Flow Reconstruction for Ares Vallis, Mars: Goro Komatsu[1)2)], Gian Gabriele Ori[1)3)], P. Kyle House[4)] and Victor R. Baker[1)4)]: 1) Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721: 2) School of Geology, University of Tokyo, Tokyo, Japan: 3) Dipartimento di Scienze Geologiche, Universita' di Bologna, Bologna, Italy: 4) Department of Geosciences, University of Arizona, Tucson, AZ 85721

The next U.S. Mars mission, Mars Pathfinder, has selected a primary candidate landing site located at the mouth of the Ares Vallis, one of the huge outflow channels debauching into Cryse Planitia. Our studies focus on the geological aspects of this area by employing geological mapping [1][2] and by estimating paleodischarges for the channel (this report). We hope to provide pre-mission support data and insights which can be examined more thoroughly based on the mission results.

Discharges for the Martian outflow channels have been estimated by a number of researchers [3][4][5] using a modified Manning equation. This equation provides a first-order estimate of discharge, but it is limited in its ability to predict water-surface profiles. Furthermore, the depth measurements of the channels were not very accurate for these studies. In the present study, we use more accurate depth measurements (Digital Terrain Model) and a step-backwater method to determine the probable dynamics of the flooding events. The step-backwater method has been widely used in the terrestrial hydrology. In 1986, Baker and O'Conner [6] applied the HEC-2 program, which encodes sophisticated step-backwater computer algorithms developed by the U.S. Corps of Engineers, to calculate the paleodischarge of Kasei Vallis. We used the HEC-2 program to estimate the peak discharge rates by matching the paleoflow surface with extant channel geometry. The flow velocity (v) can be estimated by the Chezy equation, $v = C(ds)^{1/2}$ in which C is the Chezy coefficient; $C = (2g/C_f)^{1/2} = 1/n(d)^{1/6}$ (where g is gravity; C_f is friction coefficient; n is Manning coefficient; d is depth) , and s is energy slope. The Manning coefficient for Mars (n_M) can be related to the empirical terrestrial Manning coefficient (n_E), by the equation $n_M = n_E(g_E/g_M)^{1/2} = 1.62n_E$ (where g_E is terrestrial gravity; g_M is Martian gravity). More realistically, the empirical Manning coefficient on Earth ranges over a factor of about two, and, for our application, the influence on the final result is minimal. We chose a section of channel where the channel is well-defined and unusually deep. For simplicity, the cross-sections of the Ares Vallis (Fig. 1) are assumed to represent the paleo-geometry of the channel at the time of flooding. Because finding high-water marks, such as trim lines and flotsam deposits, is difficult from the available Viking imagery, we assumed that water surface reached the rims of the channel. The Manning coefficient of Mars (n_M) was assumed to be 0.0324 (n_E=0.02). The results are shown in Figure 2. The flow discharge of the closest-matching water surface is 1.25×10^9 m^3/s. Note that cross-sections of the two upper-most reaches do not match well with the paleoflow surfaces. This discharge rate is of a same order to the estimates for the Kasei Vallis [4]. The flow velocity ranges from tens of meters per second to just over 100 m/s. We expect that the water may have incised the channel and therefore may not have filled the channel to the rims. In this case, the discharge could well have been much lower. In any case, this section experienced extremely high discharge flows concentrated at a constriction formed by the influence of regional topography. Figure 3 illustrates how the incised, constricted channel section is related to a nearby topographic rise. Calculations by Komar [7] show that flow velocities of 10s m/s transport basalt fragments of 1 to several meters in diameter. A 100 m/s flow would transport a basalt boulders larger than 10 meters in diameter. These unusually large flood-transported blocks may occur in the vicinity of the Pathfinder landing site.

REFERENCES: [1] Komatsu, G. et al. (1995) *LPSC* **XXVI**, this volume. [2] Ori, G.G. et al. (1995) *LPSC* **XXVI**, this volume. [3] Baker, V.R. (1982) *The Channels on Mars.* [4] Robinson, M.S. and Tanaka, K.L. (1990) *Geology,* **18**, 902-905. [5] De Hon, R.A. and Pani, E.A. (1993) *J. Geophys. Res.*, **98**, 9129-9138. [6] Baker, V.R. and O'Conner, J.E. (1986) *NASA Tech Memo*, 88383, 274-276. [7] Komar, P.D. (1980) *Icarus*, **42**, 317-329.

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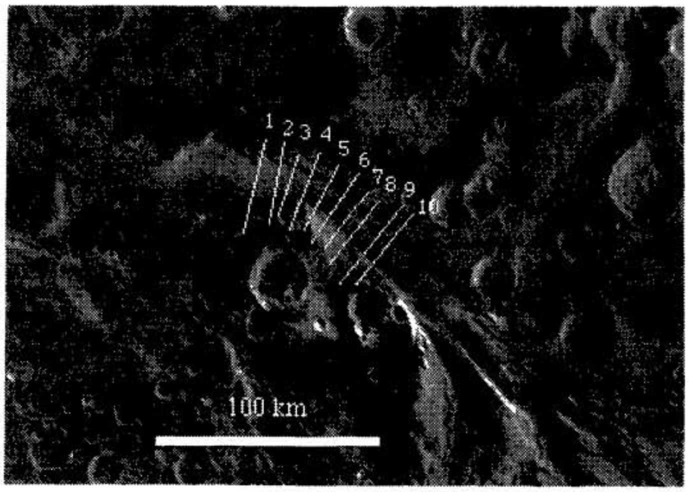

Fig. 1 Constricted section of Ares Vallis and locations of channel cross-sections.

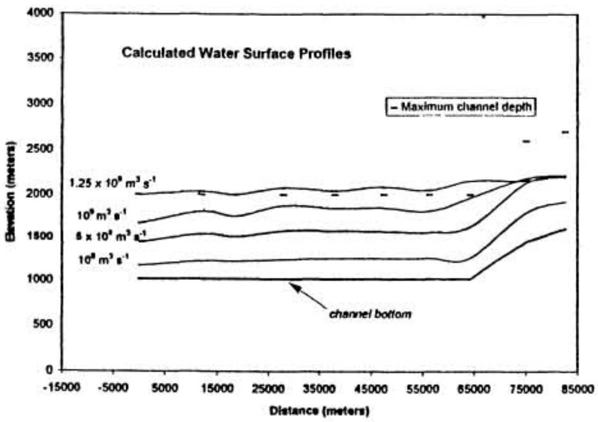

Fig. 2 HEC-2 calculation results of the water-surface profiles.

Fig. 3 3-dimensional rendition of the Ares Vallis (arrow) and surrounding regions.