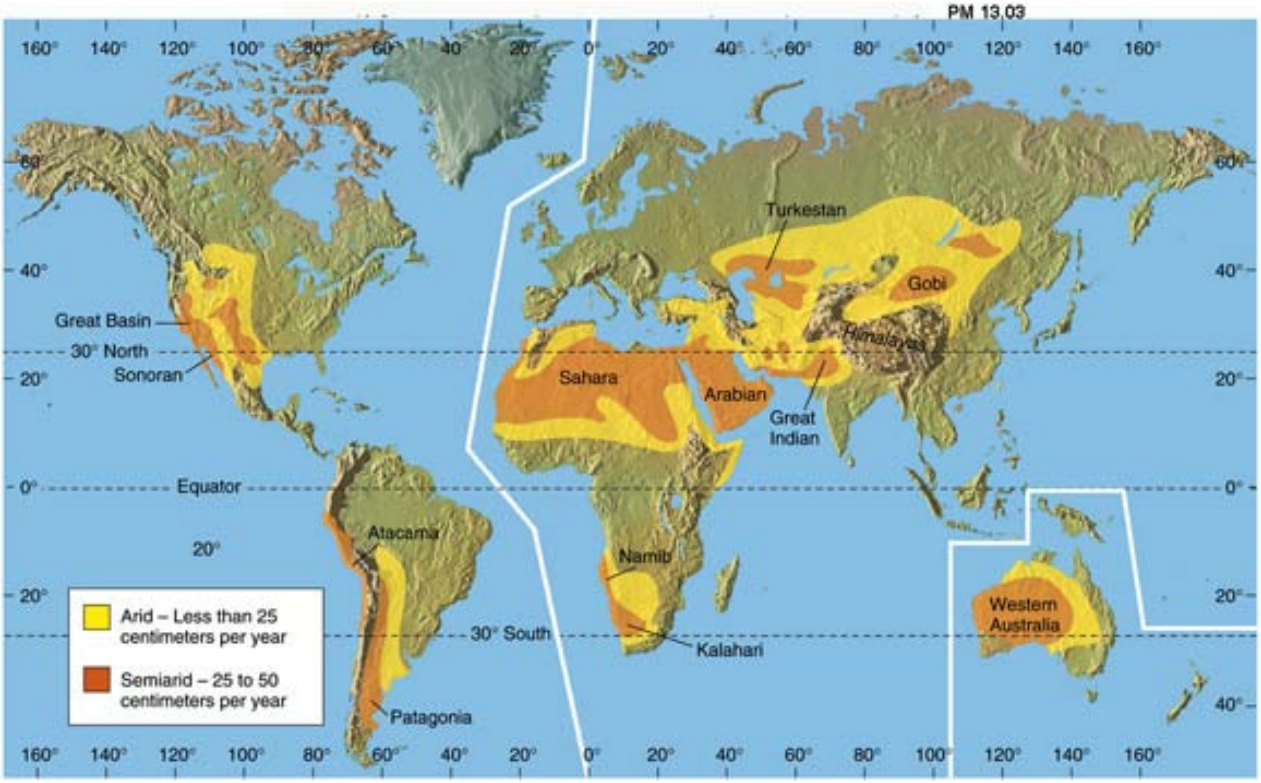
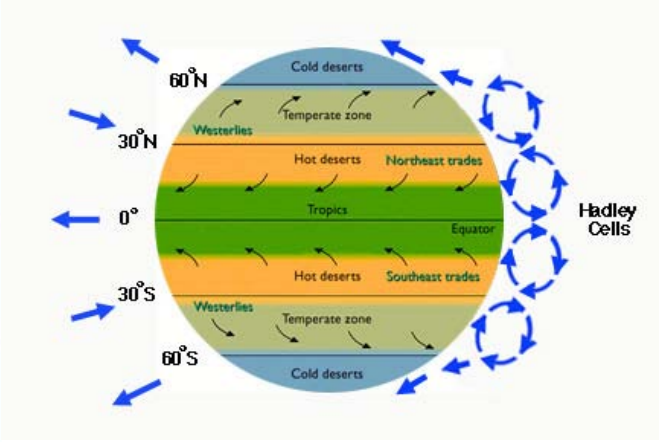
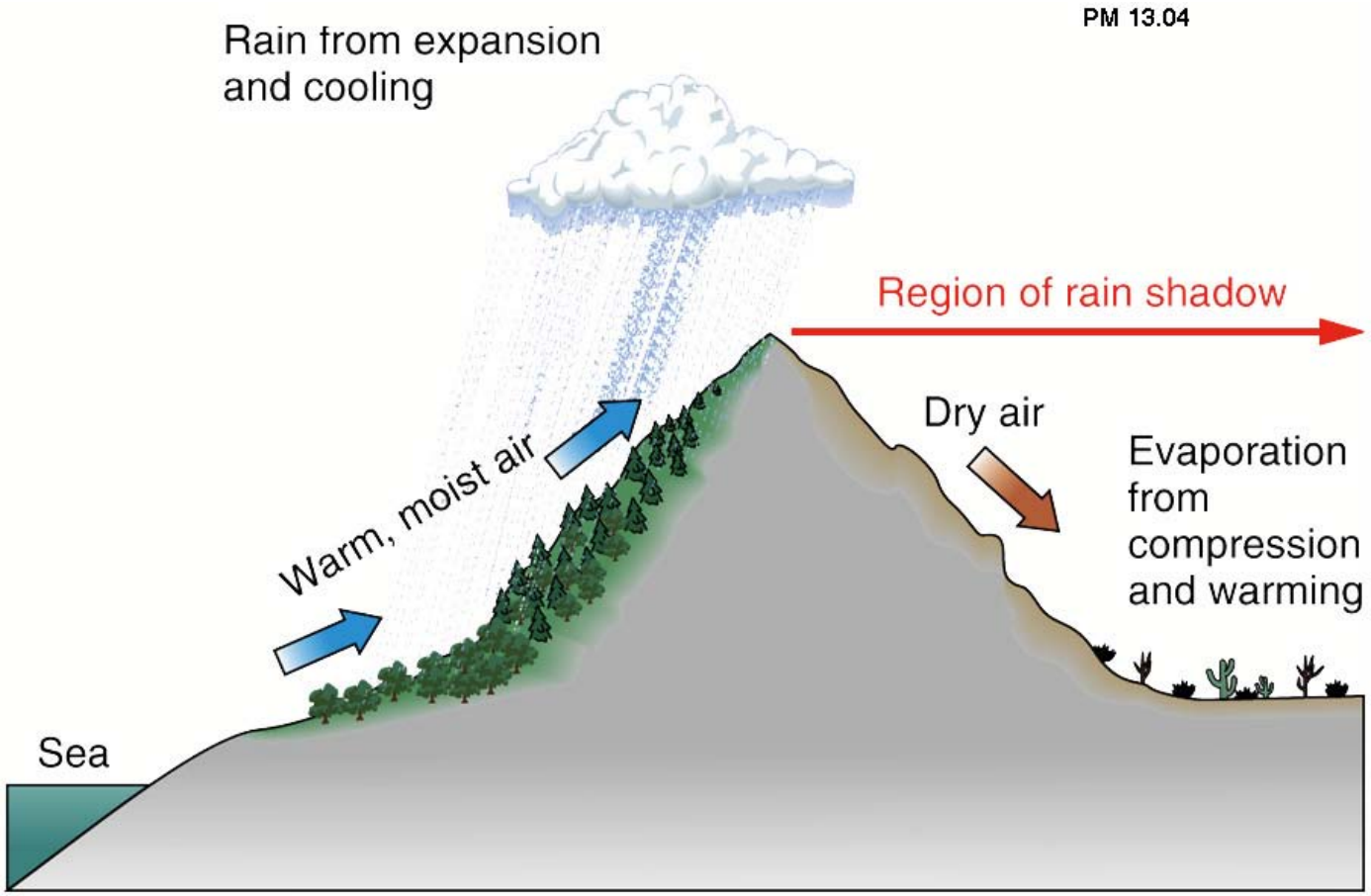
Eolian desert systems

World deserts

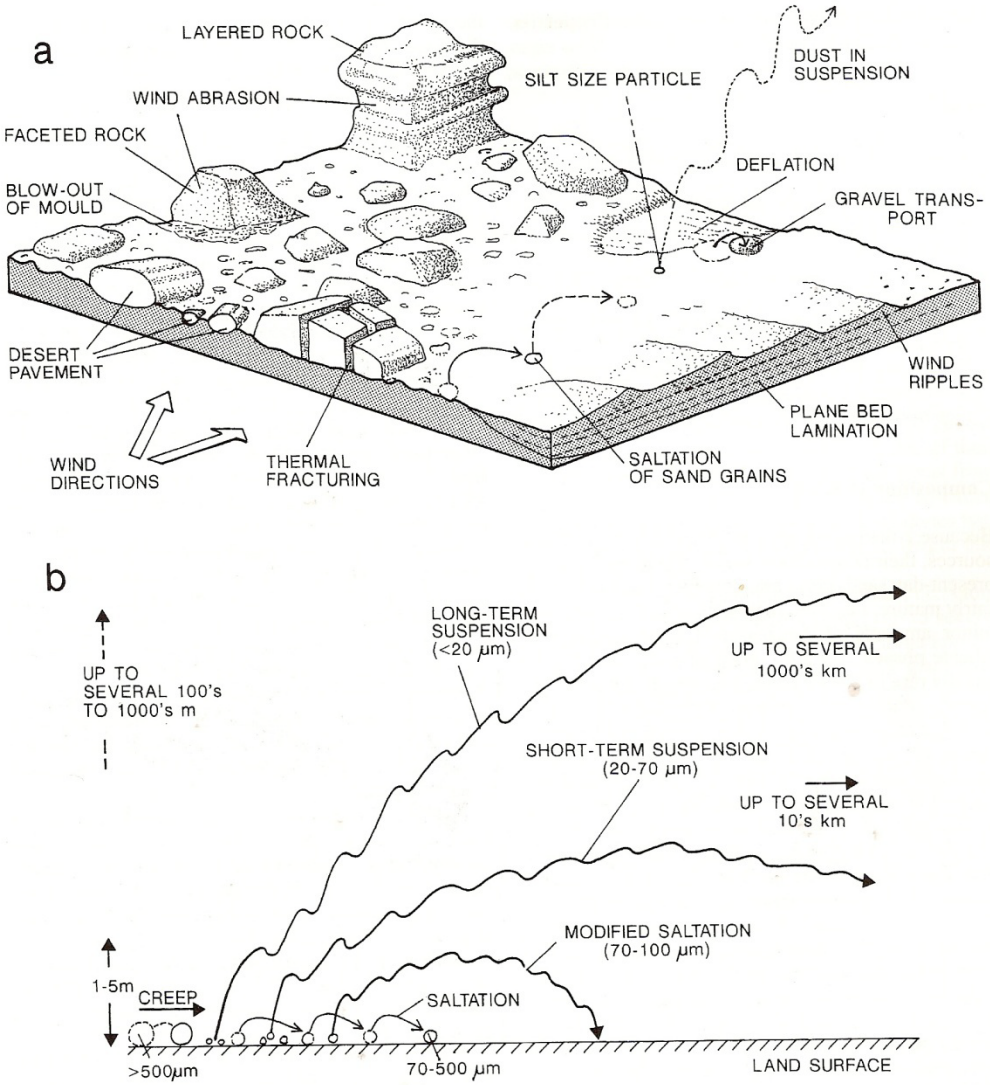




Desert – rain shadow

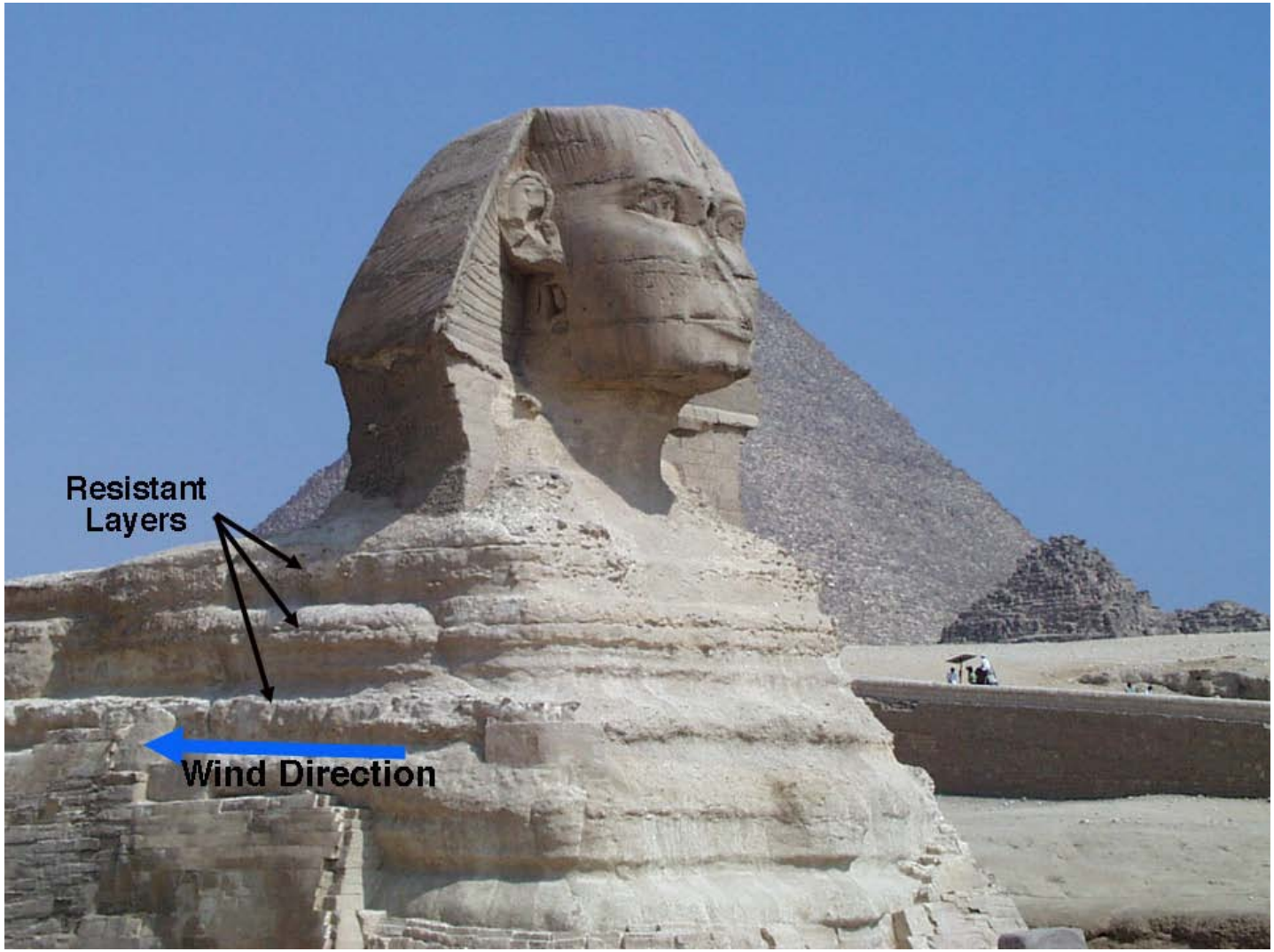


Sedimentary processes

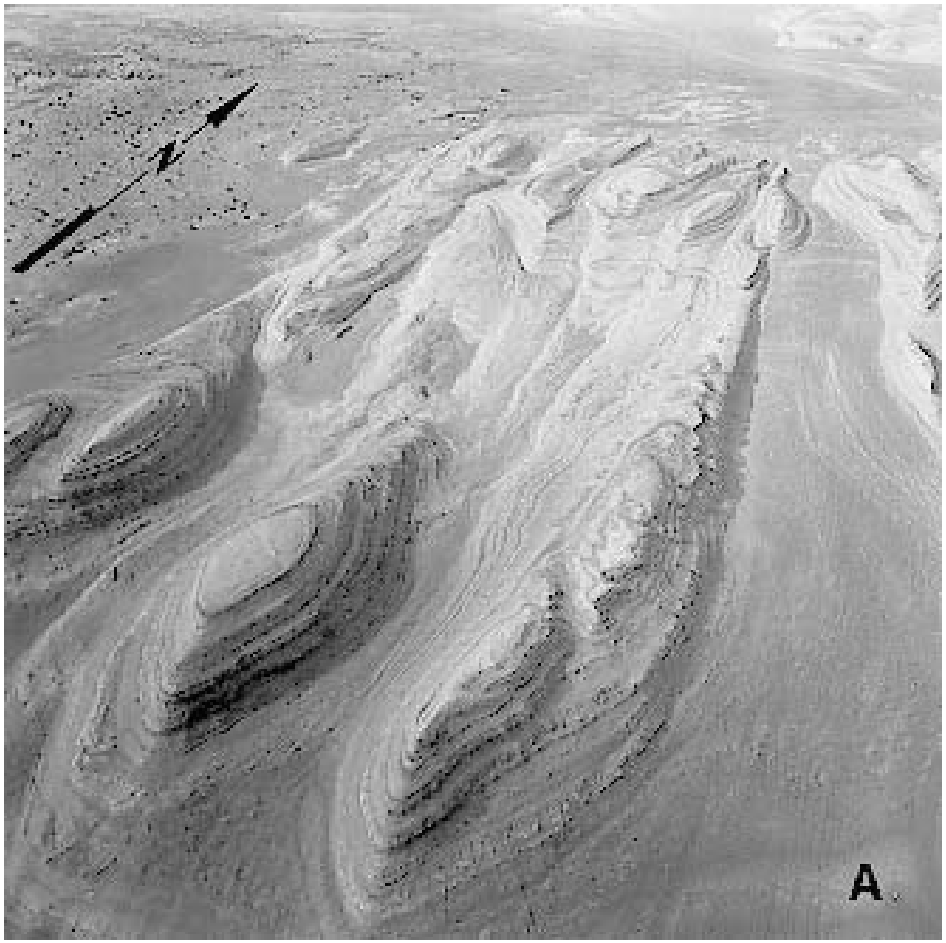


Desert pavement - Reg

Wind abrasion…



Fluted bedrock hills - Yardangs



Erosion of chalk rock formations

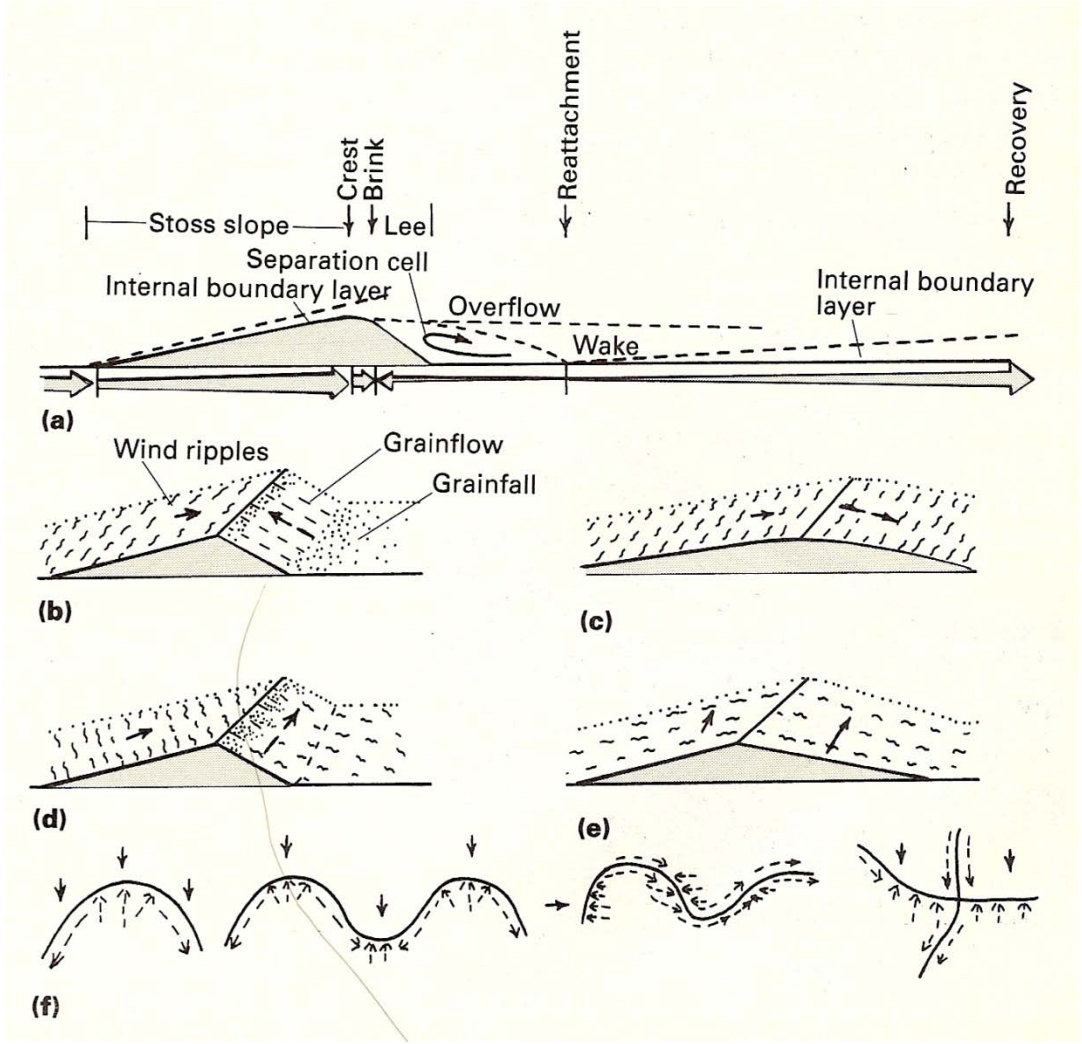
Erosion of older sandstone

Acfer plateau, Algeria

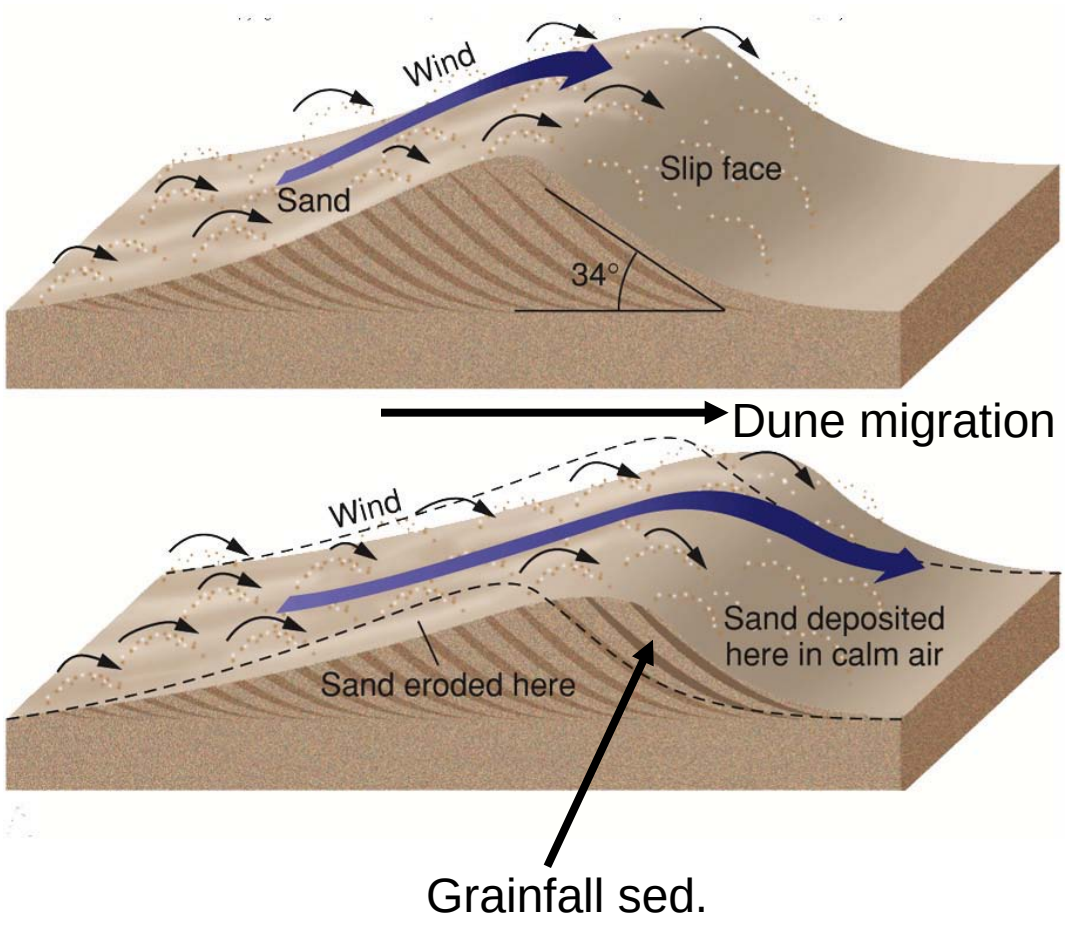
Hammada al Hamra plateau, Libya

Sand seas - Erg

Dunes and airflow



Dunes and airflow



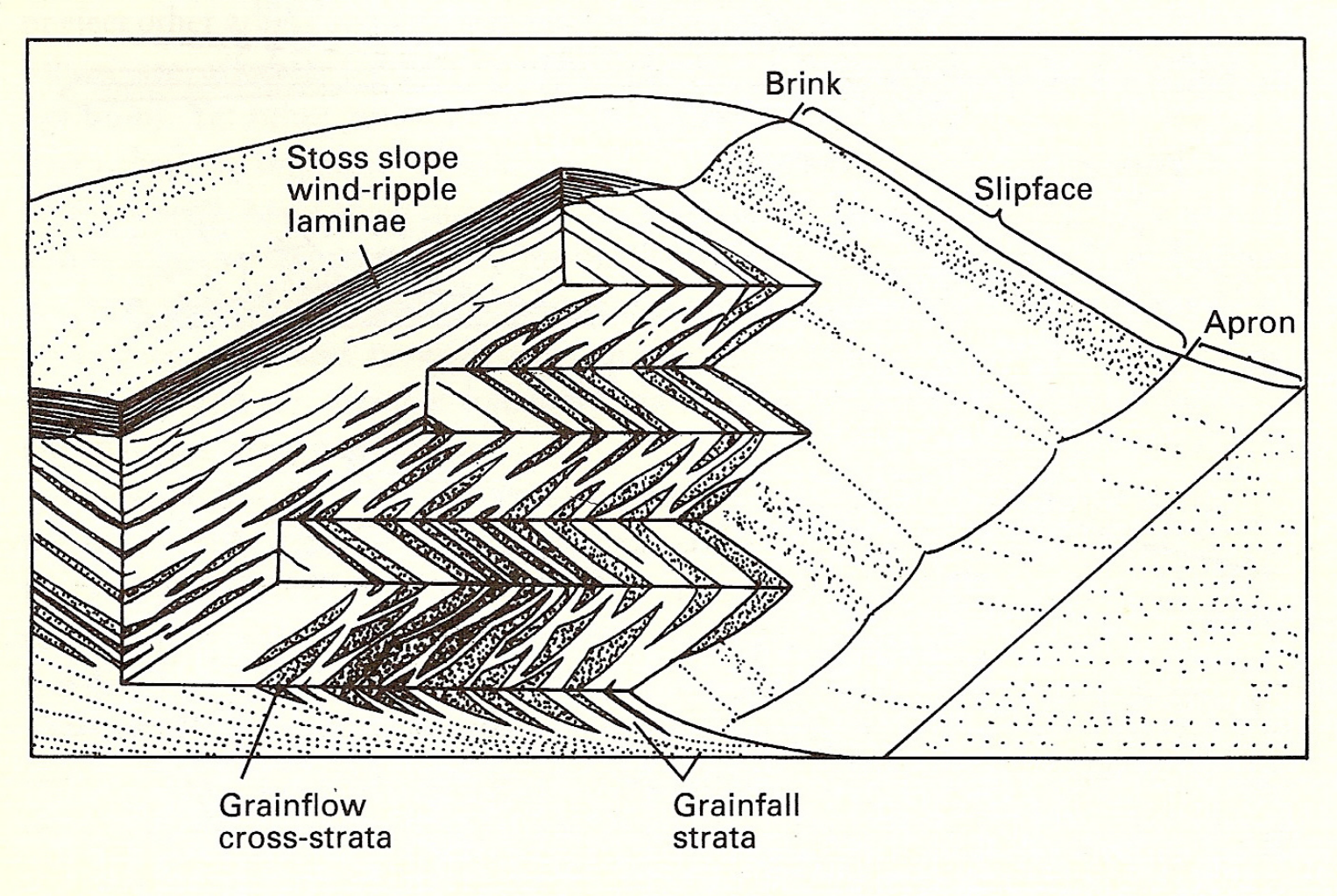
Grain fall

Kelso Dunes, Mojave Desert, March 2005. Photograph by Brennan Jordan

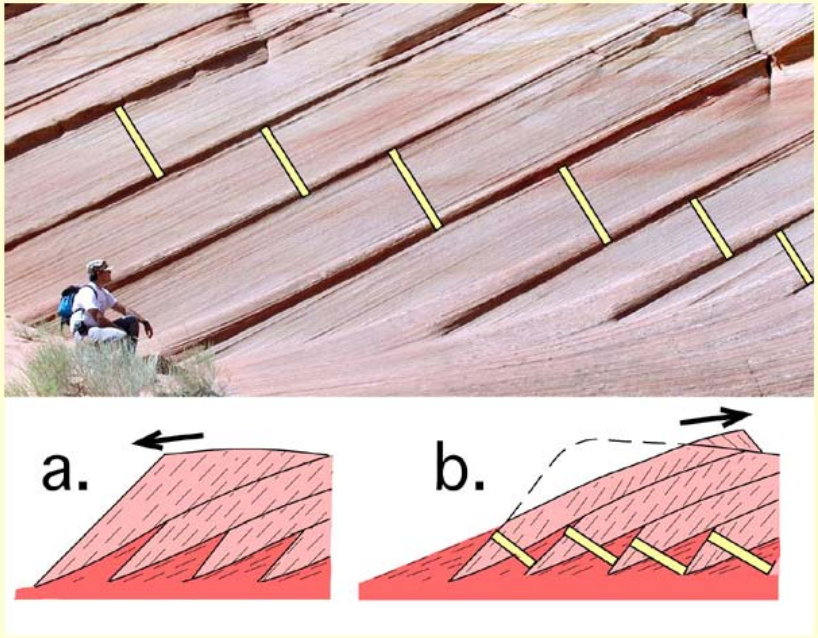
Grain flow

Internal structures – Dry sand

Small dune

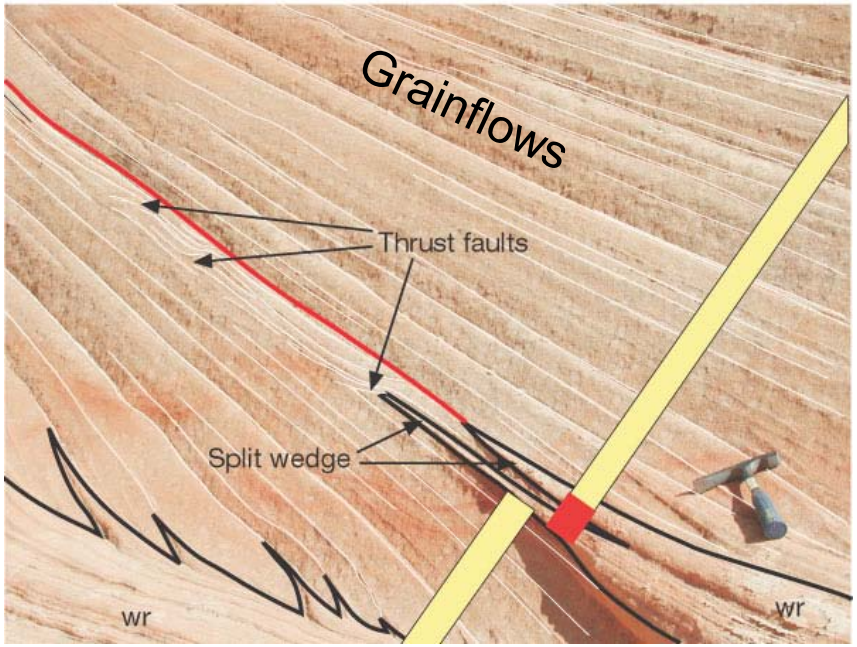


Depositional cycles



The depostional cycles are the result of shifts in wind direction. The yellow bars each show annual increments to the dune deposits. In the diagram, the lighter-colored avalanche deposits were emplaced by the dominant winds out of the northwest; the darker ones are composed of wind-ripple deposits emplaced by opposing winds.

Spring/autumn trade winds

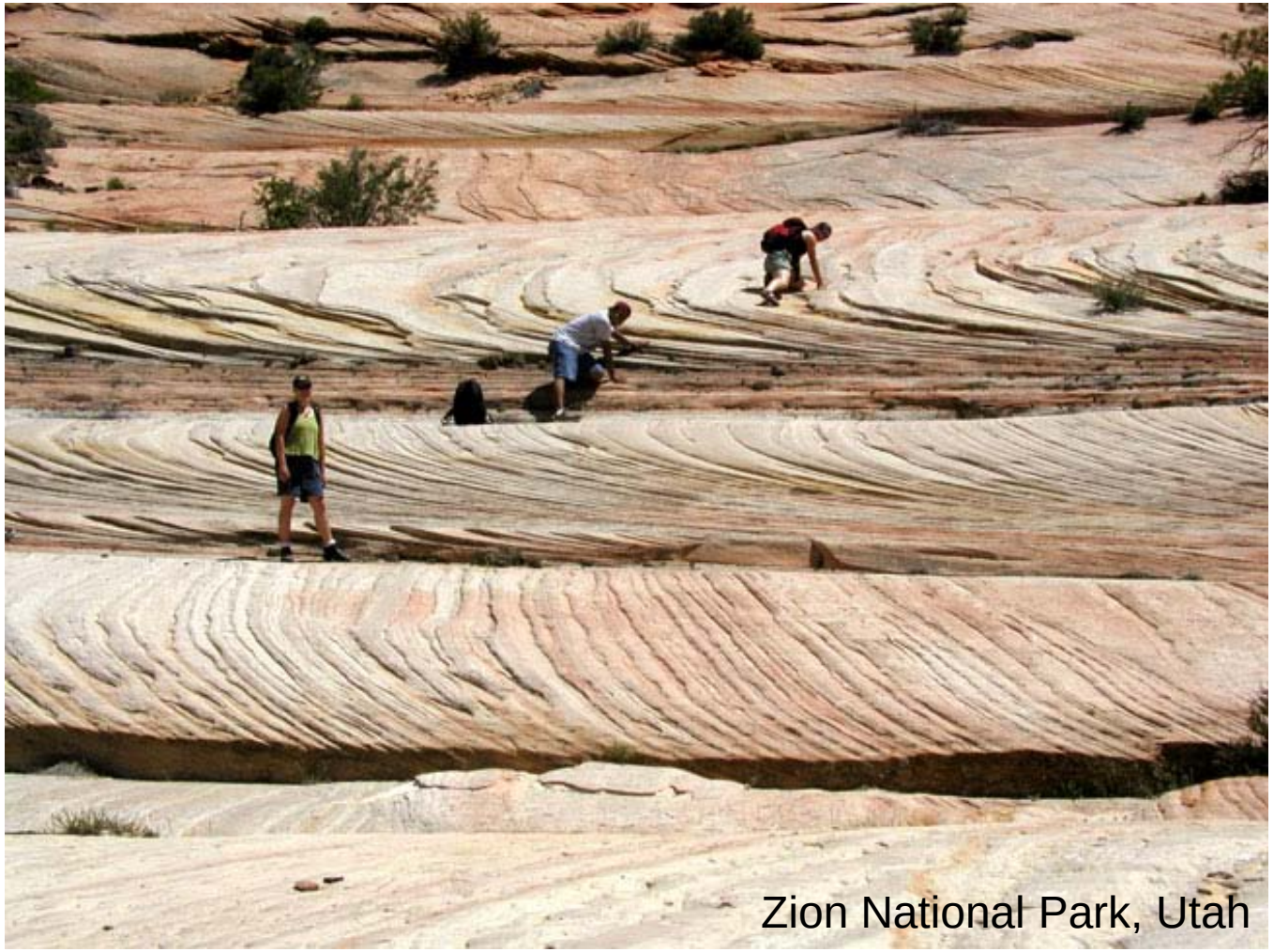


Wr = wind rippled sand

Slumping during summer monsoon rains
Grainflows emplaced by dominant winds during winter

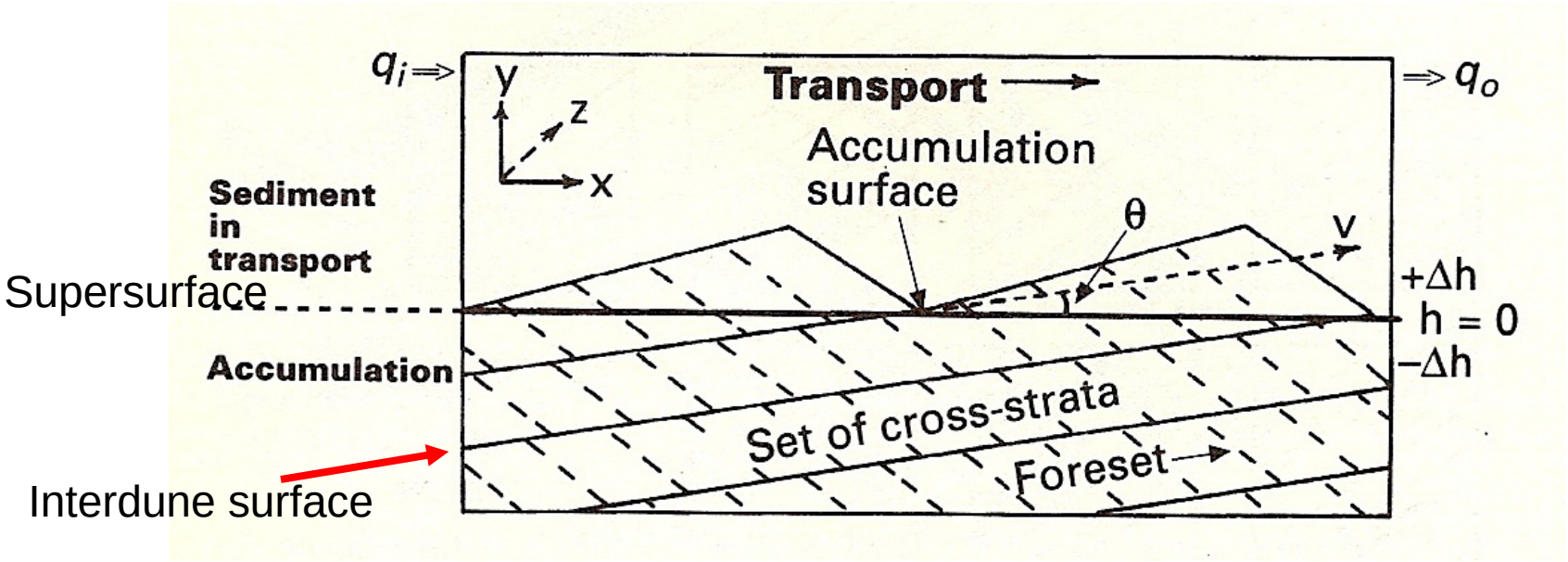
Loope et al. (2001), Nature, v. 412

Ancient eolian deposits



Zion National Park, Utah

Generation of sets of cross-strata



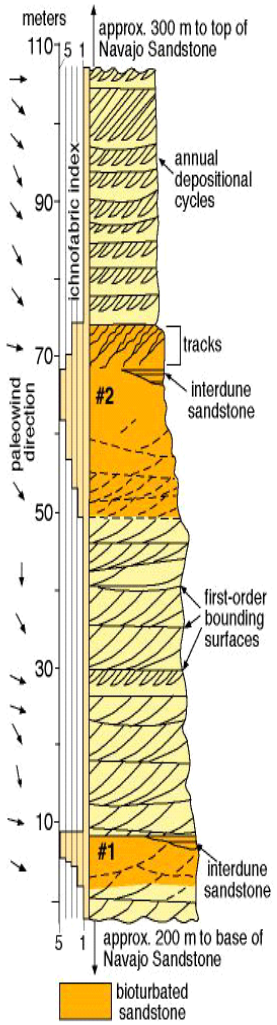
θ = Angle of climb ; $\tan \theta = V_y / V_x$ for most natural situations $V_y << V_x$

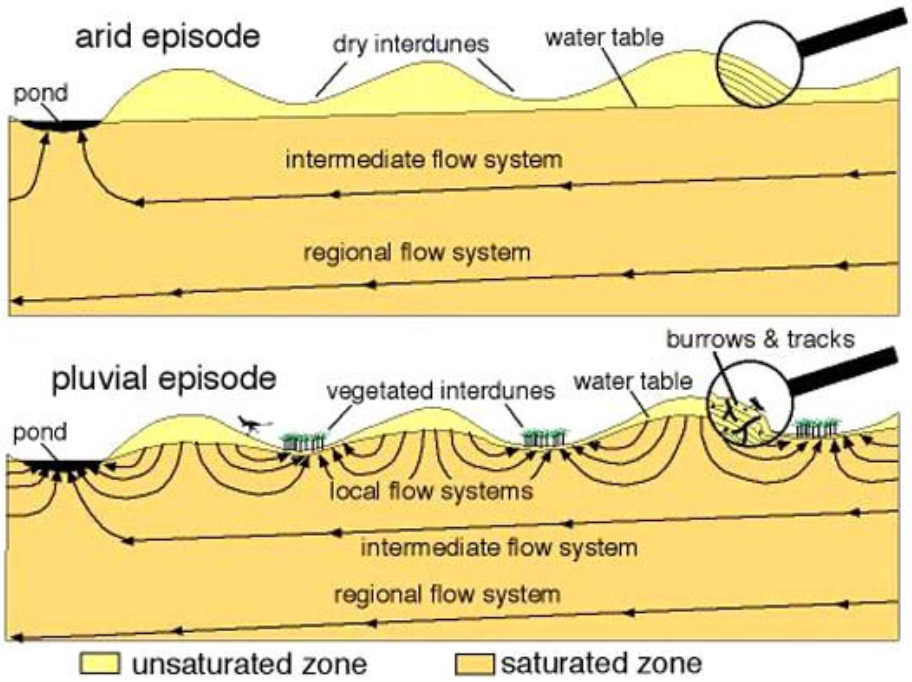
V = Vector of climb

Δh = Rate of accumulation or V_y

V_x = Rate of bedform migration

Cross-beds and climate-related features



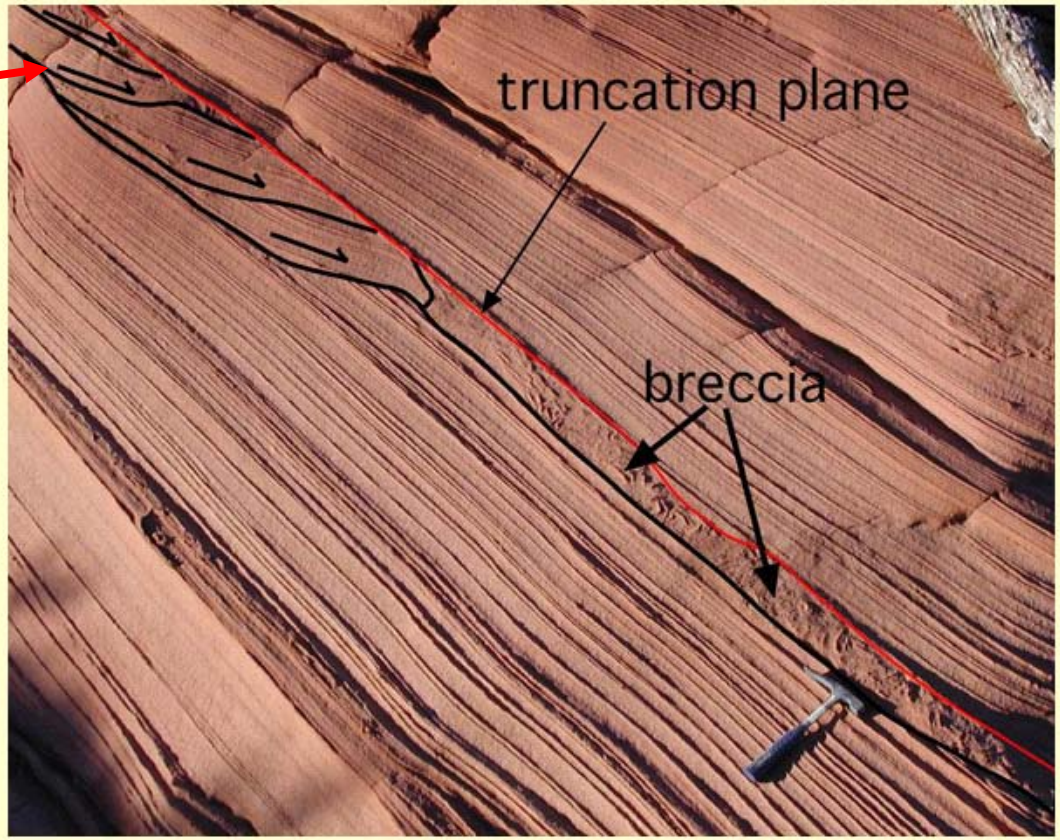


Failure structures – moist sand

Heavy rainfall on sand dunes can lead to large-scale slumping of the lee face, as shown here in the Pinacate Region of northern Mexico. Note breciation of the slump sheet near its toe. Photo by Nick Lancaster

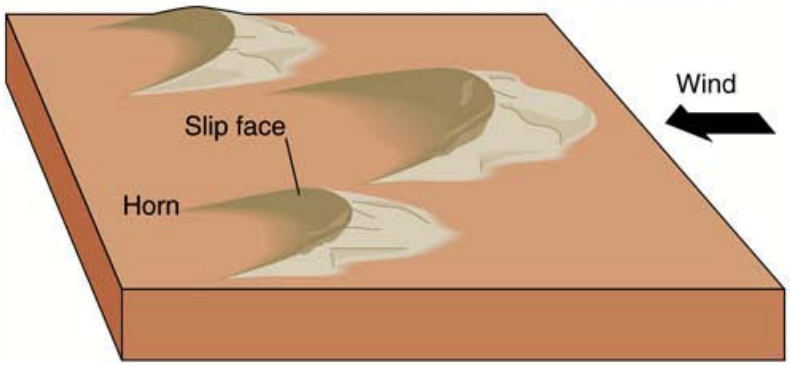
Ancient example - Lee-side slumps

Syndepositional thrust faults

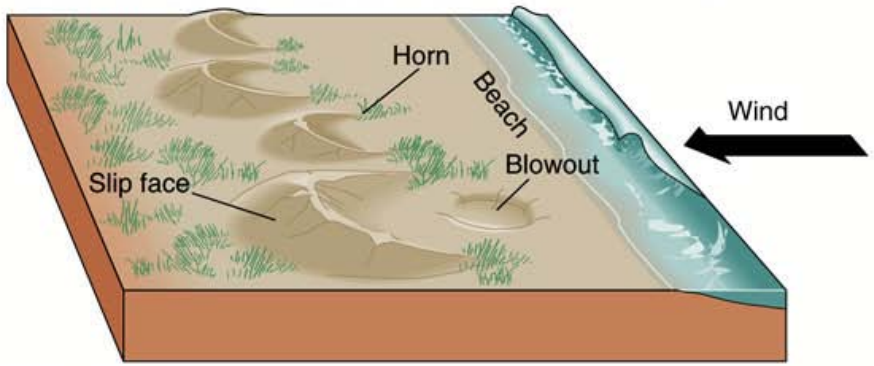


Soft-sediment slumps are present within the Early Jurassic Navajo Sandstone on the Colorado Plateau near the Arizona-Utah border.

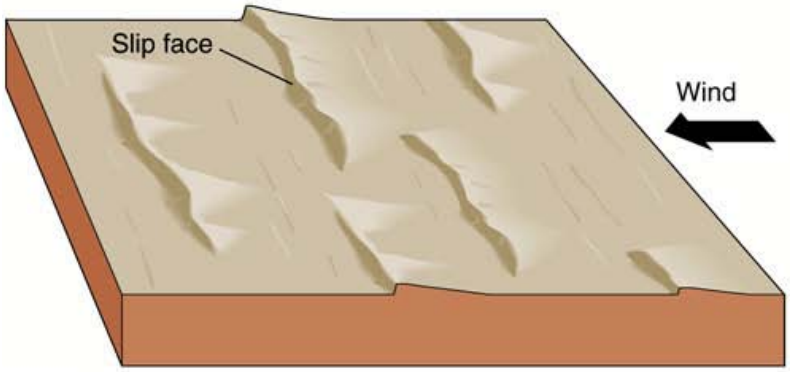
Dunes



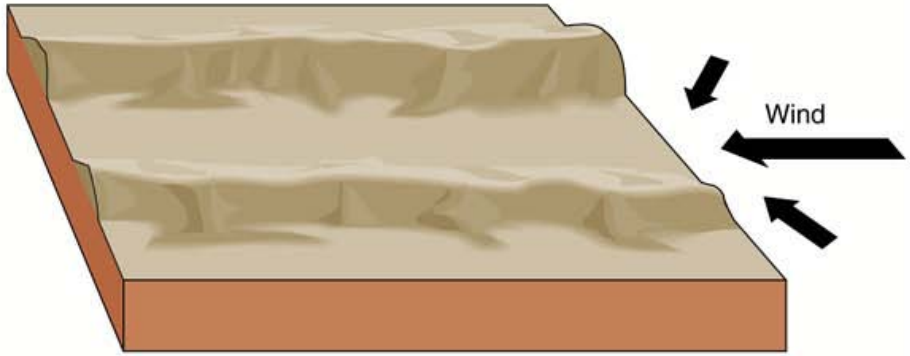
A Barchans



C Parabolic dunes

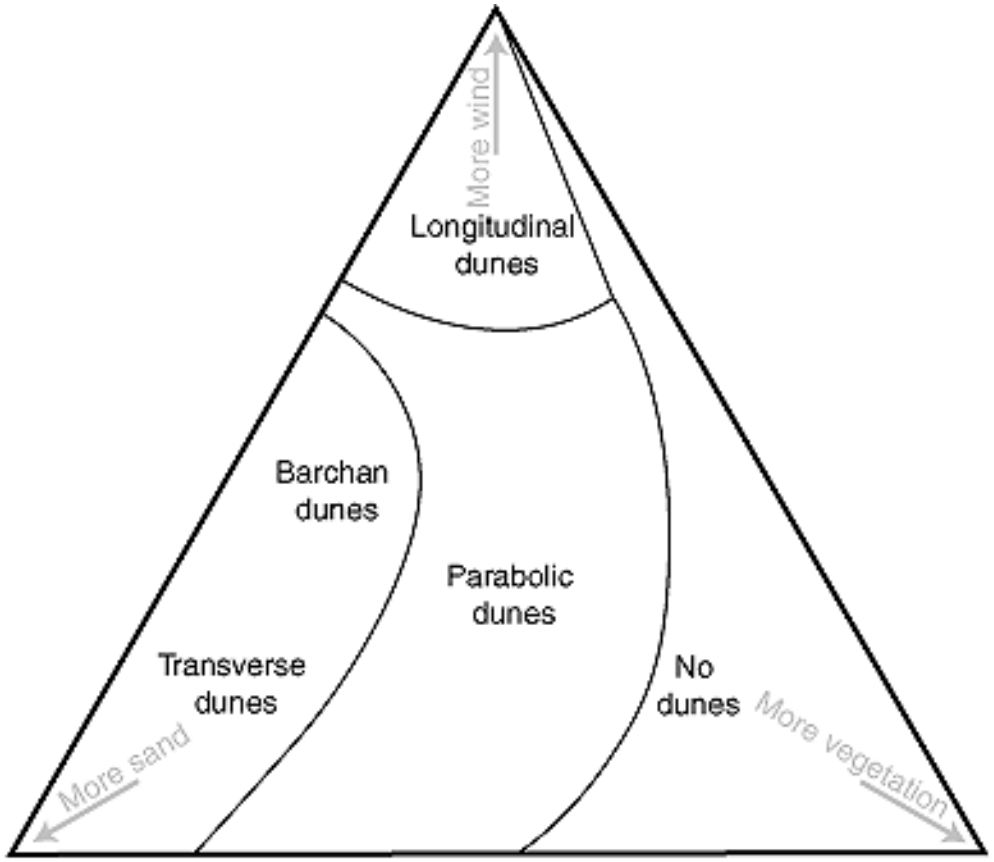


B Transverse dunes

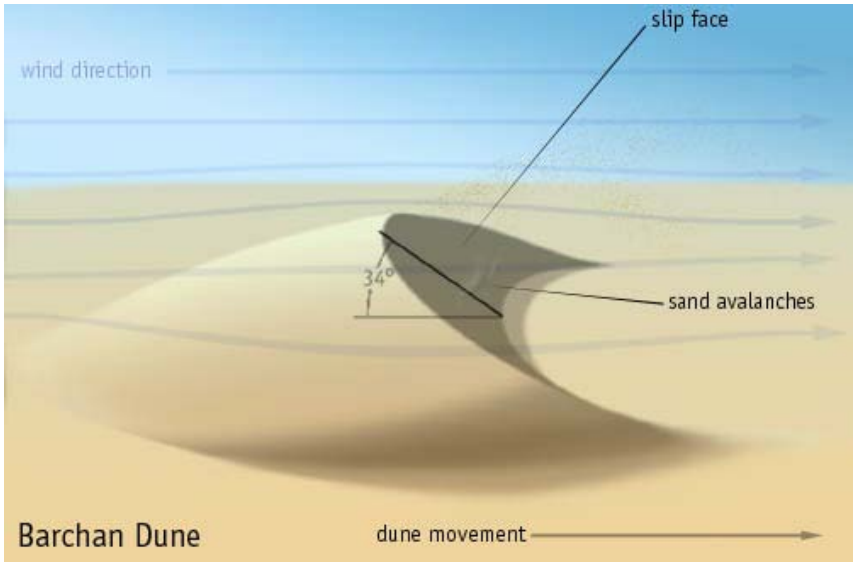


D Longitudinal dunes (seifs)

Controlling factors



Barchan dune



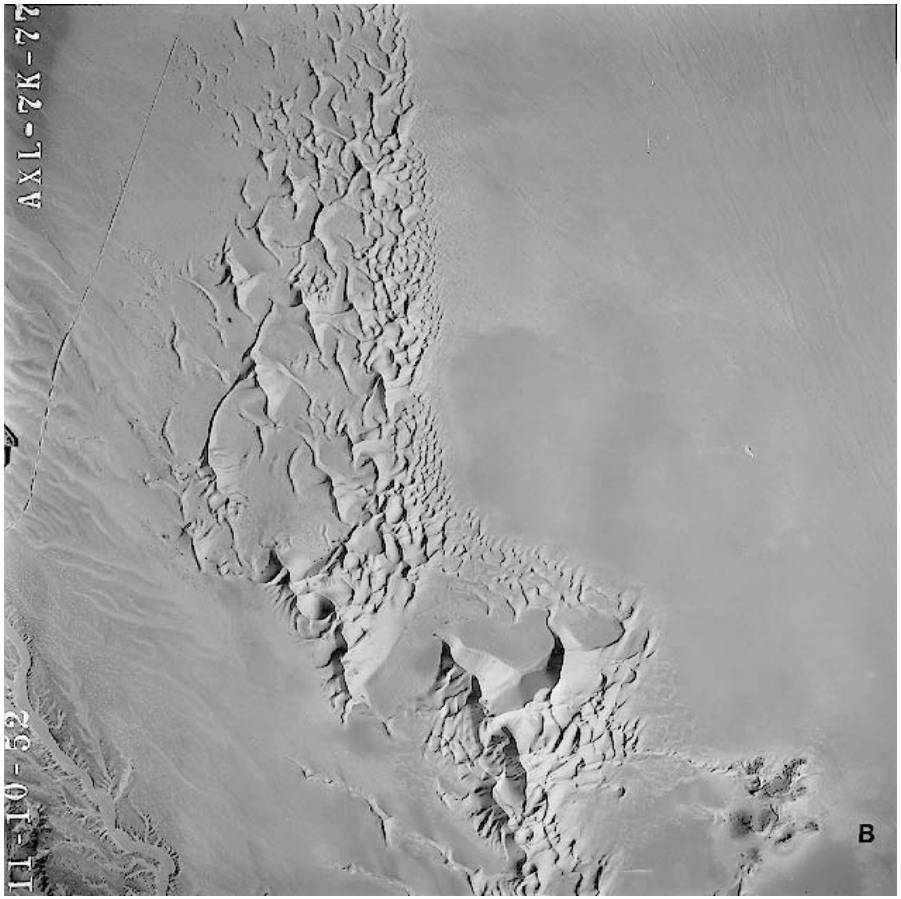

© shunya.net

Barchanoid – Transverse dunes

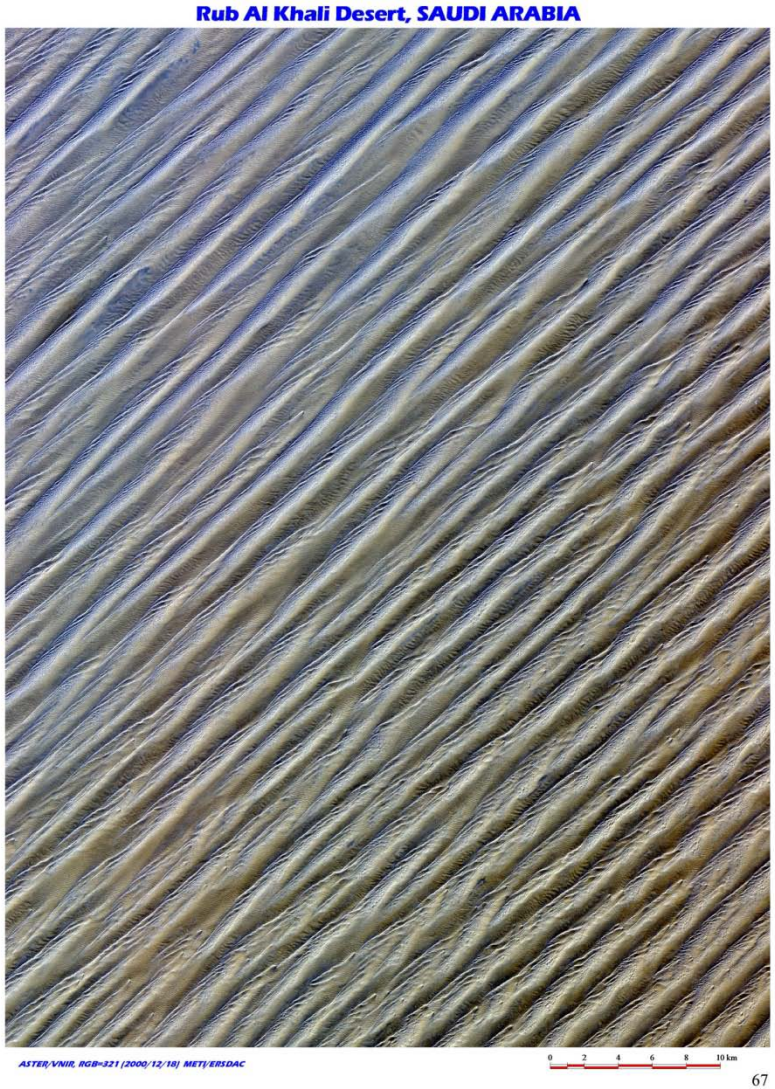
Sinuous, barchanoidal transverse dunes on a transgressive dunefield in an arid environment at Guerrero Negro, Baja California, Mexico

Photograph by Patrick Hesp

Star dunes



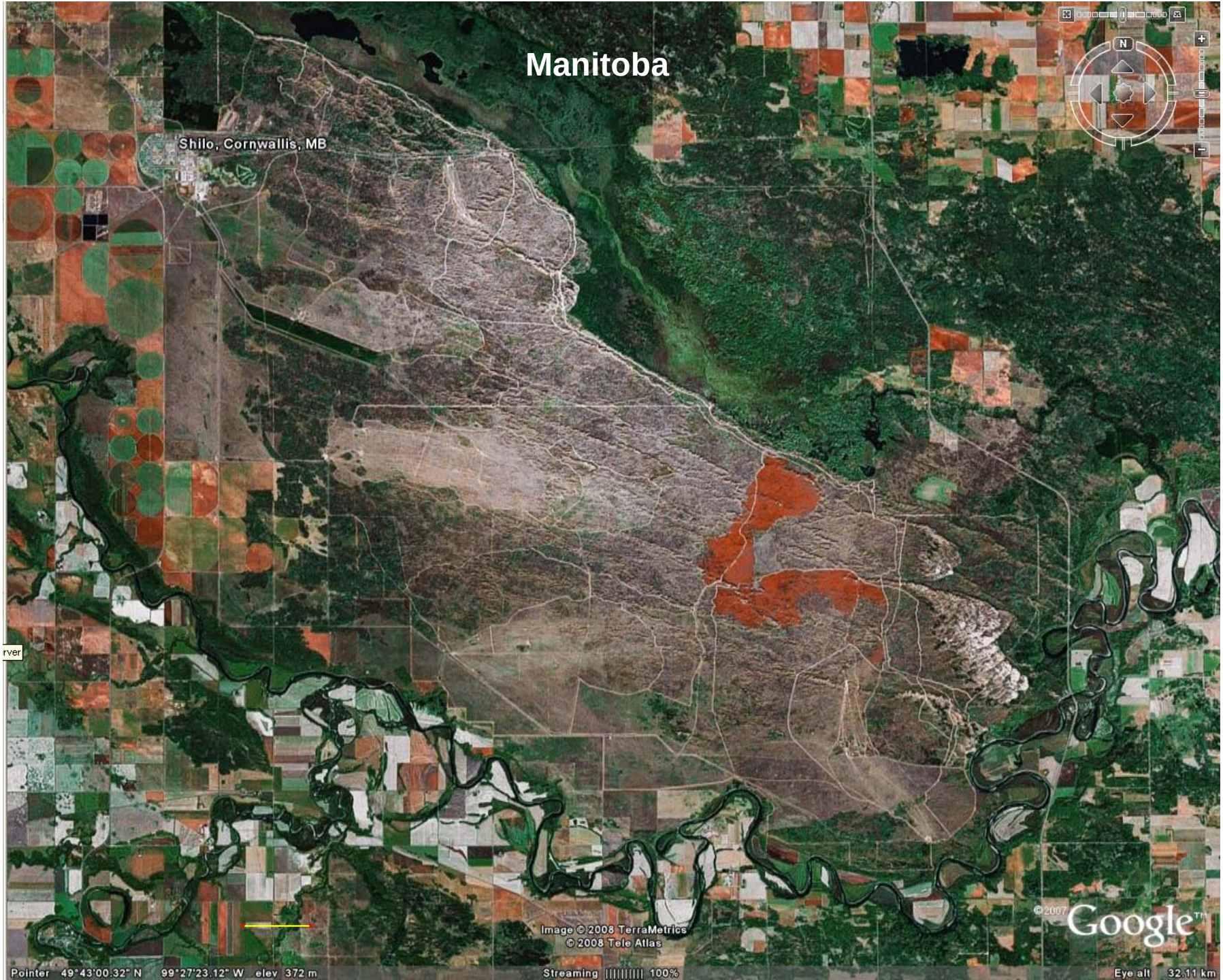
Longitudinal dunes



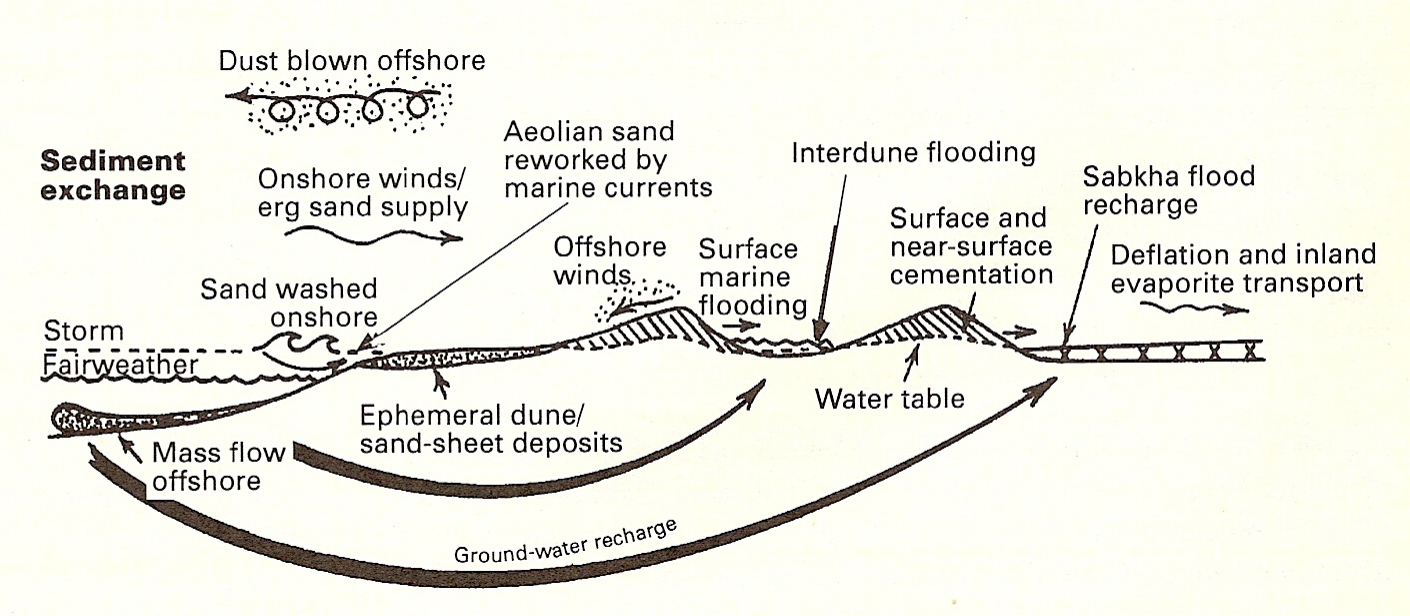
Stabilized Holocene dunes in Ontario

Longitudinal dunes; Chalk River, ON


East-central Alberta
2 km
Image © 2008 DigitalGlobe
©2007 Google™
Pointer 52°43'02.89" N 110°44'50.53" W elev 664 m
Streaming 100%
Eye alt 8.64 km


Manitoba
Shilo, Cornwallis, MB
Image © 2008 TerraMetrics
© 2008 Tele Atlas
© 2007 Google™
Pointer 49°43'00.32" N 99°27'23.12" W elev 372 m
Streaming 100%
Eye alt 32.11 km

Interaction with other systems – coastal, oceanic…



Dust storms

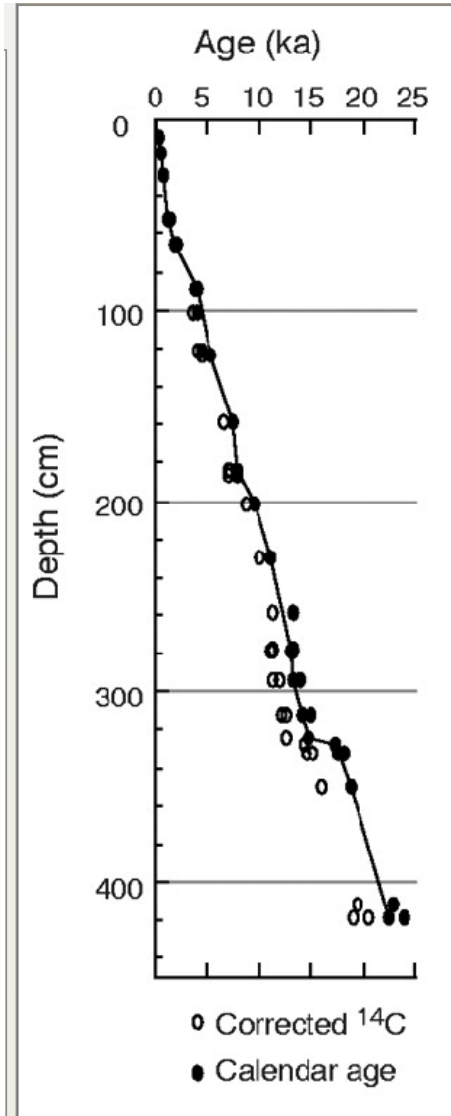
Up, up, and away…

http://earthobservatory.nasa.gov/

And then down deep…

Constraining SR

- **ODP Hole 658C off Cap Blanc, West Africa (2263 m water depth)**
  - AR are high due to:
    - strong seasonal upwelling (high bio-productivity)
    - High supply of windblown dust (African/Saharan eolian dust plume)
- Age-depth profile: continuous SR 22 cm/ka spanning the last ~14 ky. Note a brief hiatus between 328 and 324 cm (17.4 to 14.3 ka)



(deMenocal *et al.*, Science 2000)

Summary

- Windblown sands and dust originate from dry deflation surfaces and abrasion of rocks
- Sand transport occurs close to the land surface
- Dust can be kept in suspension and travel over large distances
- Eolian sands tend to become mature, yellowish and later red in color
- Structures: Large planar cross-bedding and minor ripple cross-bedding
- GW-controlled deflation surfaces
- Interactions with fluvial and playa deposits

Summary

- Eolian dust can generate loess covers of various thicknesses
- Dust contributes considerably to the composition of lake deposits in arid zones and deep sea sediments where offshore winds from desert reach the open ocean