ice-walled, typically subglacial drainage conduits, and subsequently exposed by glacier retreat (Fig 4).
- Their morphometry is strongly controlled by the geometry of their parent meltwater conduits which, in turn, is controlled by hydraulic conditions within them [e.g. 2].

We characterise candidate esker morphology with new high-resolution 3D data.

**Plan-view geometry**

<table>
<thead>
<tr>
<th>Segments</th>
<th>Systems</th>
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<tbody>
<tr>
<td>Mean</td>
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<tr>
<td>Median</td>
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<td>Min</td>
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<tr>
<td>Max</td>
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</table>

**Cross-sectional morphology** (Zone 2)

- Similar heights to Icelandic eskers (~1 - 14 m) [6] (Fig 8a).
- Width more similar to terrestrial eskers (~10s m - 2 km [2,6]) than Dorsa Argentea [4] (Fig 8b).
- Intermediate side slopes between Icelandic eskers (~11-22°) [6] and Dorsa Argentea, Mars [4] (Fig 8c).
- Lower side slopes than terrestrial eskers could result from fundamental differences in subglacial hydrology between Earth and Mars, which should be explored further.

**Ongoing work**

Phlegra Montes candidate esker morphometry

- Tests for esker-like response of ridge height to longitudinal bed slope.

NEW DCG-linked candidate esker in a similar graben setting

- Abstract #1234, this conference.
- Supports the hypothesis that elevated geothermal heat was a prerequisite for recent basal melting of mid-latitude glaciers on Mars [1].

Modelling environmental conditions required for basal melting in Phlegra Montes

- Exploring atmospheric temperature and geothermal heat scenarios using the JPL/University of California Ice Sheet System Model (ISSM) [8].

**References**:

[8] Leouere, E. et al. (2012), JGR, 117(F1), F01022.

**Acknowledgements**: FEGB is funded by STFC grant ST/N00218X/1 and is grateful for travel support from the 2017 PSI Pierazzo International Student Travel Award. We are grateful to R.D. Storrar for the Canadian esker data.