POSSIBLE LATE-STAGE MUDFLOWS IN KASEI VALLES R. M. E. Williams[1] M. C. Malin[1] and K. S. Edgett[1], [1]Malin Space Science Systems, Inc. P. O. Box 910148, San Diego, CA 92191, beckyw@msss.com

Observations: High resolution (1.5 to 15 m/pix) narrow angle (NA) images obtained by the Mars Orbiter Camera (MOC) reveal a surface texture in Kasei Valles that is unique among the circum-Chryse outflow channels. The morphology is referred to as 'platy' in this abstract and includes the following characteristics:

1) Surface: Plates or slabs that appear to have moved as if they were rafted pieces of a jigsaw puzzle is the most common expression of this surface morphology (Figure 1). The plates can be tightly packed, outlined by ridges or surrounded by topographic depressions. In the later case, deflation may have created the hollows.

2) Margins: Within the two channels of Kasei Valles, lateral margins of this unit have rounded, lobate forms that embay the pre-existing topogrpahy (Figure 1). Bulbous toes, generally boulder-laden, are found between some ridges of longitudinal grooves in Kasei Valles (Figure 2).

3) Craters: The surface is peppered with small (<250 m diameter) craters. A visual inspection of crater density indicates that the platy surface has approximately 5 times fewer 200 m diameter craters relative to the underlying, non-platy surfaces. This observation reinforces the perception that the platy flow surface represents a later-stage event in this region. The material appears to have followed the pre-existing drainage.

4) Thickness: While a direct measurment of the units thickness has not been made, we estimate it to be a few tens of meters based on partially filled longitudinal grooves within the underlying material, which have maximum depths of 100 m.

5) Geographic Distribution: The platy surface morphology is pervasive in Kasei Valles and is observed on the floor of Echus Chasma, in 'lower' Kasei Valles (~10°-20° N, ~75°-78° W), on both the northern and southern valley floors, and on the floor of large channels forming the network on Nilus Mensae. Thus, the lateral extent of the platy surface spans nearly 3000 km from Echus Chasma reaching almost to the lowlands of Chryse Planitia in the southern channel.

The location of platy surface morphology in the region of a small cataract in the southern Kasei Valles channel (centered at ~21.0° N, 72.7° W) provides clues to the properties of the material forming the platy surface. Viking high resolution images show a topographic funnel leading to the cataract head. At the terminus of the cataract, the material spreads out (Figure 3A). The MOC NA images reveal platy morphology upstream of the cataract head, on the cataract floor and downstream of the cataract (Figure 3B). The margins of the platy surface are boulder-covered lobes and form linear terrace-like structures (Figure 3B). Thus, the material forming the platy surface texture traversed through the cataract system.

Discussion: The large geographic extent of this surface texture argues for a low viscosity medium while the lobate terminations suggest a high viscosity medium. Previous mapping has interpreted much of the broad floor of Kasei Valles and portions of the north channel (i.e. locations where the platy material is located) as lava flows from the Tharsis region [e.g. 1, 2]. Boulders along the margins of the platy unit are inconsistent with a magmatic fluid. Thermal models of martian flood lavas invoking insulated sheet flow with periodic, sudden flood-like breakouts and eruption rates one order of magnitude greater than those estimated on earth obtain traverse distances of only ~1000 km, 1/3 the length we observe in Kasei Valles [3]. Furthermore, lava flowing through the cataract system would likely clog it, rather than move through the narrow channel.

Given the superposition relationship of the platy surface with landforms inferred to be created during catastrophic floods (e.g. longitudinal grooves), one might suggest that this texture was associated with floodwaters waning during the later stages of flooding. However, the difference in crater density between the inferred flood scoured surface and the platy surface texture indicates considerable time elapsed between the catastrophic flood events and emplacement of the platy unit. Furthermore, lobate margins are generally not observed in deposits from Newtonian flow of floodwaters.

The medium which best fits the observations are mudflows. The properties of a moving fluid comprised of a mixture of mud/debris and water are very different from pure water. Mudflows are known to transition between viscous Newtonian behavior at low sediment concentrations to properties of a Bingham or visco-plastic fluid when particle volume concentration exceeds 60% [4]. Particles, ranging in size from cobbles to boulders, are supported through a combination of turbulence and particle interactions within the flow and can be transported distances of several hundred kilometers on earth [5-7]. The lobate terminations observed at the platy margins are attributed to removal of fines and/or volatiles from the flow matrix. It may be reasonable to reexamine other regions of platy flow on Mars (e.g. Marte Valles) in light of the mudflow hypothesis. Curiously, the platy textures are not observed in many of the other outflow channels on Mars, perhaps indicating their antiquity and/or poor preservation state.

References: [1] Rotto, S. and Tanaka, K. L. (1995) *U. S. Geol. Surv. Misc.* Developments and applications of geomorphology, 268-317; [2] Chapman, M. G., Masursky, H., and Scott, D. H. (1991) *U. S. Geol. Surv. Misc. Inv. Ser. Map I-2107*; [3] Keszthelyi, L., McEwen, A. S. and Thordarson, T. (2000) *JGR, 105*, 15,027-15,049; [4] Costa, J. E. (1984) *In Geol. Survey Prof. Paper,* 1447-A, 1-74; [5] Pierson, T. C. and Scott, K. M. (1985,) *Water Resources Research*, *21*, 1511-1524; [6] Scott, K. M. (1988) *U.S. Inv. Ser. Map I-2441*; [7] Smith, G. A. (1986) *GSA Bull*, 97, 1-10.

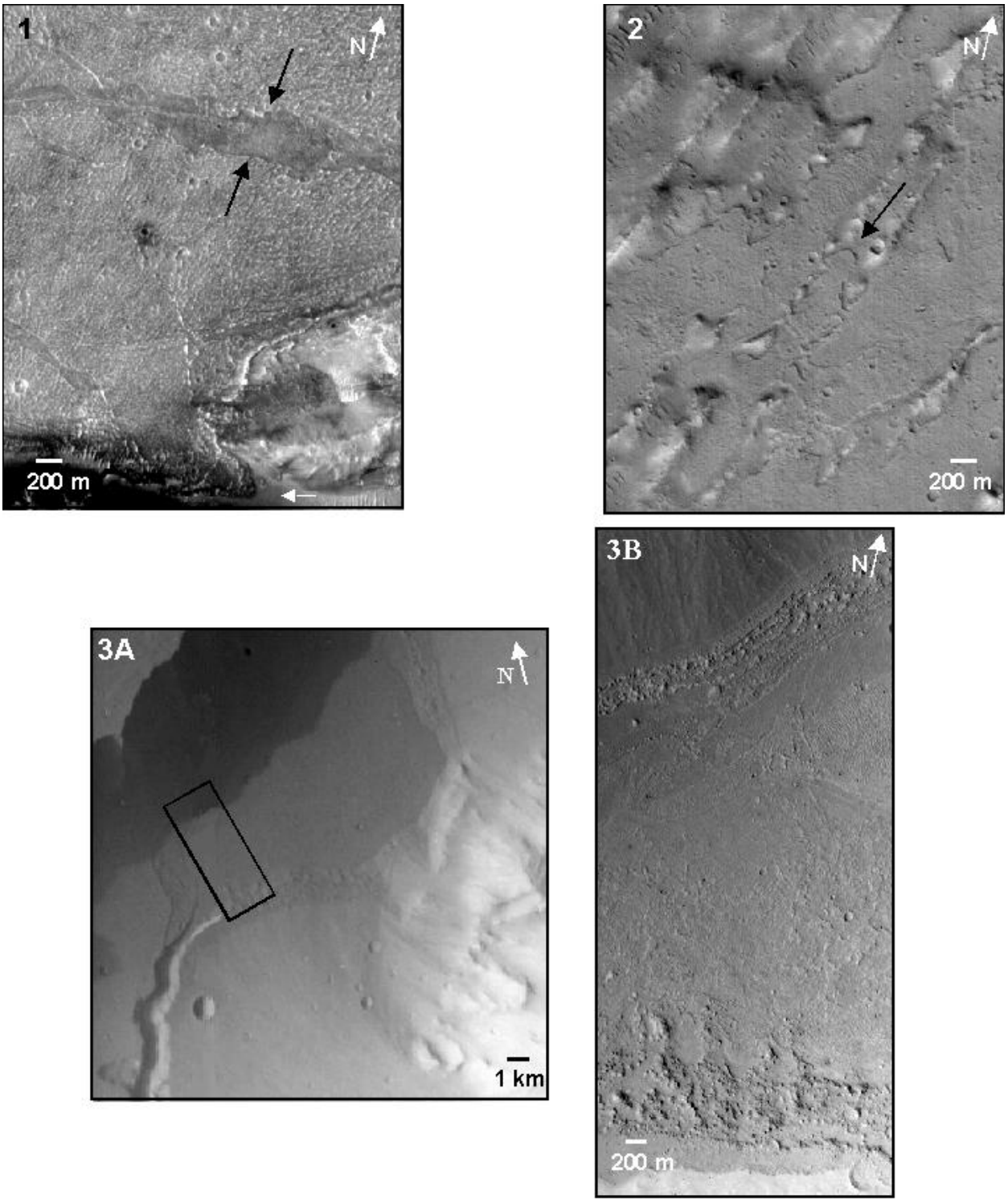

Figure Captions: 1) Typical expression of platy surface morphology in the southern channel of Kasei Valles. Plates are separated by a darker, smoother medium (between black arrows), suggesting a crack fromed and the plates moved apart. The margin of the unit embays local topography at lower center of image (white arrow). Illumination from upper left. (E03-02670, 22.9° N, 65.1° W). **2)** Boulder-laden lobate tongues are in between ridges of the longitudinal grooves (striking uppper right to lower left). Illumination from lower left. (E11-00270, 20.2° N, 77.2° W). **3A)** Context image of cataract in southern channel of Kasei Valles. Black box is location of cut-out from E05-01141 shown in 3B. Illumination from upper left. (Viking image 664A14). **3B)** Cut-out from E05-01141 (21.2° N, 72.6° W) showing platy unit downstream from cataract. Northern margin.is covered with boulders and linear patterns appear terrace-like. Southern margin is rugged and boulder-covered. Illumination from lower left.