A VALLEY GLACIER REMNANT OF THE MAIN TROUGH OF KASEI VALLES, MARS. J. D. Arfstrom, 3820 Losco Rd, #625, Jacksonville, Fl 32257, www.JohnArfstrom.com 904.200.2619.

Introduction: It appears that the head of the main trough of Kasei Valles contains the remnant of a valley glacier. The feature is approximately 50 km long and comprises a relatively small portion of the full length of the main trough it occupies, which extends another 500 km to the east. The main trough of is an important element of the Kasei Valles system, which overall shows geomorphology consistent with both ice sheets and valley glaciations [1].

Geomorphology: Hanging valleys (troughs) and tributary troughs are incised along the length of the walls of the upper reaches of the main trough, reaching many kilometers into the surrounding plains, which show parallel groves consistent with significant areal scour (Fig. 1). A viscous material occupies the main trough and appears to connect to tributaries in a valley glacier-like arrangement. The tributaries of viscous material are as wide as the troughs themselves near the trunks where they connect, but the upper reaches of the tributary troughs are rather thinly filled.

Because the hanging valleys and tributary troughs are not significantly filled with viscous material, and no connections between the the hanging valleys and the main trough deposit are evident, rock glaciers probably do not play a role in the development of these upper troughs because they do not ablate completely. On the other hand, the viscous material in the main trough could be a rock glacier that was supplied by glaciers occupying the upper troughs. However, distant sections of the main trough show similar deposits, suggesting dissection by ablation, which supports interpretation as a remnant of a complete valley glacier.

Alcoves are also evident along the wall of the main trough (Fig. 1), especially where hanging valleys and tributaries are not located, and are dwarfed by them. The region surrounding the head of the main trough is broken by graben networks (Fig. 1 and 2). Exploitation of faults by headward erosion is also evident at many locations. This suggests that the occurrence of the hanging valleys and tributaries are partly a consequence of the underlying structural weakness in the bedrock associated with the graben networks. Otherwise, erosion might have been limited to alcoves, as is the case where graben networks are not evident.

A major tributary of the main Kasei Valles trough, located over 200 km to the north (Fig. 2), also shows a dramatic headward erosion under the influence of structure. The co-relationships of graben evolution, which would not require material transport for troughs to form, and glacier or rock glacier transport, which, in effect, excavates troughs, is of particular importance. The critical question being: how much material was down-dropped and how much was transported down-valley for the headward troughs to develop? The co-evolution of graben complexes and glaciation is also represented throughout much of Dao Vallis, a partially ice-filled valley complex that shares a similarly complex origin and geomorphology [2, 3].

The terminus of the possible glacier remnant is located at 18.78 degrees north latitude and 285.81 degrees longitude. Material slumped off of the high wall near the terminus of the viscous flow appears to be reflected in the morphology of the terminus. But, the surface of the viscous material further from the walls is mostly smoother, suggesting a separate origin, composition, or ice supported viscous flow. Although it is surprising to find surface ice at latitudes so near the equator, patches of mantling consistent with ice also appears to cover the surrounding plateau so as to mute underlying areal scour (Fig. 1). The graben networks are obscured by regolith in some areas, and likewise, by what appear to be icy mantles in others.

Significant valley-wide and uniform areal scour throughout much of Kasei Valles is more consistent with the widespread areal scour typical of ice sheets, than the more spatially variable and localized erosion typical of the generally more focused erosion caused by floods. Scoured plains remnants are also present in the headward section of the main trough (Fig. 1), which indicates that the period of headward erosion followed the period of areal scour.

It appears that a major episode of erosion associated with ice sheets caused areal scour, stripped regolith to leave behind streamlined landforms, and widely exposed bedrock and graben networks. This was probably followed by continued graben network evolution, more localized modification by structural collapse, and smaller scale glacial erosion that commonly exploited the graben networks, especially by headward erosion (Fig. 2), which may imply a winding down of glacial erosion from areal to steeper slopes.

Some 180 km down the main trough from the head are located two inner channels that may be keystone landforms in the glacial and flood hypotheses debate. The geomorphology and elevation data strongly support the interpretation of these inner channels as tunnel valleys, which can only form under glaciers. An important point for consideration is: were these possible tunnel valleys eroded under a channelized ice sheet that may have scoured the plains, or eroded under a subsequent trough only glaciation associated with the headward erosion? More recent occupations of the Kasei Valles main trough by glaciers are more likely to have been cold based and without subglacial meltwater, limiting erosion and preserving the inner channels.

References: [1] Benn B.I. and Evans J.A. (1998) Glaciers & Glaciation. Arnold Pub., p. 323-365. [2] Arfstrom, J.D. (2004) LPSC Abstract, 35, 1193. [3] Arfstrom, J.D. (2002) LPSC Abstract, 33, 1092

Figure 1: (left) The head of main trough of Kasei Valles. CTX P18 007891 1987 XN 18N074W.

Figure 2: (right) Western Kasei Valles, Themis IR.