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AIM

Qualify and quantify morphological elements of Martian fan-shaped deposits with HRSC-data and categorically classify types of large fan-shaped deposits.

BACKGROUND

Martian fan-shaped deposits show architectural elements similar to those of terrestrial analogues. Fan morphology is related to upstream and downstream conditions such as water discharge and flow duration; sediment flux and properties; as well as basin size and water level [1, 2]; and is indicative of climatic conditions at time of deposition [3]. From experiments in the Eurotank (see our abstract for this meeting), we have seen that various types of fan-deposits are merely different phases of development of the same system. Also from these experiments, it is evident that both discharge and sediment mobility (a function of grain size) play a large role in the morphology of the deposit.

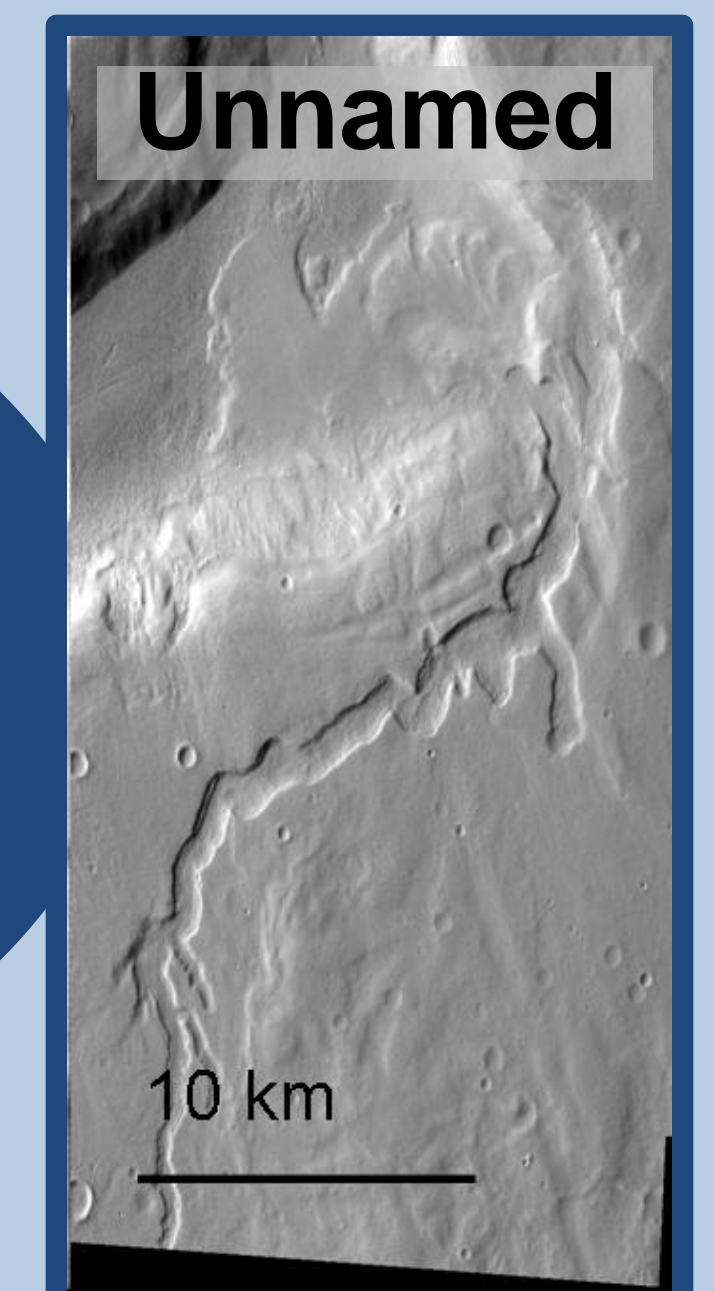
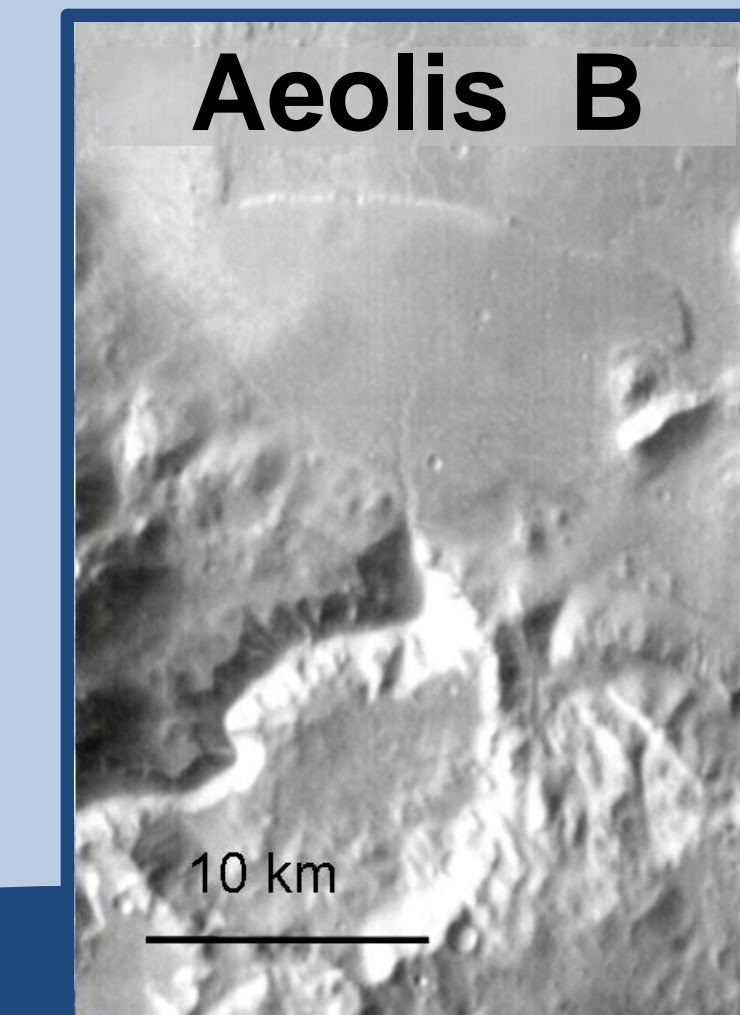
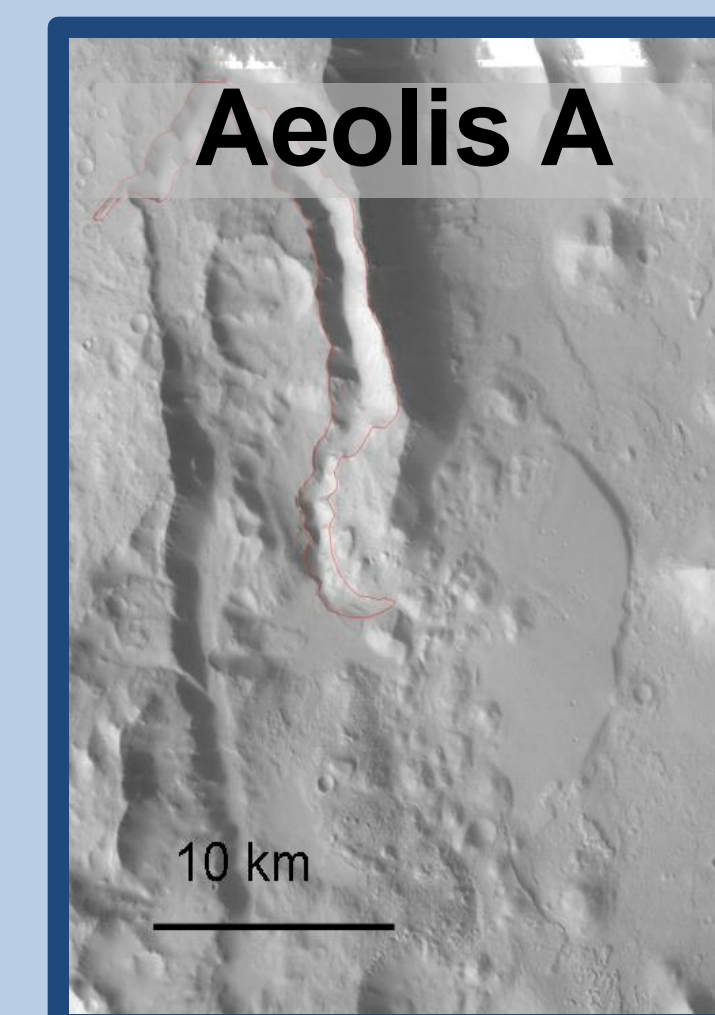
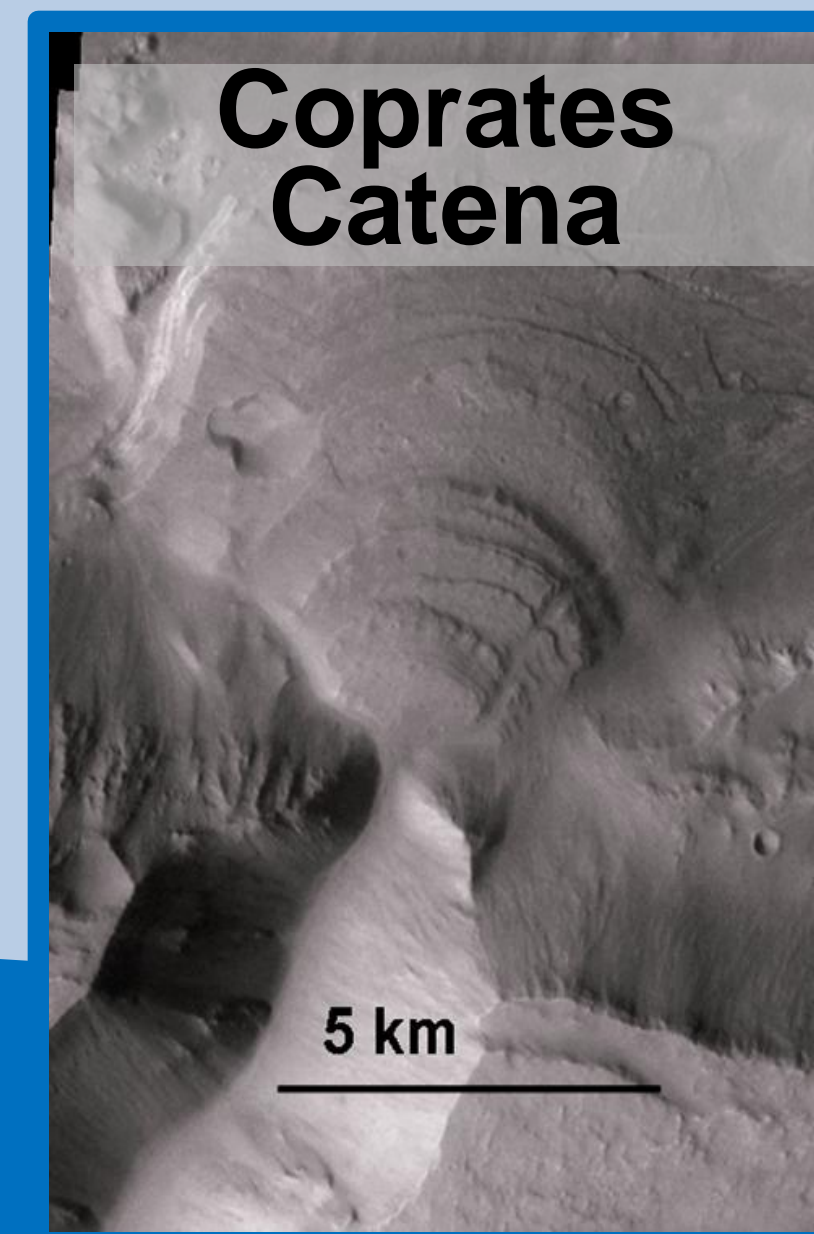
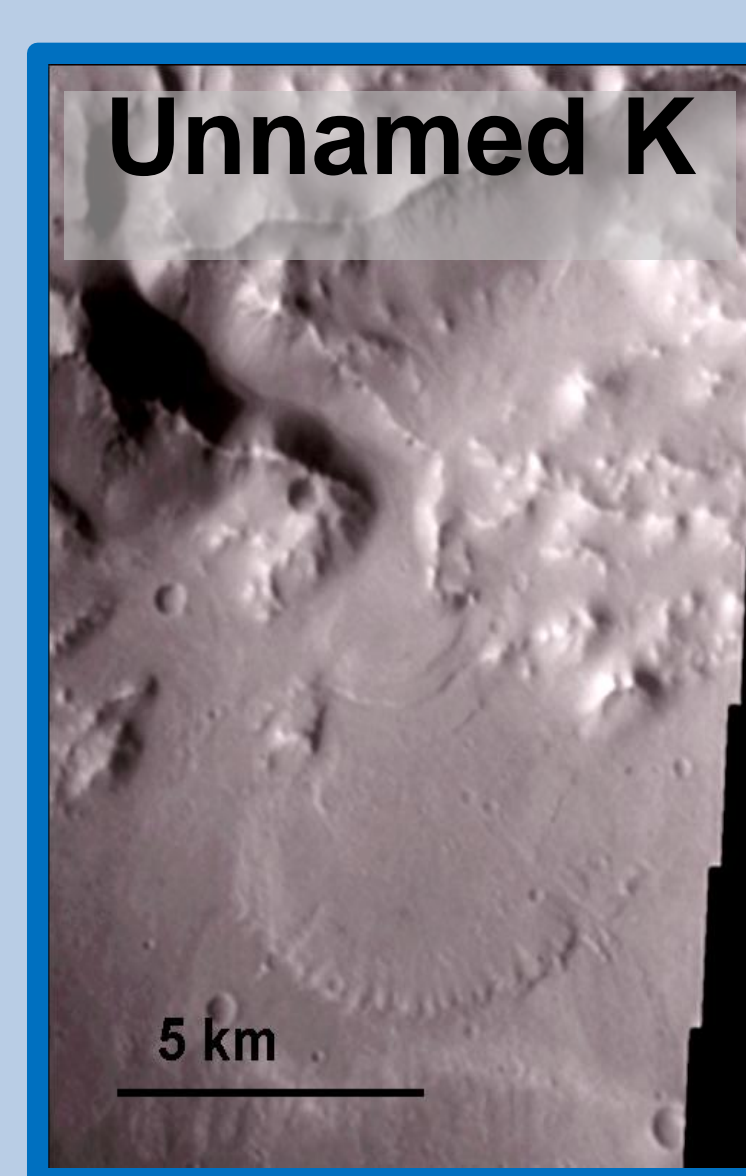
TYPES OF DEPOSITS

Lengths, gradients and shapes of roughly 30 deposits from 20 sites were measured and described:

- **Alluvial Fans:** Large, relatively low-gradient, fluvial dominated fans with classic conical shapes with short and steep or absent feeder channels [e.g. 4]
- **Smooth Deltas:** Semi-circular, flat-topped, Gilbert-type deltas with steep fronts indicating sheet-flow conditions and with long feeder channels suggesting bed-load dominated transport [e.g. 5]
- **Branched Deltas:** Bird-foot shaped, branched deltas indicating channelized-flow conditions and with medium to long feeder channels [e.g. 6, 7]
- **Stepped Deltas:** Terraced deltas with clear fronts and frayed toe-sets, as well as short feeder channels [e.g. 8, 9]
- **Sliding Deltas?:** A variety of terraced deltas with less well-developed steps, but rather drapes (difference is more evident in profile than in plan view) – we see this in the laboratory and have found at least one candidate for this type on Mars [e.g. 10]!

MORPHOLOGICAL PARAMETERS

	Alluvial Fans	Sliding Deltas	Stepped Deltas	Branched Deltas	Smooth Deltas
Shape	Classic cone	Stacked terraces	Stacked terraces	Branched fan-shape	Smooth semi-circular
Average Gradient	~ 3 degrees	Varies	Varies	~ 1 degree	~ 1 degree
Average Length	~ 20 km	~5 km	~10 km	~ 5 km	~10 km



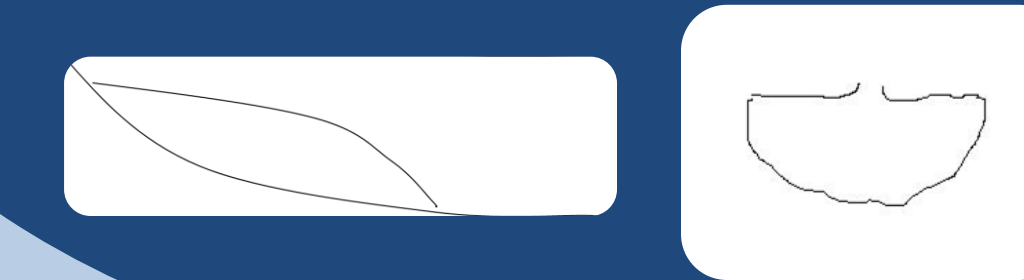
Stepped Deltas

Inferred Processes – Fluvial flow
Water Level – Rapidly Rising
Feeder Channels – Mainly short and steep



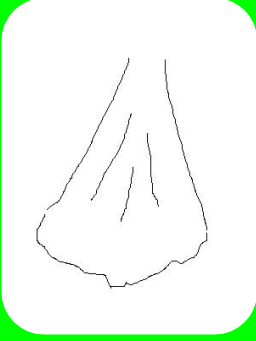
Smooth Deltas

Inferred Processes – Sheet-like fluvial flow
Water Level – Steady at basin breach level
Feeder Channels – Varies in length



Alluvial Fans

Inferred Processes – Fluvial flows; but significant post-depositional aeolian erosion
Water Level – Little or no ponding water in basin
Feeder Channels – Absent or short and steep



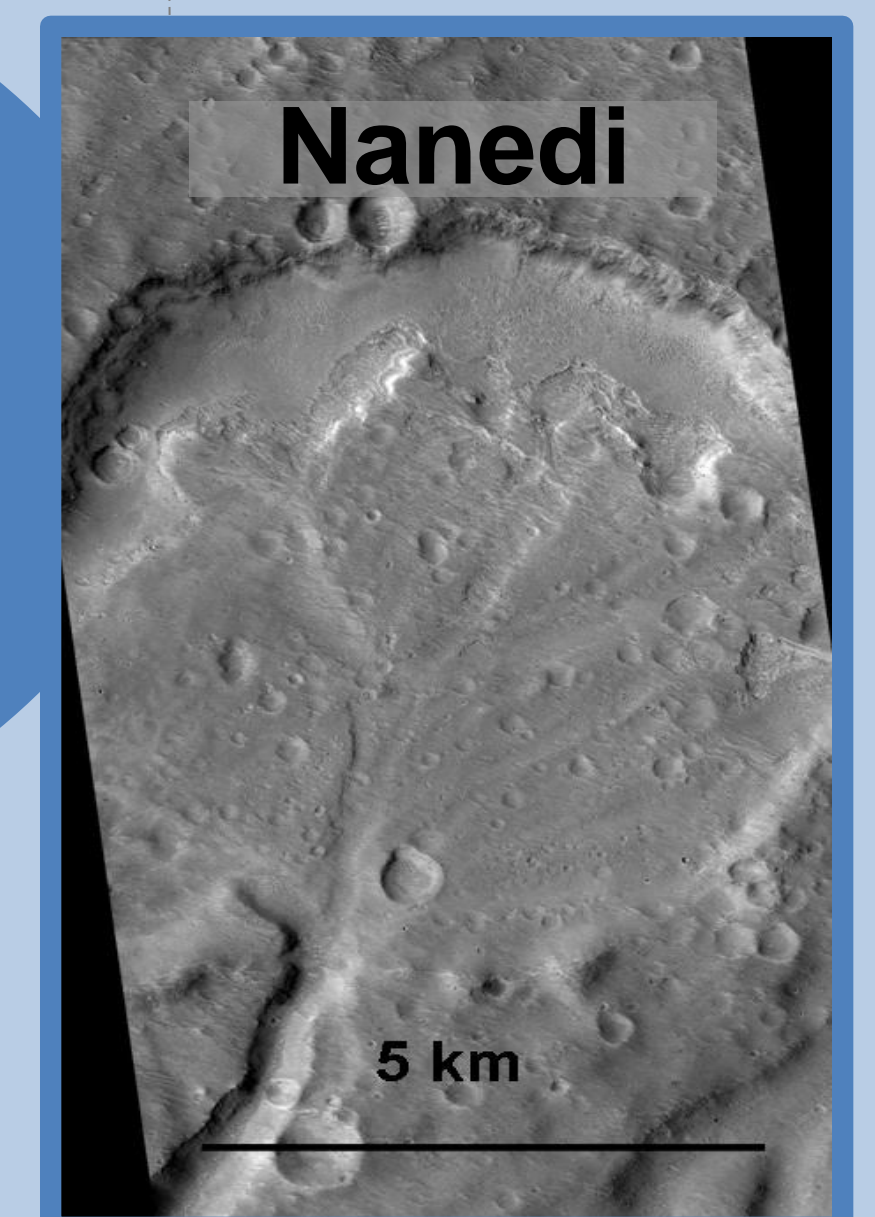
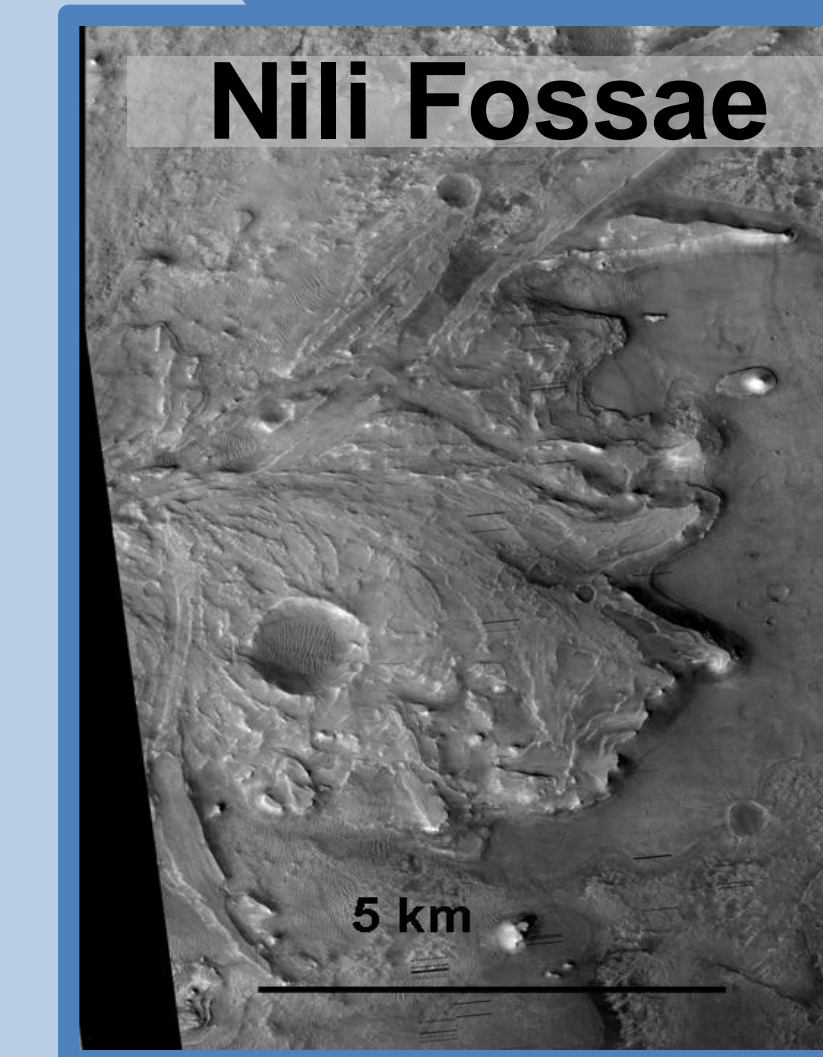
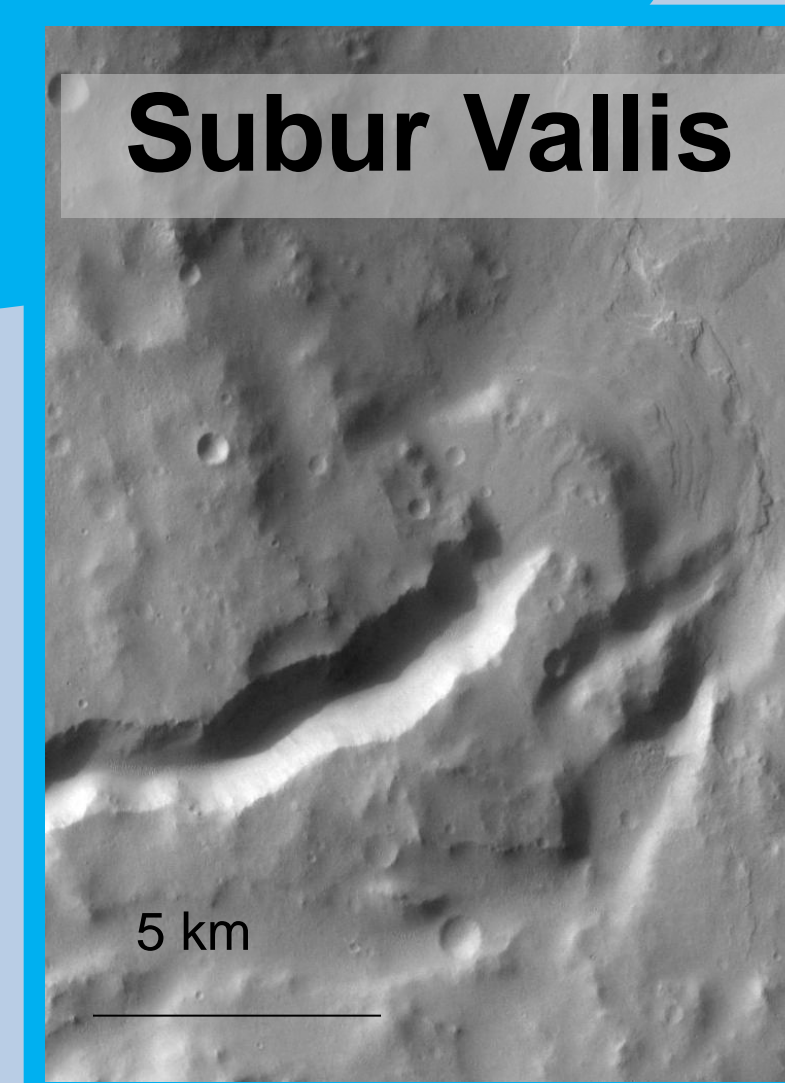
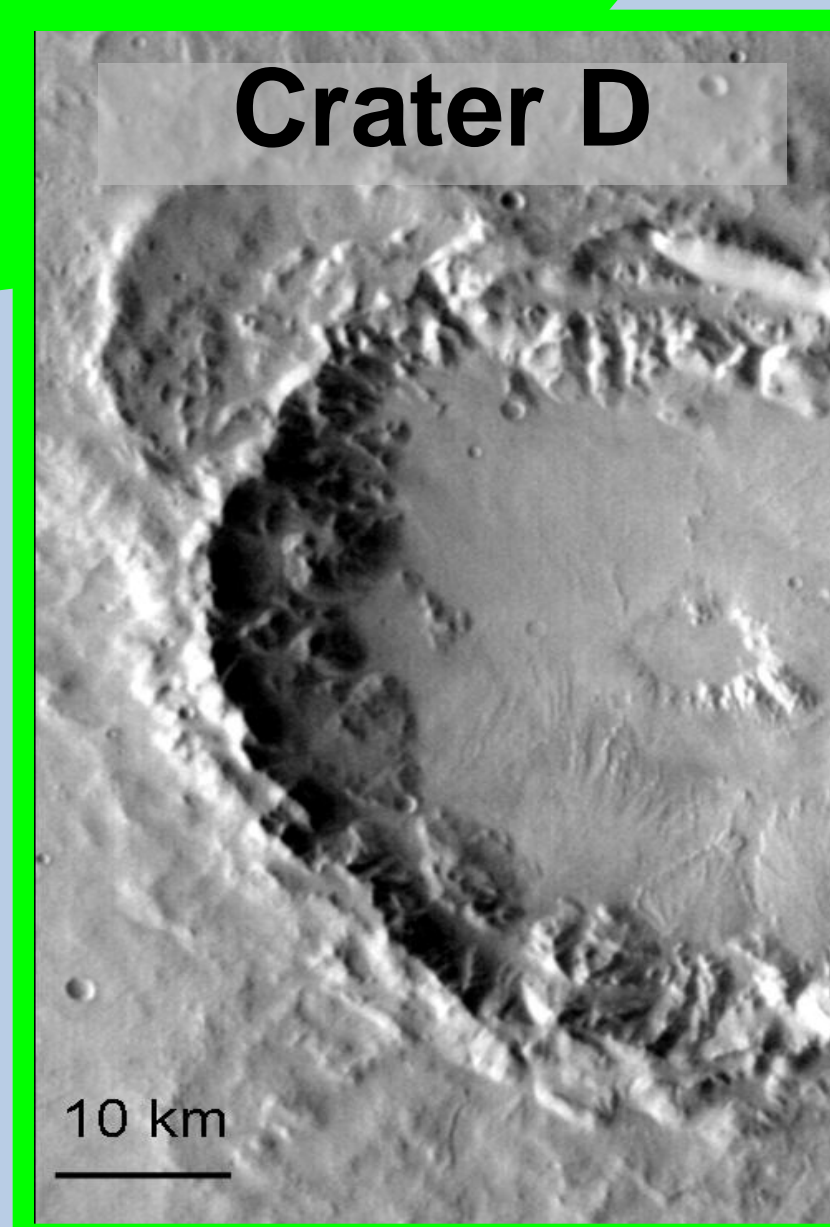
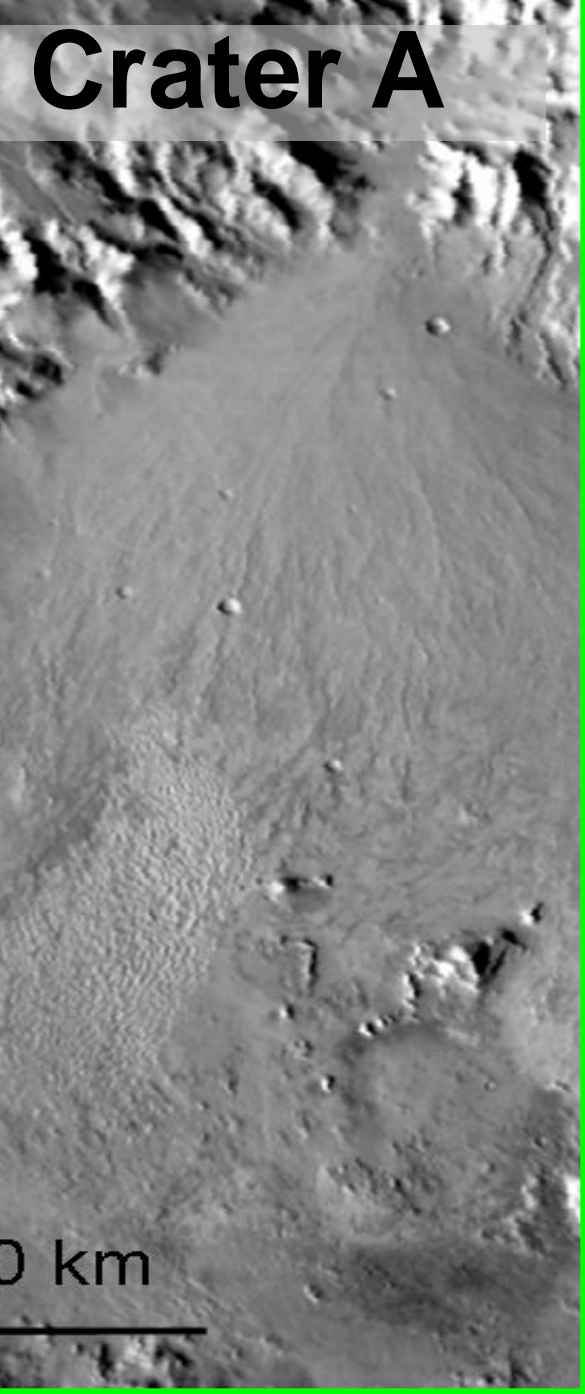
Sliding Deltas?

Inferred Processes – Fluvial flow
Water Level – Slowly Rising
Feeder Channels – Mainly short and steep



Branched Deltas

Inferred Processes – Channelized fluvial flow
Water Level – Steady at basin breach level
Feeder Channels – Long and shallow



No Water Level

Rising Water Level

Constant or Falling Water Level

Increase in Discharge or Decrease in Mobility?

SUMMARY

- Two important parameters, *water level* and *degree of branching*, can be used to distinguish between different morphological types of deposits
- Degree of branching seems to be a function of both *discharge* and *sediment mobility* (a function of grain size); deltas can be dominated by sheet-flow or channelized flow
- Stepped and sliding deltas differ more in profile than in plan view; branched and smooth deltas differ more in plan view than in profile
- Relationships exist between the different “end-member” types of deltas shown here and overlap between types does occur
- Different morphological types of fan-shaped deposits indicate different types of processes and possibly different types of climatic conditions during formation

REFERENCES AND ACKNOWLEDGEMENTS

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