

Martian Fan-shaped Sedimentary Deposits



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OBJECTIVES

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

BACKGROUND

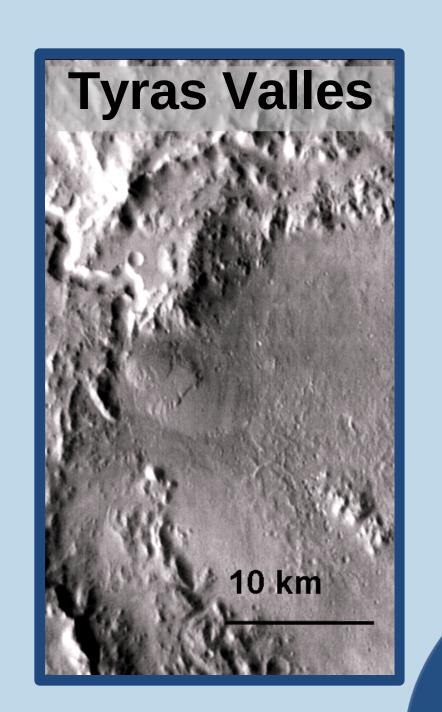
Martian fan-shaped deposits show architectural elements similar to those of terrestrial analogues. Fan morphology is related to upstream and downstream conditions such as water discharge and duration, sediment flux and properties, as well as basin size and water level [1, 2]; and is indicative of climatic conditions at time of deposition [3].

TYPES OF DEPOSITS

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

- **Type 1 Alluvial Fans**: Large, relatively low-gradient, fluvially dominated fans with classic conical shapes with short and steep or absent feeder channels [e.g. 4]
- Type 2 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]
- Type 3 Branched Deltas: Bird-foot shaped, branched deltas indicating channelized-flow conditions and with medium to long feeder channels [e.g. 6, 7, 8]
- Type 4 Stepped Deltas: Terraced deltas with clear fronts and frayed toe-sets, as well as short feeder channels [e.g. 9, 10, 11]

MORPHOLOGICAL PARAMETERS								
	TYPE 1	TYPE 2	TYPE 3	TYPE 4				
	Alluvial Fans	Smooth	Branched	Stepped				
		Deltas	Deltas	Deltas				



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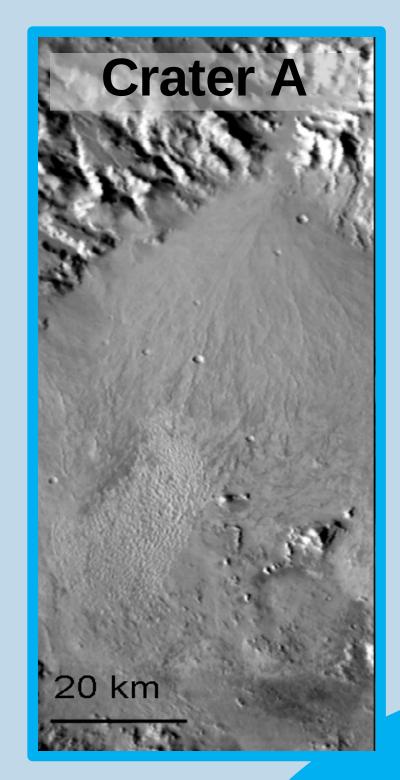
RISING PONDING WATER IN BASIN

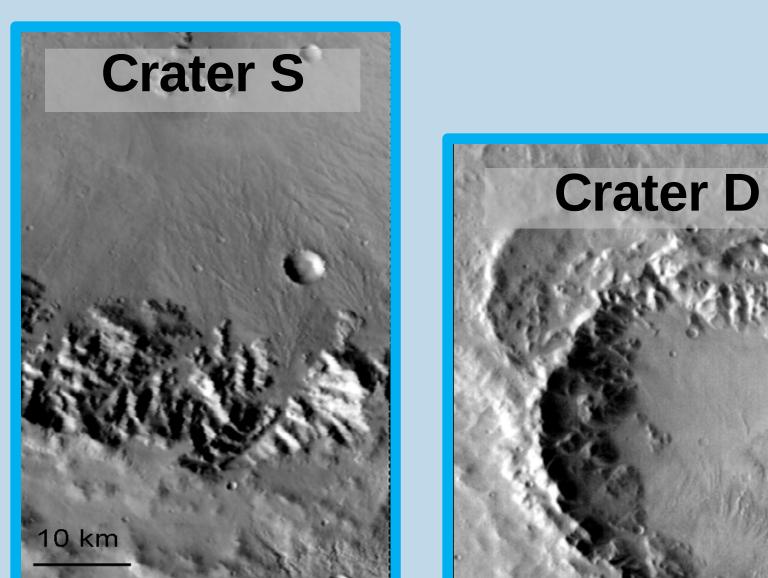


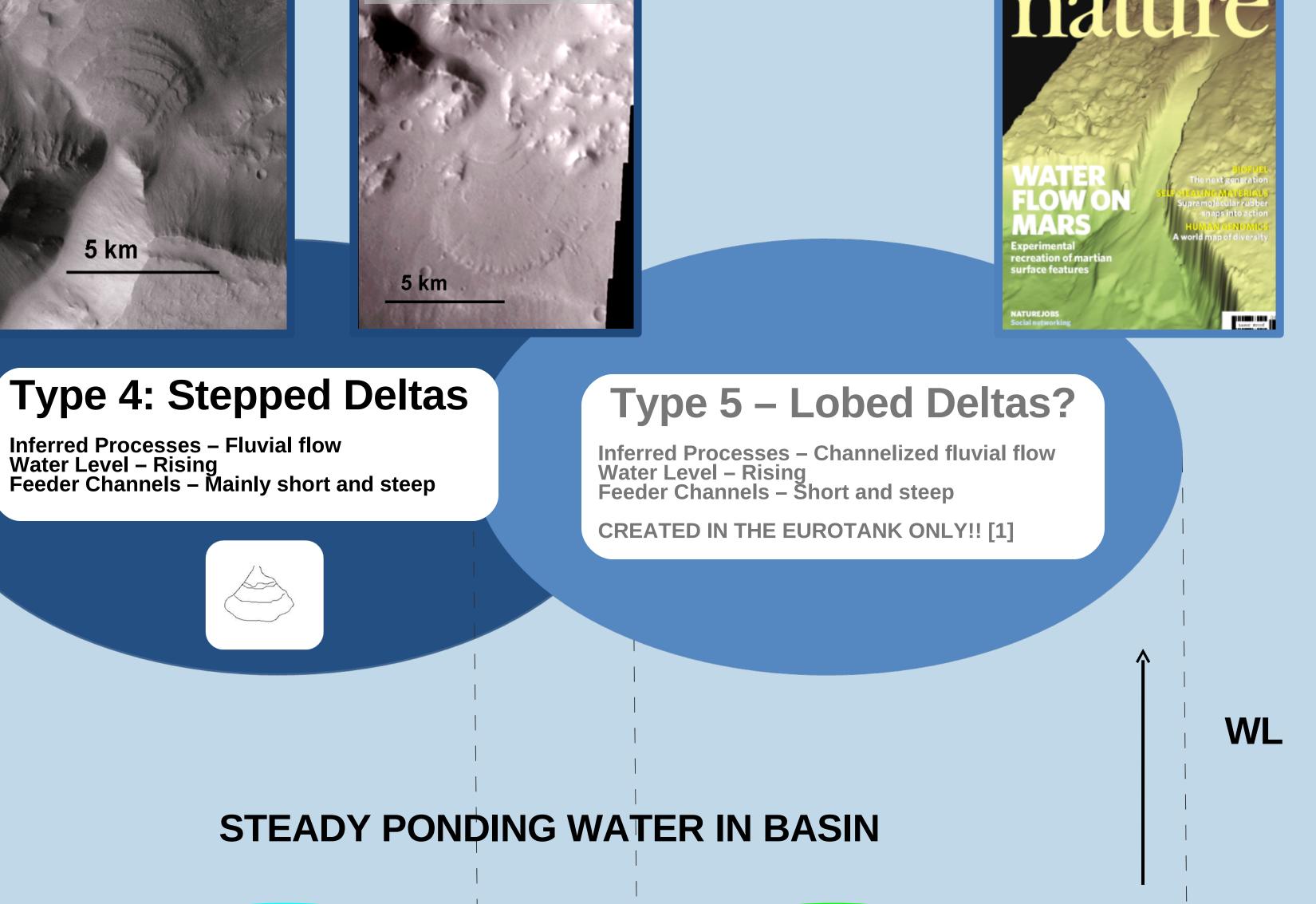


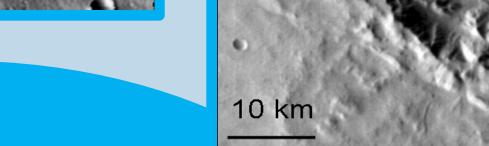
Approximate Shape	Classic cone-shape	Smooth semi-circular	Branched fan-shape	Stacked terraces
Average Gradient	~ 3 degrees	~ 1 degree	~ 1 degree	Varies
Average Length	~ 20 km	~10 km	~ 5 km	~10 km

NO PONDING WATER IN BASIN







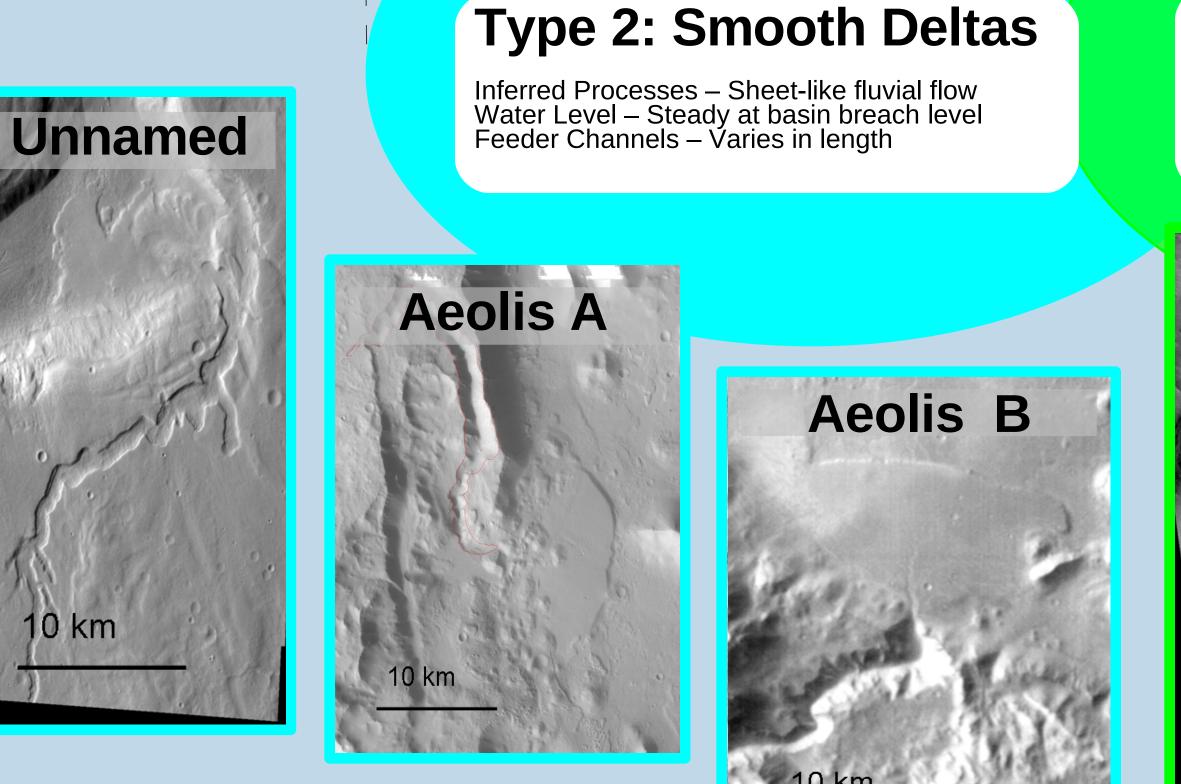


Type 1: Alluvial Fans

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

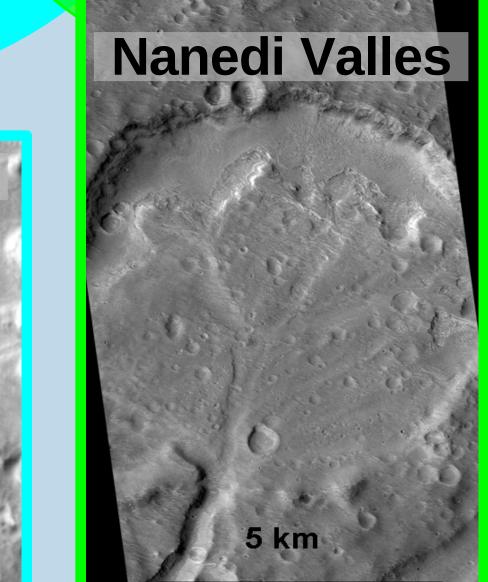
SUMMARY

- Two important parameters, *water level* and *degree of branching*, can be used to distinguish between different types of deposits
- Alluvial fans form into dry basins, whereas deltas form into basins with ponding water and steady or rising water levels
- Deltas can be dominated by sheet-flow or channelized flow
- Relationships exist between the different "end-member" types of deltas and overlap between types do occur (see Venn-diagrams)
- Different morphological types of fan-shaped deposits indicate different types of processes and possibly different types of climatic conditions at formation [13]

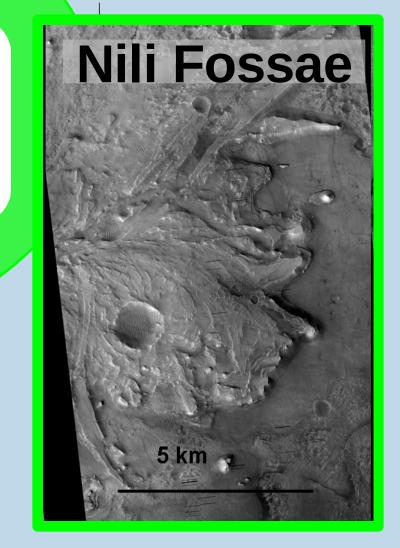


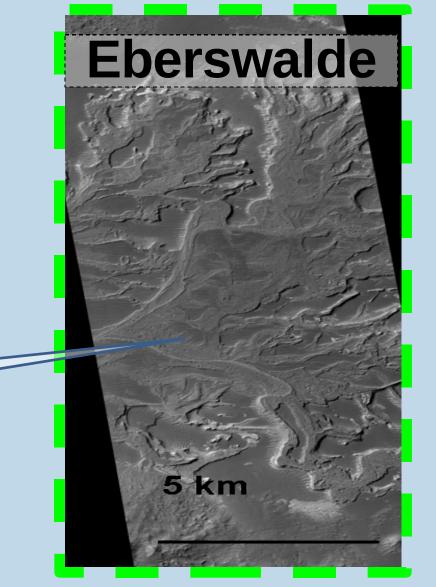
Type 3: Branched Deltas

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



Uncertainty exists about whether the Eberswalde deposits formed through fluvial or debris flow processes and hence the classification here is not conclusive [12].







[1] Kraal, Van Dijk, Postma and Kleinhan

[2] Postma (1990). "Depositional archited

[3] Postma (2001). "Physical climate sign

[4] Moore and Howard (2005). "Large all

[5] Cabrol and Grin (2001). "The Evolutio

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[7] Hauber, Gwinner, Kleinhans, Reiss, D

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[9] Di Achille, Ori, Reiss, Hauber, Gwinne

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[11] Di Achille, Marinangeli, Ori, Hauber,

[12] Kraal and Postma (2008). "The chall

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