Figure DR1. A. Elevation profiles along cirque valleys in the Aeolis Mensae region. B. 3-D DEM of a cirque valley dissecting the topographic dichotomy. C. Example of a trough-side cirque eroded into the basalt plateau above Isafjordur, northwest Iceland. From Evans (2007).
Figure DR2. Image mosaic of the East coast of Greenland as a possible analogue of the Martian fretted terrains. Credit: USGS
Regional context

Crater counting area

Crater model age(s)

Projection: Equidistant Cylindrical
Datum: Mars sphere
Central Meridian: 0.0000
Standard Parallel 1: 0.0000
Units: Meter
Regional context

Crater counting area

Projection: Equidistant Cylindrical
Datum: Mars sphere
Central Meridian: 0.0000
Standard Parallel 1: 0.0000
Units: Meter

Background images:
MOLA shaded relief & digital terrain model

Crater model age(s)

Elevation [m]

Gale
Aeolis Mensae
Aeolis Planum

633 ± 50 Ma
633 ± 50 Ma
Regional context

Crater counting area

Crater model age(s)

Projection: Equidistant Cylindrical
Datum: Mars sphere
Central Meridian: 0.0000
Standard Parallel 1: 0.0000
Units: Meter
Regional context

Crater counting area

Crater model age(s)

Elevation [m]

Background images: MOLA shaded relief & digital terrain model

Projection: Equidistant Cylindrical
Datum: Mars sphere
Central Meridian: 0.0000
Standard Parallel 1: 0.0000
Units: Meter
Regional context

Crater counting area 5

Background images:
MOLA shaded relief &
digital terrain model

Crater model age(s)

Elevation [m]

Projection: Equidistant Cylindrical
Datum: Mars sphere
Central Meridian: 0.0000
Standard Parallel 1: 0.0000
Units: Meter
Regional context

Projection: Equidistant Cylindrical
Datum: Mars sphere
Central Meridian: 0.0000
Standard Parallel 1: 0.0000
Units: Meter

Background images:
MOLA shaded relief & digital terrain model

Crater model age(s)

Elevation [m]

Gale
Aeolis Mensae
Aeolis Planum

Crater counting area 7

Projection: Equidistant Cylindrical
Datum: Mars sphere
Central Meridian: 0.0000
Standard Parallel 1: 0.0000
Units: Meter
Table DR1: Detailed documentation of crater statistics for seven areas. Graphs and counting areas are portrayed on subsequent pages of the annex.

<table>
<thead>
<tr>
<th>Description</th>
<th>Crater count ID</th>
<th>Coordinates(^1)</th>
<th>Area ([\text{km}^2])</th>
<th>Total no. craters</th>
<th>Resurfacing correction</th>
<th>D [km] in fit range</th>
<th>No. craters in fit range</th>
<th>Age(^2) [Ga]</th>
<th>(N_{\text{cum}}(1 \text{ km}) /10^6 \text{ km}^2) of fitted isochron(s)</th>
<th>Epoch(^3)</th>
<th>Instrument</th>
<th>Image No.</th>
<th>Image Resolution [m/px]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lobate feature</td>
<td>area_1</td>
<td>7.77, 145.16</td>
<td>625</td>
<td>61.7</td>
<td>no</td>
<td>1.2</td>
<td>4.9</td>
<td>3.68</td>
<td>0.072</td>
<td>3.75</td>
<td>2.53</td>
<td>HRSC</td>
<td>h4136_0000.nd4.05, h4147_0000.nd4.07</td>
</tr>
<tr>
<td>Crater filling</td>
<td>area_2</td>
<td>-4.09, 141.68</td>
<td>45.91</td>
<td>118.2</td>
<td>no</td>
<td>0.15</td>
<td>11.9</td>
<td>0.633</td>
<td>0.18</td>
<td>0.813</td>
<td>0.453</td>
<td>CTX</td>
<td>P05_002899_1759_XI_04S218W</td>
</tr>
<tr>
<td>Valley floor</td>
<td>area_3</td>
<td>-5.00, 145.52</td>
<td>482.7</td>
<td>94.6</td>
<td>no yes</td>
<td>0.5</td>
<td>6</td>
<td>2.86</td>
<td>0.48</td>
<td>1.1</td>
<td>1.76</td>
<td>CTX</td>
<td>P17_007593_1739_XN_06S214W</td>
</tr>
<tr>
<td>Top of mesa</td>
<td>area_4</td>
<td>-4.61, 144.69</td>
<td>1,309</td>
<td>323.9</td>
<td>no yes</td>
<td>0.8</td>
<td>8</td>
<td>3.5</td>
<td>0.089</td>
<td>0.22</td>
<td>3.28</td>
<td>CTX</td>
<td>P02_001844_1738_XN_06S214W, B22_019029_1764_XI_03S215W</td>
</tr>
<tr>
<td>Top of mesa</td>
<td>area_5</td>
<td>-5.73, 145.69</td>
<td>444.4</td>
<td>206.6</td>
<td>no yes</td>
<td>0.6</td>
<td>24</td>
<td>0.802</td>
<td>0.13</td>
<td>0.932</td>
<td>0.672</td>
<td>CTX</td>
<td>P17_007593_1739_XN_06S214W, B20_017456_1738_XN_06S214W</td>
</tr>
<tr>
<td>Lobate feature</td>
<td>area_6</td>
<td>-7.05, 144.53</td>
<td>741.3</td>
<td>134</td>
<td>no</td>
<td>0.5</td>
<td>13</td>
<td>3.25</td>
<td>0.16</td>
<td>0.8</td>
<td>2.65</td>
<td>CTX</td>
<td>B01_010619_1722_XI_07S215W, B07_012287_1722_XI_07S215W</td>
</tr>
<tr>
<td>Crater filling</td>
<td>area_7</td>
<td>-10.25, 142.36</td>
<td>334.1</td>
<td>448</td>
<td>no yes</td>
<td>1.4</td>
<td>19</td>
<td>3.91</td>
<td>0.084</td>
<td>0.22</td>
<td>3.69</td>
<td>CTX</td>
<td>B16_015887_1704_XN_09S217W, B17_016454_1696_XN_10S217W</td>
</tr>
</tbody>
</table>

\(^1\) Centre coordinates of counting area; multiple coordinates mean multiple subareas.

\(^2\) Crater model ages were determined using the Ivanov (2001) production function and the Hartmann and Neukum (2001) chronology function.

\(^3\) Epoch boundaries after Werner and Tanaka (2011); N (Noachian), H (Hesperian), A (amazonian); e (Early), m (Middle), l (Late).
Table DR2: Quantification of the likelihood of glacial overdeepening of valleys in the Aeolis Mensae region as reflected in power functions of half-valley cross sections and second-order polynomial functions fitted to entire cross-sections, excluding convex shoulders (see Figure 3), alongside values for glacial troughs on Earth.

<table>
<thead>
<tr>
<th>Location (Lat/Long)</th>
<th>Power function exponent ($b$-value) fitted to half-valley cross section (and $R^2$)</th>
<th>$R^2$ of second order polynomial fitted to entire valley cross section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mars T1 3.8° S / 141.8° E</td>
<td>1.89 (0.963)</td>
<td>0.972</td>
</tr>
<tr>
<td>Mars T2 4.4° S / 142.0° E</td>
<td>1.66 (0.933)</td>
<td>0.968</td>
</tr>
<tr>
<td>Mars T3 3.8° S / 140.3° E</td>
<td>1.97 (0.955)</td>
<td>0.992</td>
</tr>
<tr>
<td>Mars T4 4.3° S / 143.8° E</td>
<td>1.91 (0.900)</td>
<td>0.970</td>
</tr>
<tr>
<td>Mars T5 3.6° S / 143.8° E</td>
<td>1.89 (0.953)</td>
<td>0.964</td>
</tr>
<tr>
<td>Mars T6 3.1° S / 141.8° E</td>
<td>2.19 (0.933)</td>
<td>0.994</td>
</tr>
<tr>
<td>Mars T7 5.6° S / 140.0° E</td>
<td>2.07 (0.856)</td>
<td>0.961</td>
</tr>
<tr>
<td>Mars T8 5.6° S / 140.7° E</td>
<td>1.60 (0.989)</td>
<td>0.974</td>
</tr>
<tr>
<td>Mars T9 6.2° S / 145.8° E</td>
<td>2.46 (0.936)</td>
<td>0.972</td>
</tr>
<tr>
<td>Mars T10 6.5° S / 146.5° E</td>
<td>1.96 (0.972)</td>
<td>0.952</td>
</tr>
<tr>
<td>Mars T11 2.9° S / 132.4° E</td>
<td>1.75 (0.944)</td>
<td>0.995</td>
</tr>
<tr>
<td>Mars T12 0.0° / 125.6° E</td>
<td>1.49 (0.911)</td>
<td>0.966</td>
</tr>
<tr>
<td>Mars T13 2.0° N / 121.2° E</td>
<td>1.84 (0.946)</td>
<td>0.922</td>
</tr>
<tr>
<td>Earth Sierra Nevada, USA (James, 1996)</td>
<td>1.15 to 3.3 (non-stepped profiles)</td>
<td>0.623 to 0.996</td>
</tr>
<tr>
<td>Earth British Columbia, Canada (Evans, 2007)</td>
<td>n/a</td>
<td>0.951 to 0.974</td>
</tr>
<tr>
<td>Earth Wastwater, UK (Evans, 2007)</td>
<td>n/a</td>
<td>0.997</td>
</tr>
<tr>
<td>Earth Beartooth Mountains USA (Graf, 1970)</td>
<td>1.63 to 1.84</td>
<td>n/a</td>
</tr>
<tr>
<td>Earth Lapporten, Sweden (Svensson, 1959)</td>
<td>2.05 to 2.18</td>
<td>n/a</td>
</tr>
<tr>
<td>Earth Tian Shan, China (Li et al., 2001)</td>
<td>1.03 to 3.50</td>
<td>0.871 to 0.997</td>
</tr>
<tr>
<td>Theoretical Numerical modeling of glacial erosion (Harbor, 1992)</td>
<td>2.22 to 2.32 (approx 'steady-state' valley form)</td>
<td>n/a</td>
</tr>
</tbody>
</table>

*Power-law curves were fitted to half-valley cross-profiles with the origin defined as the lowest point in the valley (see Harbor and Wheeler, 1992).