MARTIAN OUTFLOW CHANNELS AND THE OCEAN HYPOTHESIS. T. J. Parker, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, timothy.j.parker@jpl.nasa.gov.

Introduction:

The martian outflow channels exhibit a range of degradation states from very degraded systems with little evidence of fluvial morphology at high image resolutions (e.g. Uzboi Vallis), to sharply defined systems with fluvial bars and bank margin indicators that are prominent at all resolutions (e.g., Marte Vallis). Many outflow channels terminate at "contacts" identified based on Viking Orbiter images over 20 years ago, and interpreted by [1,2] as shorelines of an ancient martian ocean. Better-preserved outflow channels nearly always contain flow features suggestive of volcanism that might indicate a transition from hyperconcentrated floods to debris flows. Accumulating high-resolution image data and gridded MOLA topography enable a reassessment of the elevations and morphologies of proposed shoreline contacts and their putative associations with outflow channels of various ages.

Flow morphology in outflow channels: Probably the most familiar example of outflow channels associated directly with lava flow morphology is in southern Elysium – Athabasca through Marte Vallis [3]. Based on a number of features associated with these flows, the best interpretation for the development of the system seems to be that a fluvial channel was reoccupied at a later date by very high effusion rate/low viscosity lava flows. There are problems with this interpretation, however. Not the least of which is that for a lava flow to occupy the same channel carved by a prior fluvial system over regional distances, it would have to have identical physical properties, primarily discharge volume (effusion rate) and viscocity, because the channel dimensions and longitudinal profile are intimately tied to the discharge volumes and viscosity of the sediment-laden floods.

As progressively more degraded outflow channel systems are examined, the lava flow/debris flow-like morphology that is obvious with younger systems becomes increasingly difficult to recognize. In Granicus Vallis, for example, reaches of the channel transition from fluvial to fluvial-occupied-by-lava/debris flow morphology (Fig 1). Associations like this might suggest that all outflow channels with flow morphology within them simply served as conduits for later flows. Or, it might suggest that hyperconcentrated floods "crust over" with freezing and desiccating debris.

In the most-degraded, ancient outflow channels, flow morphology is largely or completely unrecognizeable, but curious landforms can be identified that might indicate an advanced degradation state of debris flow morphologhy. In Ares Valles, upstream of the MPF landing site, for example, very large blocks were identified that appear to have been transported by the flood, yet they are far too large for even traction load within the channel [4]. Similarly, Ladon Valles' source region exhibits blocks of chaotic terrain material that appear to have been transported many tens of kilometers downchannel [5](Fig 2). These examples might be more easily understood if they're remnants of once continuous debris flow surfaces that have been largely removed by erosion and gardening over geologic time.

Figure 1: Section of Granicus Vallis (22N,132.5E), exhibiting pressure-ridge dominated flow morphology occupying a "previous" anastomosing fluvial system. THEMIS image V09657015.

High resolution "shoreline" morphology: As with the outflow channels, morphology associated with the "shoreline" contacts proposed by [1,2] include landforms remiscient of lava or debris flow processes in accosciation with forms interpreted as aqueous in origin, particularly the more pristine interior contacts. Notably, the "Deuteronilus Level" (Contat 2 in [1]) exhibits lobate flow fronts with relief at the margins (Fig 3), suggesting a flow direction from the plains interior and up the flanks of the highlands, to about an elevation of -3900m locally.

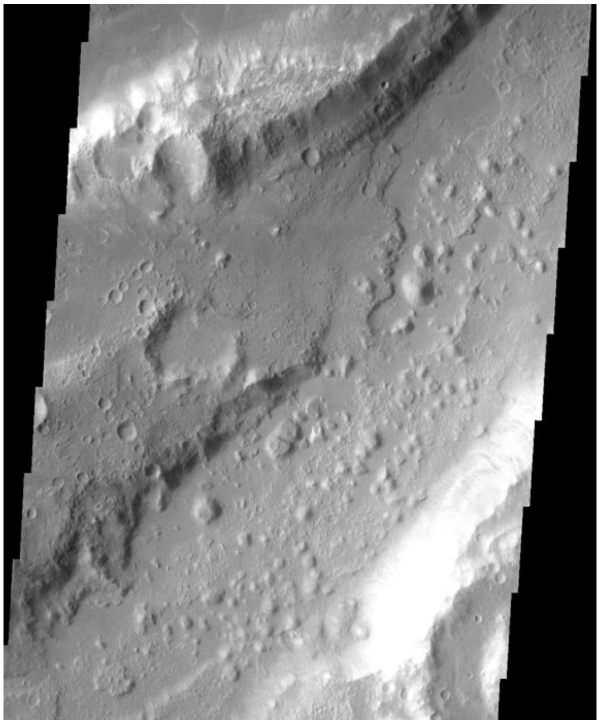

Figure 2: Section of Ladon Valles (24S,330.5E), where blocks of chaotic terrain material appears to have been transported tens of kilometers from the source chaotic terrain. THEMIS image V0V09913003.

Figure 3: Section of "Deuteronilus level" contact in west Deuteronilus Mensae (46.5N,14.5E), where plains material appears to have flowed up fret valley from the northern plains interior. THEMIS image V04481003.

At the time of this writing, this contact is the most extensively-traced of the proposed shoreline features. For the most part, it does appear to define a formerly level surface, though it ranges from about -3900m in west Deuteronilus Mensae, to as much as -4200m in west Cydonia Mensae.

In [2], high albedo lobate features were described that appear to have advanced upchannel in the northern Chryse region, and a similar margin was identified in western Utopia. These were interpreted as backfill deposits associated with ponding within the northern plains associated with the circum-Chryse floods. However, post-Viking high-resolution images from MGS, Odyssey have revealed this material to be similar in texture to that in west Deuteronilus Mensae (Fig 4), and MOLA topography reveals the margin in this area to have as much as 50m of relief associated with it. Plainward of this deposit margin, the topography drops off, suggesting lowering of the surface of the plains interior by up to several hundred meters via removal of material. It is suggested, then, that these lobate deposits are debris-rich flow fronts at the margin of a late transgressive phase of a debris and ice-covered ocean that has since receded.

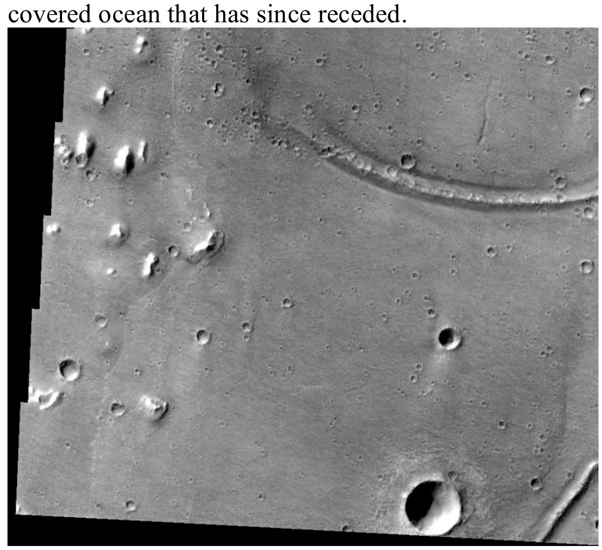

Figure 4: Lobate flow front encroaching on small knobs (at left) in northern Ares Valles (28.5N, 330.5E), where plains material appears to have flowed up the mouths of the circum-Chryse channels from the northern plains interior. MOLA indicates relief of ~50m on these lobes. THEMIS image V11597006.

References: [1] Parker T. J., et al. (1989) *Icarus,* 82, 111-145. [2] Parker T. J. et al. (1993) *JGR*, 98, 11061-11078. [3] Jaeger, W.L. et al. (2007) Science, 317, 1709-1711. Author G. H. (1996) *LPS XXVII,* 1344–1345. [4] Parker T J and J W Rice (1997) *JGR,* 102, 25641-25656. [5] Parker T J (1985) *MS Thesis*, Cal. State Univ. L. A., 165p.