HANGING VALLEYS AND SCABLANDS OF KASEI VALLES REVEAL PROLONGED DEEP HYDRODYNAMIC EROSION. Neil Coleman and Christopher Coughenour, University of Pittsburgh at Johnstown (Department of Energy & Earth Resources, Johnstown, PA 15904; ncoleman@pitt.edu).

Introduction: The interwoven channels of Kasei Valles form the widest and longest fluvial system on Mars (Fig 1). The first successful landing, Viking I, set down in western Chryse Planitia, southeast of the Kasei terminus. The channels are deeply incised in basalts of the upper crust, which by itself reveals extensive erosion that required large volumes of floodwaters. The Kasei floors contain enormous dry-falls cataracts (white ovals in Fig 2), dwarfing the largest Pleistocene megaflood cataract known on Earth [1]. Hanging valleys and scablands reveal that the flooding included multiple episodes or pulses of flooding with deep incision. The eroded depth is readily found from the elevation difference between the hanging valleys and scablands and the final depths of channel floors. We use Gridview and MOLA grids to estimate the flood volumes needed to erode the channels.

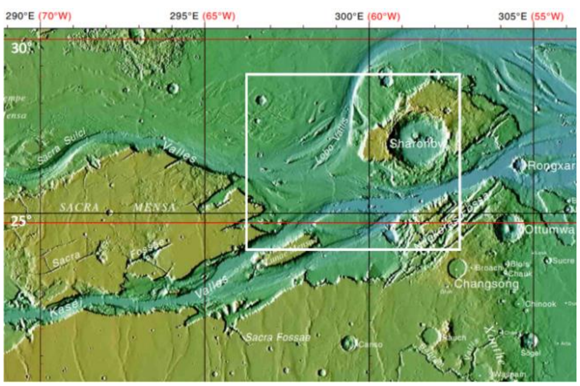

Fig. 1. Kasei Vallis study region [2]. White box is outline of Fig. 2.

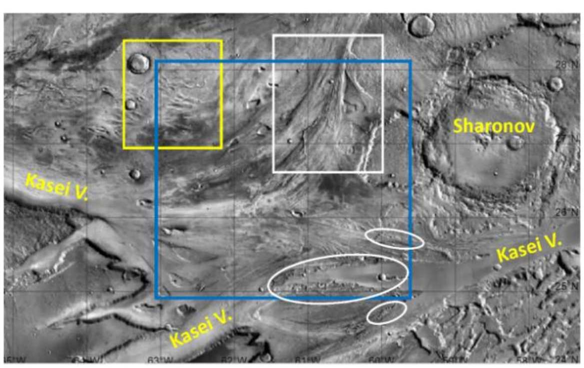

Fig. 2. Locations of Fig. 3 (yellow box), hanging valley (white box), area to estimate eroded volume (blue box), and cataracts (white ovals). Day IR mosaic [3].

Early Overland Flooding: We have identified the earliest fluvial erosion features in Fig. 2. These are outlined by the margins of scabland flooding to the west (Fig. 3) and on the east by a high-standing hanging valley just west of Sharonov Crater. Anastomosing channels in the scabland are only about 100-150 m deep (Fig. 4) because deeper channels formed rapidly to the south, capturing the flows and draining and preserving the higher-standing terrain.

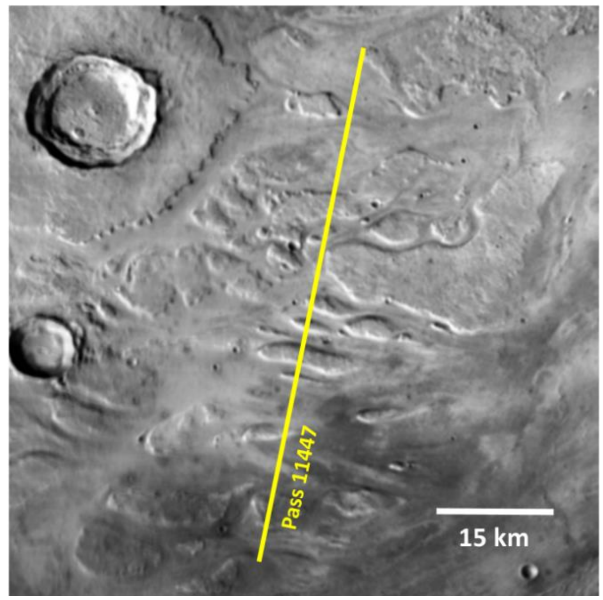

Fig 3. Eroded scabland west of Lobo Vallis preserves evidence of earliest overland flows in Kasei Valles. Image center 27°36′N, 62°46.5′W. Day IR mosaic [3].

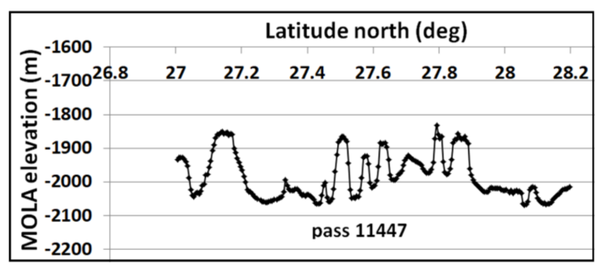

Fig. 4. MOLA profile across scabland in Fig. 3. Initial scabland flooding occurred at an elevation near the tops of the mesas revealed here in profile.

Note the curving channel at center right in Fig. 5. Like the scabland, it was incised by the earliest overland floods but then was cut off, left hanging, as Lobo Vallis deepened and captured all flows. The curved channel forms hanging valleys at its northern and southern ends. This hanging valley was first described by Coleman and Baker [4] (2009, Fig 9.5). The floor of this channel stands >700 meters above the adjacent Lobo Vallis (Fig. 6, MOLA pass 19526).

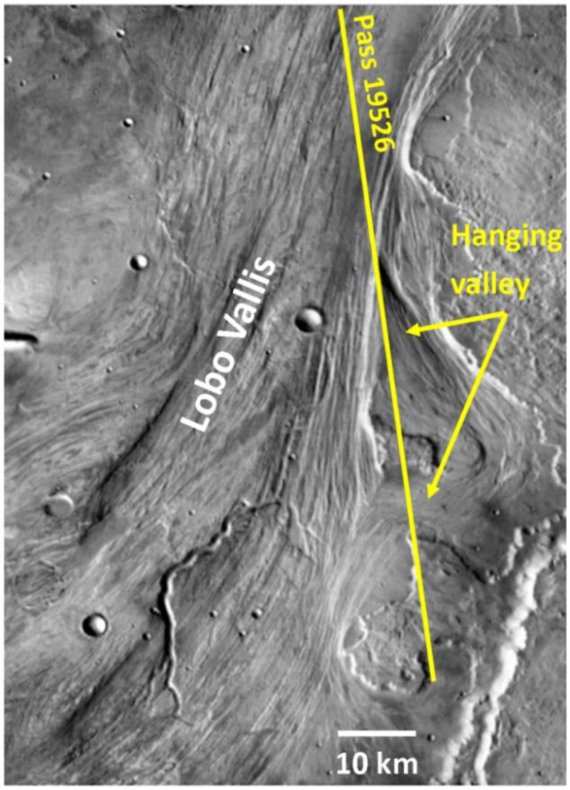

Fig 5. THEMIS day IR image [3] shows hanging valley. Location of this figure is white box in Fig. 2. Note traces of eroded layered basalts on channel flanks.

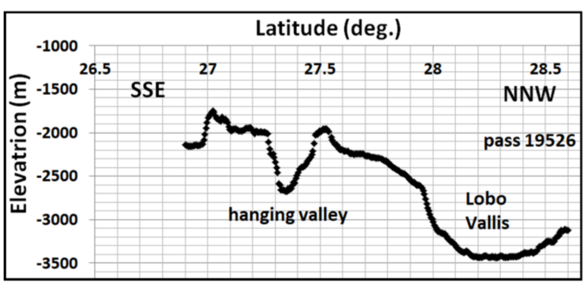

Fig. 6. MOLA profile across hanging valley in Fig 5.

Cataracts: Gridview [5] and gridded MOLA data were used to prepare the map in Fig. 7. The deepest channels contain dry-falls cataracts carved by the last catastrophic flows in the area [1]. In the lower part of Fig. 7, cataract headwalls occur at the western ends of the dark blue channels. The biggest cataract in Kasei (largest white oval in Fig. 2) has a floor depth below an elevation of -3500 m. This cataract complex migrated by headward erosion 125 to 250 km, until flooding ceased [1]. The Kasei cataracts are flanked by many hanging valleys. The cataracts also confirm that debris-filled water floods (*not* lavas) eroded these channels.

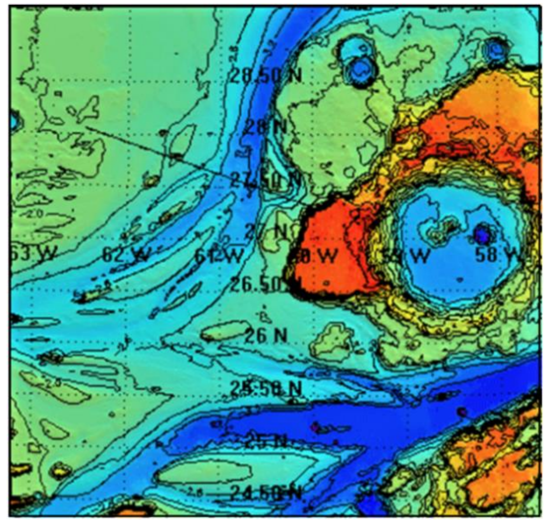

Fig. 7. Gridview [5] contour map of study area. Highest elevations are red, lowest dark blue. Black line shows location of MOLA profile in Fig 8.

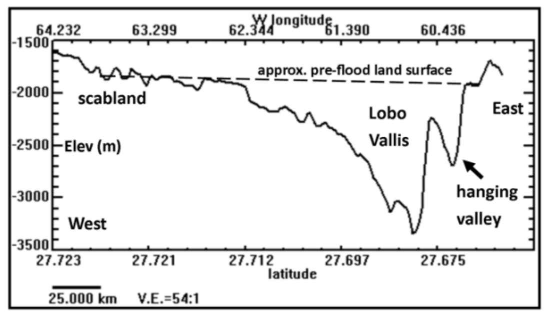

Fig. 8. MOLA profile from scabland across Lobo Vallis to hanging valley (using [5] and MOLA grid).

Calculation and Conclusions: Gridview [5] was used to compute the area and cavity volume (below -1900 m) of the blue square in Fig. 2. This is only part of the total area eroded by the Kasei channels, but the deepest incision occurred here where major channels intersected. The area is 34,500 km^2 with an eroded volume (below -1900 m) of 20,050 km^3. As an example, if the eroded volume is 10% of the flood volume needed to incise the channels, then a water volume >200,000 km^3 was needed to erode just the channels within the blue outline. That is nine times the total water volume of the Great Lakes. Much greater volumes would have been needed to erode the entire Kasei channel system. The extraordinary erosion volume reveals that Kasei flooding was prolonged. A plausible source of floodwaters was catastrophic melt of surface ice sheets by episodic Tharsis volcanism [4].

References: [1] Coleman (2010), LPSC 41, #1174. [2] https://planetarynames.wr.usgs.gov/images/mc10_mola.pdf. [3] Christensen et al., http://themis-data.asu.edu. [4] Coleman and Baker (2009) Ch. 9 in "Megaflooding on Earth and Mars" (ISBN 9780521868525). [5] Gridview (nasa.gov).