Interpretation of Martian Delta Morphology and Processes

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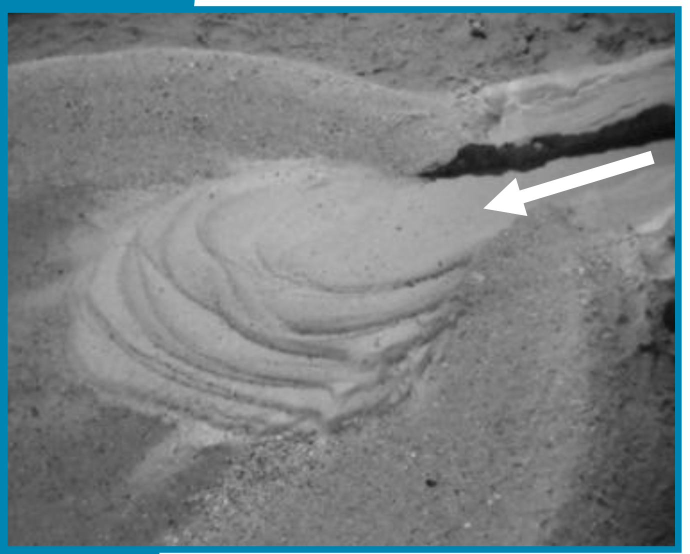
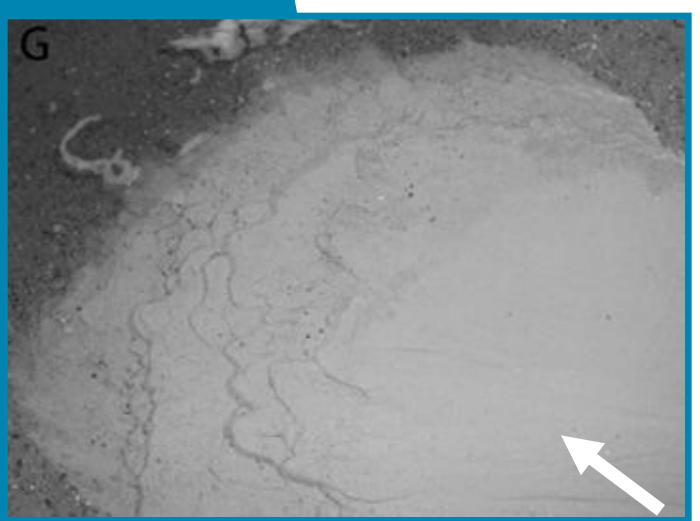
Research group
River and delta morphodynamics





Aim

Martian deltas exhibit architectural elements similar to those of terrestrial analogues and we demonstrate that the interpretation of these elements (using physical and numerical modelling) can be used to infer the processes that were active on the fan surface during formation.

Background

- Physical modelling was done in the Eurotank (Fig. 1)
- Numerical modelling have been done using a model developed by Kleinhans et al. (2009) (Fig. 2)

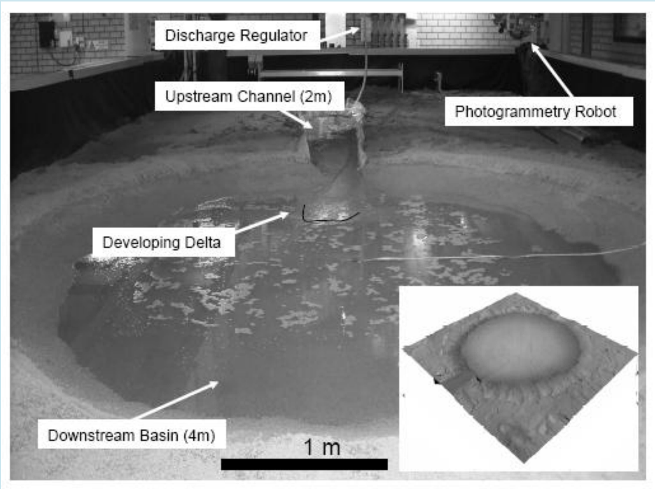


Figure 1: Physical model setup

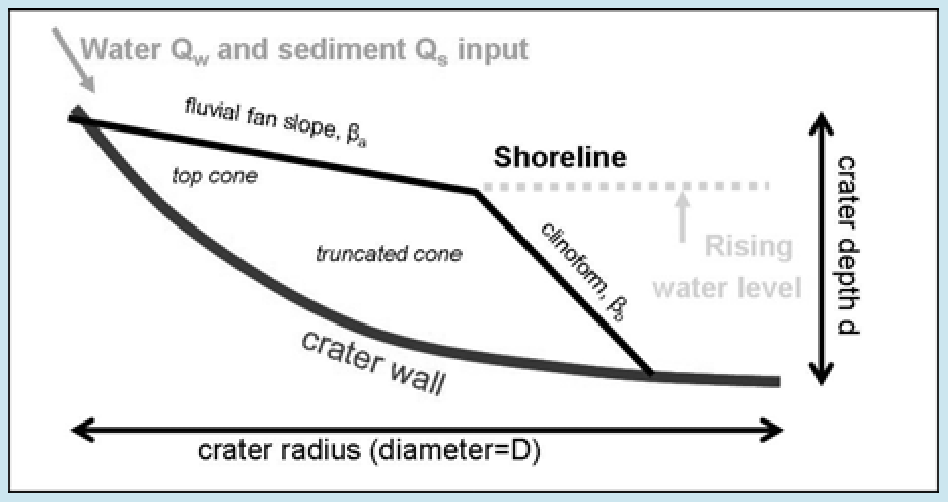


Figure 2: Numerical model setup

Results

Our results show the development of two distinct types of deltas (Fig. 3):

- Stepped delta (during water level rise)
- Gilbert-type delta (during stable water level)

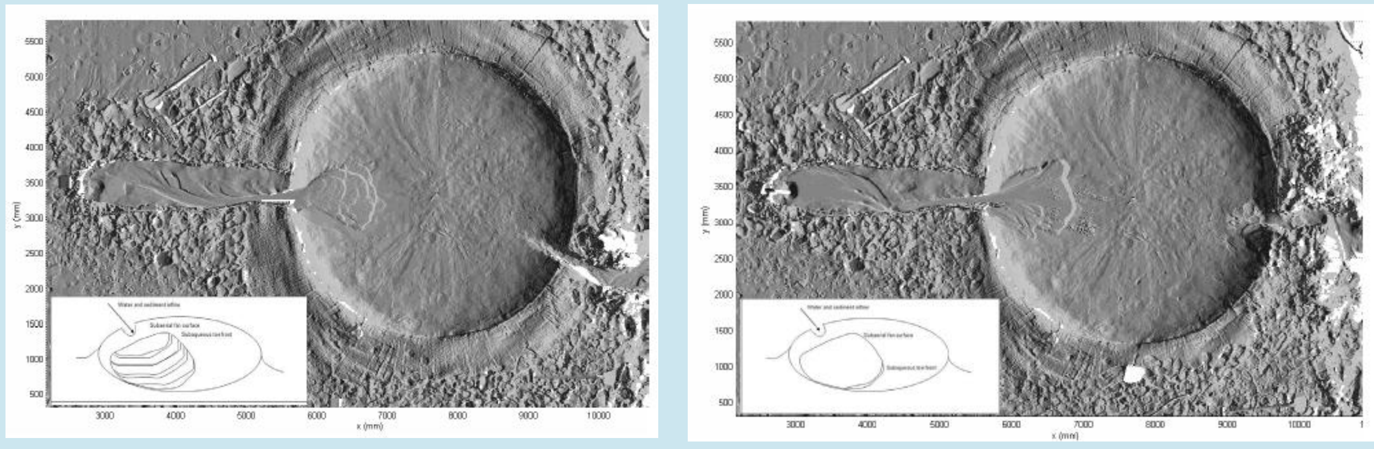
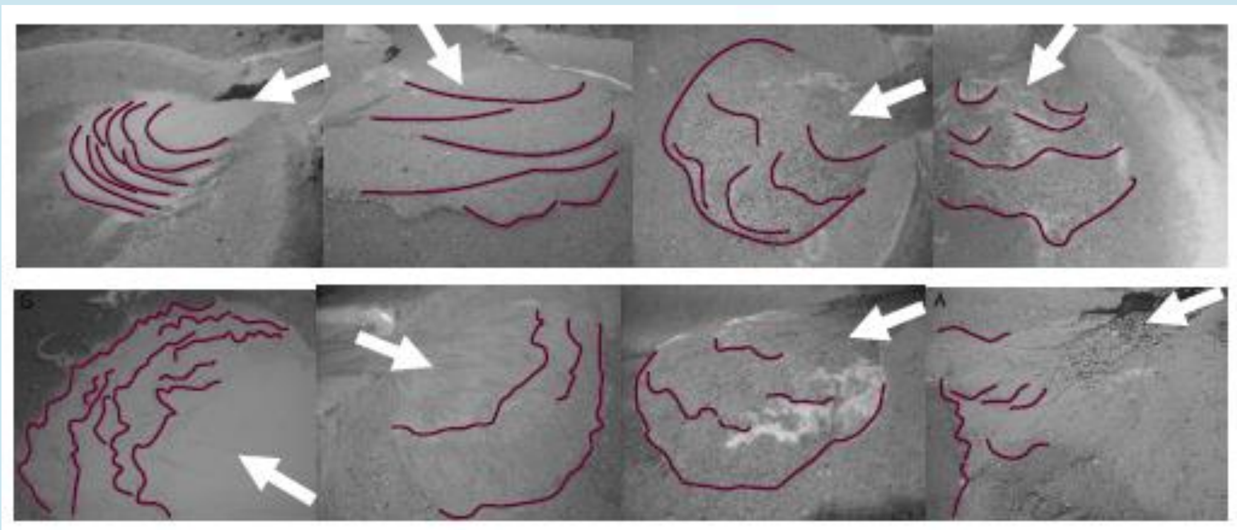


Figure 3: DEMs and schematic side views of two delta types (first and second events)

Discussion

- Further observation of the experimental deltas indicate that different sub-types develop based on the variation in discharge and grain size between experiments (Fig. 4). Variations in these parameters are responsible for more or less channelization on the delta surface – a process which may be directly related to climate
- Investigation of the numerical model suggests that we have a two major differences between the ideal scenario in the model and the real scenario in the lab (Fig. 5):
  - Pulsing in the rate of sediment delivery (responsible for a stepped morphology in phase 1)
  - Initial strength of the crater rim (responsible for a lower initial sediment transport rate in phase 1)



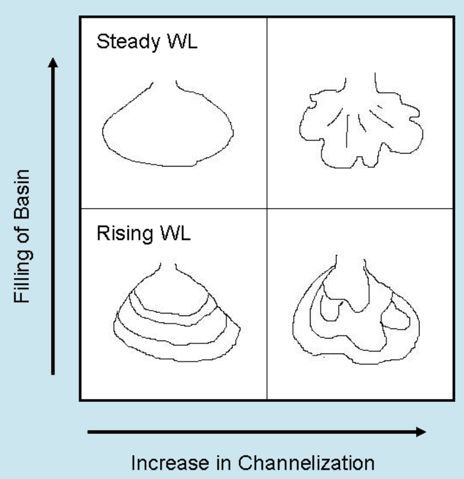


Figure 4: Different sub-types with increase in grain size (x-dir) and discharge (y-dir)

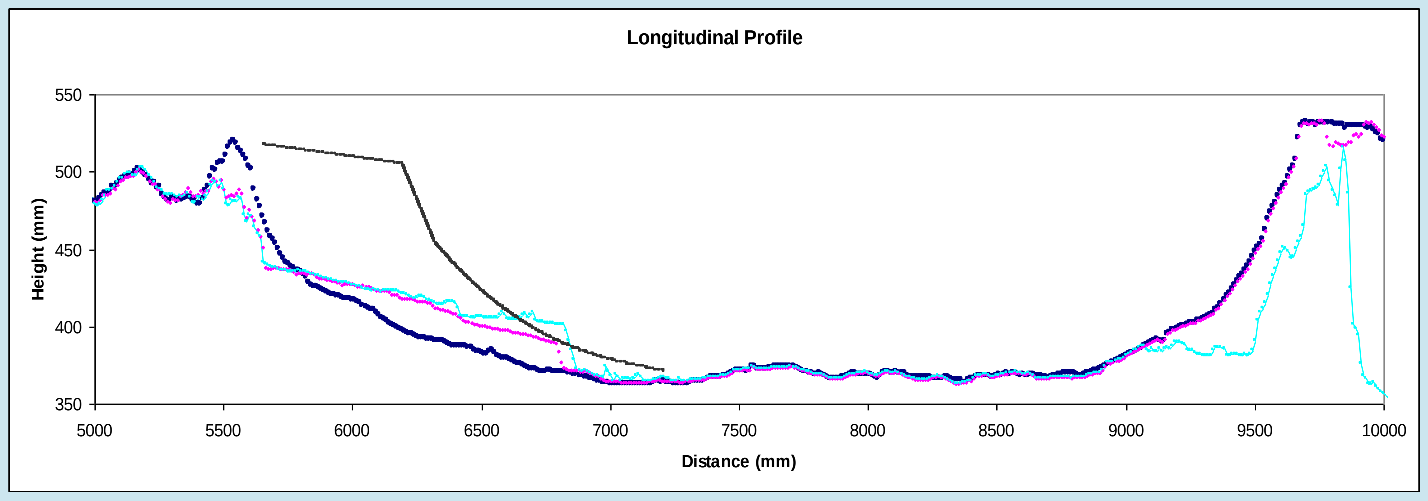


Figure 5: Numerical model results plotted on a profile of a laboratory delta

Conclusions

Three processes that may have been very important for the formation of deltas on Mars:

- Channelization or sheet flood
- Sediment transport pulsing
- Resistance of rim material to initial erosion

LPSC 2011
Houston, TX