TESTING HYPOTHESES IN GUSEV CRATER USING THE ATHENA PAYLOAD

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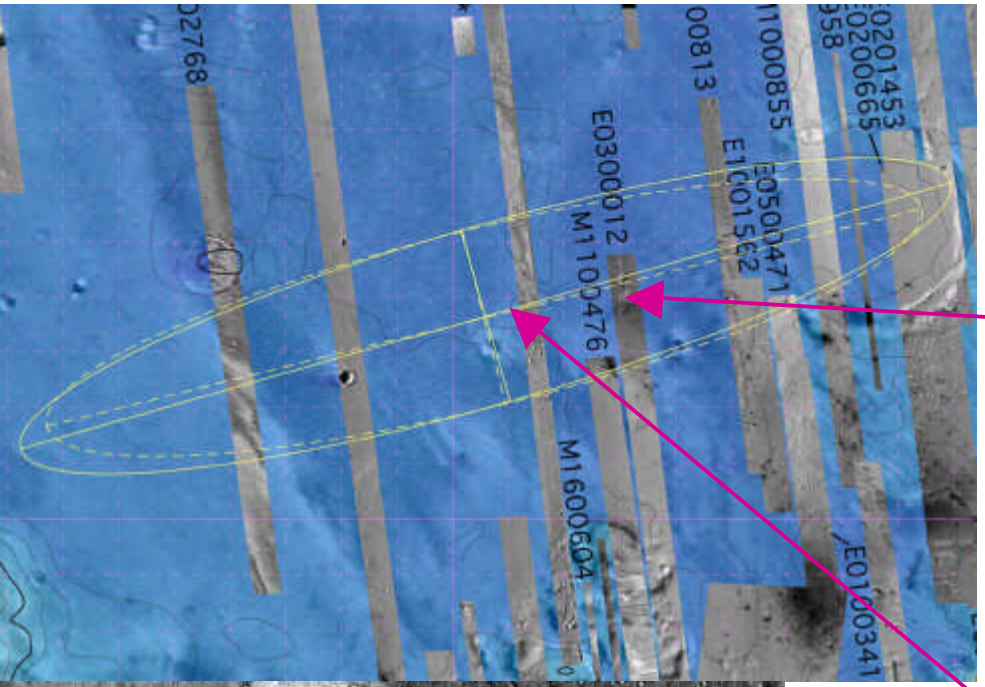
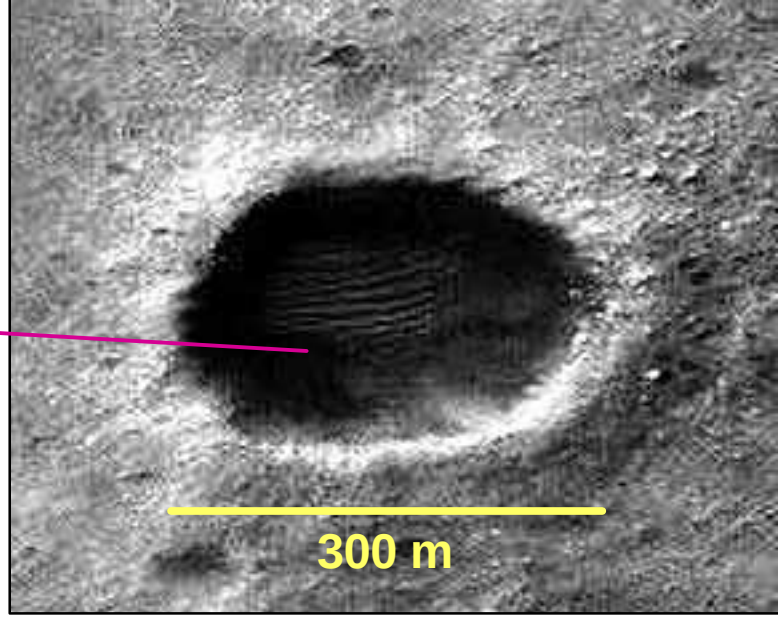
LAYERED DEPOSIT HYPOTHESES

- Lacustrine
- Eolian
- Fluvial
- Volcanic
- Glacial

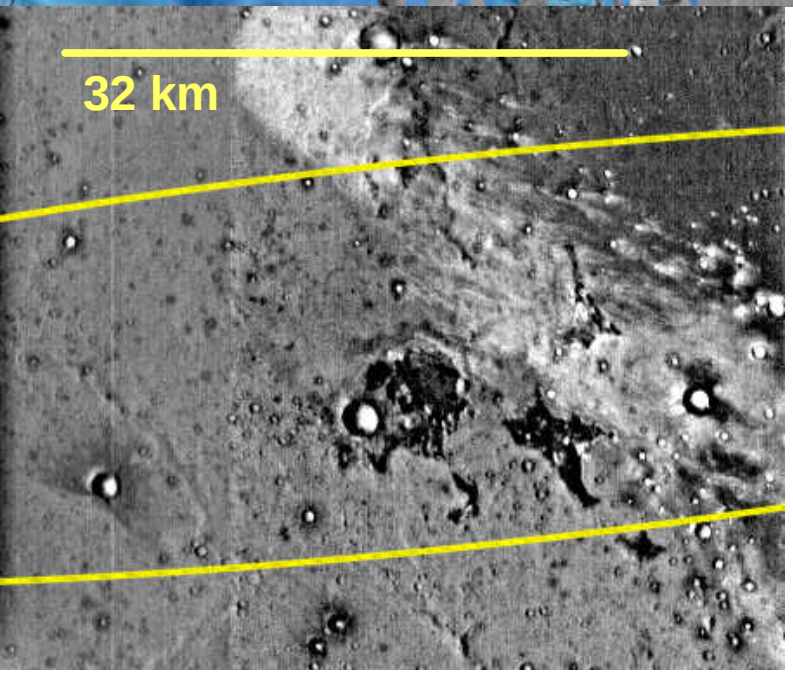
Layered Structures in Gusev

- Cliff Faces (deflation zones)
- Ejecta blocks

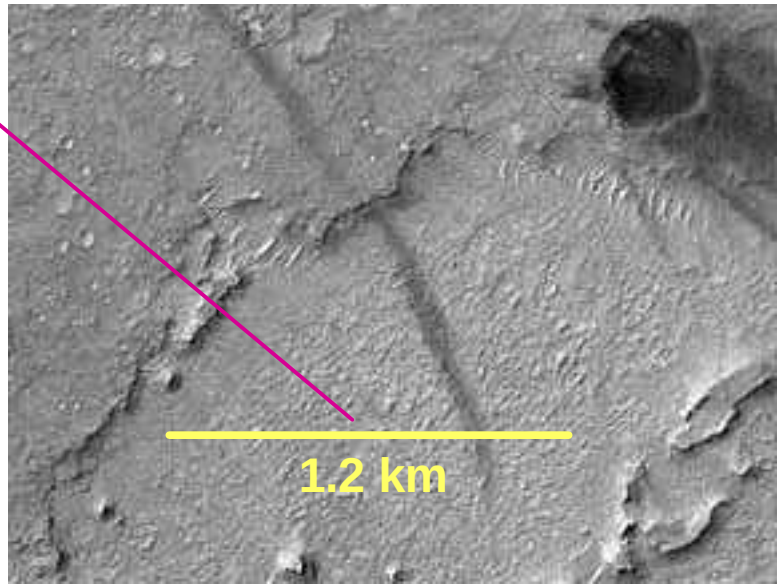




Ejecta Blocks (E03-00012-02)



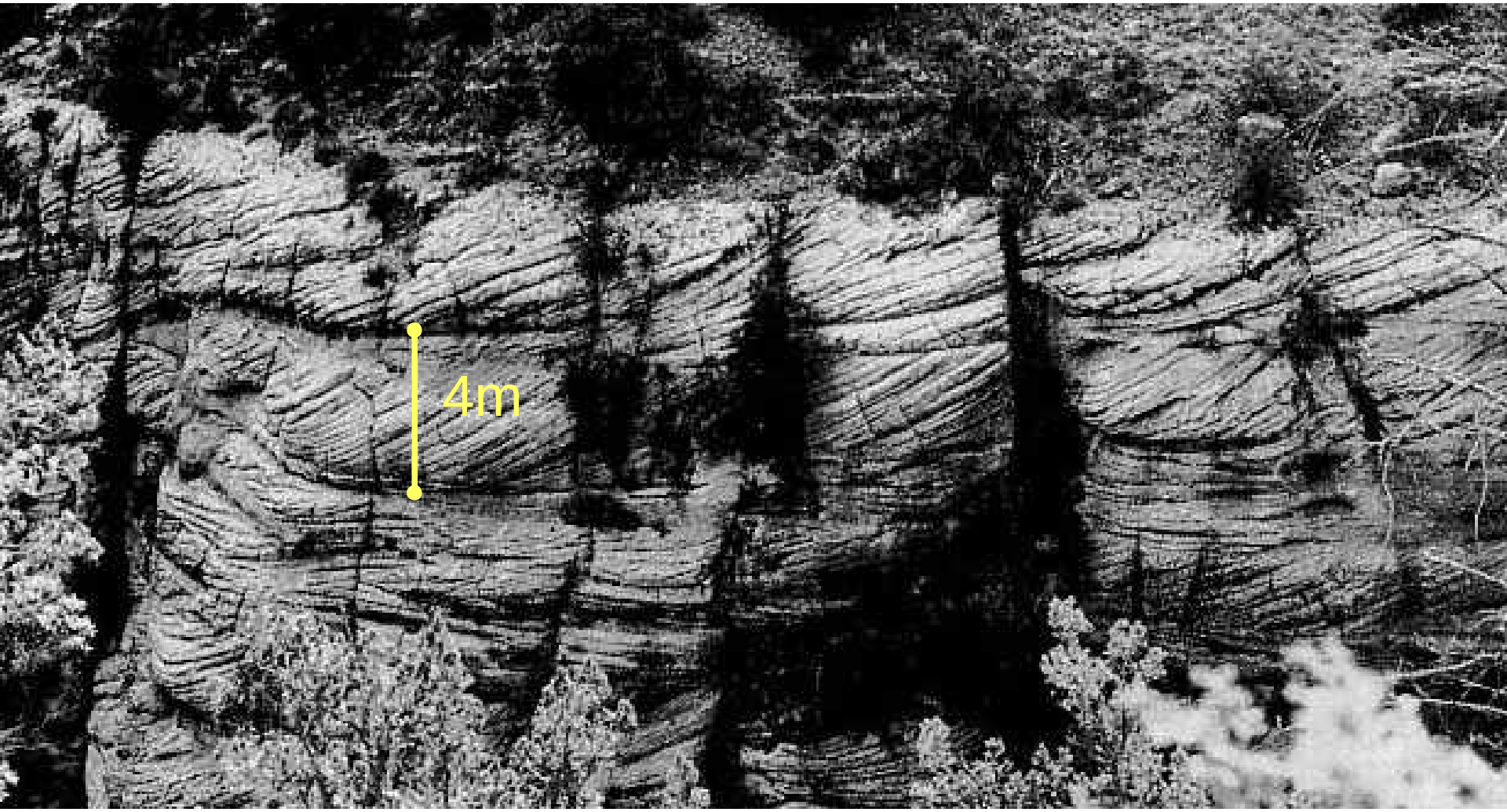
Daytime thermal infrared (THEMIS)



Deflation (E17-00827-03)

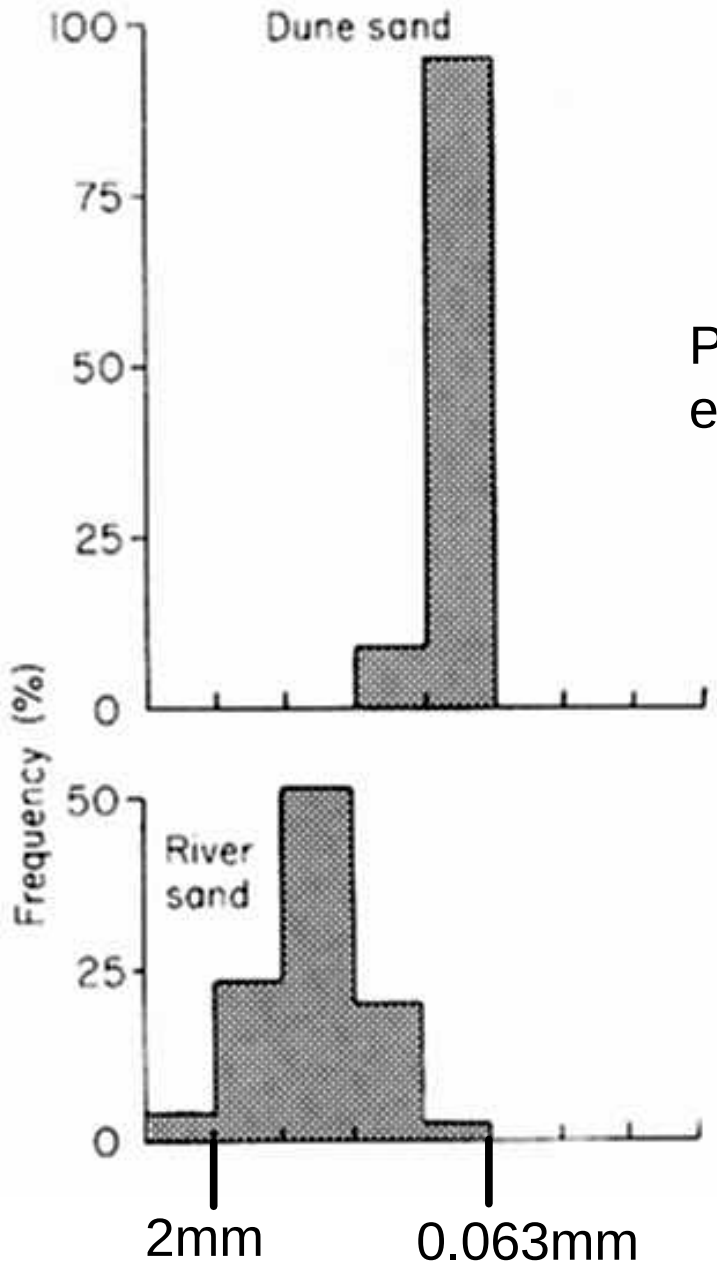
EOLIAN DUNE SANDSTONE

- Cross Bedded Structures
  - Thick (several meters)
- Sand Grains
  - Well sorted (in contrast fluvial, poorly sorted)
  - IRTM derived mean Martian sand size ~ 200 μm
  - Theoretical threshold saltation size 50 to 200 μm (Greeley et al. 1992)
  - Well rounded
- Mineralogy/Chemistry
  - Depends on source



Eolian cross bedded sandstone.

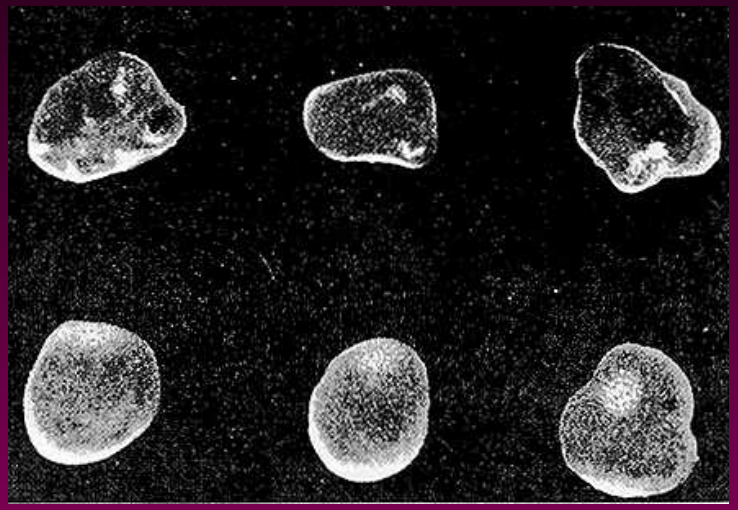
(Walnut Canyon, near Flagstaff, Arizona; Greeley, 1982).



Particle size distribution comparison of eolian sand with fluvial sand

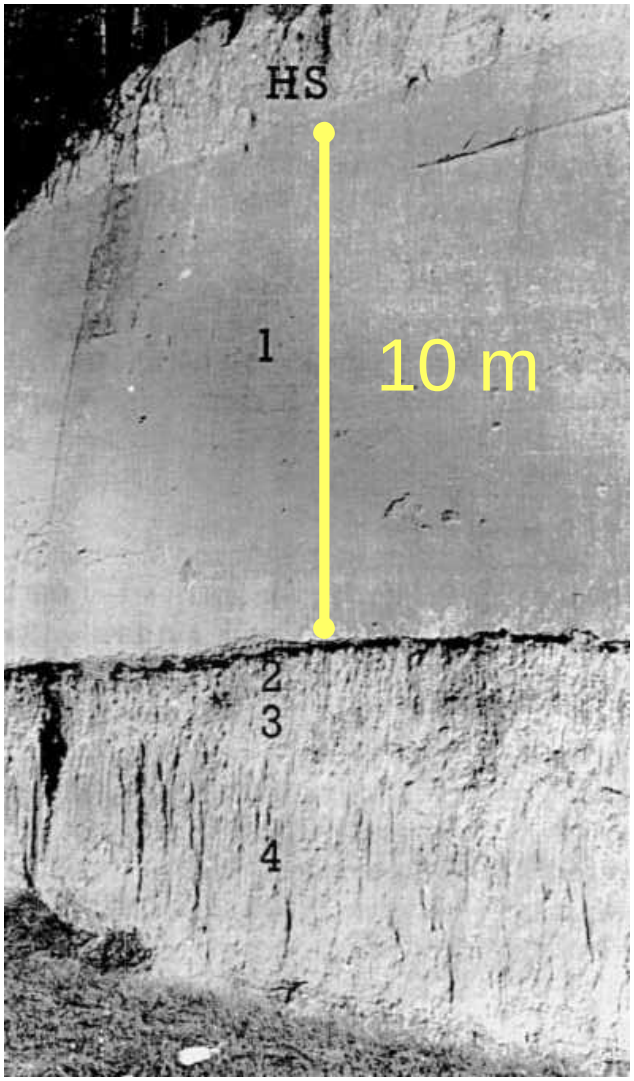
MER-A Detection of Eolian Dune Sandstone

- Pancam
  - Thick cross beds
- MI
  - ~ 200 μm
  - Well rounded
  - Well sorted
- Mini-TES
  - Basaltic mineralogy
  - Cementing agents? – iron-oxide, evaporite
- MB
  - Pyroxene, iron-oxide



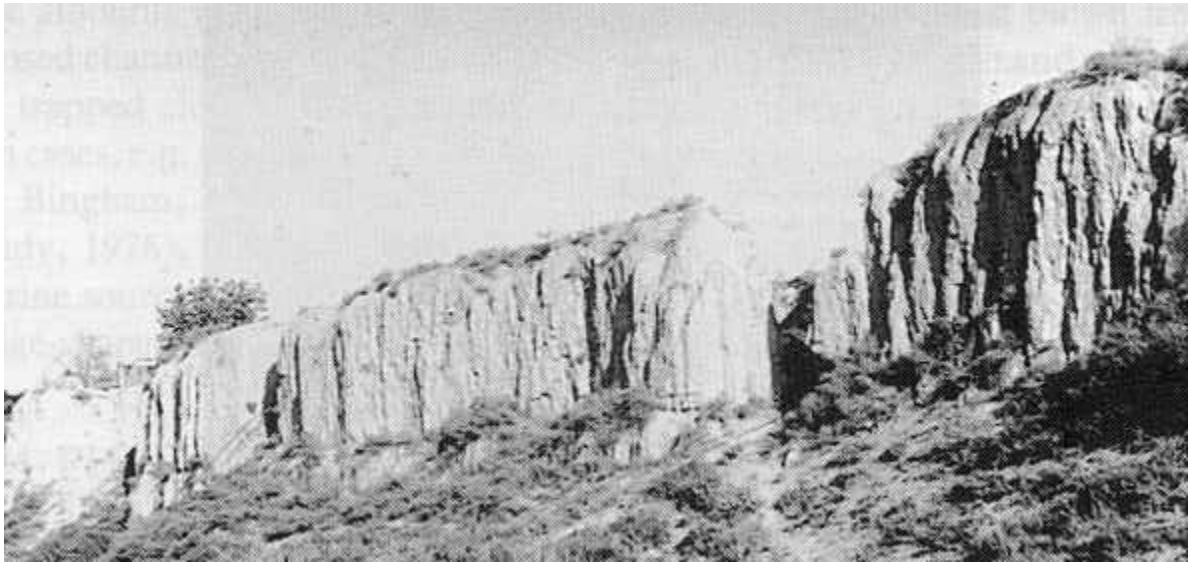
EOLIAN DUST

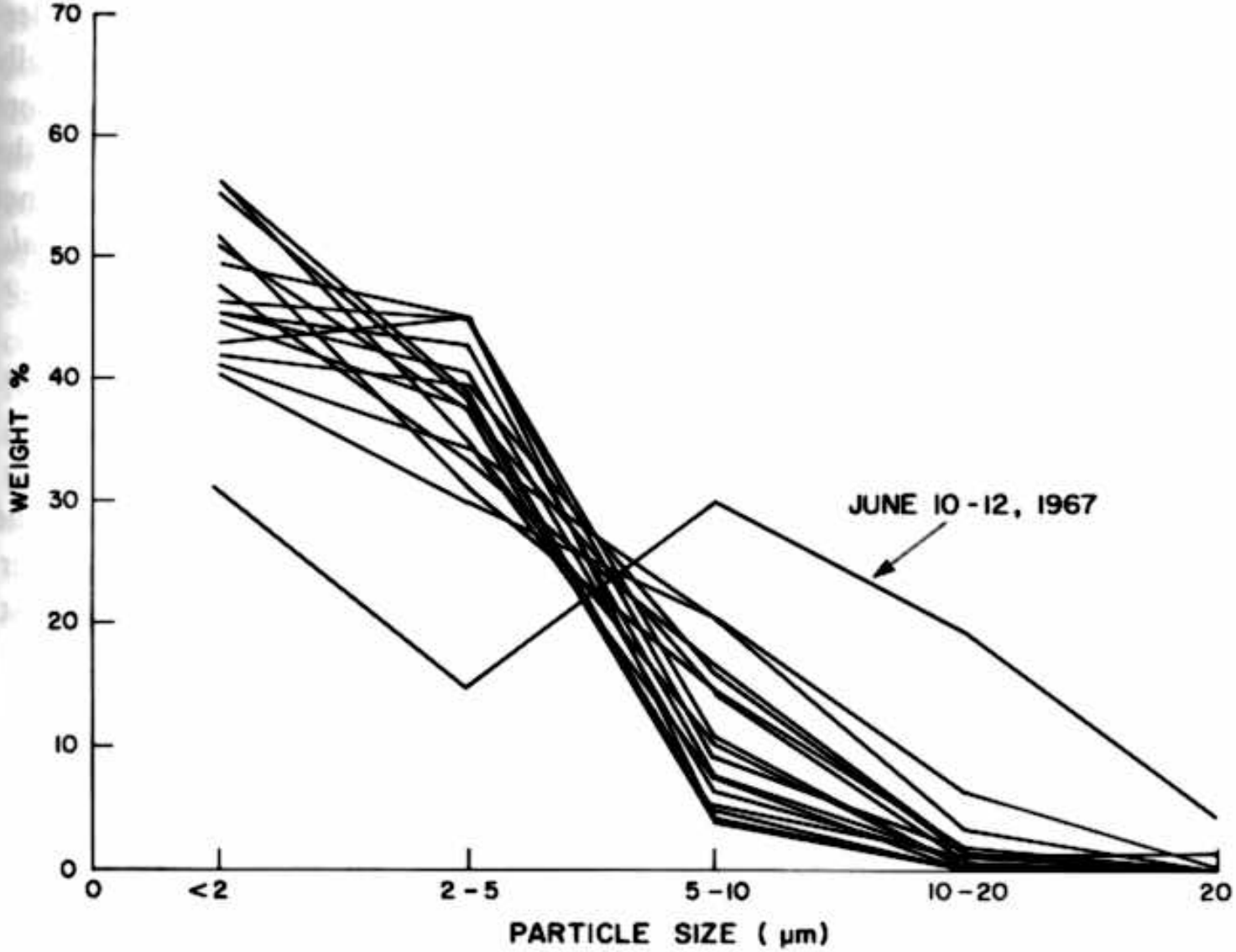
- Thick Deposits
  - Weakly stratified
- Particle size distribution
  - Martian dust 2 μm (Smith et al., 1997)
  - Sojourner tracks suggest < 40 μm (Ferguson et al., 1999)
- Mineralogy/Chemistry
  - Depends on source



Multiple loess deposits in road cut.
(Natchez, MS; Pye, 1987)

Loess bluffs capping fluvial terrace
(Chirchick River, Uzbekistan; Pye, 1987).





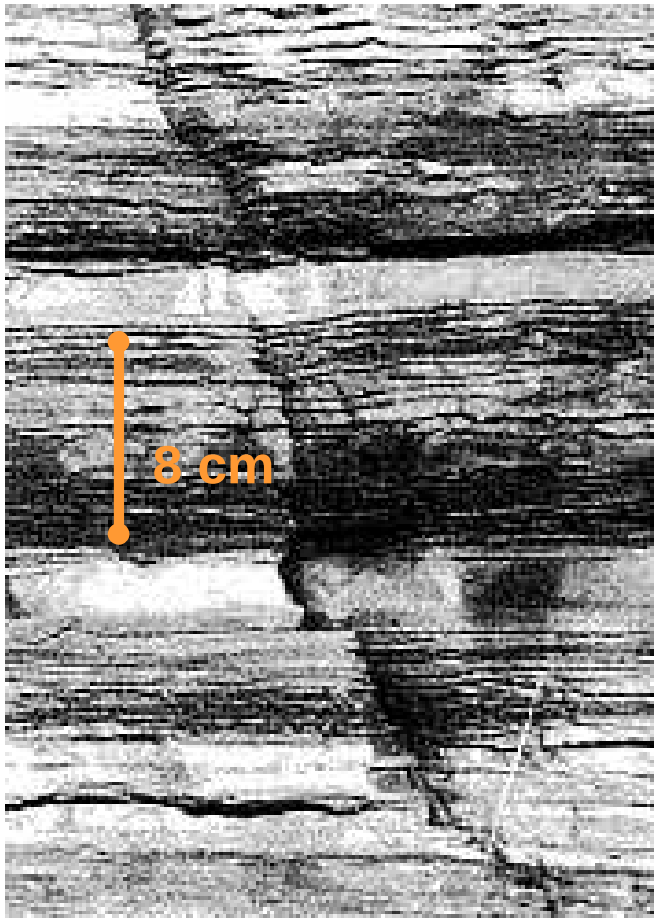
Particle size distribution of airborne dusts from Africa collected in Barbados (Prospero et al., 1970).

MER-A Detection of Eolian Dust

- Pancam
  - Thick deposits (meters)
  - Weak to no stratification
- MI
  - Confirmed fine grained particles
- Mini-TES
  - Basaltic mineralogy
  - Poorly crystalline material
  - Phyllosilicates? sulfates?
- MB
  - Pyroxene, iron-oxide, Fe-smectite?

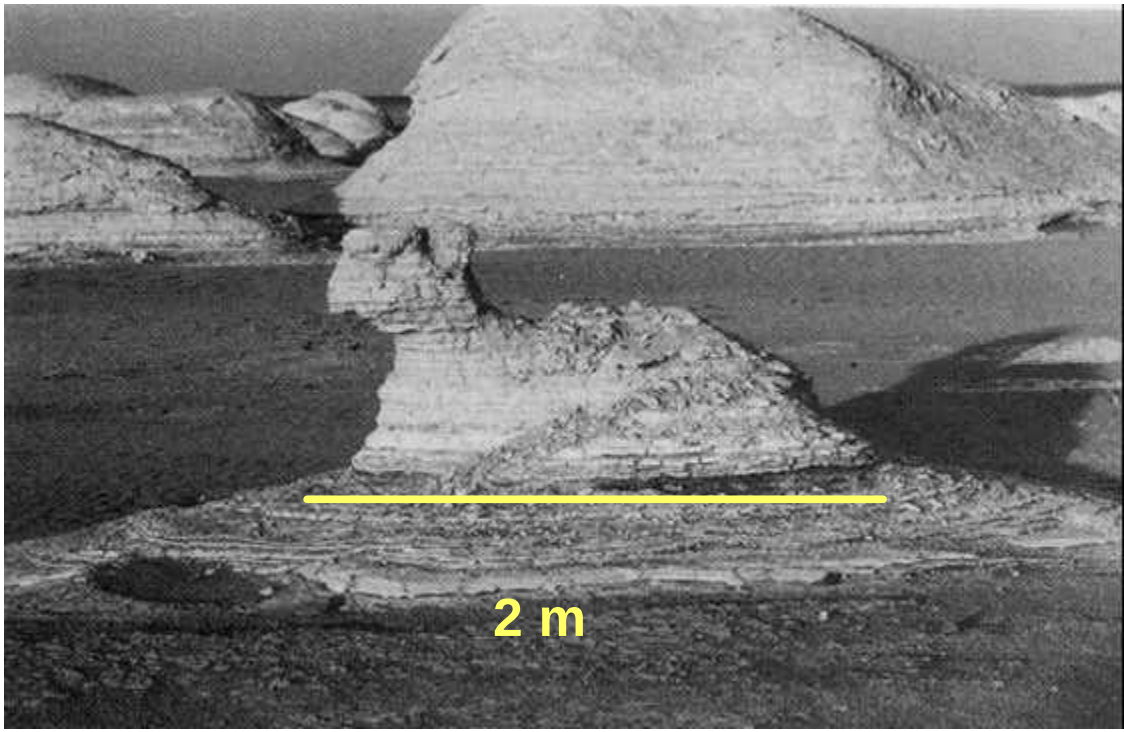
Lacustrine Deposits

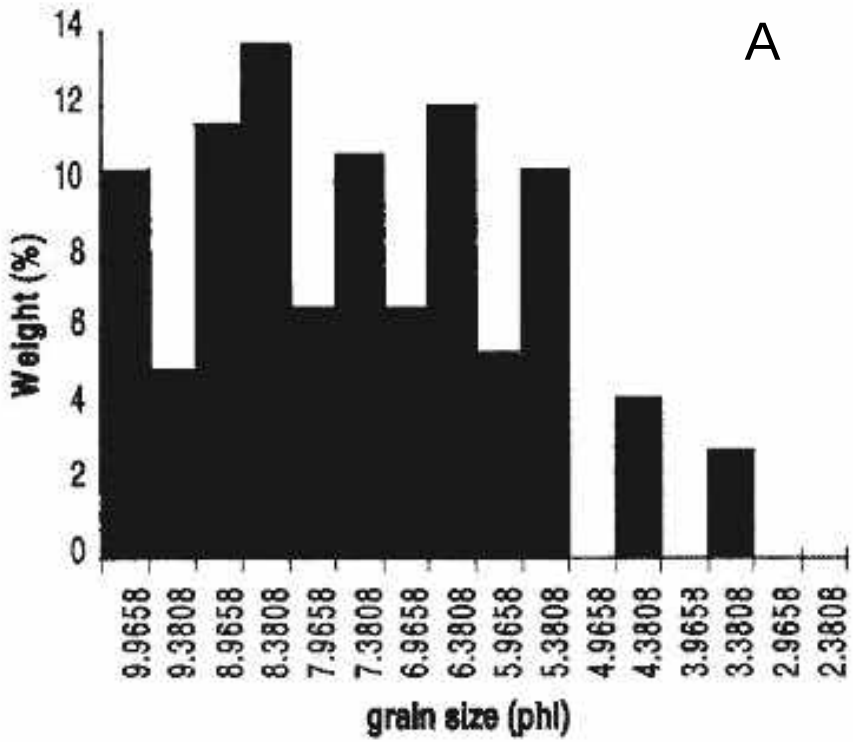
- Thin planar layer ~ 1 to 10 cm
- Clay and silt size particles < 63 μm
  - > 63 um possible
- Mineralogy
  - Evaporite -- carbonate, sulfate, chloride, nitrate
  - Phyllosilicates
  - Basaltic mineralogy
  - Poorly crystalline material

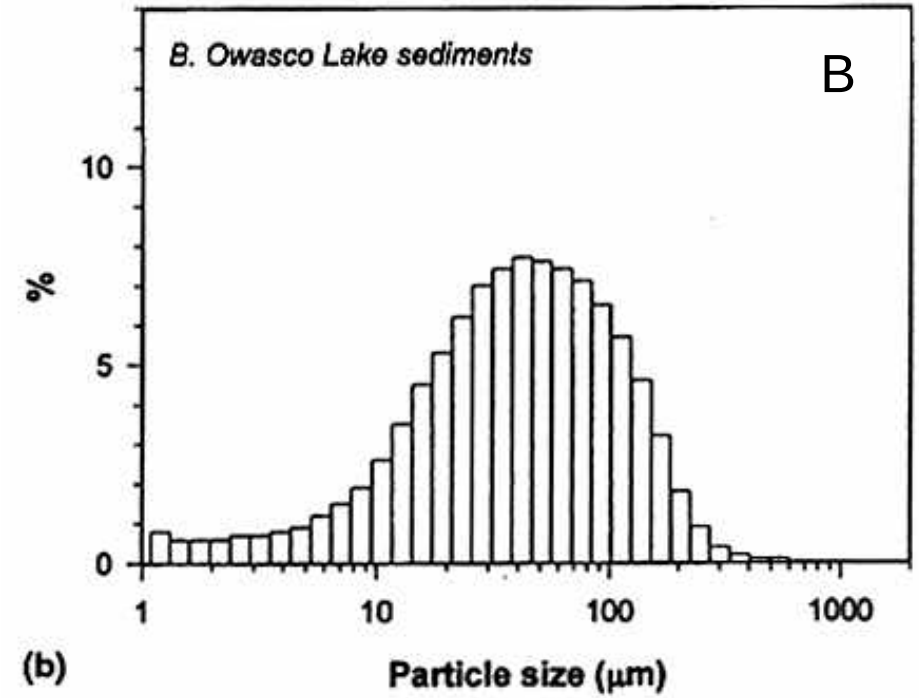


Flagstone lacustrine deposits
(Devonian Orcadian, Scotland)

Yardang, quanternary lacustrine
deposit (Farafra Depression, Egypt)







1 μm 24μm 100 μm

Particle size distribution of lake sediments. A. Lake Turkana, Kenya (Olago and Odada, 2000); B. Owasco Lake, New York (Kim and Ree, 2001).

MER-A Detection of Lacustrine Deposits

- Pancam
  - Thin planar layering ~ 1 to 10 cm
- MI
  - Confirmed fine grained particles
  - Sand (>63 μm)
- Mini-TES
  - Phyllosilicates
  - Evaporite (carbonate, sulfate, nitrate?)
  - Basaltic mineralogy
- APXS
  - High levels of Ca, K, Mg, Na, Cl, S, N?
- MB
  - Fe-smectite, siderite, pyrite, iron-oxide

- Applied the above procedure to other hypothetical sedimentary processes
  - Fluvial
  - Volcanic
  - Glacial
- MER-A instrumentation has potential to yield data that can be used to differentiate between hypothetical sedimentary materials in Gusev