Soil Conditions and Dust Production

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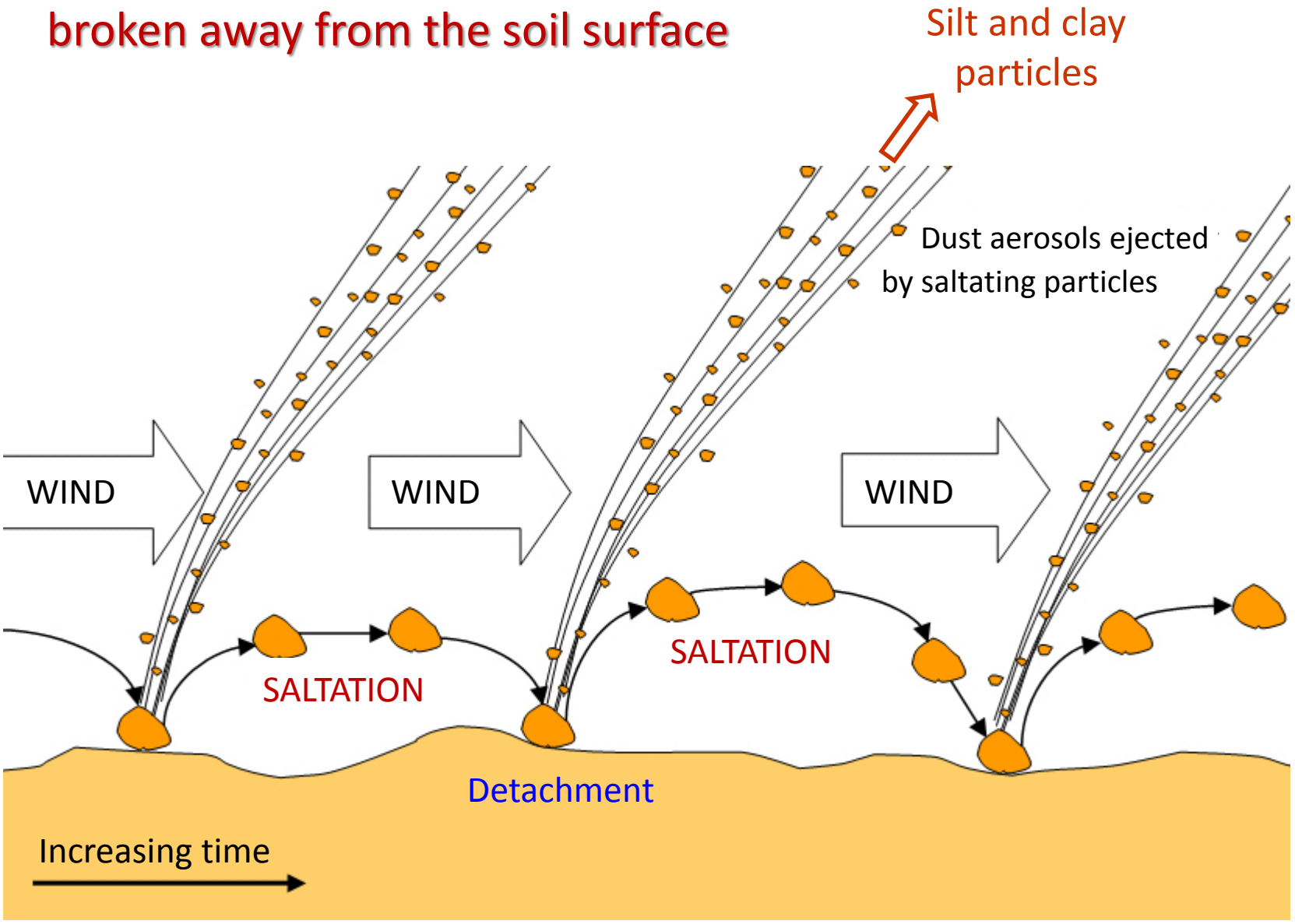
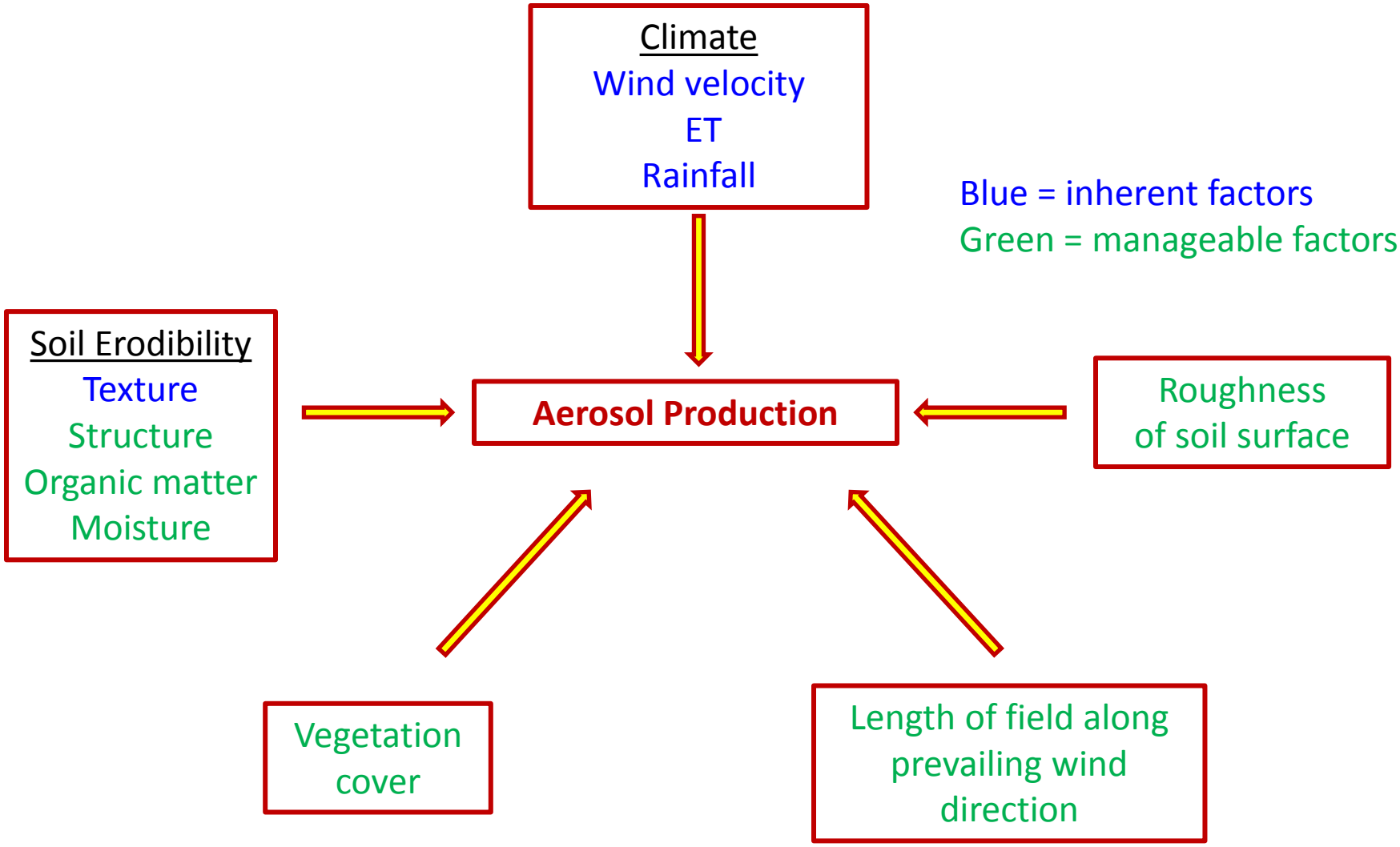
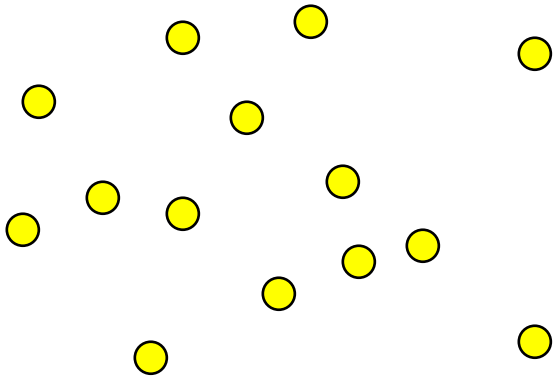
The process of soil aerosol production requires silt and clay particles to be broken away from the soil surface



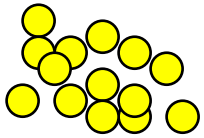
Factors that control the process of soil aerosol production



- Soil structure is the arrangement of soil sand, silt, clay particles into stable secondary units or aggregates
- Aggregates are composed sand, silt, and clay particles, cemented together by clays or organic matter
- Structure influences water infiltration, drainage, water holding capacity, aeration, salinity, erodibility

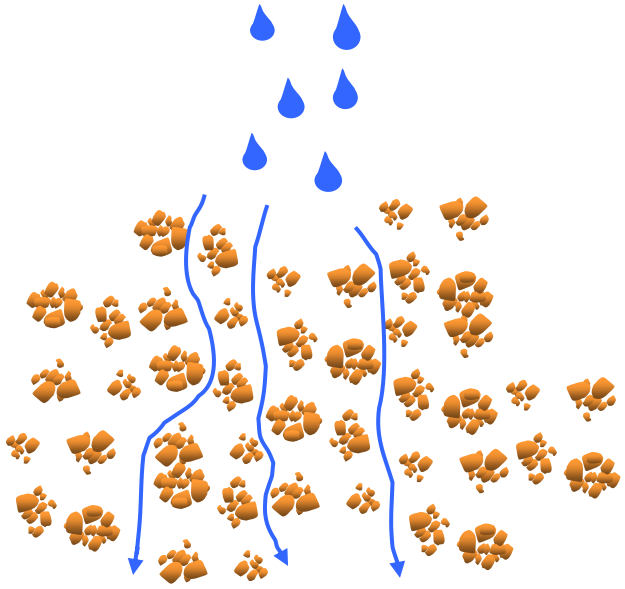


Dispersed Particles

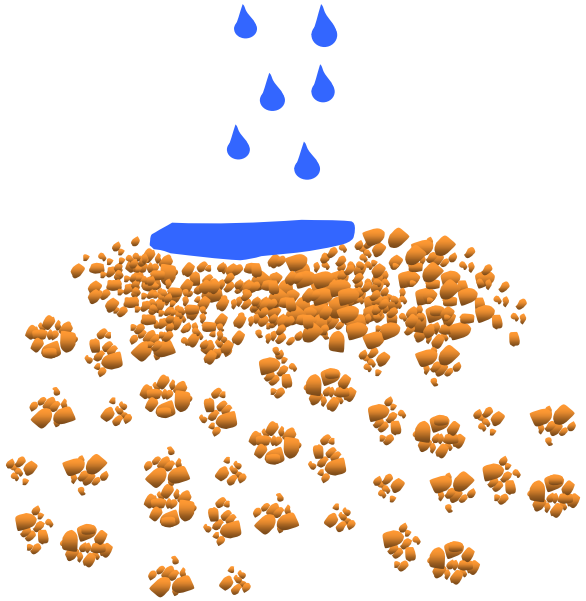


Aggregated or Flocculated Particles

Water, roots move in macropores between aggregates



Dispersed soil plugs macropores

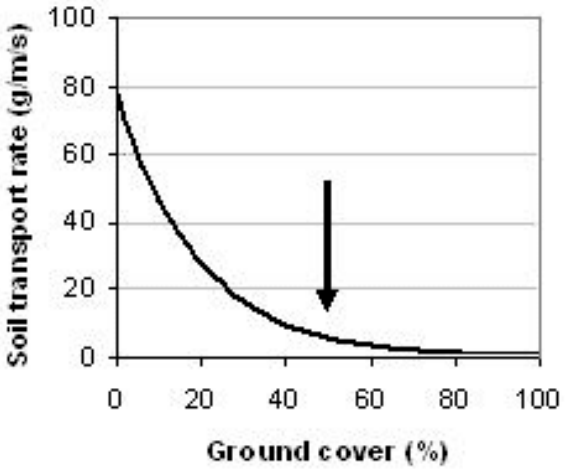


If soil is dispersed

1. Water can’t soak into soil
2. Water accumulates, along with dissolved salts
3. Water evaporates, leaving salts behind
4. Soil becomes saltier
5. Plants die, leaving bare erodible soil

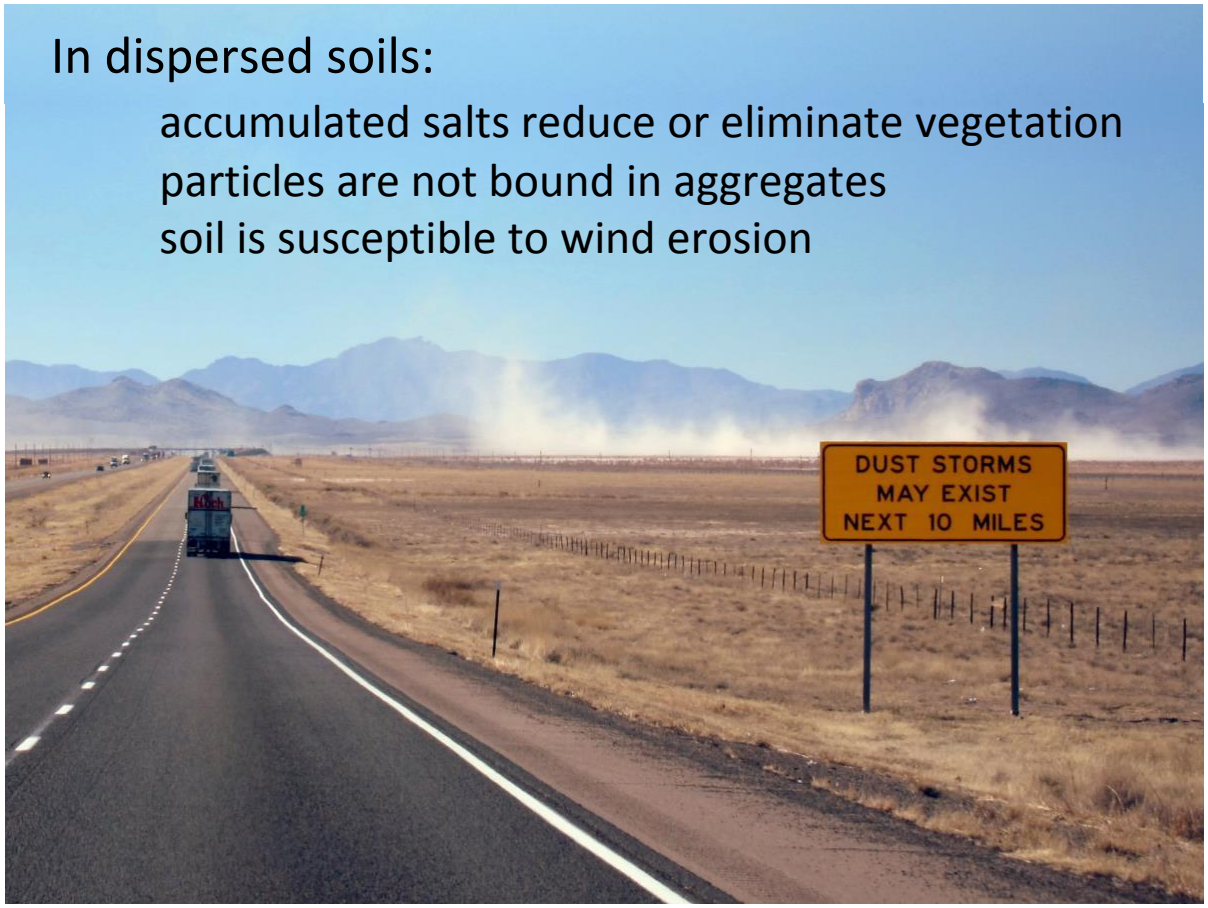
Bare soil is susceptible to wind erosion

vegetation cover protects the soil surface



In dispersed soils:

- accumulated salts reduce or eliminate vegetation
- particles are not bound in aggregates
- soil is susceptible to wind erosion



Flocculation versus Dispersion

- Flocculation is controlled by salt concentration and cation properties (charge and hydrated radius)

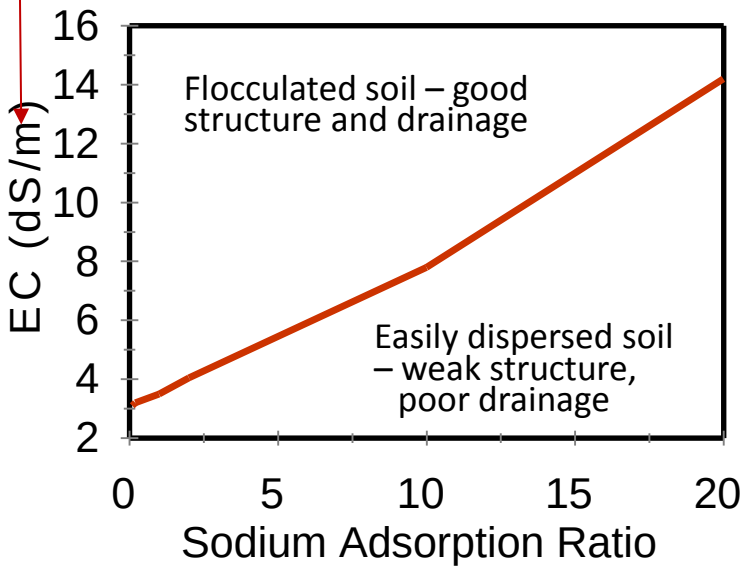
Ion		Relative Flocculating Power
Sodium	Na^{+}	1.0
Potassium	K^{+}	1.7
Magnesium	Mg^{2+}	27.0
Calcium	Ca^{2+}	43.0

Sumner and Naidu, 1998

- Soil cations vary in their ability to flocculate particles

Soil Aggregate Stability

EC (electrical conductivity) is a measure of total salinity: EC x 640 = ppm

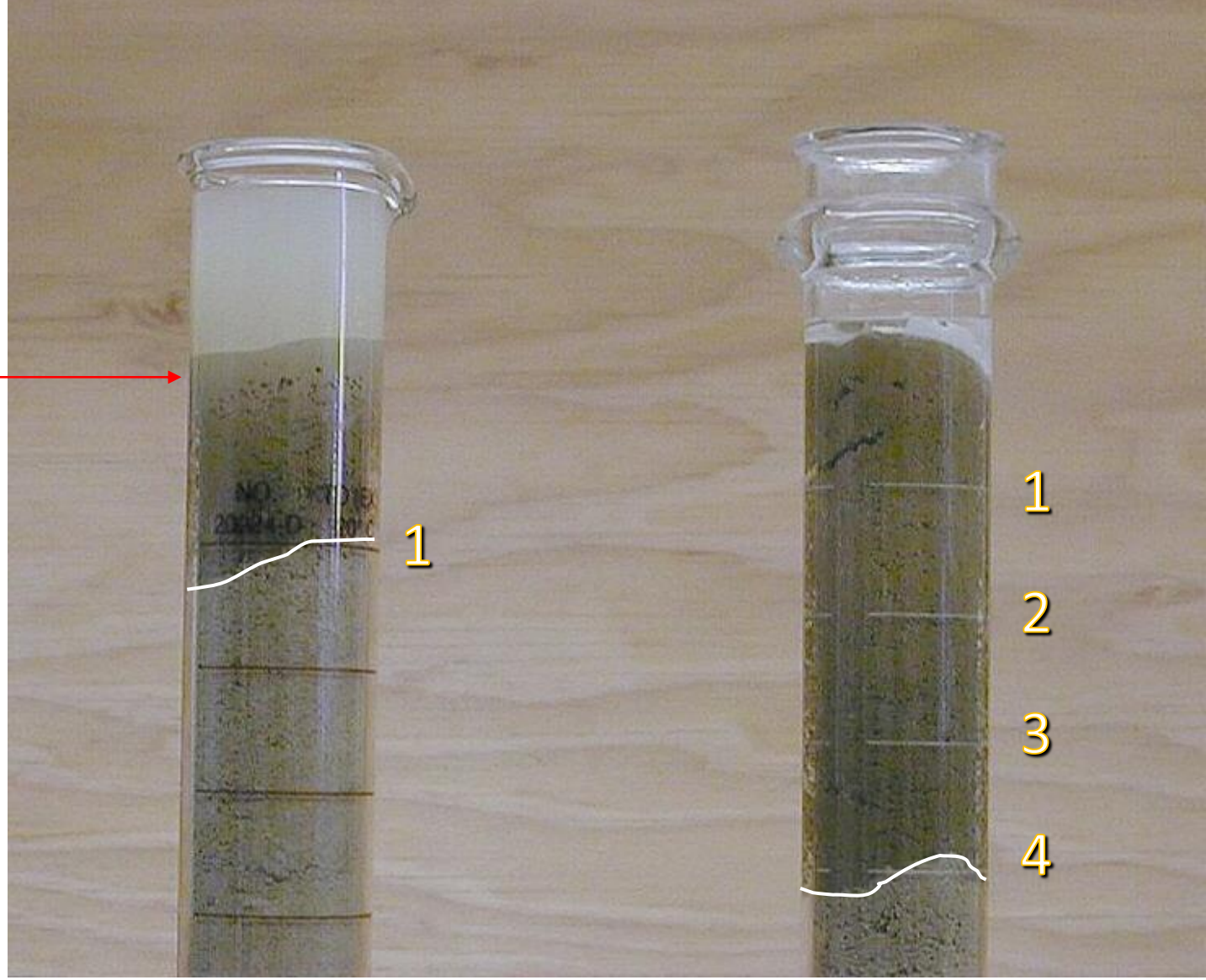


$$SAR = \frac{[Na^+]}{\sqrt{[Ca^{2+}] + [Mg^{2+}]}}$$

Rainwater standing on a non-absorbent soil along I-10 North of Picacho. This is typical of sodium-affected soils.

TIME = 10 min

Dispersed soil

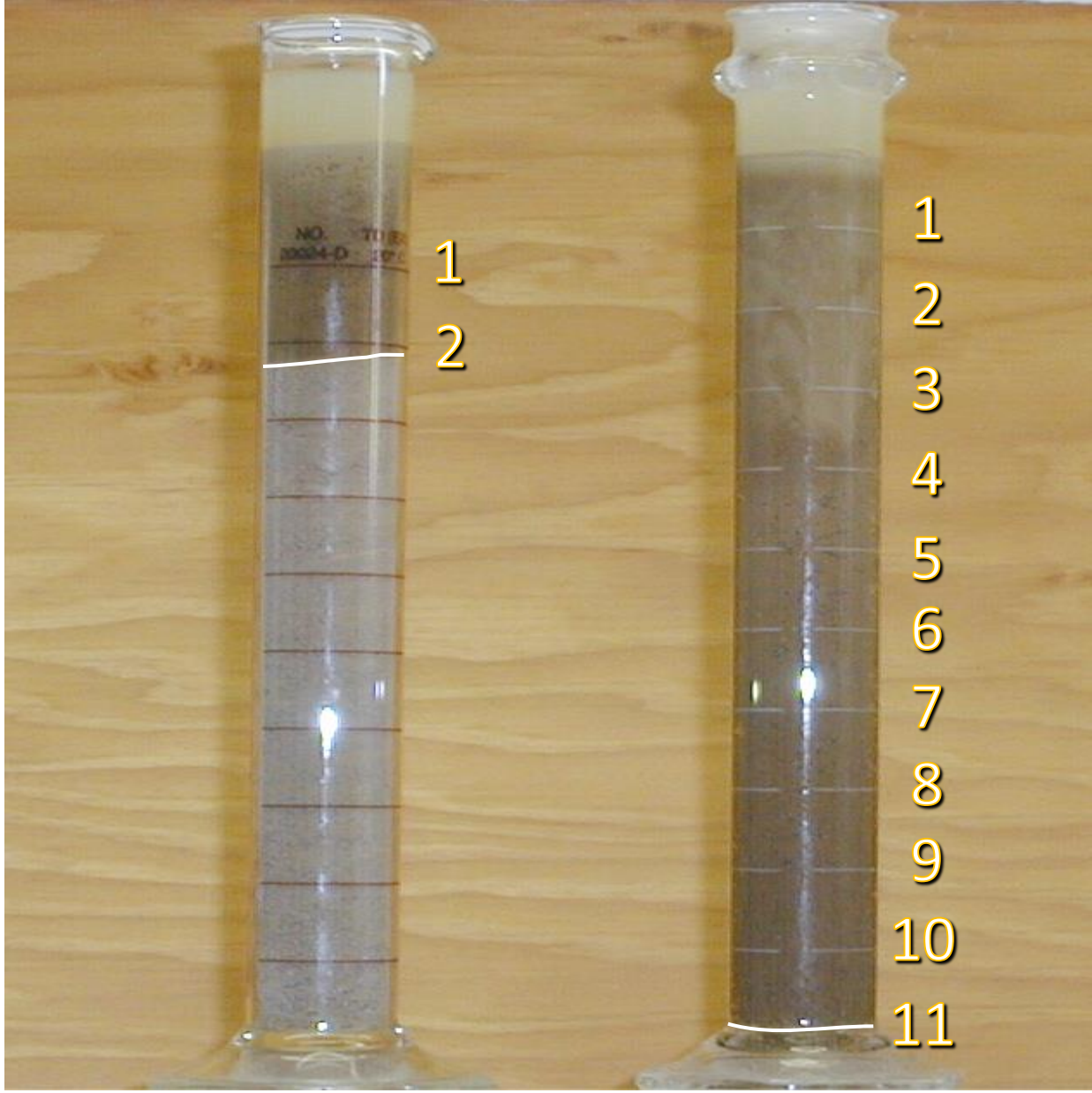


Water

Water & Gypsum

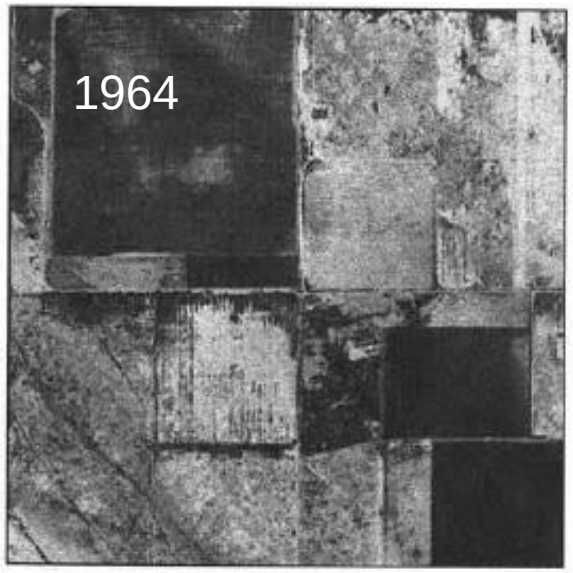
($CaSO_4 \cdot 2H_2O$)

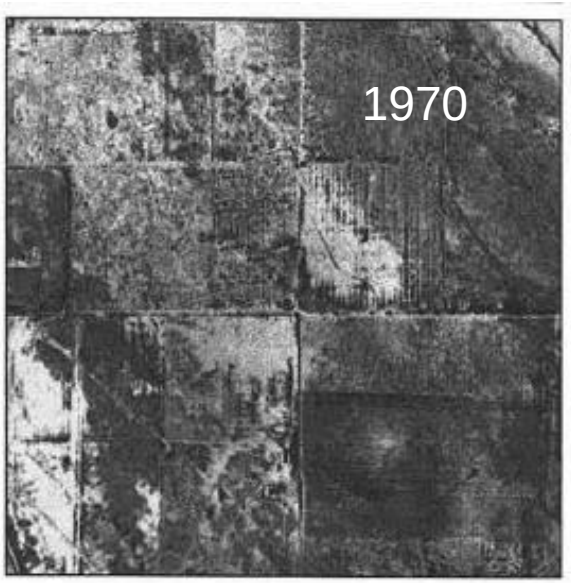
TIME = 24 hours

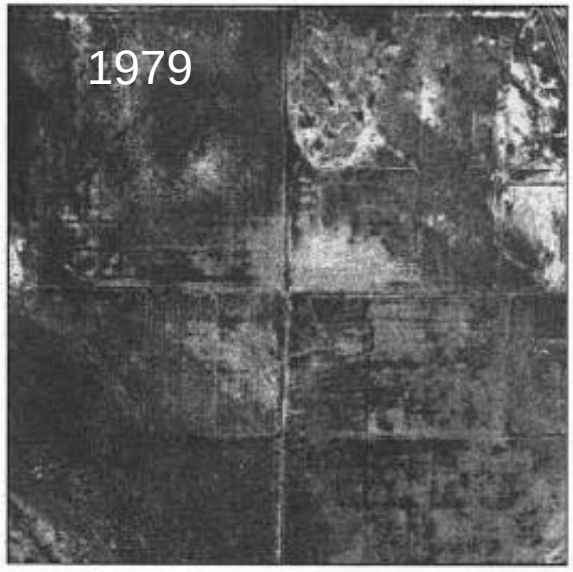


Water

Water & Gypsum







Former farmland North of Picacho, AZ

- This soil has poor structure because of sodium accumulation
- Over 50 years, this land has not re-vegetated
- The low areas (where water accumulates) have the highest sodium levels; water does not soak in, and soils are nearly bare

Summary

Keys to wind erosion

- *Soil cover*
  - *Moisture*
  - *Tillage*
  - *Soil salinity*
  - *Soil sodicity*
- *Soil structure*
  - *Organic matter*
  - *Soil salinity*
  - *Soil sodicity*
  - *Moisture*
- *Wind speed*
  - *Surface roughness*
  - *Vegetation*