

A POSSIBLE ESKER AND TUNNEL VALLEY PAIR IN EAST KASEI VALLES, MARS. J. D. Arfstrom, www.JohnArfstrom.com, jarfstrom@gmail.com.

Geomorphology: In East Kasei Valles, a remarkable pair of landforms adorn a landscape marked by regional parallel groves resembling areal scour (Fig. 1, 2, and 3). One landform (Fig. 1) is a convex feature with a peculiar nature resembling the “string-and-beads” morphology of some eskers [1]. The other (Fig. 2) is concave and channel-like, exhibiting minor sinuosity and branching, and is morphologically similar to other landforms in the area that resemble tunnel valleys [2]. Ice sheets leave behind telltale landforms, and tunnel valleys and eskers are amongst the most unique indicators of past glaciations [1]. Of unnecessarily association, the landscape is muted by pitted mantles consistent with others at Kasei Valles interpreted as icy mantles [3 and 4]. Amusingly, a boundary between thick and thinly mantled terrain separates the “topographically opposed” landforms of primary interest.

The convex landform is well-defined and narrow, with a string-and-bead esker morphology. Such well-defined examples of eskers form as partial sediment cast of subglacial conduits (Fig. 1). Though eskers may have englacial and supra-glacial origins, these are less well-defined, becoming distorted as they are transposed unevenly to the ground surface as the ice melts or sublimates [1]. There is a possibility that the convex landform is a frontal or lateral moraine, but these are usually found in certain associations with other moraines and tend to be broader, especially at moraine bases. Compare the Kasei Valles landscape to that of a fine analog of an esker amidst areal scour (Fig. 3).

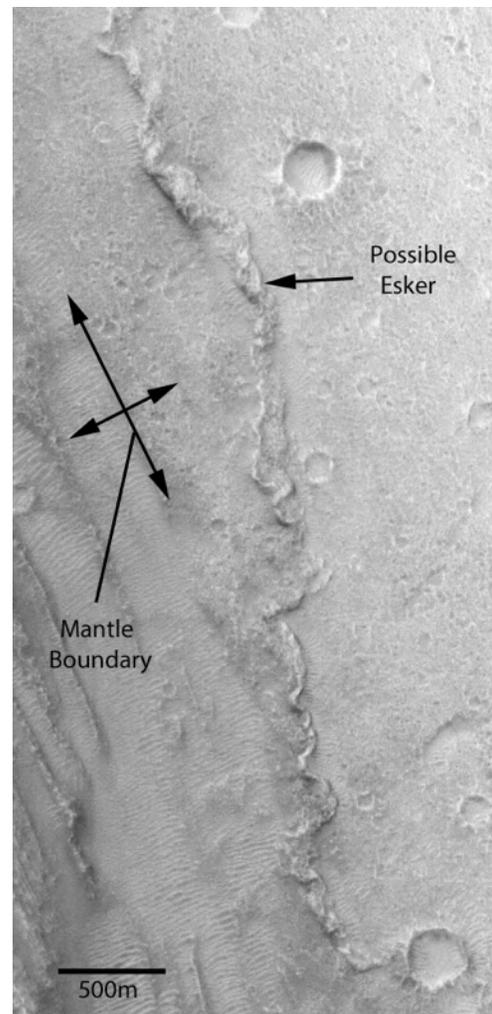
The concave, channel-shaped formation is morphologically consistent with tunnel valleys, which are channels that are eroded under glaciers and ice sheets by flowing subglacial water. In the case of sediment-floored tunnel valleys, the eroded channels may be considerably larger than the water conduits that carries the sediment load because the channels progressively enlarge as material creeps in towards the conduit and the overlying ice deforms to fill the void. Erosion occurs more gradually where the ice overlies bedrock, in which cases the width of the tunnel valley would more likely reflect the actual flow dimensions [1].

Interesting, the ridge and the trough do not run parallel to slope, with the trough crossing a noticeable step-up in elevation (see MOLA). Eskers often do not run parallel to slope because the water flowing through the conduit is often pressurized so that flow direction is not governed by gravity alone. Rather, slope orientation is influenced by both glacier surface gradients and ground topography, as they relate to pressure and grav-

ity [1]. Likewise, this phenomenon of pressure and gravity controls tunnel valley slope orientation. Further, it is believed that a continuum may exist between eskers and tunnel valleys, with the sediment load and carrying capacity of the water in a subglacial conduit determining when and where an esker or a tunnel valley may be generated [1].

Conclusions: Elevation undulations of hydraulically eroded channels are features that are only produced under hydrostatic pressure beneath glaciers and ice sheets because normal overland flow cannot push sediments upslope.

The interpretations of this and four previous abstracts on Kasei Valles [2, 3, 4, and 5], support a glacial origin of Kasei Valles, and is the first region investigated as part of the author’s ongoing research on the possible past equatorial ice sheets of Mars [6].



References: [1] Benn B.I. and Evans J.A. (1998) *Glaciers & Glaciation*. Arnold Pub., p. 332, 450.
 [2] Arfstrom, J.D. (2014) LPSC Abstract, 45, 1013.
 [3] Arfstrom, J.D. (2013) LPSC Abstract, 44, 1001.
 [4] Arfstrom, J.D. (2013) LPSC Abstract, 44, 1002.
 [5] Arfstrom, J.D. (2015) LPSC Abstract, 46, 1006.
 [6] J.D. (2012) *Comp. Clim. Ter. Pl. Abstract*, 8001 (poster paper at ResearchGate).

Figure 1: (first page) Possible esker in East Kasei Valles. A closeup of a portion of Fig. 2.

Figure 2: (second page, top) Possible tunnel valley and esker pair amid areal scour. East Kasei Valles. CTX: 2P16 007442 2078 XN 27N055W.

Figure 3: (second page, bottom) Esker and areal scour of Laurentide ice sheet. Northeast Quebec, near N58, W064, Aerial photo: (c) Brian Whittaker (.com).

