



# Landscape Evolution

*Arid/Aeolian Landscapes*

# Weathering

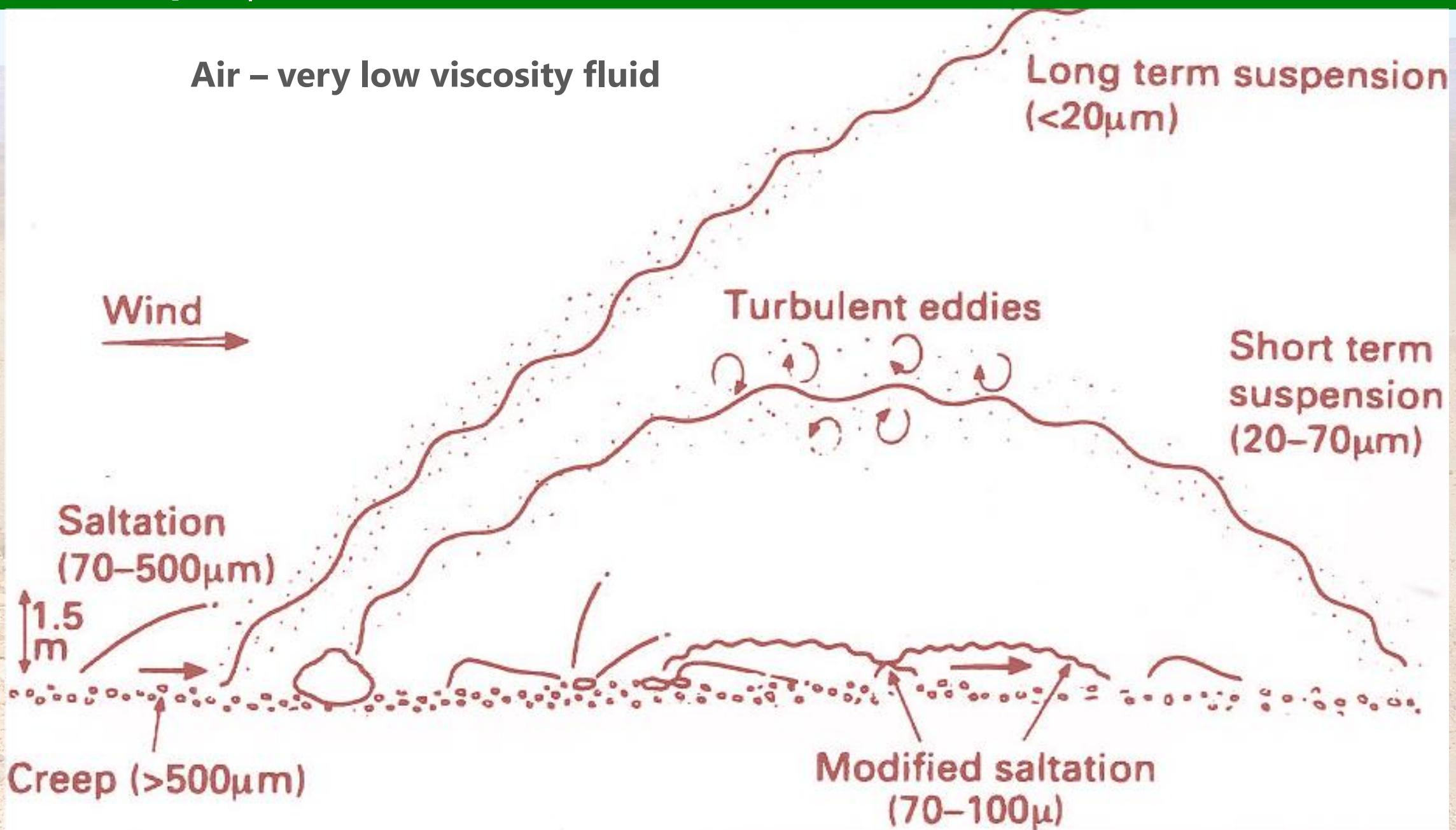
- Mechanical weathering
- Chemical weathering
- Biological weathering



## Transport - processes

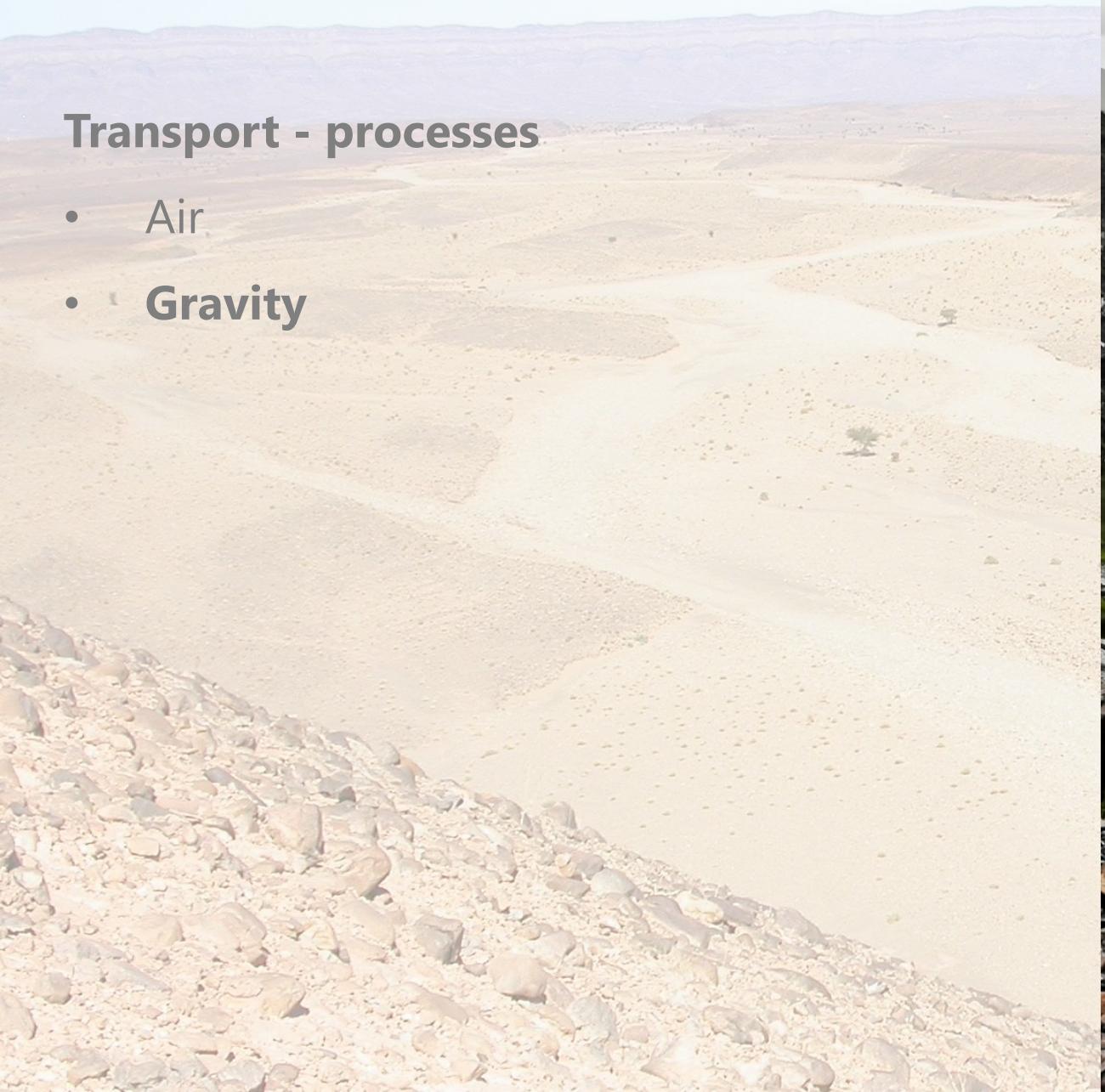
- Air





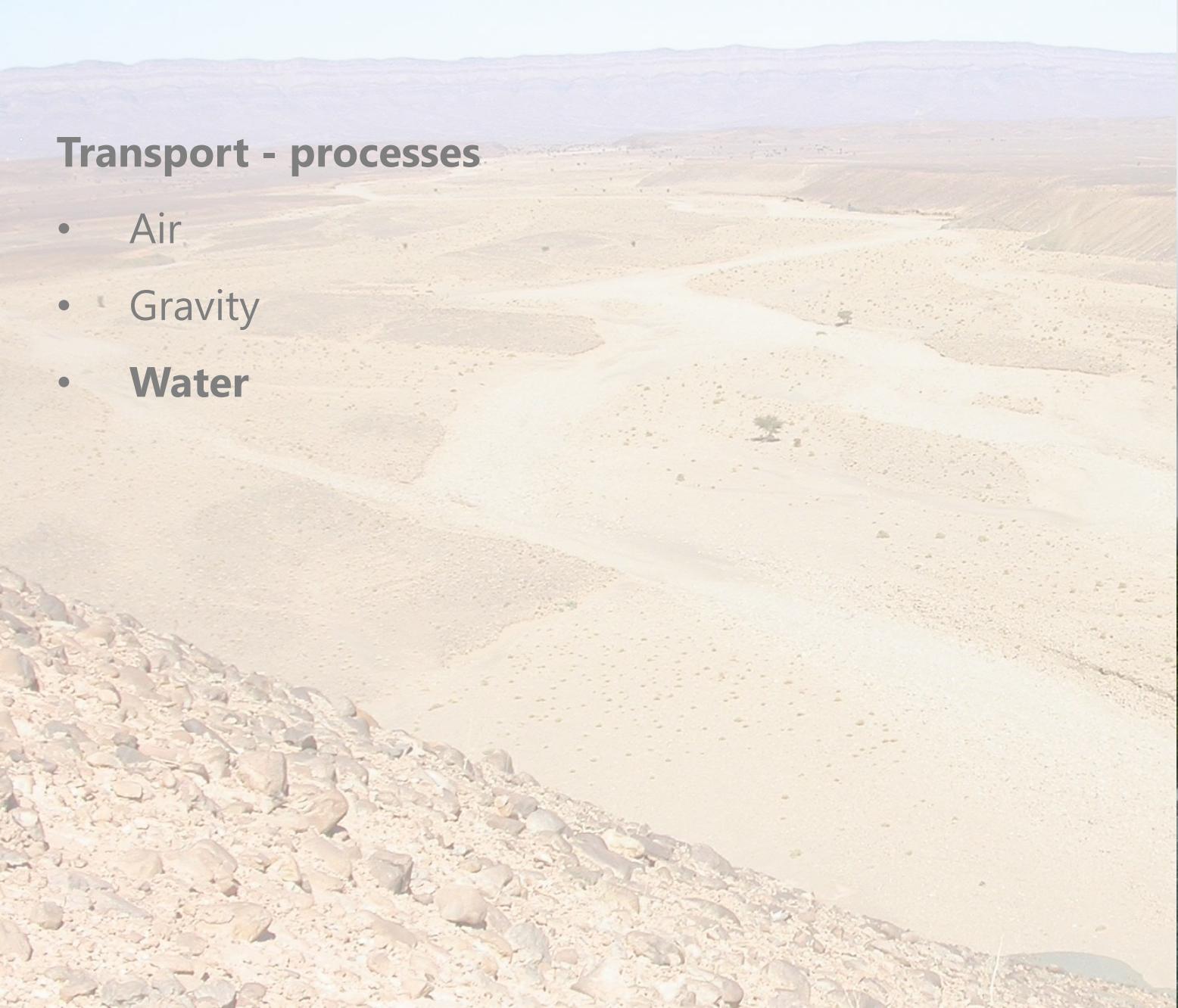
## Transport - processes

- Air
- Gravity



## Transport - processes

- Air
- Gravity
- Water



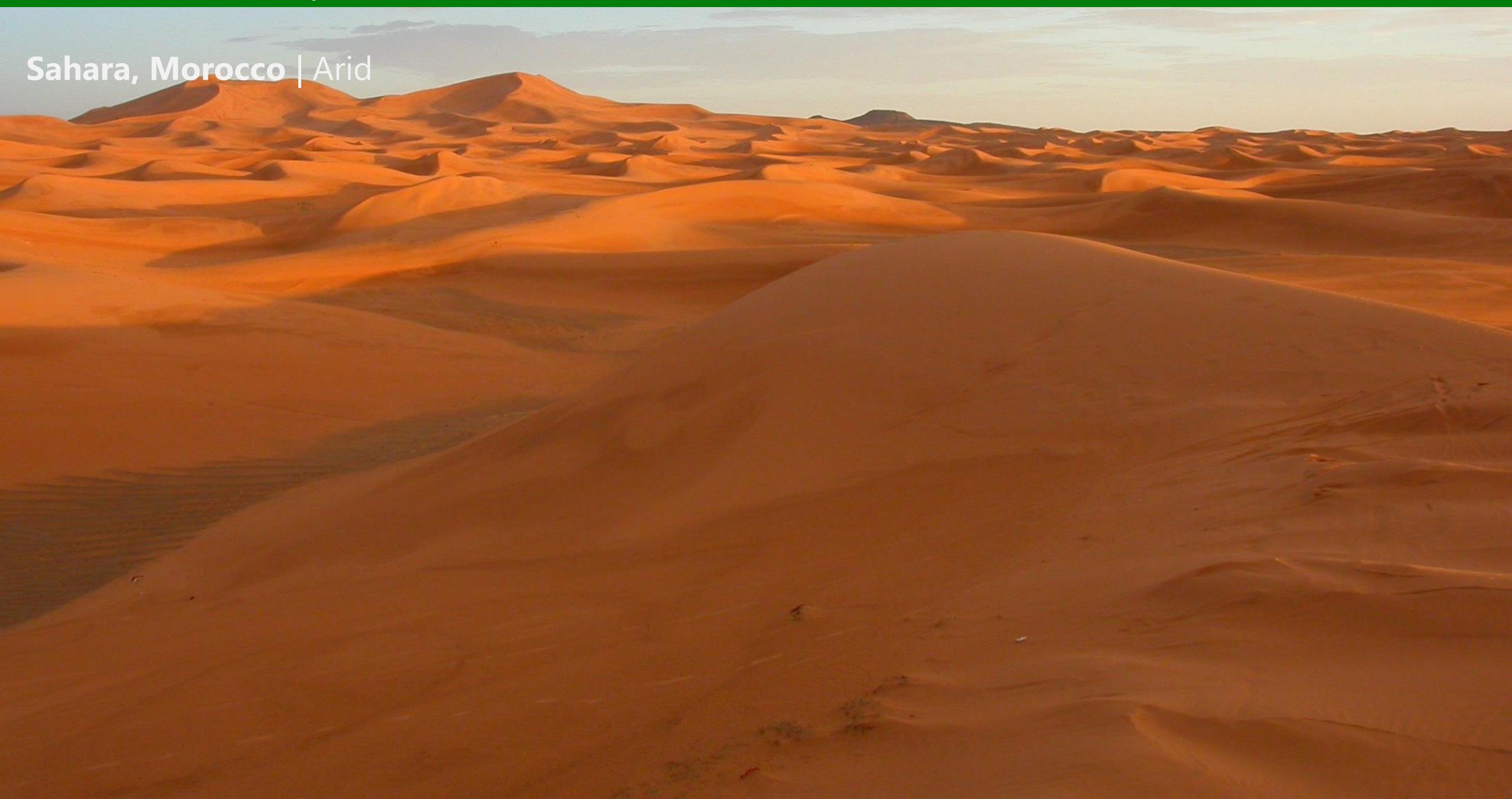
- **Hyper-arid areas = 'true deserts' ( $P/PET < 0.05$ )**
  - Periods more than 12 months with no rainfall
  - Modern examples: Central Sahara, Arabian Peninsula, Namib Desert
- **Arid areas ( $P/PET$  between 0.05–0.2)**
  - Modern examples: Central Australia, northern/southern fringes of Sahara
- **Semi-arid areas ( $P/PET$  between 0.2–0.5)**
  - Modern examples: Western interior North America, much of the Mediterranean
- **All are subject to large year to year precipitation variations**

Namib Desert, Namibia | Hyper-Arid



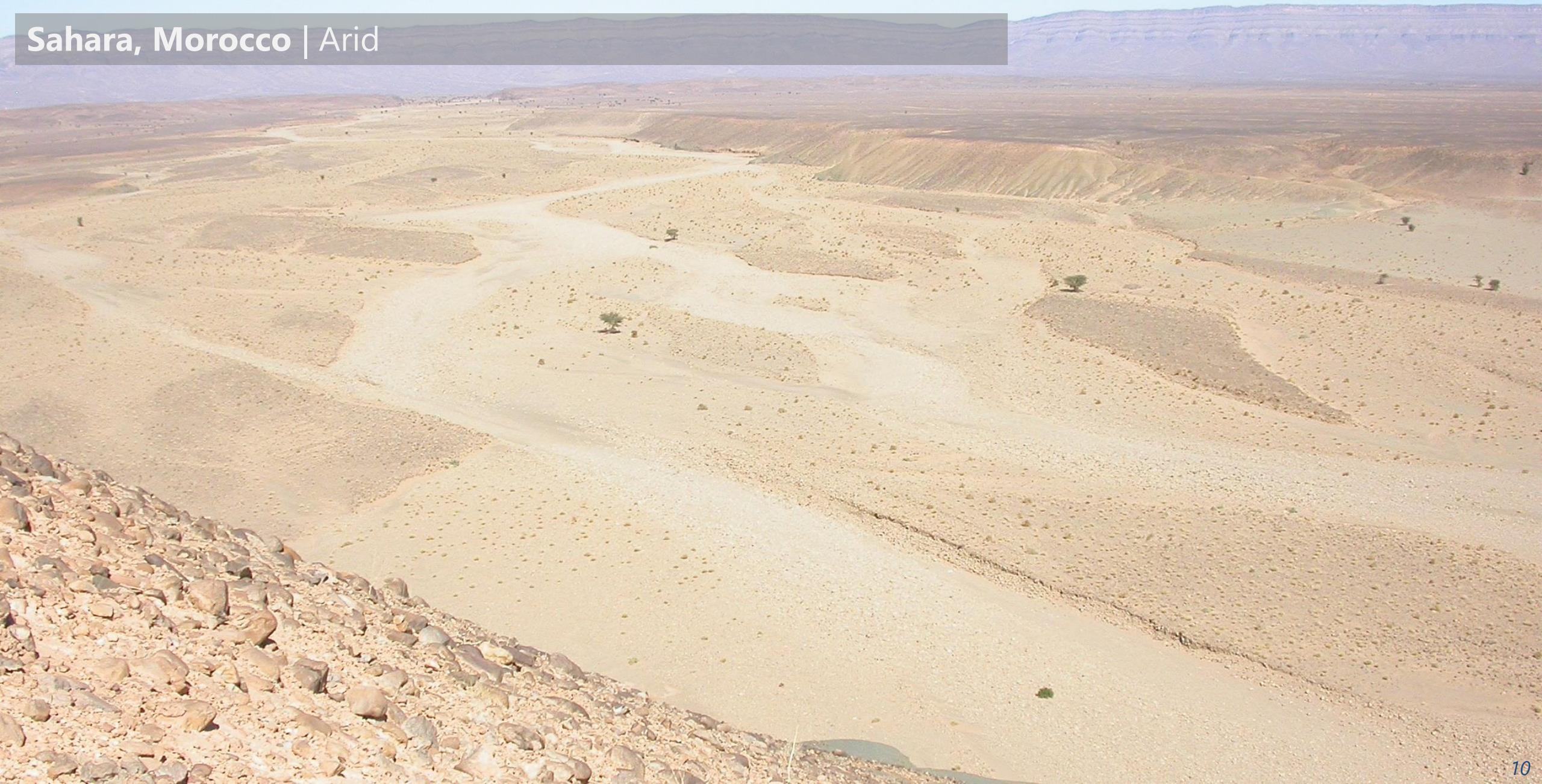
# Arid Landscapes | Where are arid landscapes?

GY4027: Landscape Evolution



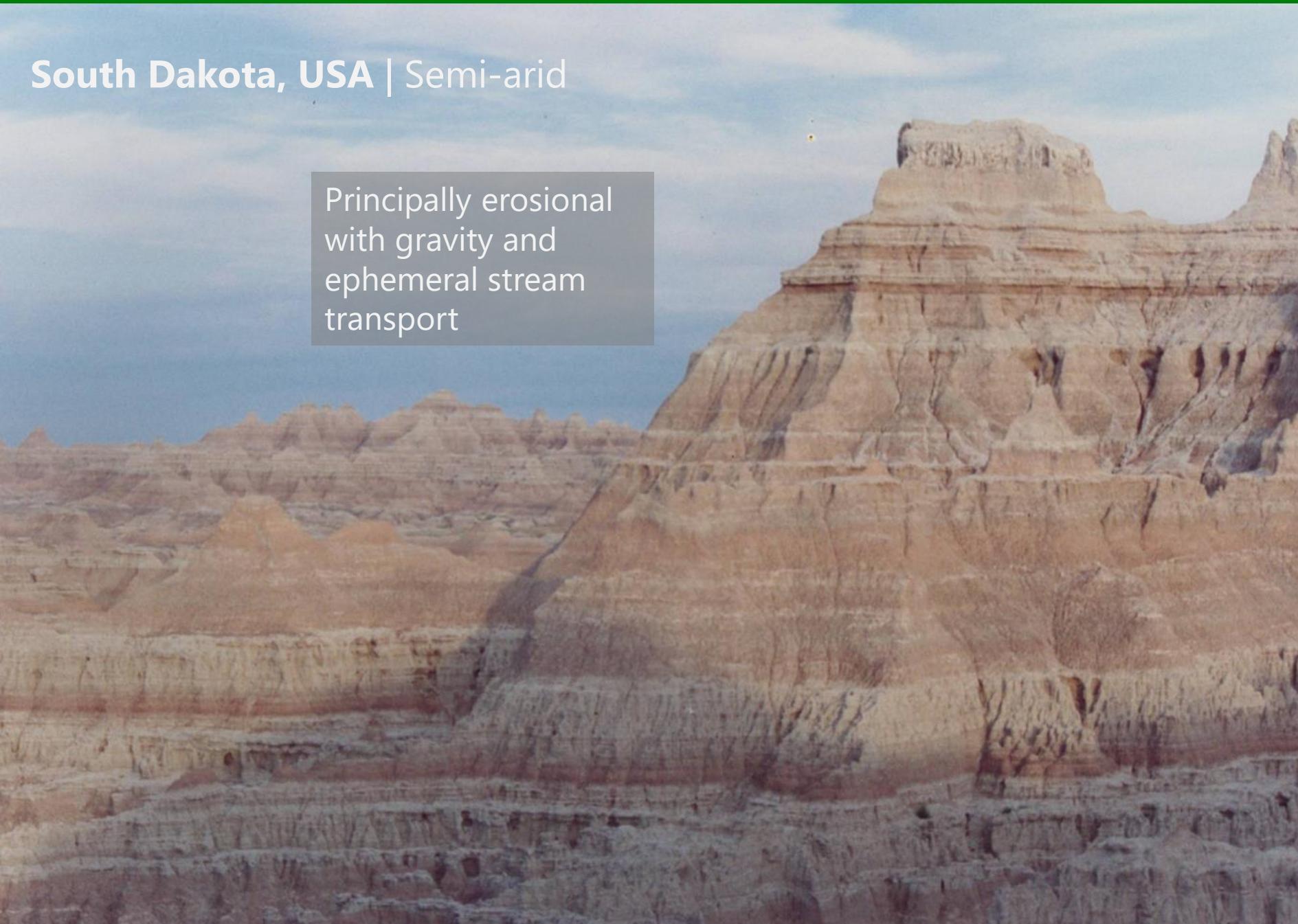
Sahara, Morocco | Arid

Sahara, Morocco | Arid



South Dakota, USA | Semi-arid

Principally erosional  
with gravity and  
ephemeral stream  
transport



Andalucia, Spain | Semi-arid



Mojave Desert, USA | Semi-arid



# Can be both hot and cold environments

Temperature regime	Percentage of global drylands	Mean monthly temperature (°C)	
		Coldest month	Warmest month
Cold winter	24	<0	10-30
Cool winter	15	0-10	10-30
Mild winter	18	10-20	10-30
Hot	43	10-30	>30

## Atacama Desert, Chile | Hyper-Arid



Wright Valley, Antarctica | Hyper-Arid



Photo David Saul

# Arid Landscapes | Arid sediment production

## GY4027: Landscape Evolution



Sinai desert, Egypt | Hyper-Arid

High diurnal temperature ranges – 50+°C range, high thermal weathering

Bare rock surfaces – ample exposure

Gravity and occasional runoff processes are often the initial transporting agents, with wind coming into play later

Not much water – low chemical weathering

Wind become important as sediment size decreases

Torridonian, Scotland | Fangularite (Tonian)

Discontinuous  
poorly-defined  
layers



### Sinai desert, Egypt | Hyper-Arid

Bare rock surfaces – ample exposure

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## Sahara, Morocco | Arid

Wind is a highly selective sorting medium (c. ~0.001 the density of water)

Very well sorted, well rounded deposits due to sand abrasion

Silt/clay removed as loess

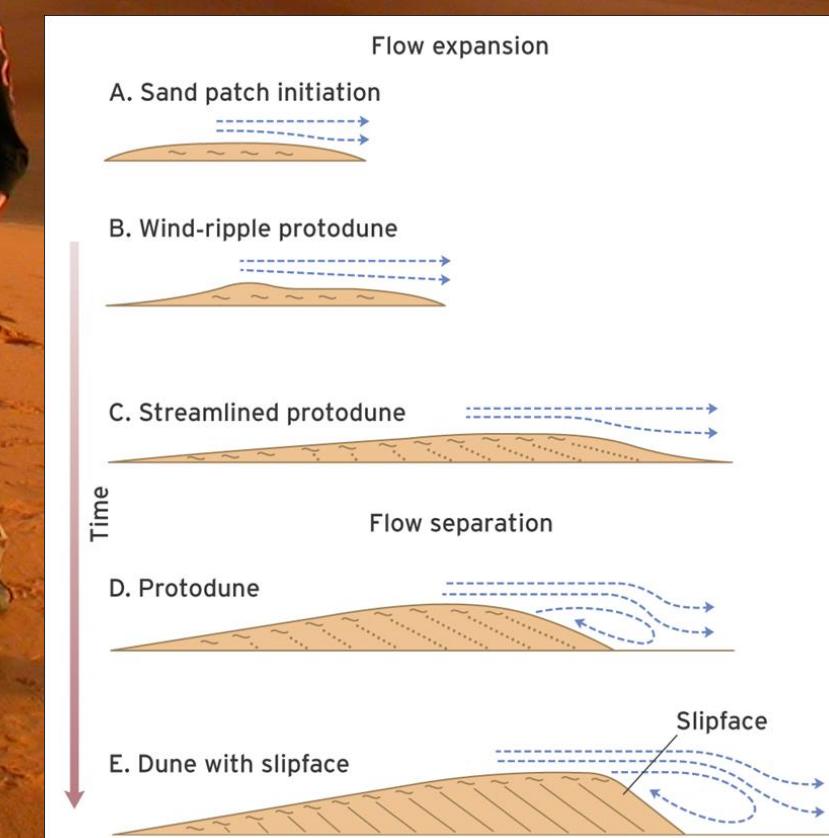
Kalahari Desert | Semi-arid



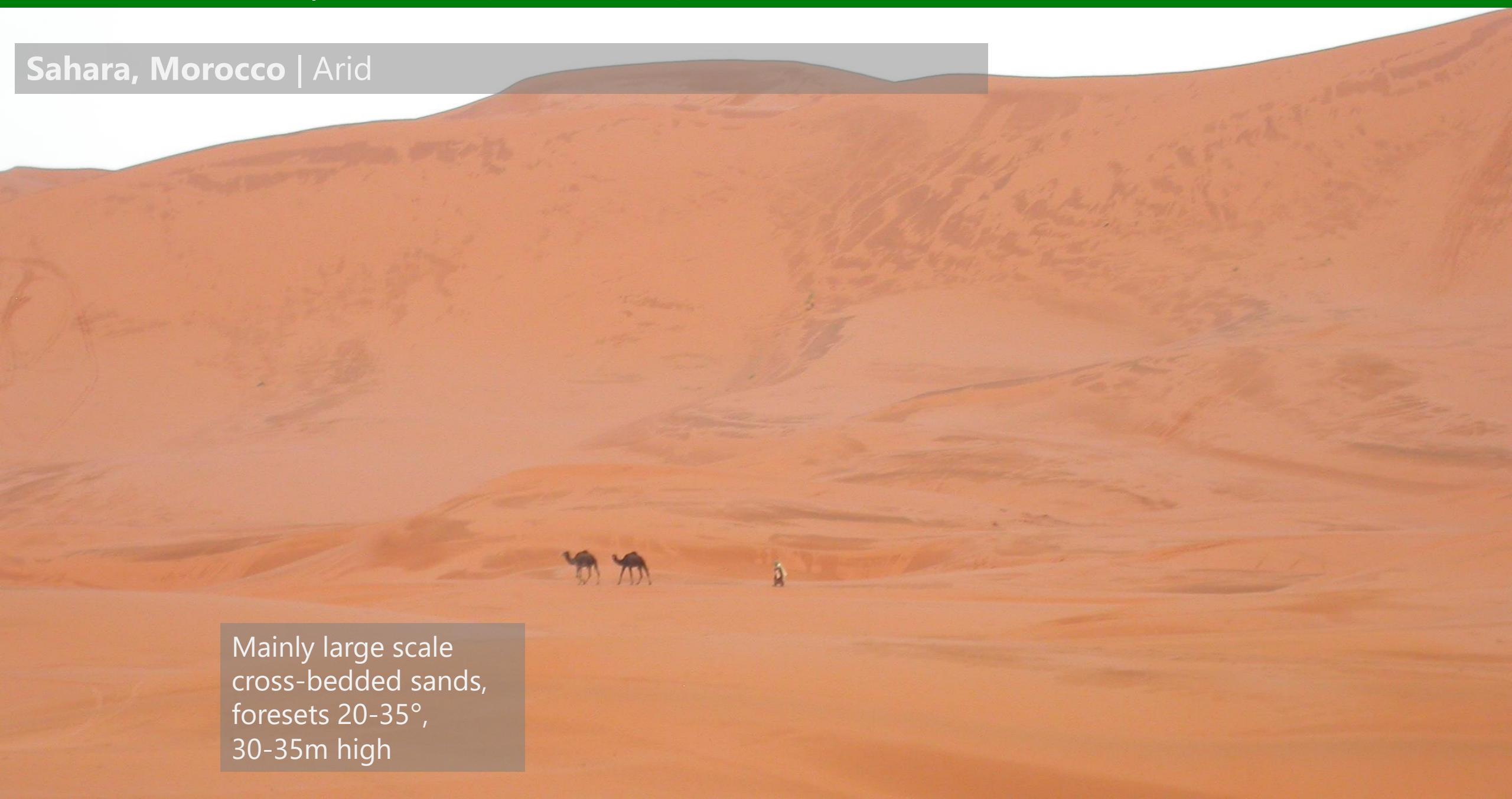
Sahara, Morocco | Arid



Dunes tend to sigmoidal, asymptotic base



Sahara, Morocco | Arid



Mainly large scale  
cross-bedded sands,  
foresets 20-35°,  
30-35m high

Northumberland, England | Arid (Permian/Triassic)

Dunes tend to  
sigmoidal, asymptotic  
base

Sahara, Morocco | Arid

Superimposed wind  
ripples common

Death Valley, USA | Hyper-Arid

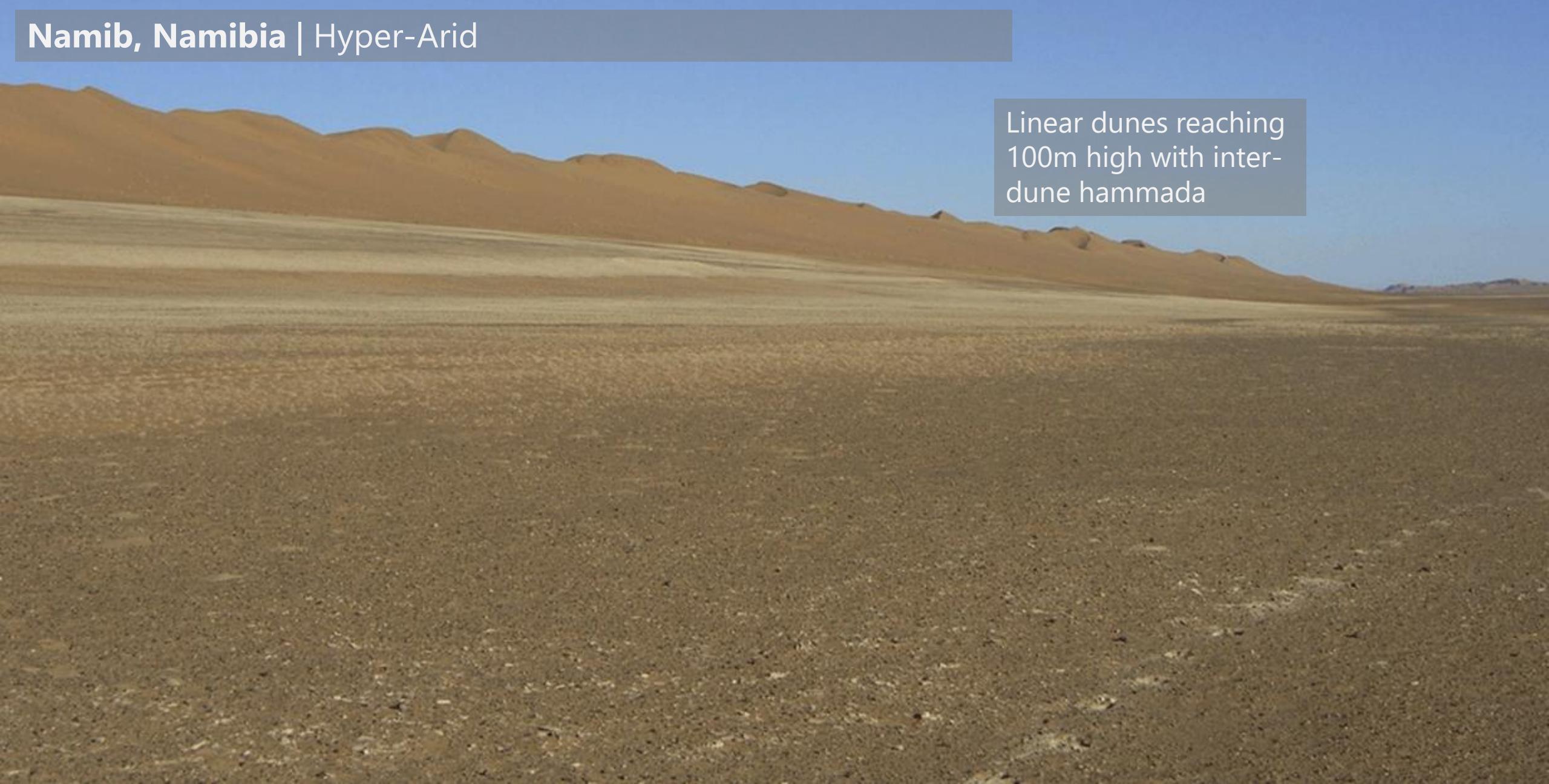


Superimposed wind  
ripples common

Mallorca, Spain | Semi-Arid



Namib, Namibia | Hyper-Arid



Linear dunes reaching  
100m high with inter-  
dune hammada

## Sahara, Morocco | Arid



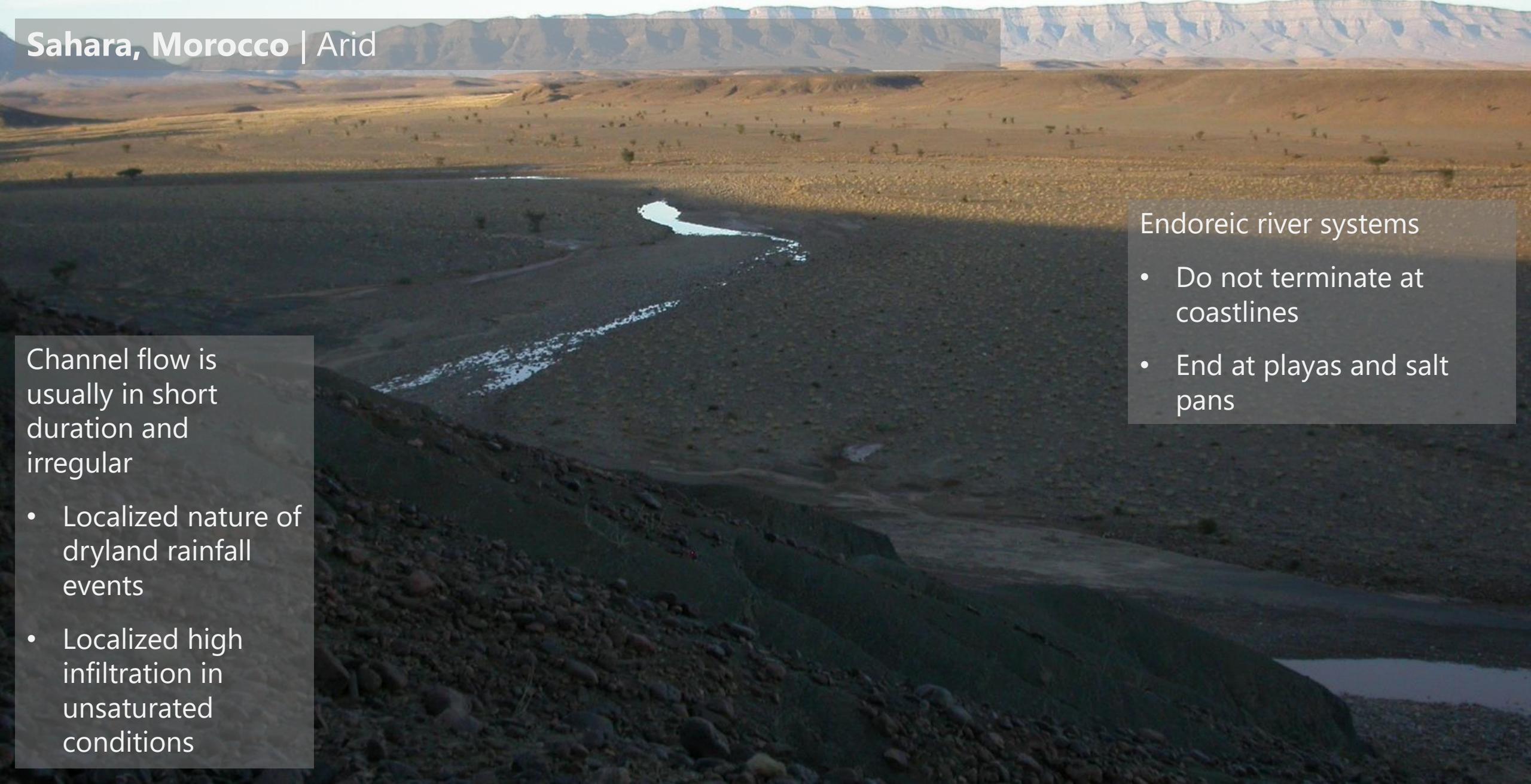
### Sahara, Morocco | Arid

Channel flow is usually in short duration and irregular

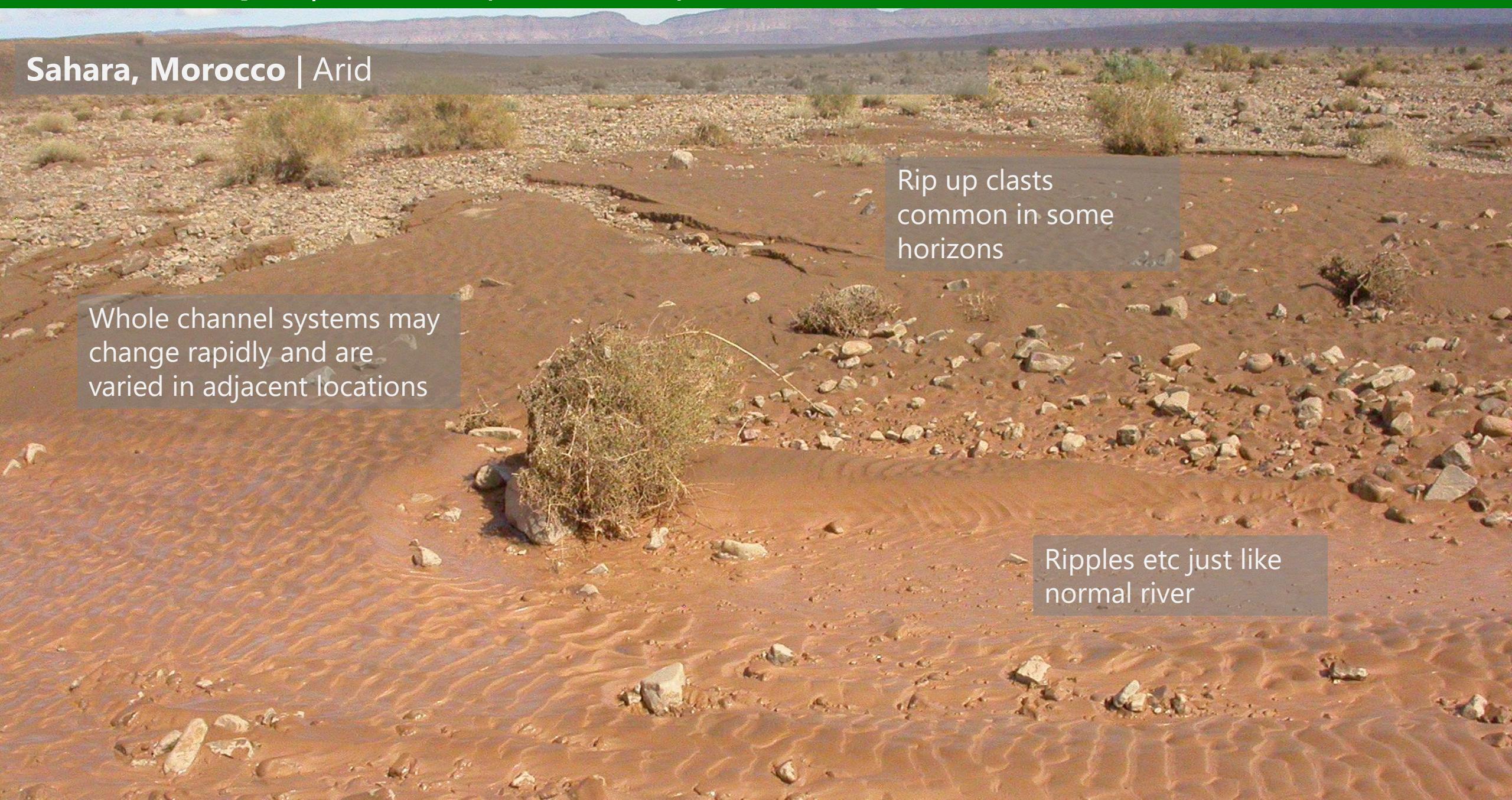
- Localized nature of dryland rainfall events
- Localized high infiltration in unsaturated conditions

Endoreic river systems

- Do not terminate at coastlines
- End at playas and salt pans



### Sahara, Morocco | Arid

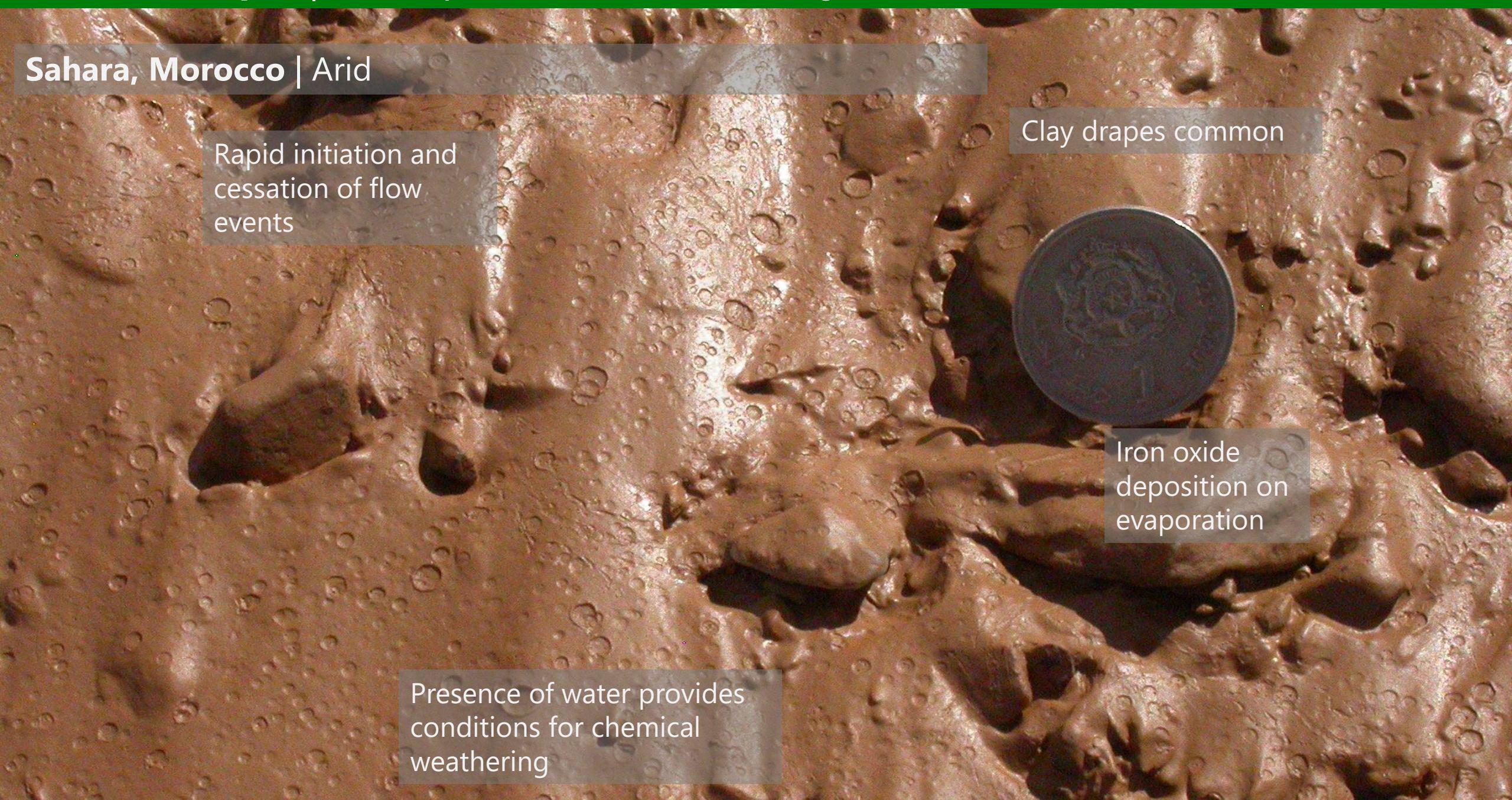


Sahara, Morocco | Arid

High flow velocities and sediment load capacity and competence

Can be poorly sorted, from clay to boulders

Stream flow irregular leading to wide shallow channels with rapid spatial changes in channel form



Mallorca, Spain | Semi-Arid



Sahara, Morocco | Arid



Evaporation may lead  
to salt weathering

Laguna Colorado, Bolivia | Playa Lake

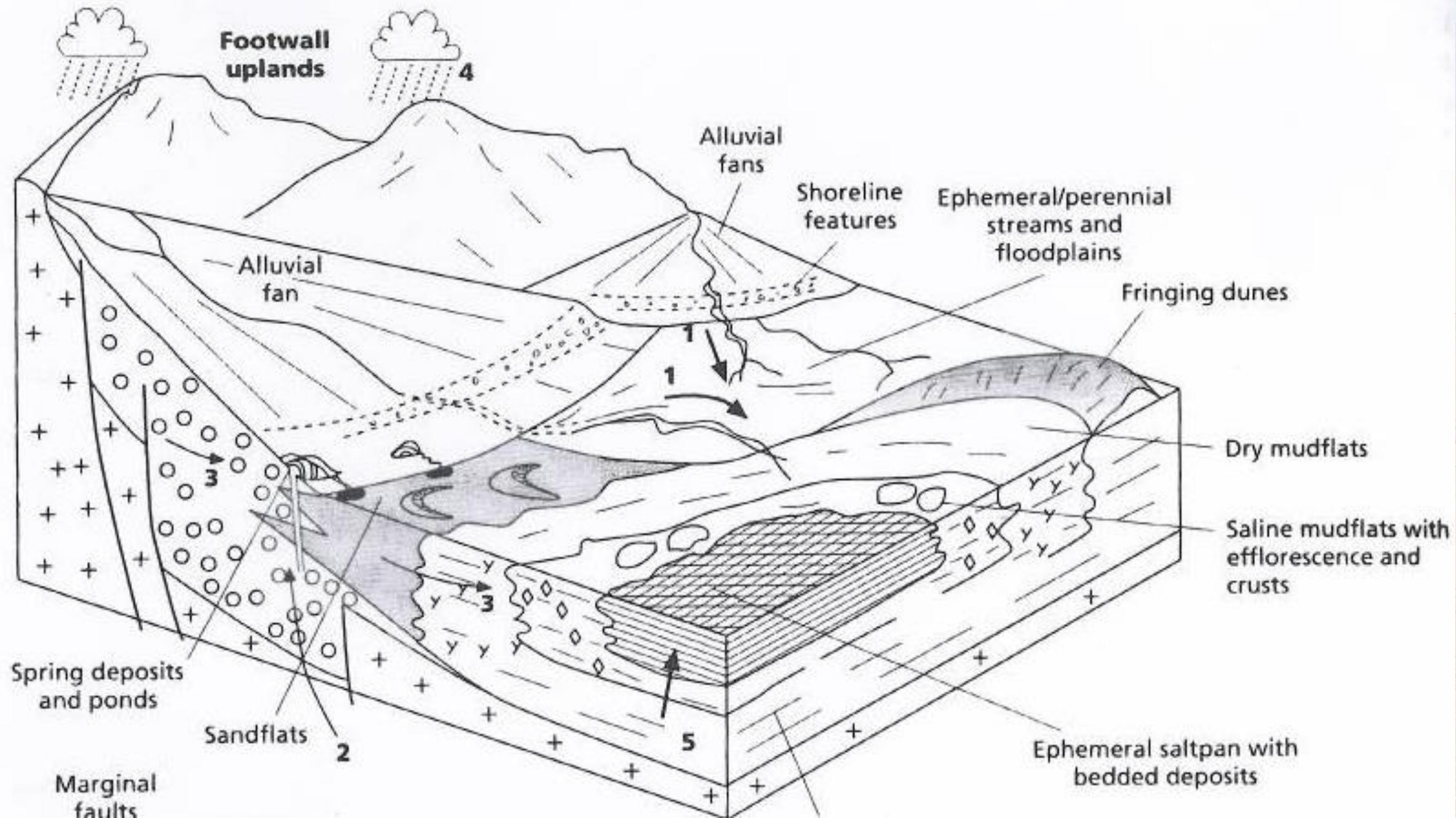


Image G Lucas

Uyuni, Bolivia | Salt flat



Image G Lucas





## Traction and saltation across a beach





**Traction and saltation across a beach**





