ARES VALLIS, MARS – MEGAFLOOD VOLUME NEEDED TO ERODE THE MAIN CHANNEL.
Christopher Coughenour and Neil Coleman, University of Pittsburgh at Johnstown (Department of Energy & Earth Resources, Johnstown, PA 15904; coughenour@pitt.edu).

Introduction: Ares Vallis is one of the largest of the many ancient channels that emptied into the basin of Chryse Planitia. As shown in Fig. 1, Ares begins near the equator in SW Arabia Terra at Iani Chaos, from which floodwaters traveled northward. Ares may be the terminal portion of an enormous flood channel complex and longest surface-water pathway in the Solar System [1, 2], extending thousands of km from the Argyre basin (−44 S) to the northern plains. The Pathfinder lander and rover set down near the mouth of Ares Vallis in 1997.

Fig. 1. Location map for Ares Vallis [3]. Yellow X is Pathfinder landing site. White circle is cataract complex. Blue box outlines Fig. 3. Other features: UV (Uzboi V), LV (Ladon V), MV (Morava V).

Floodwater sources: This lengthy flow system began as valleys that drained the south polar region then flowed north to form a sea in the impact basin of Argyre Planitia [1,2], which eventually overtopped at Uzboi Vallis. South of 24°S the channels were partly obscured by large impact craters (Hale, Bond, Holden), which suggests Late Noachian Argyre overflows.

In addition to distant flows from Argyre, Ares was directly fed by flows from Iani Chaos, by discharges from a former crater lake in Aram Chaos, and by outflows from Hydaspis Chaos, a water source for Tiu Valles. Hydaspis outflows also carved a channel to the northeast between Galilaei Crater and Aram Chaos and were so energetic that a cataract complex 15 km wide (Fig. 2) with headwalls 300 m high formed in a side channel of Ares [4]. Warner et al. [4] give crater-age estimates for the floors of the cataract and Ares Vallis of 2.61 ± 0.13 Ga, while they conclude concurrent outflows occurred from Hydapsis and Iani Chaos at ~3.7 Ga. Channel evolution here, thus, required episodic activity spanning ~1 Ga.

Fig. 2. Cataract complex (white circle in Fig. 1) [5].

Channel geometry: In comparison to Scamander Vallis, another very large outflow channel, Ares Vallis is an order of magnitude wider, over 5 times deeper, and possesses a highly variable average slope that ranges from very flat (<5° between MOLA passes shown in Figure 3) to steeper reaches (2°-2°) [Komatsu & Baker, 1997]. Note that channel slope alteration is likely in some areas due to post-fluvial processes (landslides, lavas, or tectonics). Average gradient is around 1°-4° [6]. Figures 3 and 4 provide plan- and cross-sectional views of two Ares transects used here.
Using a range of transported eroded fractions (sediment volume eroded/hypothetical water volume), we calculate a plausible range of flood volumes needed to erode the central reaches of Ares Vallis (Fig. 5).