THE CHALLENGE OF EXPLAINING MEANDER BENDS IN THE EBERSWALDE DELTA. E. R. Kraal[1] and G. Postma[2], [1]Department of Geoscience, Virginia Tech, 4044 Derring Hall, Blacksburg, VA 2406 (ekraal@vt.edu), [2]Faculty of Geosciences, Utrecht University, PO Box 80115, 3508 TC Utrecht, The Netherlands (gpostma@geo.uu.nl).

Introduction: Curved, semi- concentric loops, interpreted as meander bends (point bars) have been recognized in the delta plain of the Eberswalde Delta, Holden NE crater (Wood, 2005, Jerolmack et al., 2004, Malin & Edgett 2003, Moore et al. 2003). The structures have led to important and already deep-rooted paleo-climate interpretations of a long-lived, Noachian-aged crater lake with persistent liquid water on the Martian surface (Malin and Edgett, 2003; Moore et al., 2003; Pondrelli et al., 2005) or as formation of meander bends with alluvial fans (Jerolmack et al., 2004).

Background: Meanders, while common in some places on the earth, are non-trival features to form. They require a specific sedimentary conditions such as low energy, bank stability, and specific grain sizes and distributions (see Reading 1996 for overview).

Observations: Spacecraft data recently aquired is at a higher resolution that the images (Mars Orbiter Camera) and topography (Mars Orbiter Laser Altimeter) used to make the initial classification. Some of the new data, and reanalysis of the previous data, may indicate some challenges forming a bedload transported, meandering delta in the Eberswalde region. Some of these observations are:

1. The meander bends appear to lack the typical symmetrical organization in the channel belt as is common for terrestrial examples.

2. Recent examination of black and white images and anaglyphs taken with HiRISE camera by Fedo et al. (2007) reveals that the cut-bank side of the loop is topographically higher than the inner point-bar of the meander bends, which is a-typical in terrestrial systems. This would require the unlikely uphill migration of the channel.

3. Lithologic color alternations in the bends represent flat-lying stratigraphy (also a-typical for lateral accretion surfaces in a point bar, as pointed out by Fedo et al. (2007);

4. Large boulder trains (~1 m in diameter see Fig. 1) are found in the outer bend of the interpreted meanders. This is not characteristic of terrestrial delta environments and out of line with the low energy generally required to form meandering deltas (but hydraulically feasible according to Howard et al. 2007).

We believe that all of these observations require a careful re-analysis of the meandering delta hypothesis and have conducted research in alternative formation mechanisms (Kraal and Postma, in prep).

Methodology: An alternative for bed-load transport is 'en-masse' sediment transport triggered by catastrophic events of water discharge. This would require significantly less water, both within the flowing deposit and not require deposition in a standing body of water. To verify if similar bends as in Fig. 1A can be produced by '*en-masse*' sediment transport, we conducted a series of experiments that focused on morphological development of debris flows of variable water content. Since the ratio sediment/water exerts a primary control on viscosity and strength of the flow, we thus obtained a range of morphologies that expresses the relative amount water.

Results: Figs. 1B-D shows debris flow deposits (lobes) obtained in experiment. The flows with the highest water content develop sheet-like and do not produce significant topographic curvatures (1C), while the high viscosity ones develop steep surface slopes that are inclined upslope (1D) and have an indented relief in plan view somewhat akin to meander belts. Boulders can be picked up during flow at the side by wall plucking and be transported and deposited preferentially along the shear zones (compare Fig. 1A inset with 1B).

Conclusions: *'En-masse'* sediment transport (debris flows) offers a strong alternative explanation for the bends on the Eberswalde delta. These findings have consequences for paleo-climate interpretations and do not need the existence of a 'permanent' crater lake.

References:

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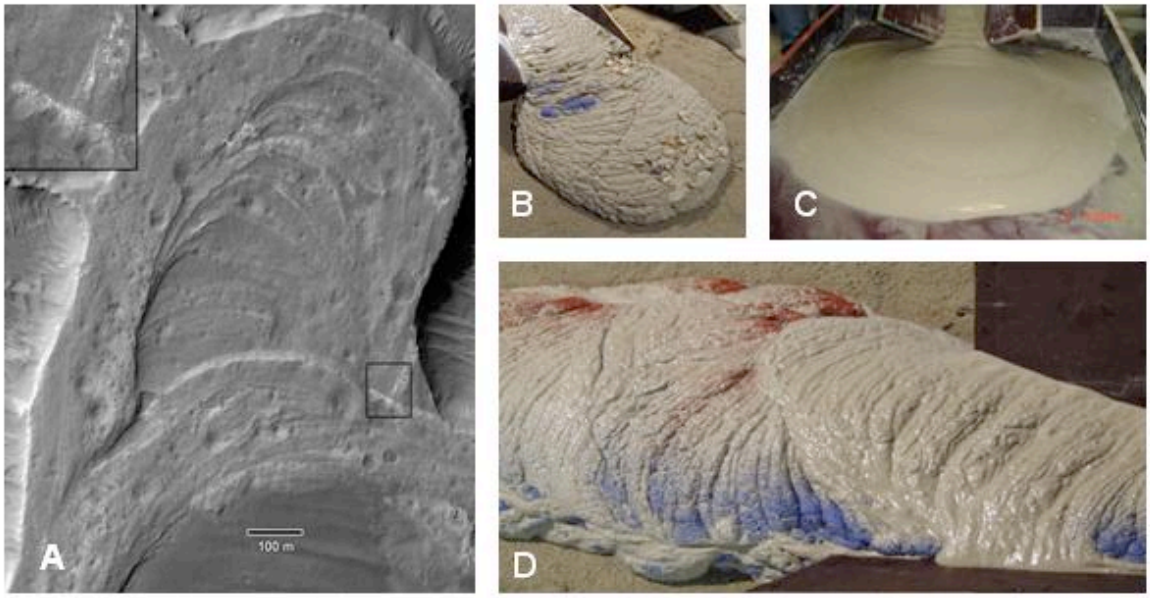

Figure 1.
A. Inferred meander-belt on the Eberswalde delta; B. High-viscosity debris flow lobe formed in the laboratory and includes gravel for simulated 'boulders.' The gravel was inserted in the duct at the flow margin and is observed to orient itself along the semi concentric zones of internal shear in the depositing lobe. C. Low-viscosity debris flow develop sheet-like deposits with light color differences in the bends; D. Composite of three flow pulses in a high viscosity flow with red and blue color tracers sprinkled, like the gravel, along the margin of the flow.