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

Conference or Workshop Item

How to cite:


For guidance on citations see FAQs.

© 2017 The Authors

Version: Poster

Link(s) to article on publisher’s website:
https://www.hou.usra.edu/meetings/lpsc2017/pdf/1238.pdf

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online’s data policy on reuse of materials please consult the policies page.

oro.open.ac.uk
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 morphometry with new high-resolution 3D data

Plan-view geometry

<table>
<thead>
<tr>
<th>Segments</th>
<th>Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>DA</td>
</tr>
<tr>
<td>Min</td>
<td>1.00</td>
</tr>
<tr>
<td>Median</td>
<td>1.02</td>
</tr>
<tr>
<td>Mean</td>
<td>1.05</td>
</tr>
<tr>
<td>Max</td>
<td>1.22</td>
</tr>
</tbody>
</table>

Cross-sectional morphology

- Similar heights to Icelandic eskers (~1 – 14 m [6]) (Fig 8a).
- Widths 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].

Acknowledgements: FEGB is funded by STFC grant ST/N00421X/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.


Fig 1: Global topographic context of Phlegra Montes from Mars Orbiter Laser Altimeter (MOLA)

Fig 2: Regional topographic context from MOLA. Black arrows show sections of a regional graben, in which the candidate esker is located. Extent in Fig 1.

Fig 3: Context Camera (CTX) image mosaic of candidate esker in proglacial zone of the parent DCG (lined valley W). Extent in Fig 2.

Fig 4: Schematic of subglacial esker formation

Fig 5: New High-resolution Imaging Science Experiment (HiRISE) anaglyph ESP_044804_2130 of (a) the candidate esker complex, and sections of (b) low-albedo clast-rich zone 1 ridge (c) zone 3 ridges (d) well-preserved, layered, high-albedo, sharp zone 3 ridge crossing a wrinkle ridge.

Fig 6: Methods: (a) oblique view of orthophoto overlay on DEM generated from HiRISE images ESP_044316_2130 and ESP_044804_2130, (b) mapped segments and plan-view geometry extraction, (c) cross-sectional profile (location shown in b) and 3D geometry extraction.

Fig 7: System lengths for the Phlegra Montes candidate eskers, Dorsa Argentea [4] and Canadian eskers [5]. Boxes - interquartile range, bars - range, dashed lines - median, points - mean.

Fig 8 (left): (a) height, (b) width, and (c) mean side slope of the Phlegra Montes candidate eskers (zone 2) and Dorsa Argentea [4]. Boxes - interquartile range, bars - range, dashed lines - median, points - mean.