

Eolian Processes and Landforms

An introduction to arid landscapes



Dry landscapes

- Largest identifiable climatic region on Earth
 - Seasonal or annual precipitation is insufficient to maintain vegetation cover and permit perennial streams to flow.
- Between 30 and 40 percent of the Earth's current landscapes may be classified as Arid!

The aridity index

- P = Annual precipitation /
 ETP = Annual potential evapotranspiration
- Hyper-arid: $P/ETP < 0.03$
- Arid: $0.03 < P/ETP < 0.20$
- Semiarid: $0.20 < P/ETP < 0.50$
- Sub-humid: $0.50 < P/ETP < 0.70$



Geomorphic Processes in Deserts

1. Weathering (slow, thin soil)
 - a. Rock varnish: coating of rocks by Fe and Mn oxides caused by bacterial ppt.
 - b. Cryptobiotic soil
2. Mass wasting
3. Erosion/Deposition

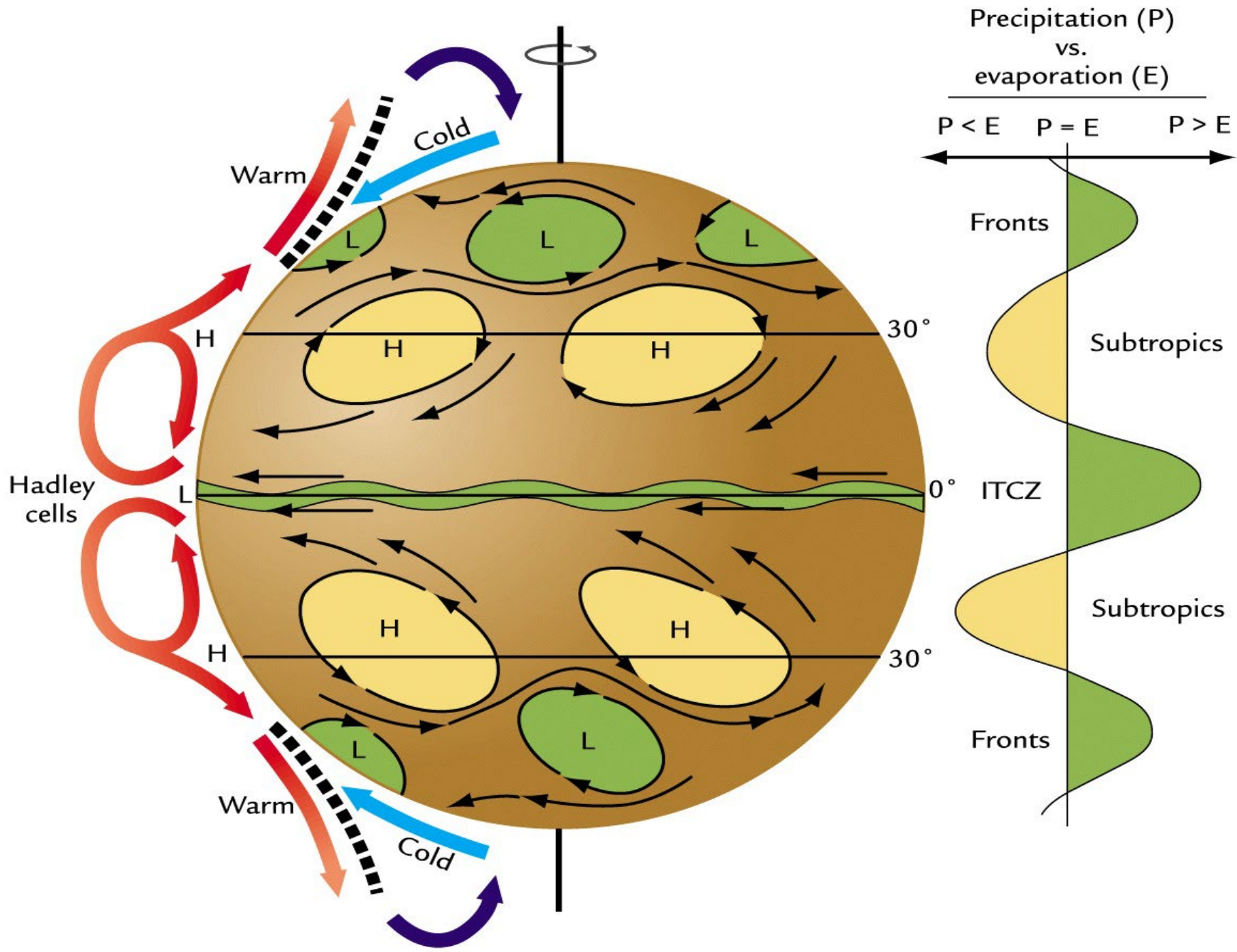






Two mechanism for dry landscapes

1. Global circulation (wind),
Between 20 to 30 latitude below and above the equator.



Mid-latitude dry areas

2. Interiors of large continents;
 - a. Wide areas of semi-aridity surrounding smaller cores of true desert;
 - b. Common freezing temperatures in winter;
 - c. West edges of continents cold ocean currents flow onshore or topographic rain shadows.



Environments of varying aridity

- Semiarid to sub-humid
- Desert plains
- Mountainous deserts
- Savannas

Semiarid to sub-humid

- Steppes (prairies, velds, and pampas)
- Characterized by;
 - Grass cover
 - Up to 2x the annual precipitation of a desert
 - Graded rivers
- Steppe regions = low plains or dissected plateaus (e.g. Our Great Plains)

Desert plains

- Playa (sabkha) lakes, plains, hammadas
 - monotonous plains and plateaus/ interiors of large continents



Mountain deserts

- Examples, Basin and Range Province; Pacific coastal desert of South America
- Characterized by
 - Bajada (coalescing alluvial fans)
 - Pediments (plains that lie at the base of mountains in an arid region)

Savanna

- Tropical regions of sparse open woodlands, thorny shrubs, grass cover.
- Inselbergs, steep-sided, isolated hills, and mountains of barren rock that rise above the surrounding flat plains.
 - Wet season/islands
- Hot year round + seasonally wet = extensive chemically weathering

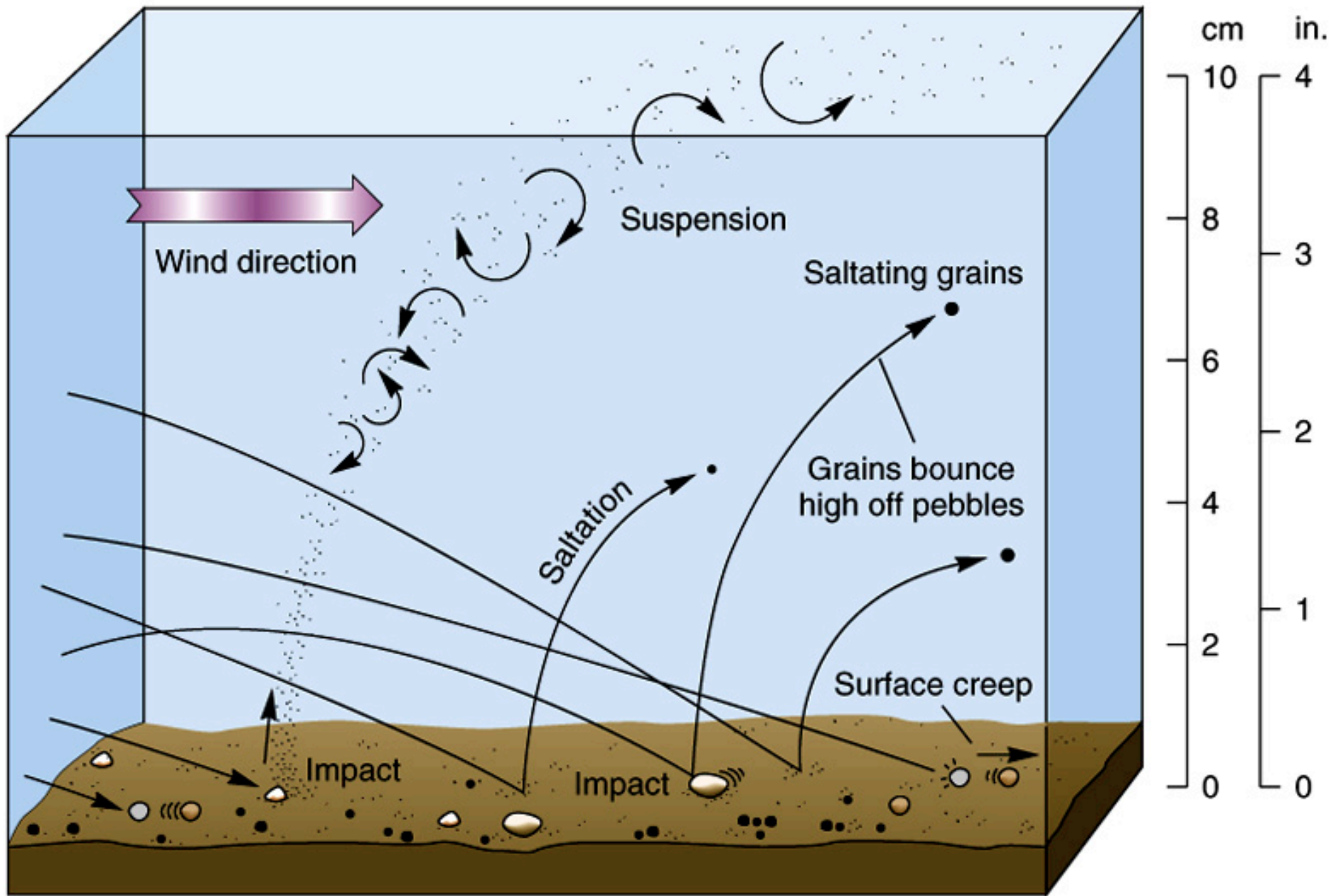






Movement of material by wind

- Suspension
- Saltation
- Impact creep
- Drag



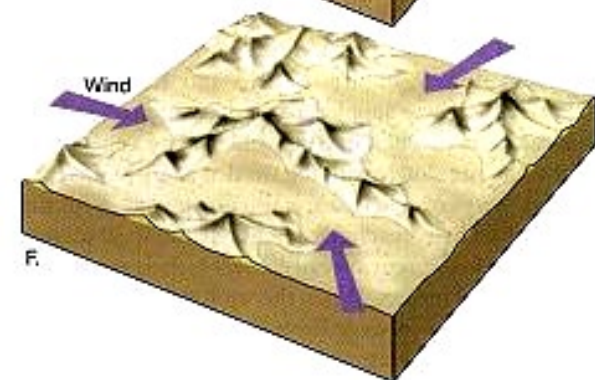
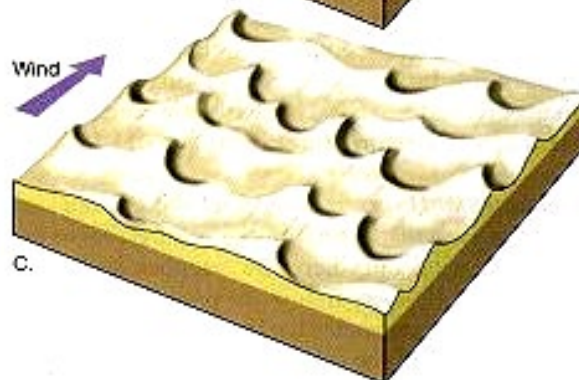
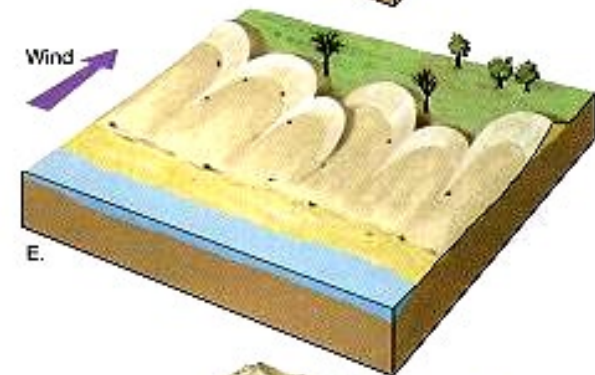
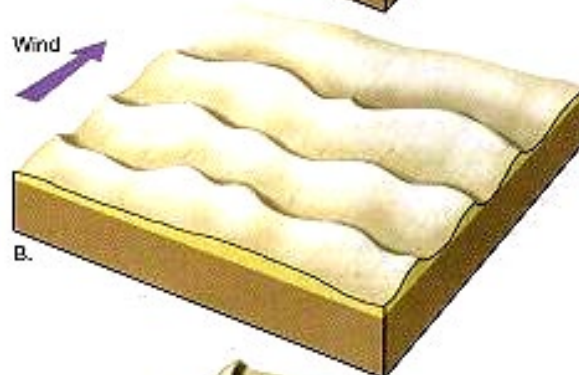
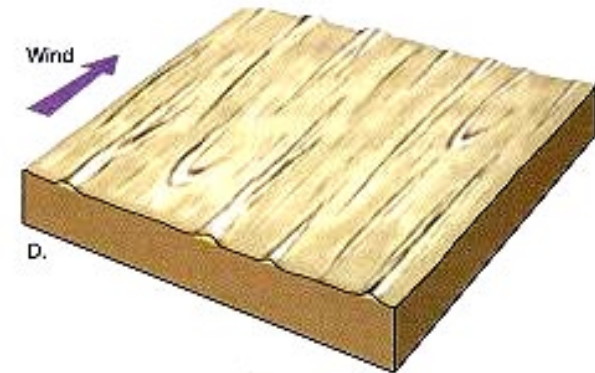
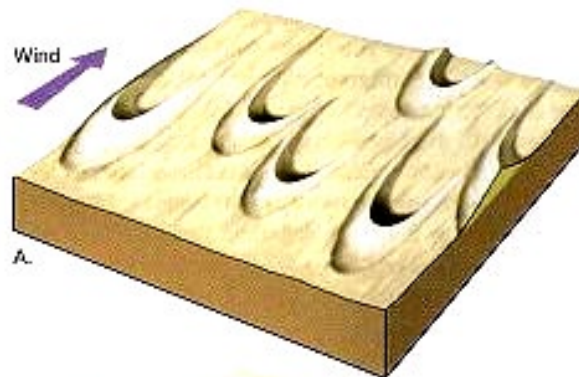
(a)

Wind velocity Vs. particle size

<u>Maximum size of moving particles</u>	<u>Wind velocity (km/hr)</u>
0.25 mm	16-24
0.50	24-30
0.75	30-35
1.0	35-40
1.5	40-45 or (25-28 mi/hr)

Twenhofel, 1932

Dune types



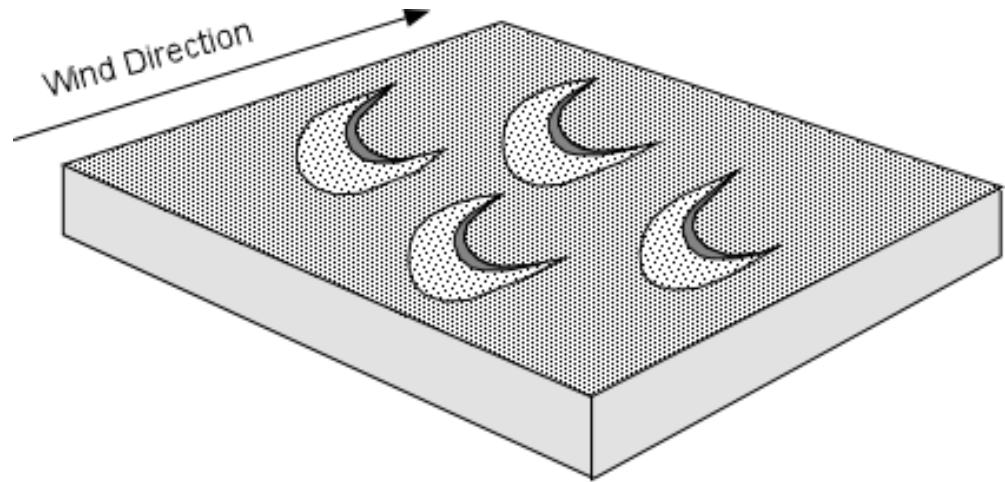


A Few Types

- Barchan
- Parabolic
- Blowout
- Linear
- Star

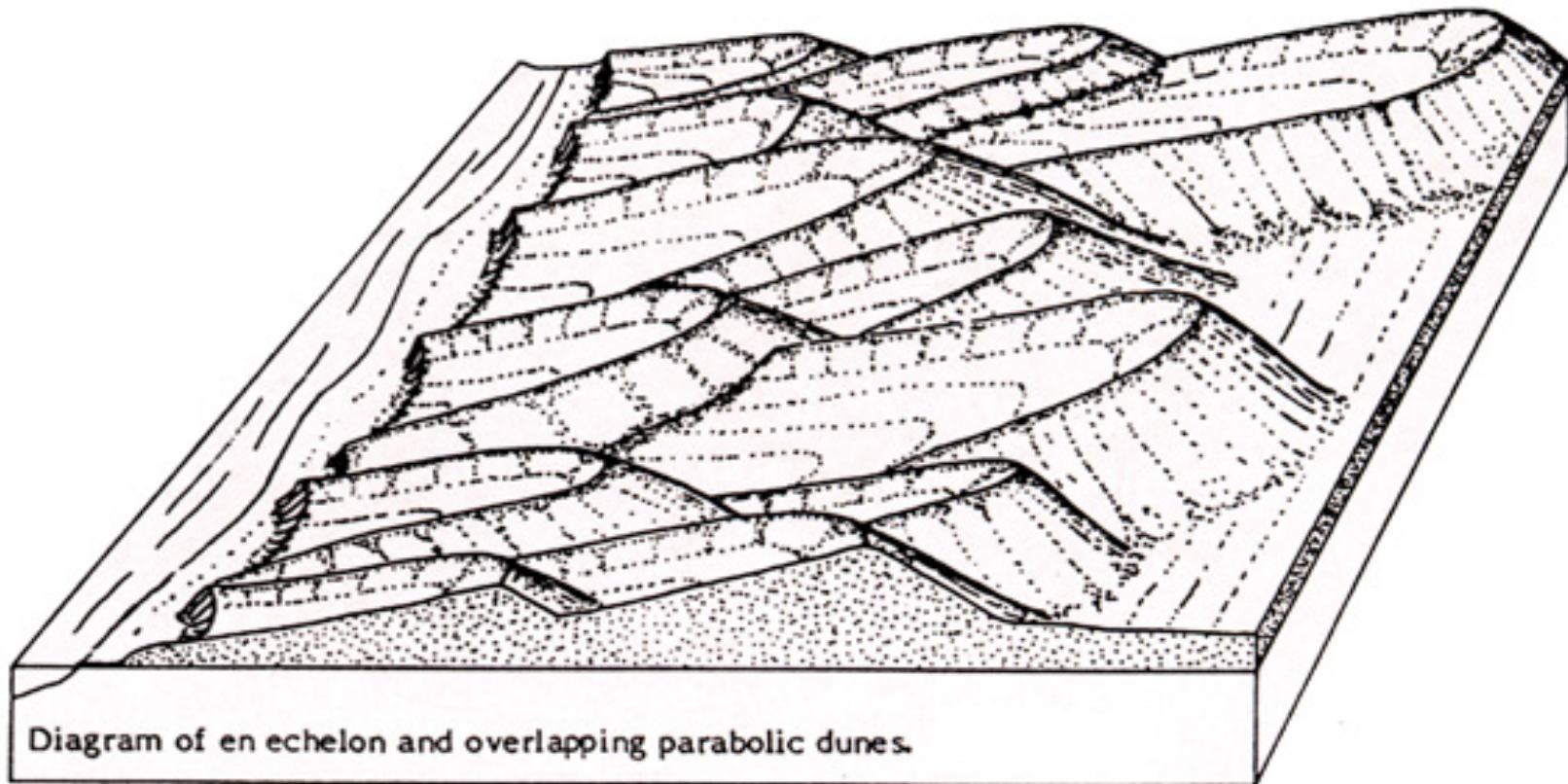
Barchan

- Concentric
- Isolated
- Move 15 to 25 m/yr in the Salton Sea Basin, CA



Parabolic

- ❑ Common on coast lines
- ❑ Singular wind direction



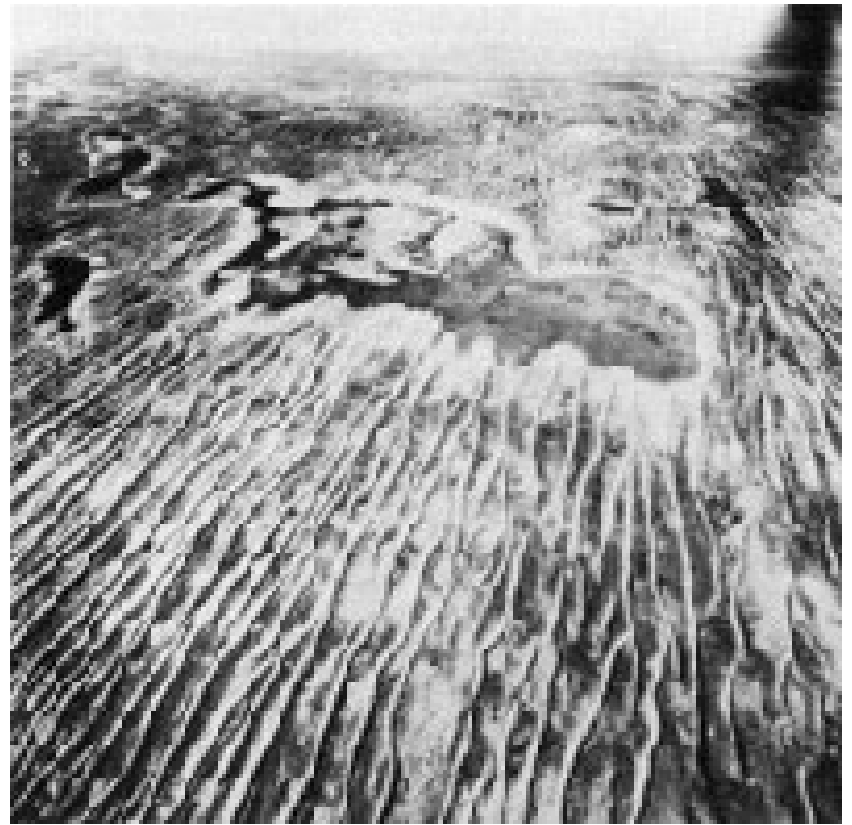
Blowout

- Partially stabilized sandy terrenes



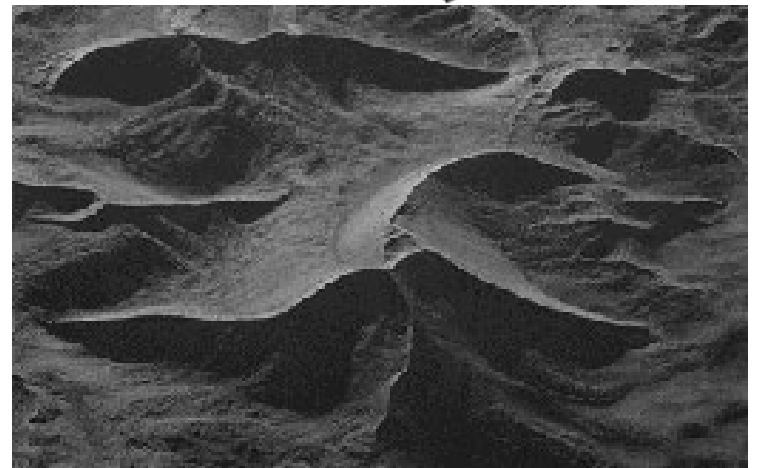
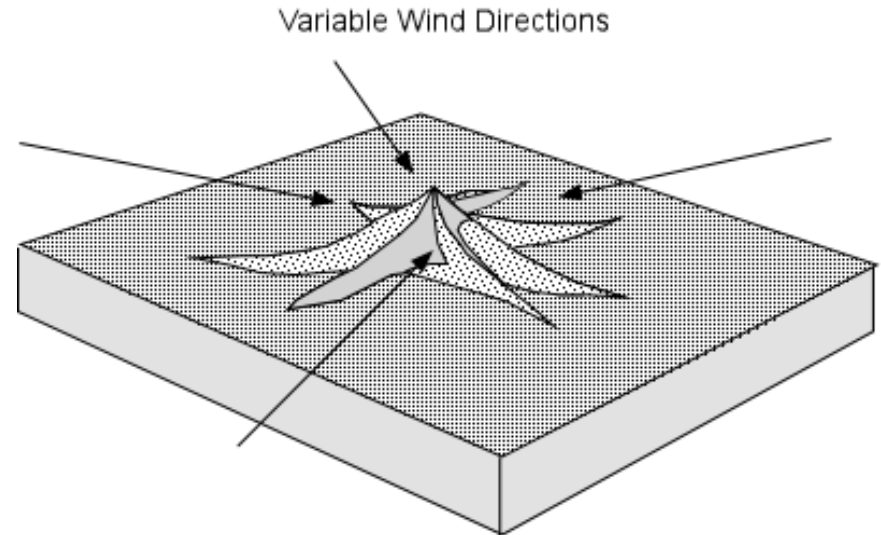
Linear or longitudinal

- May extend 100's of km
- Well developed in trade wind deserts
 - Where wind is uniform or changes seasonally



Star

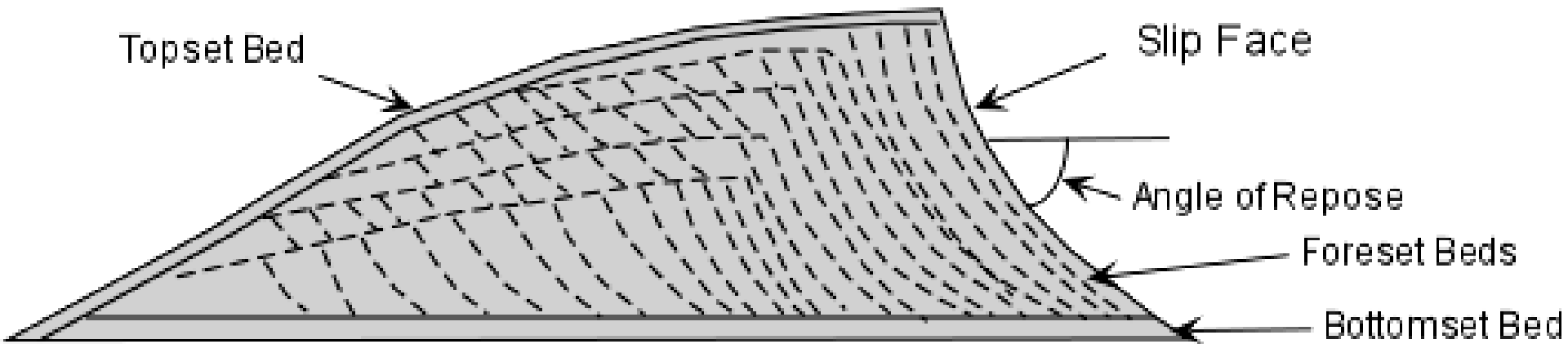
- Up to several 100's of meters in height
- Product of effective multiple winds blowing from several directions



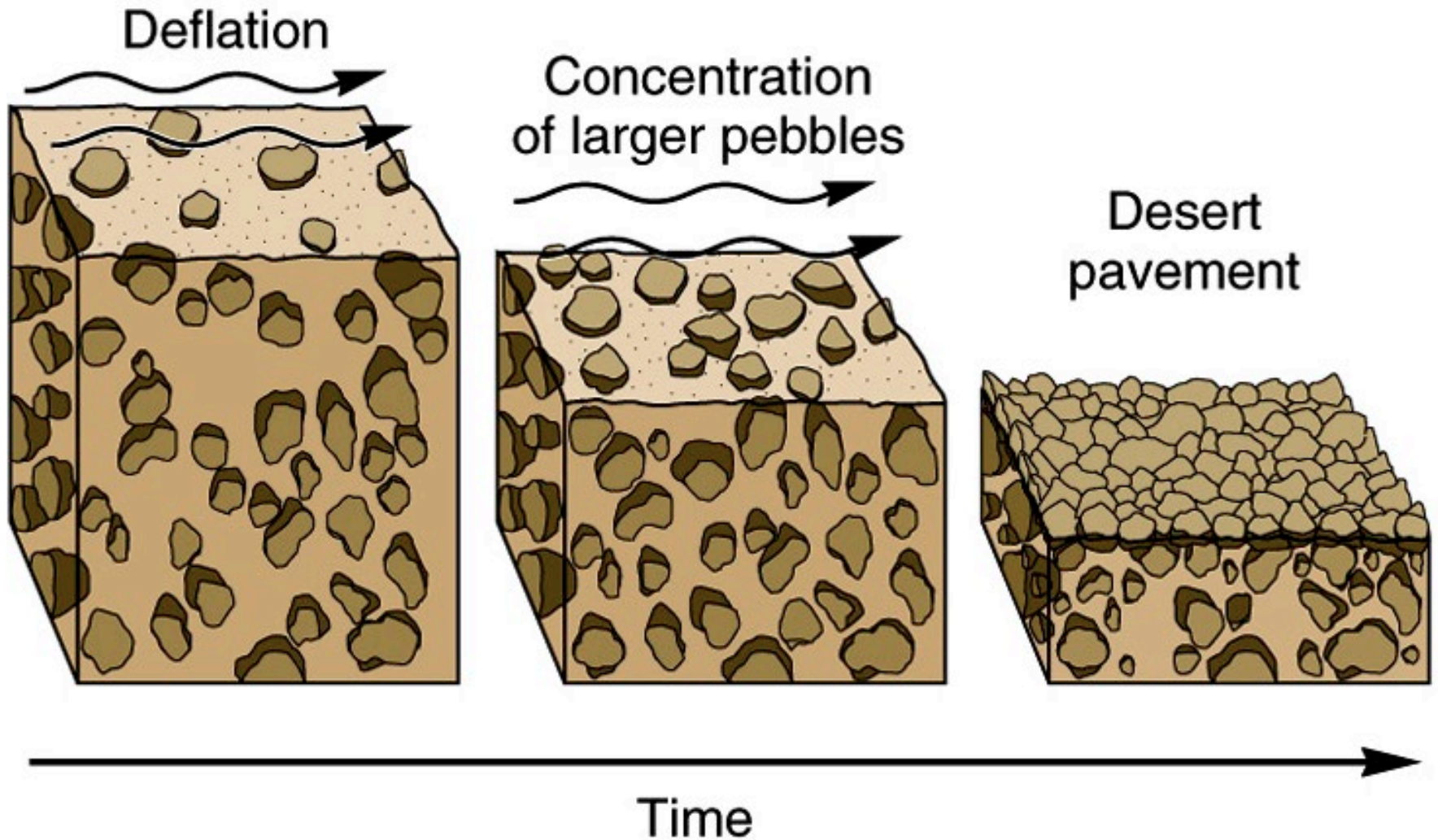
Dune Morphology

Sand Dune Cross Section

Wind Direction →



Desert Pavement

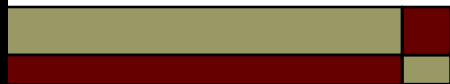






Dust and Loess

- Initially resistant to transport but, once in suspension dust can be lifted up to 1000's of meters in the air and carried long distances



Desertification Vulnerability

