A POSSIBLE TUNNEL VALLEY NETWORK IN EAST KASEI VALLES, MARS.

John D. Arfstrom, jarfstrom@gmail.com, www.JohnArfstrom.com, 904.200.2619.

Introduction: In the landscape of east Kasei Valles, which arguably resembles a model for areal scour and streamlined landforms generated by the erosion of ice sheets (see East Kasei Poster at scribd.com), there is a particular hill that appears to have a network of tunnel valleys incised across its surface. The most important point to be taken from this abstract, assuming the primary interpretations suggested here are correct, is the resulting likely conclusion that Kasei Valles is glacial in origin, as only the sub-glacial landforms that are tunnel valleys can ascend hills.

The Network: A network of channels (Fig. 1) exhibiting sinuosity, branching, elevation undulations, and an elevated terminal depositional fan are fundamental to its interpretation as a possible network of tunnel valleys (see Fig. 3 for a terrestrial analog). Two southern branches of the network climb up from the relatively flat plains onto a streamlined hill that resembles a rock drumlin or crag and tail (Fig. 2), measuring 6 km wide by 15 km long. The scale of the hill is that of streamlined landforms generated by large-scale selective linear erosion of sub-polar ice sheets [1].

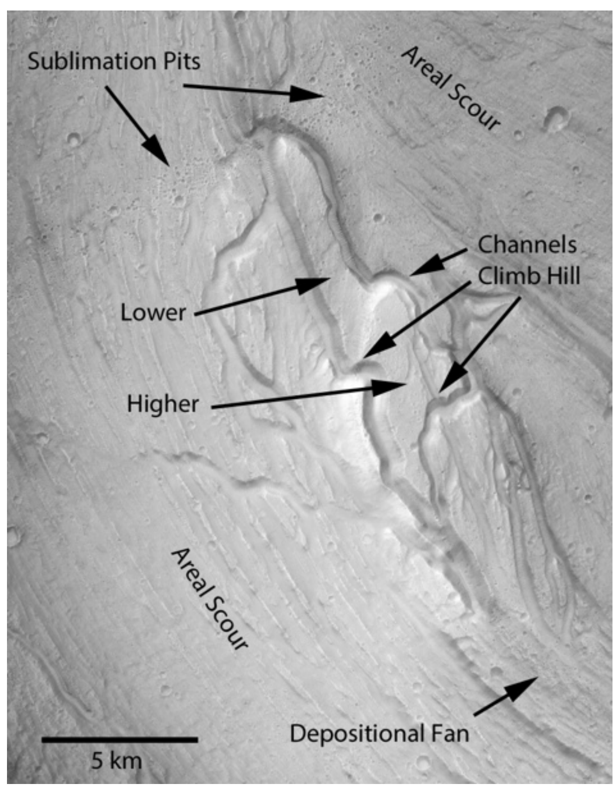
After traversing the landform for 6 km, these two branches converge at the downslope end of the hill, along with another from the plains to the east. The traverses of other branches to the north extend for up to 10 km across the hill. The long profiles of the branches of the network shows a dramatic elevation undulation of 100 to 200 meters, based on MOLA elevation data (Fig 2), as a consequence of crossing over the streamlined hill.

The network converges in a branching manner at an elongate terminal fan (Fig. 1), which appears to be at an elevation higher that the floor of the valley where it terminates. MOLA elevation data is too course to confirm this, but shows some correspondence with the visual interpretation. The terminal fan does strongly suggest that water flowed through the network and deposited sediments at a higher elevation than the floor of the channel upon exiting the network. The scale of the elevation undulations and the elevated depositional fan are consistent with tunnel valleys.

In contrast to the inner channels of the main trough of Kasei Valles located 1000km to the west southwest, which are also likely tunnel valleys [2, 3,] (also, see West Kasei Poster at scribd.com], the floors of the network are not as flat-floored. Also, hanging valleys and alcoves, which adorn the inner channels, are not represented in the network. Perhaps the bedrock of the scoured plains differs from the floor of the main trough where the inner channels are located so as to have caused different shaped tunnel valleys to erode, or the detailed nature of the glaciation and sedimentation histories in the two regions otherwise varied, resulting in different cross sections.

Another interesting feature of this landscape is what appears to be sublimation pits of a presumed icy mantle. It is relatively thin and is consistent with other related mantles of various thicknesses that cover other regions of Kasei Valles [2, 3]. Given that the landscape is probably ancient, the mantles are most likely not directly related to the origin of Kasei Valles. However, the ice sheets that possibly caused the areal scour and possible tunnel valleys seen at Kasei Valles may have been related to ice sheets possibly responsible for "outflow channel" erosion across Mars [4].

Conclusions: The only way for water to have flowed the 100 to 200 meters upslope over the streamlined hill to eroded the network is under hydrostatic pressure. Taken together, the sinuosity, the branching, the depositional fan, and the elevation anomalies, strongly suggest that the network was eroded under an ice sheet as a tunnel valley network.



References: [1] Benn B.I. and Evans J.A. (1998) Glaciers & Glaciation. Arnold Pub., p. 323-365. [2] Arfstrom, J.D. (2013) LPSC Abstract, 44, 1001. [3] Arfstrom, J.D. (2013) LPSC Abstract, 44, 1002. [4] Arfstrom, J.D. (2012) Comp. Clim. Ter. Pl. Abstract, 8001 ("Equatorial Ice Sheets on Mars" poster at scribd.com).

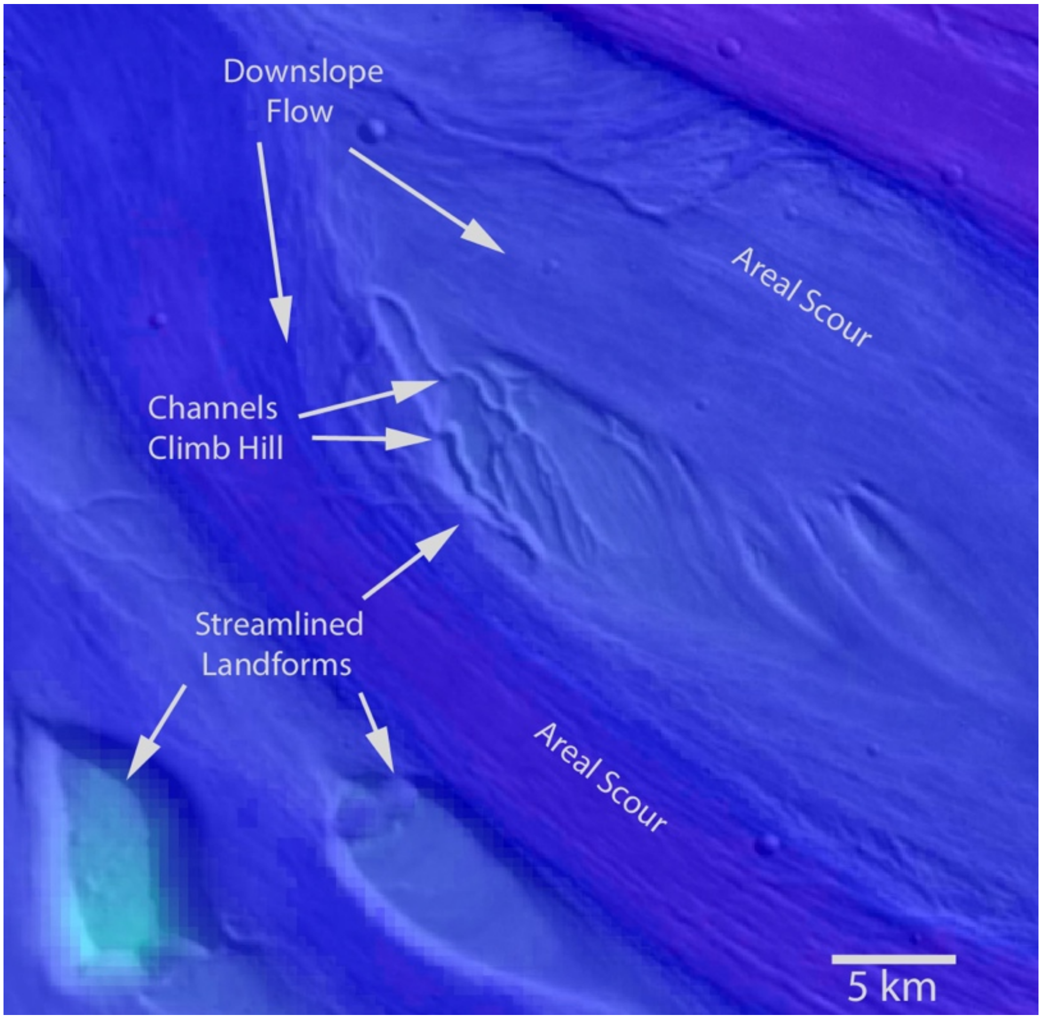


Figure 1: (first page) Trough-shaped channels climb a streamlined hill of a terrain of areal scour. A depositional fan is visible at the downslope convergence of the possible tunnel valleys. Also, sublimation pits of an icy mantle that mutes the surface. CTX P18 007943 2077 XN 27N055W.

Figure 2: (left -upper) Each shade of color represents 100m elevation change, with light blue representing higher elevation. MOLA topography and THEMIS Day IR.

Figure 3: (left - lower) Tunnel valley network analog. Lake Superior sonar model showing a submerged tunnel valley network of the Laurentide ice sheet, which transects a raised area (indicated by lighter shading), as does the network in Fig. 2.