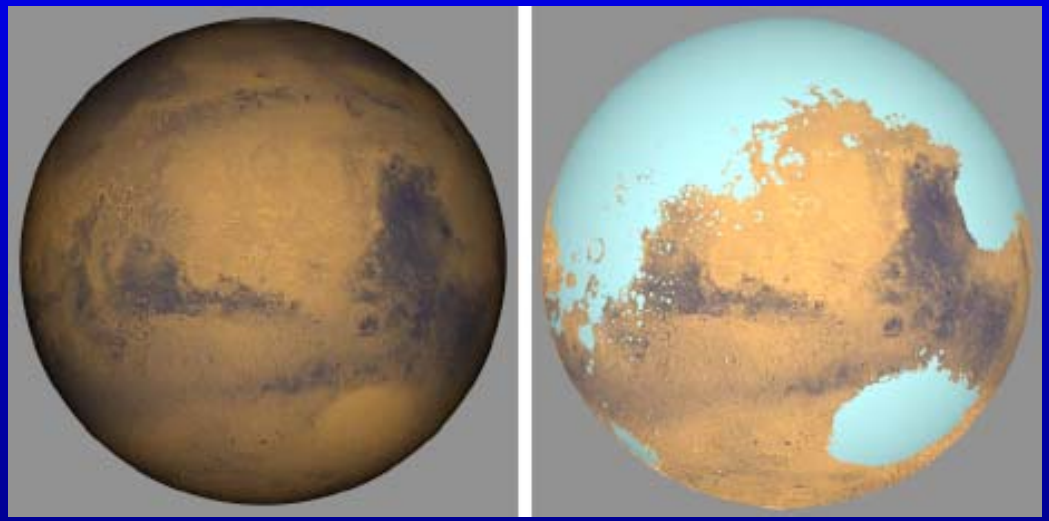
IDENTIFYING SUITABLE TERRESTRIAL ANALOGS OF MARS SHOREZONE FEATURES: PLANETARY EXPLORATION GUIDELINES



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Highlights of the Mars “ocean” controversy

- **Parker et al. (1989): Viking Orbiter images**

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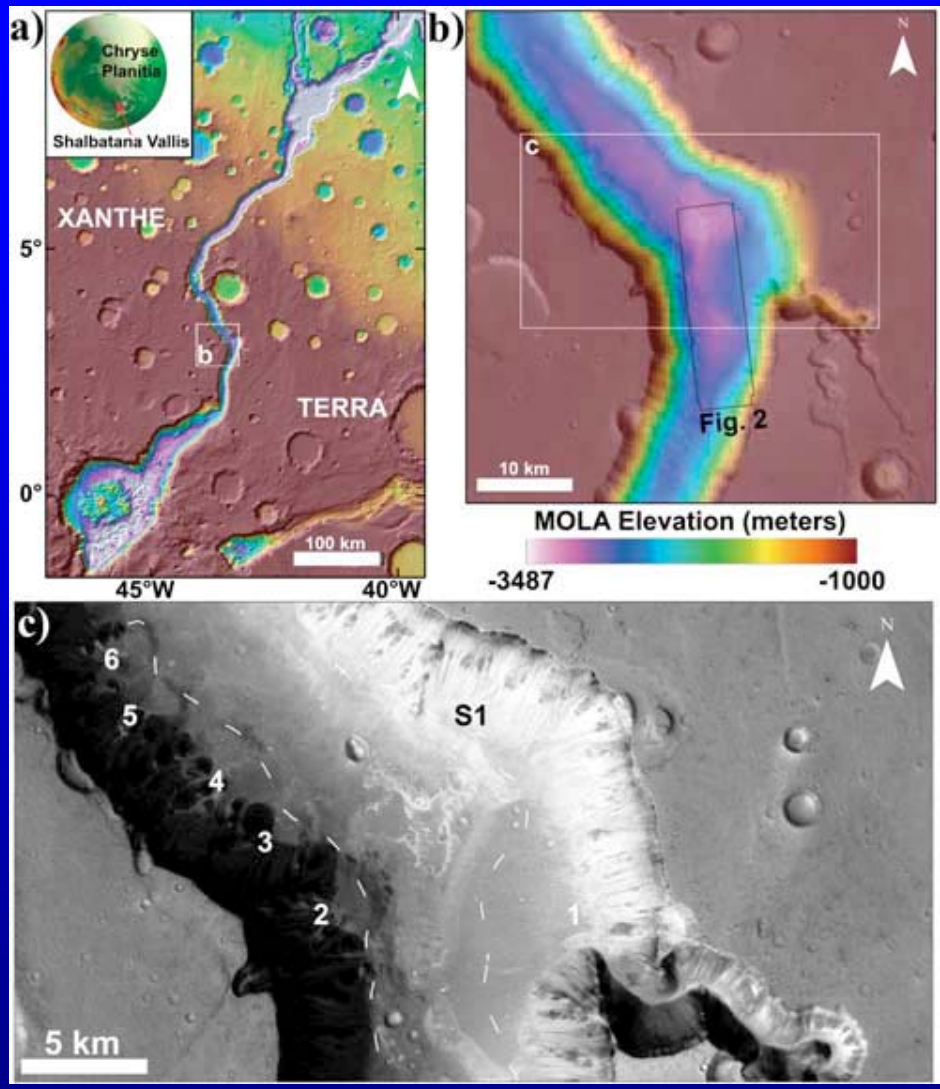
- **Parker et al. (2010)**

Questions

- What are the appropriate scales of shoreline features that might be discerned on Mars?
- Are there viable terrestrial analogs from Lake Bonneville, Lake Agassiz, the Baltic Ice Lake, others
- If so, what will it take to discern similar features on Mars?



"unequivocal shorelines" (above)?
Shalbatana Vallis (Di Achille et al. 2009)

Lake Bonneville shorelines (left)

How long might geomorphic features be expected to survive on Mars?

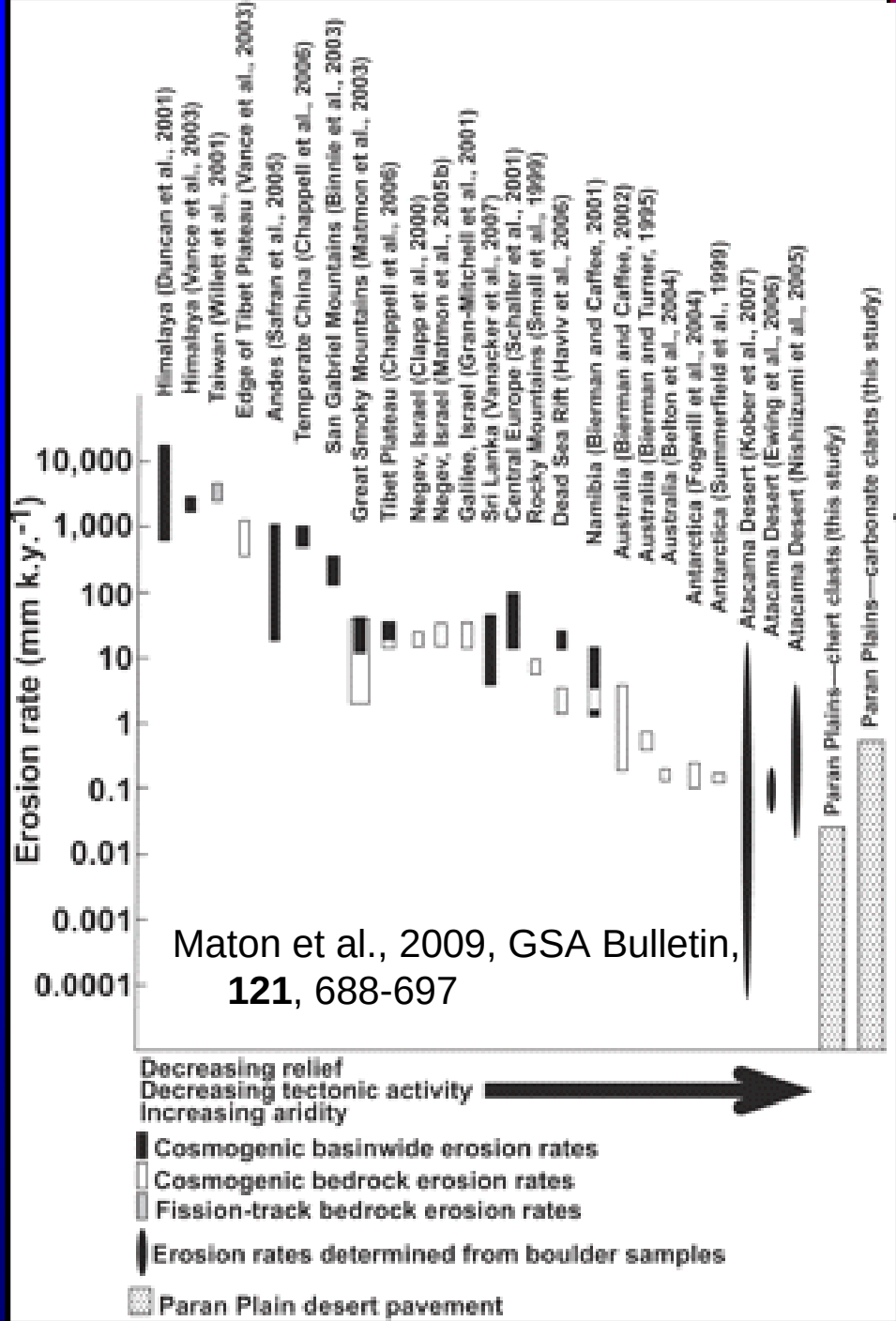
High range:

.1 mm/ k.y. = 100 mm/m.y
= 100 meters per billion years

Low range:

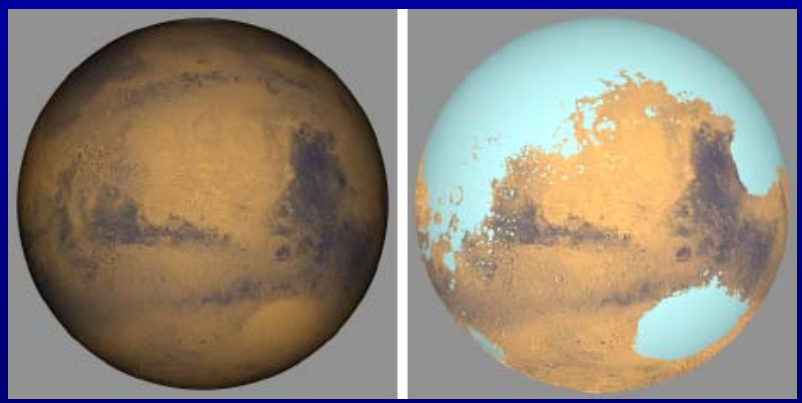
.001 mm/ k.y. = 1 mm/m.y
= 1 meter per billion years

Even Antarctica and the Atacama Desert experience active (though weak) hydrospheric weathering



Justification for large terrestrial lakes as Martian analogs

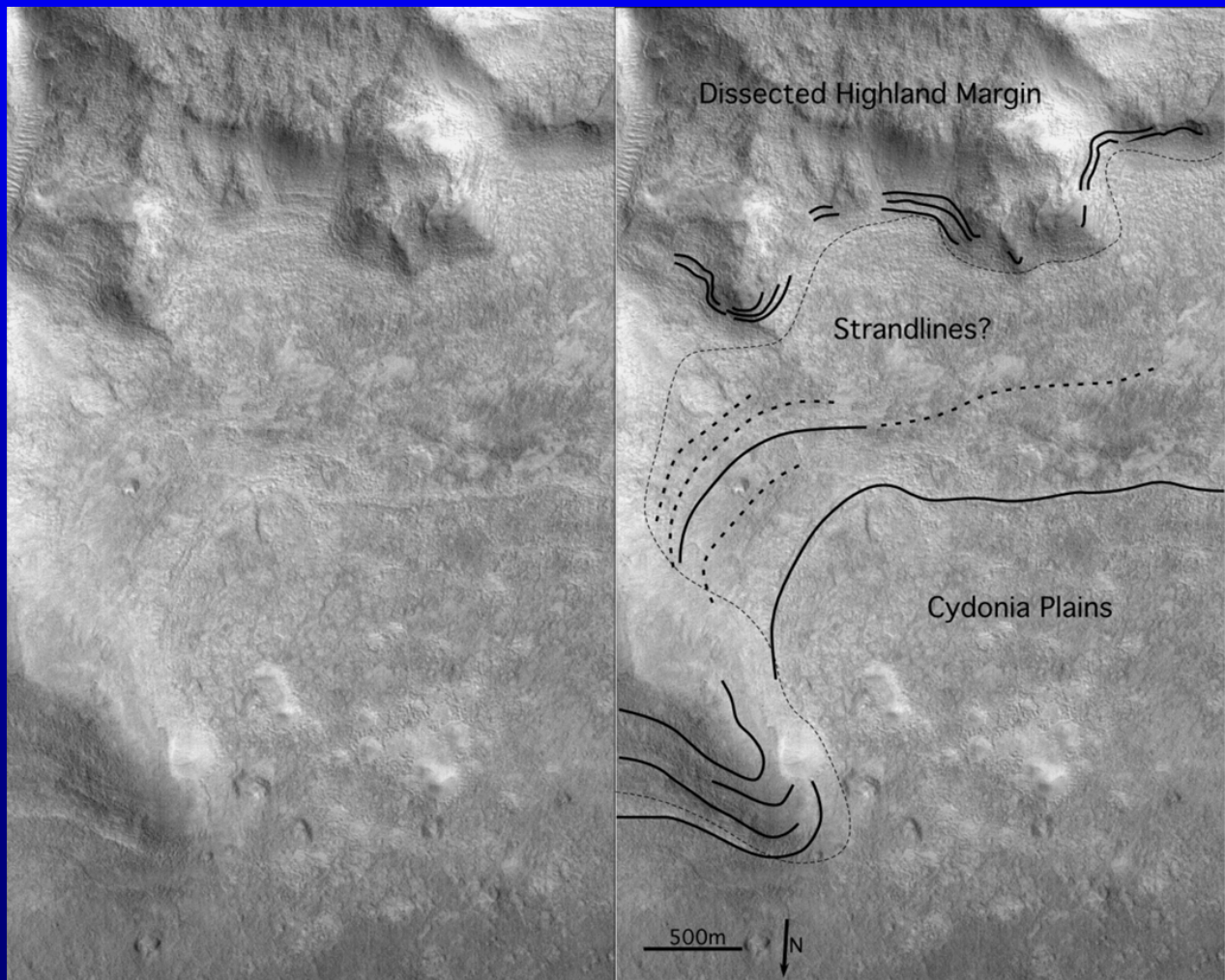
- Better than Earth's tidal oceans given Mars' small moons and its distance from sun
- Wide range of landforms & processes
- Rapid climate change (since LGM)
- Framework for imagery and DEM comparisons



How do we recognize shorelines?

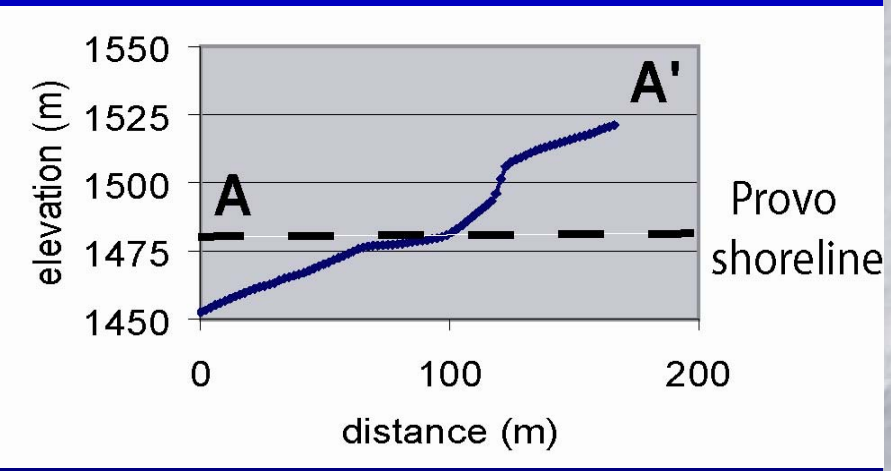
- **Linearity, horizontal continuity (already established on Mars)**

(Clifford and Parker, 2001, Figure 4)

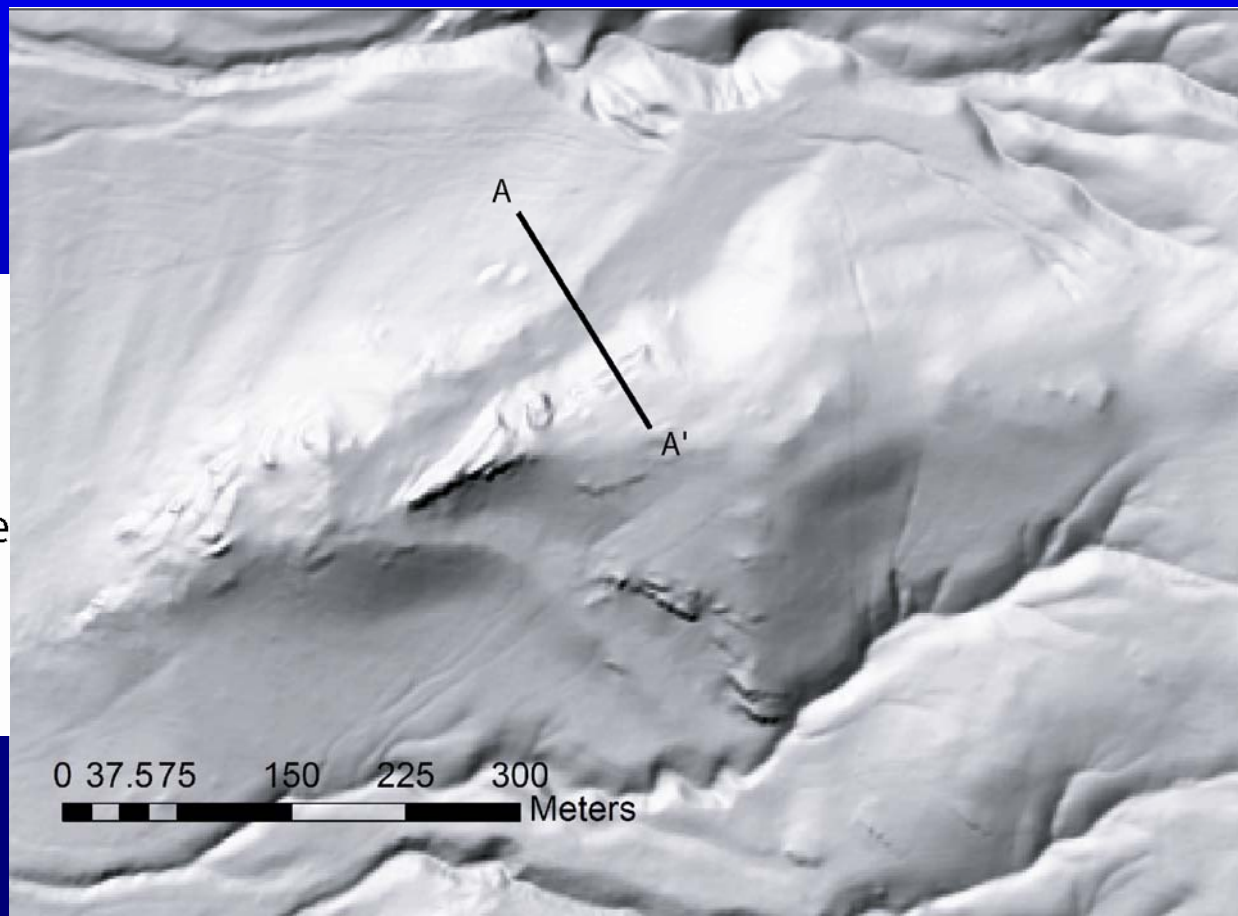


How do we recognize shorelines?

- Linearity, horizontal continuity (already established on Mars)
- **Topographic expression**



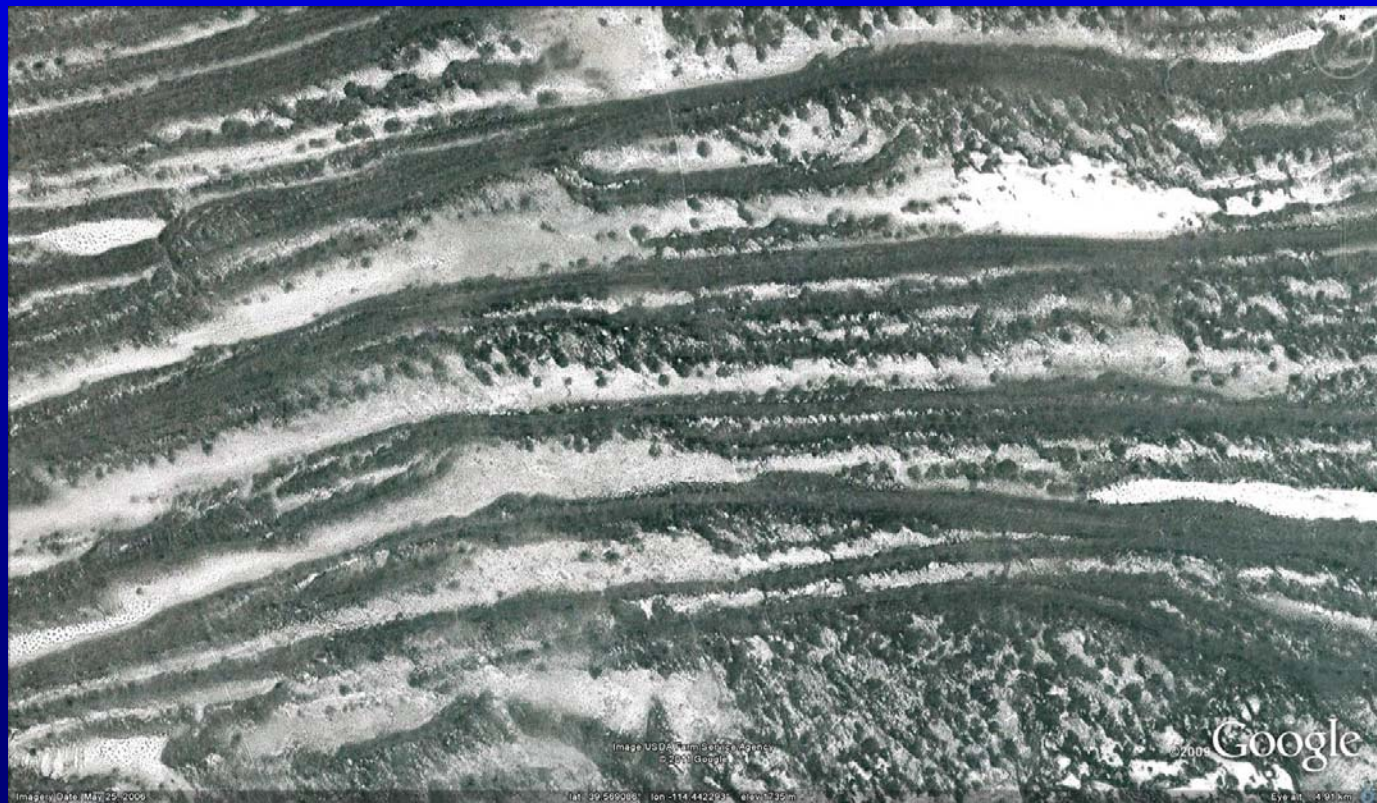
(Jewell, unpublished)



How do we recognize shorelines?

- Linearity, horizontal continuity (already established on Mars)
- Topographic expression
- **Vegetation patterns**

(Ghatan and Zimbelman, 2006, Figure 3b)

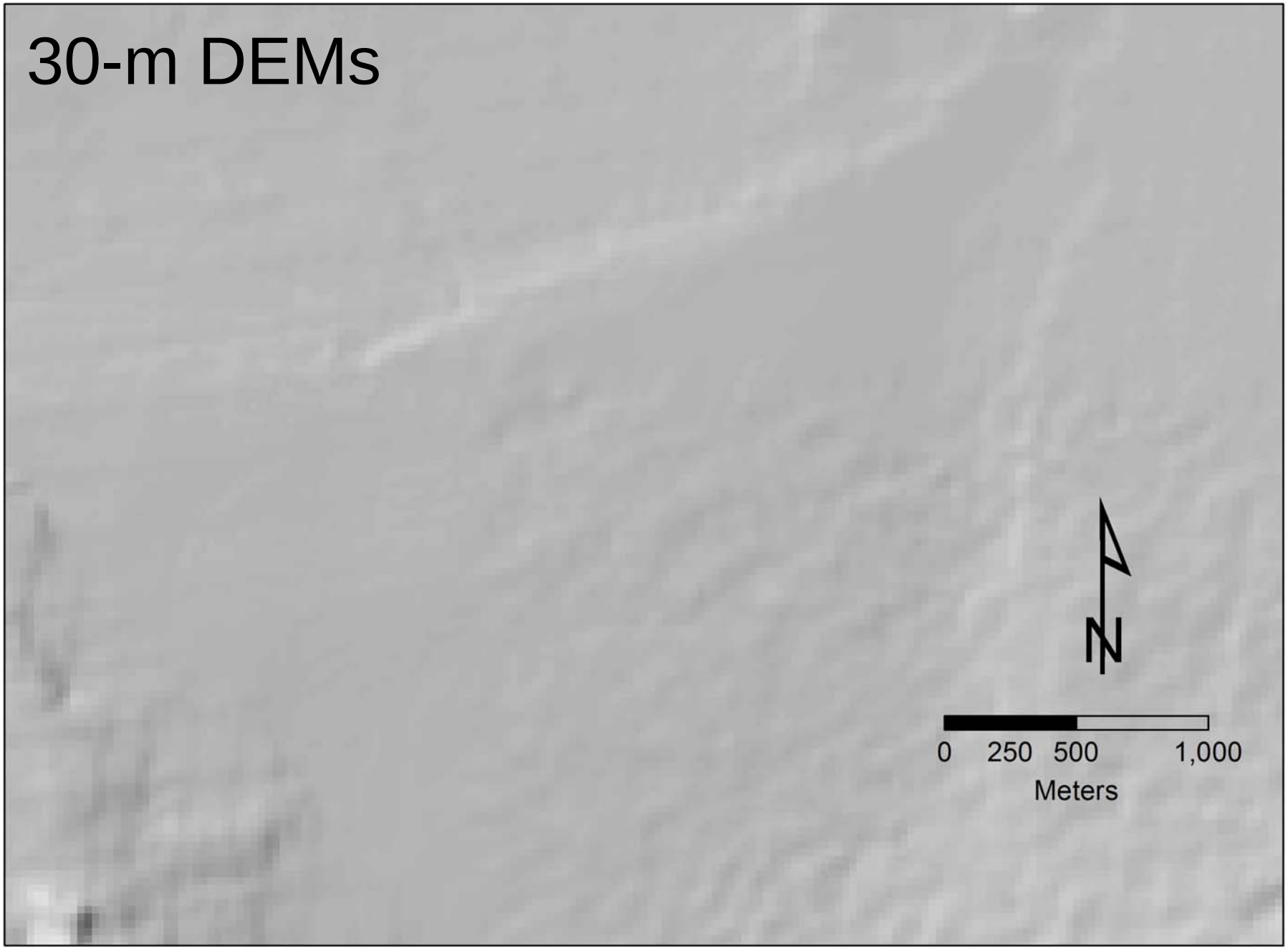


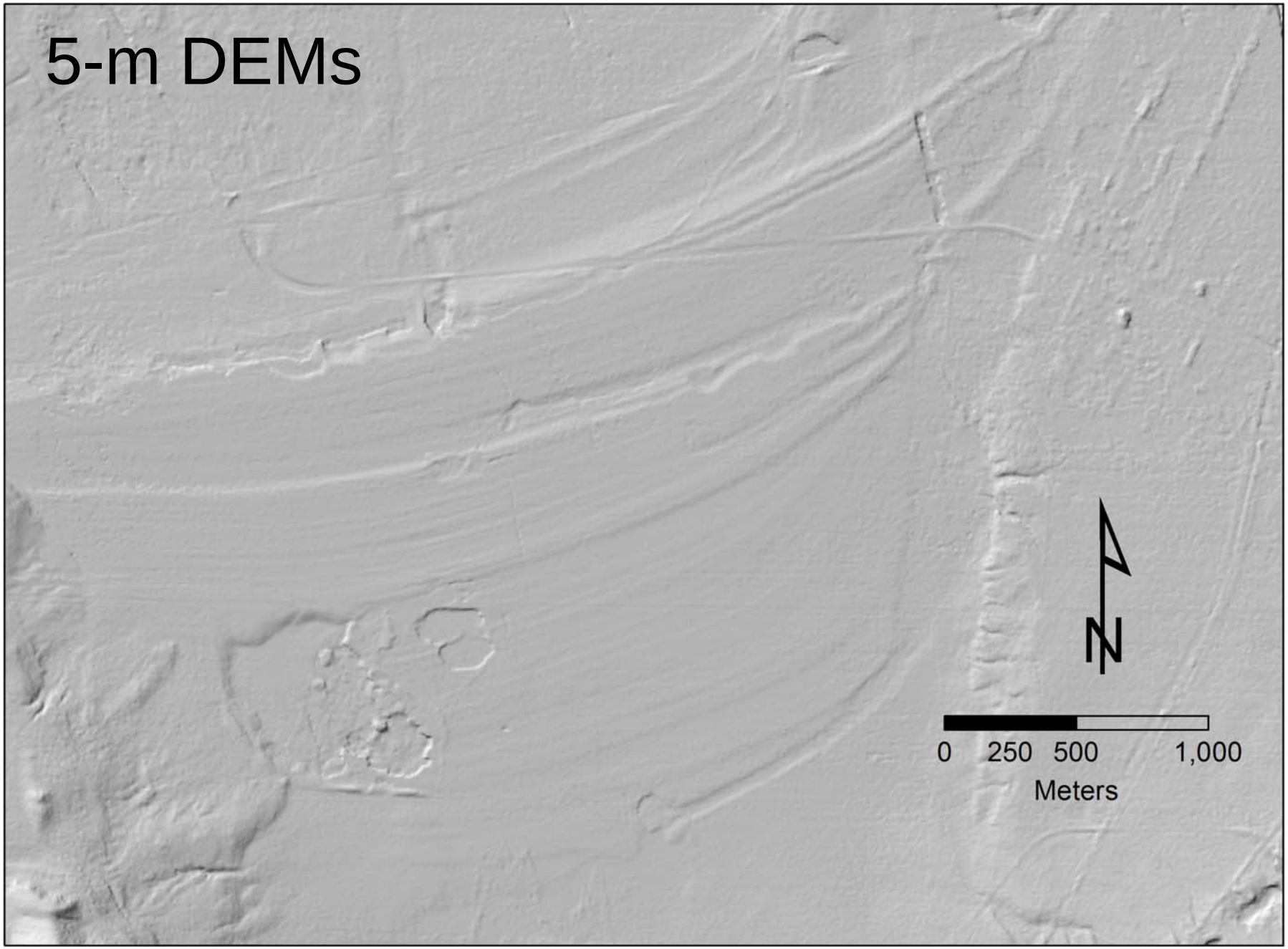
Pluvial Lake Bonneville

- prominent shorelines
- wave-cut erosional terraces
- spits & bay mouth barriers
- deltas
- gullies
- outburst channels
- playa lake features
  - -- patterned grounds
  - -- eolian systems
  - -- evaporite deposits

Lake Bonneville landform Analogs

D . T. Nelson, unpublished


30-m DEMs
N
0 250 500 1,000
Meters


5-m DEMs
N
0 250 500 1,000
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N
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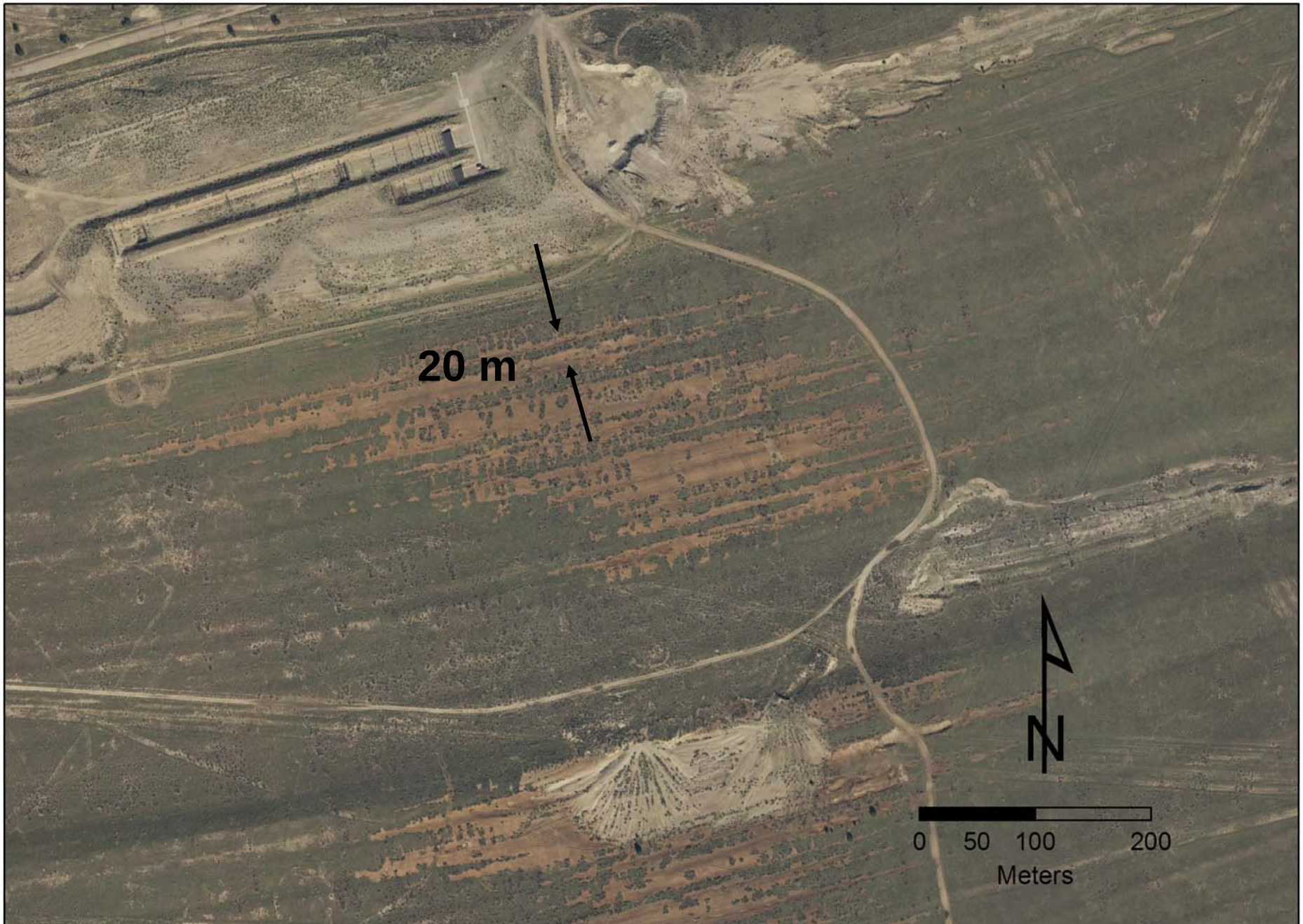
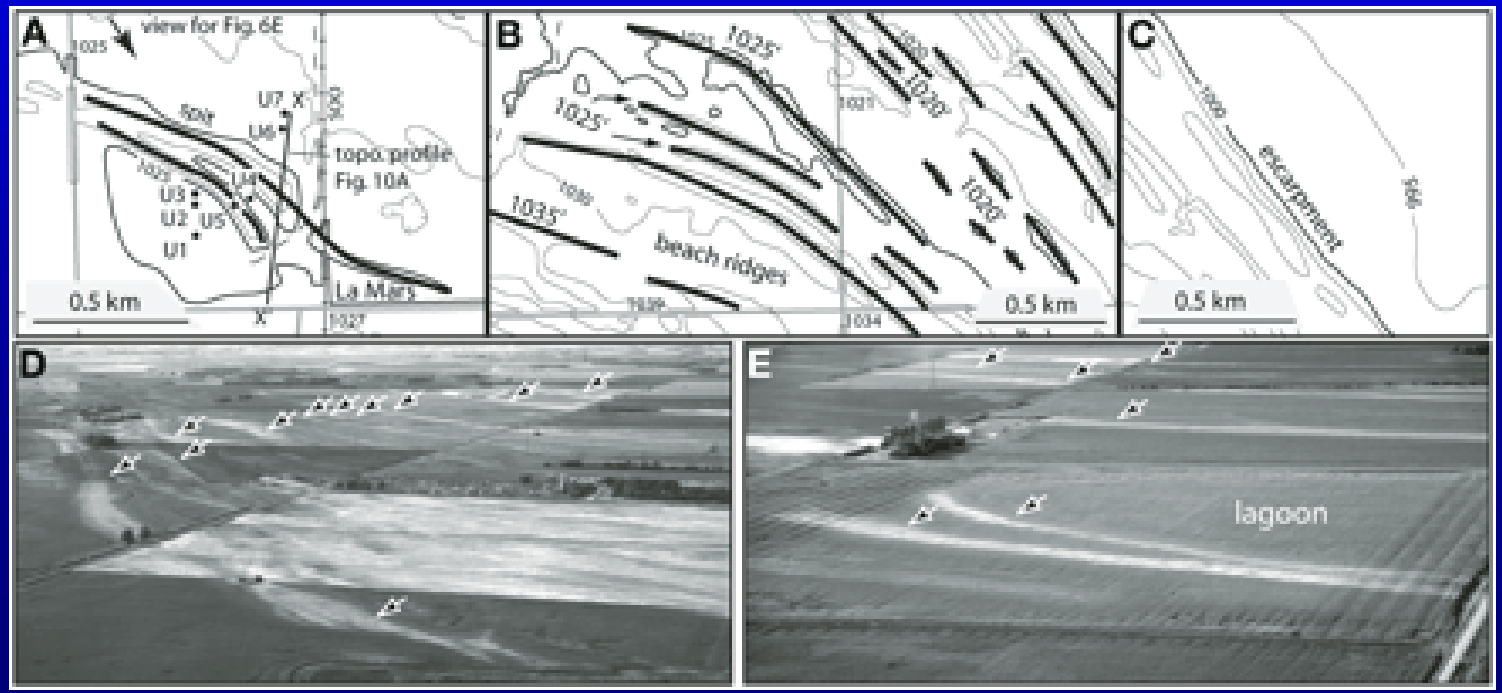

20 m
N
0 50 100 200
Meters

Glacial Lake Agassiz

- prominent shorelines
- wave-cut erosional terraces
- spits & bay mouth barriers
- deltas
- outburst channels



Bottom line:

- **Shorelines of large terrestrial lakes are legitimate analogs for shorelines that might have formed on Mars**
- **1-100 m is the appropriate scale for shoreline features that might have formed around a Mars ocean**
- **Linear features abound on Mars: maybe they're shorelines, maybe they're not**
- **Standard Mars imagery is often not comparable to shoreline features on Earth because vegetation patterns are often what define terrestrial shorelines**
- **The best criteria for recognizing shorelines are their distinctive topograhic expressions**
- **Most current DEM techniques for Mars features are inadequate to capture topographic features at this scale (HiRISE the exception)**