



Landscape Evolution

Arid/Aeolian Landscapes

Weathering

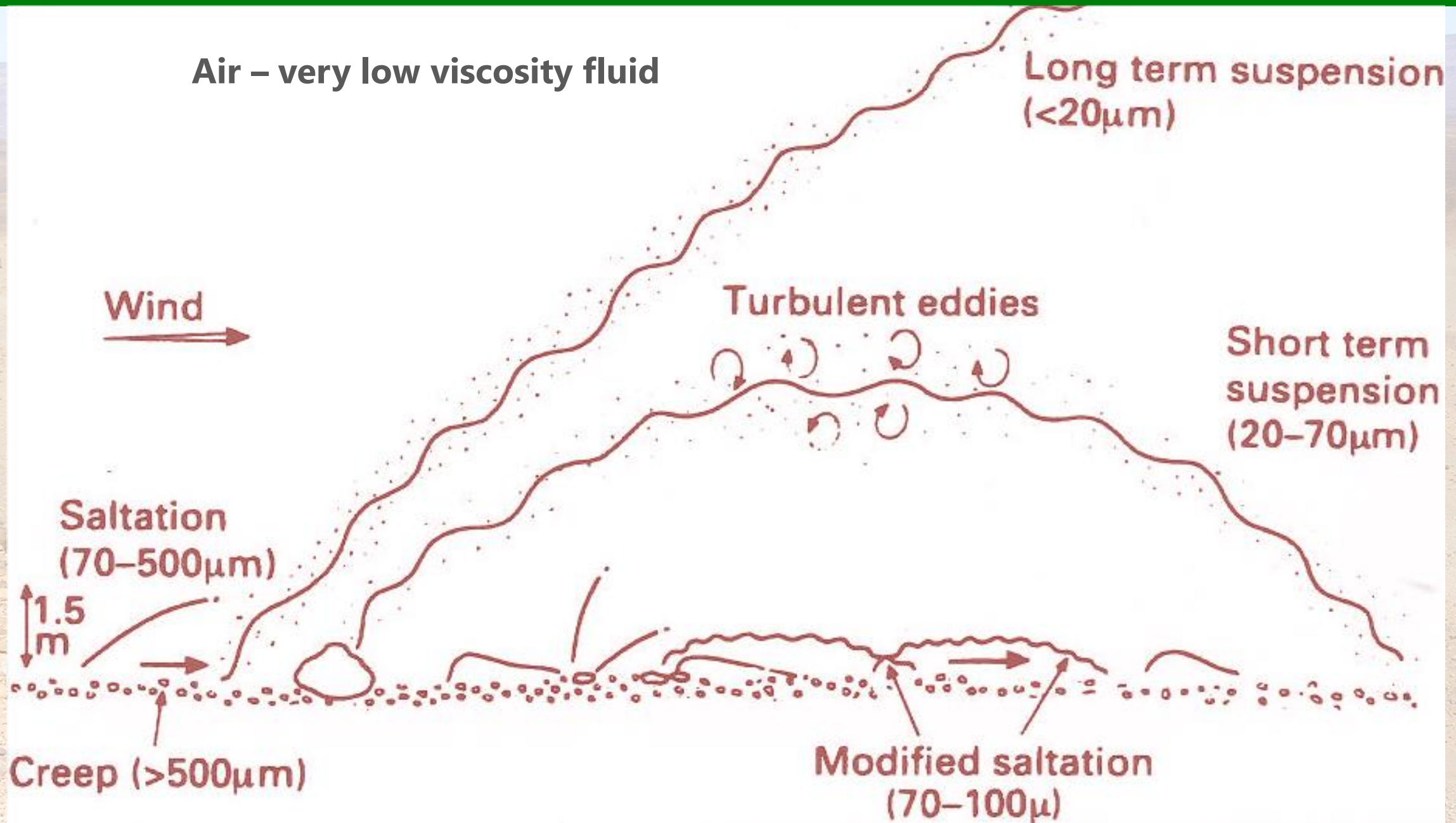
- Mechanical weathering
- Chemical weathering
- Biological weathering



Transport - processes

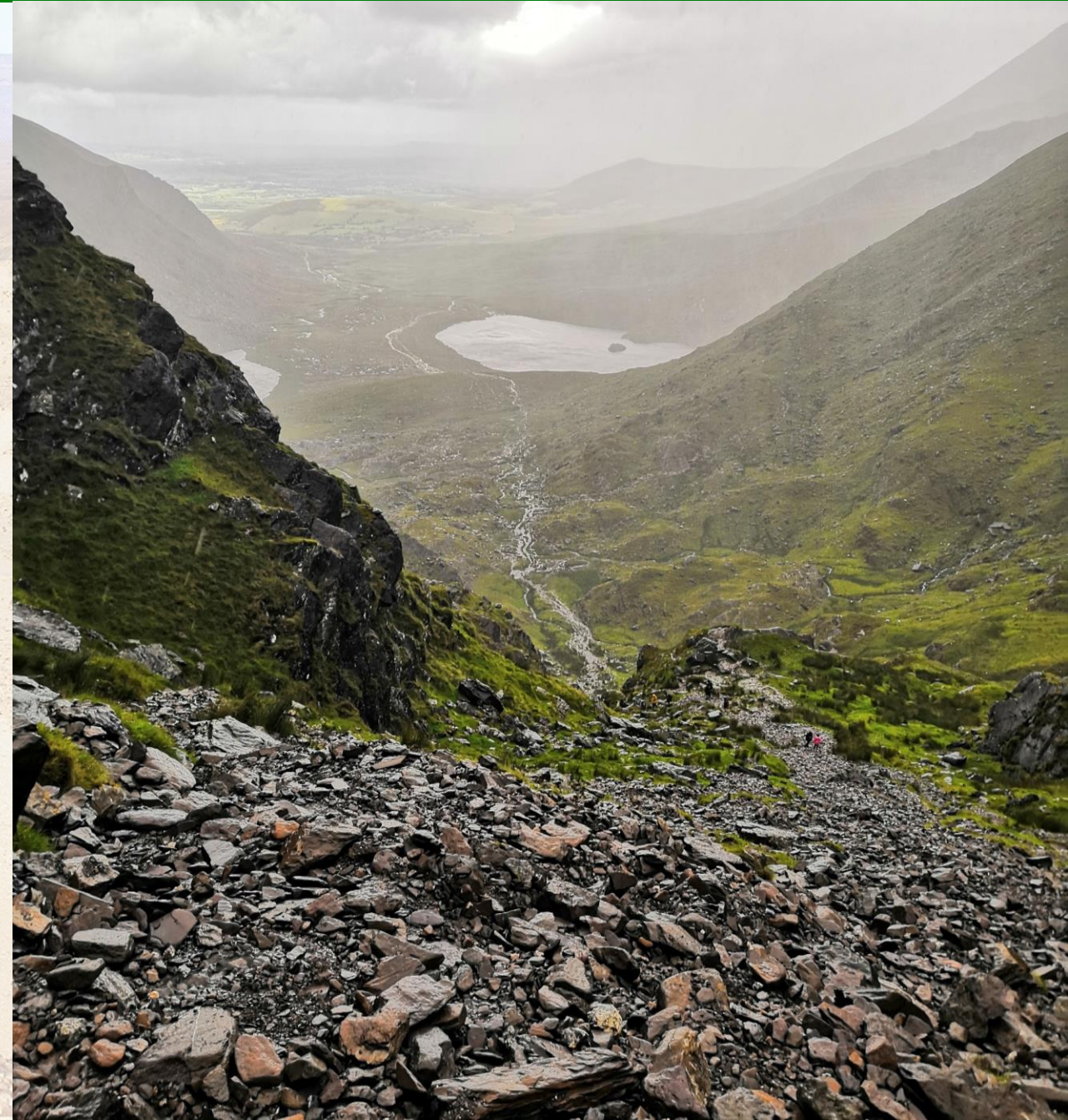
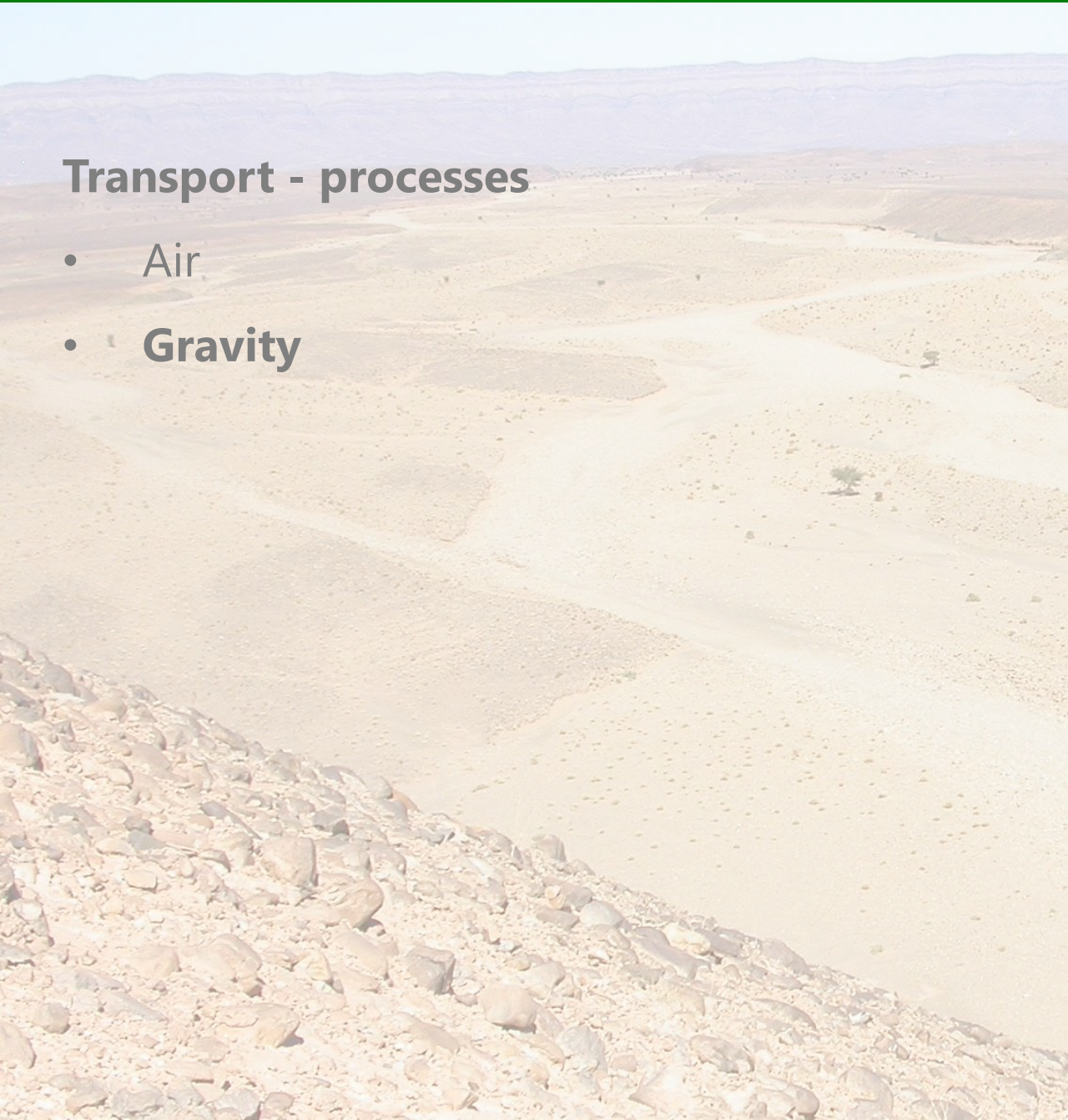
- Air





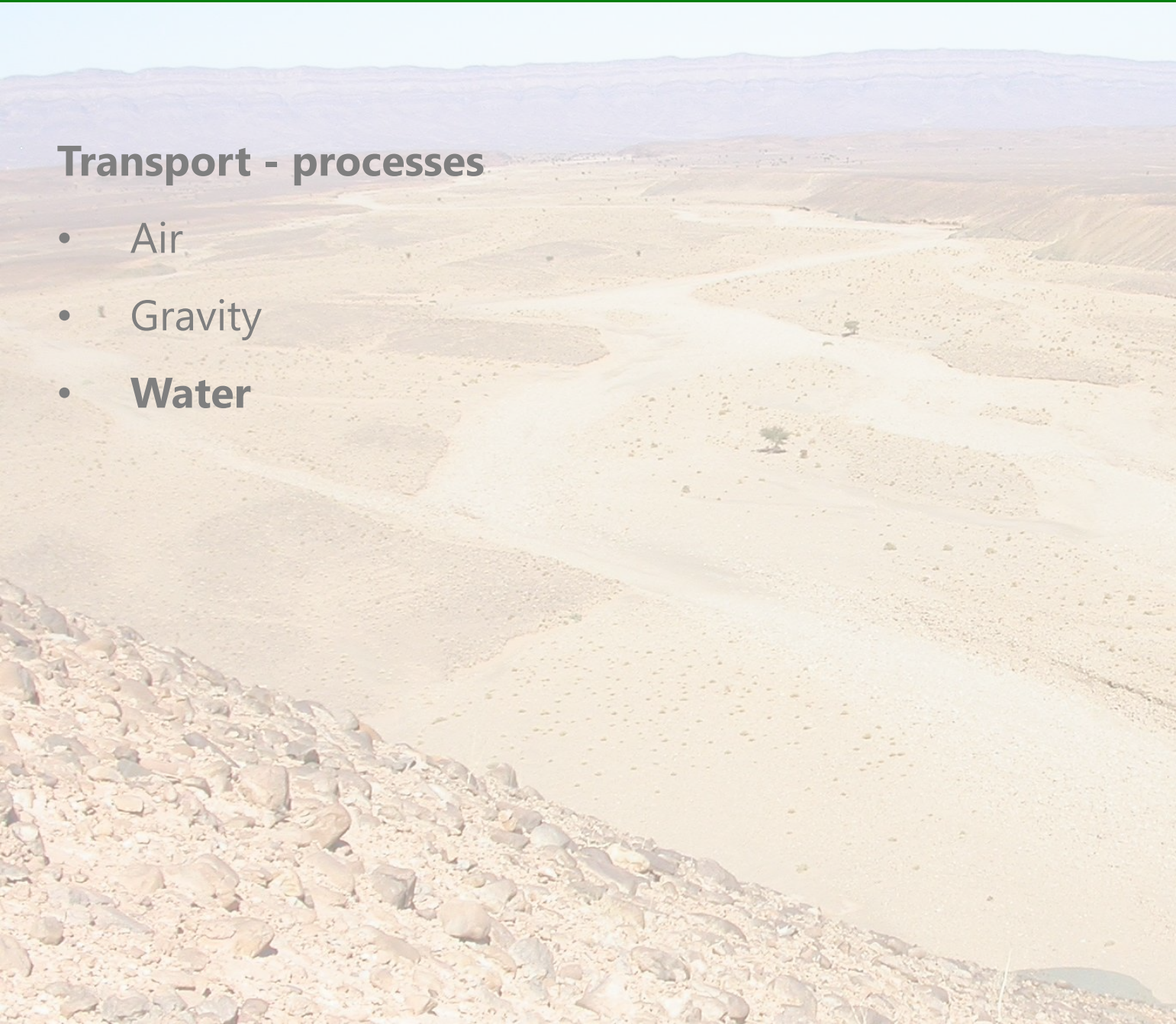
Transport - processes

- 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**

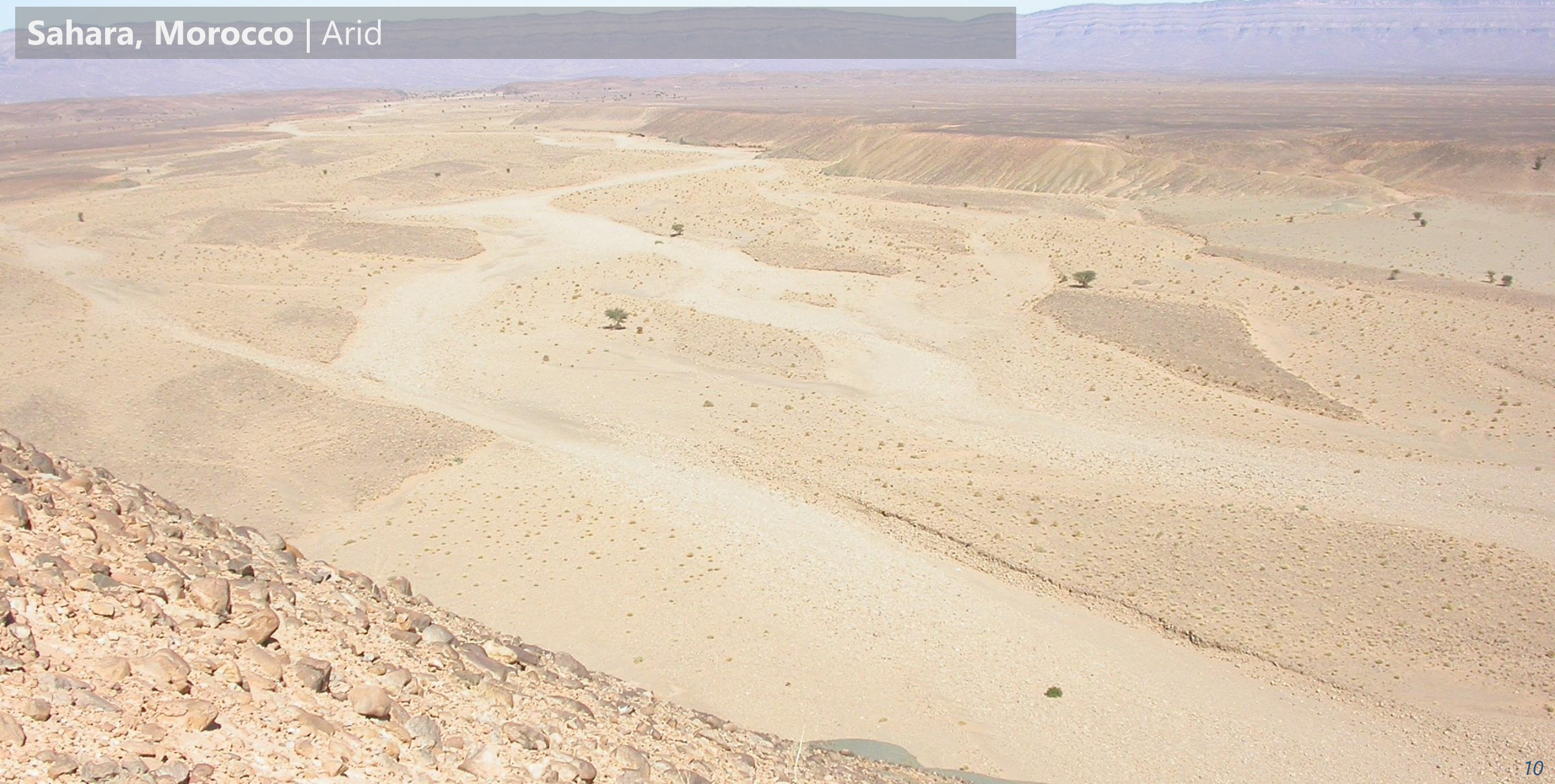
Namib Desert, Namibia | Hyper-Arid



Sahara, Morocco | Arid

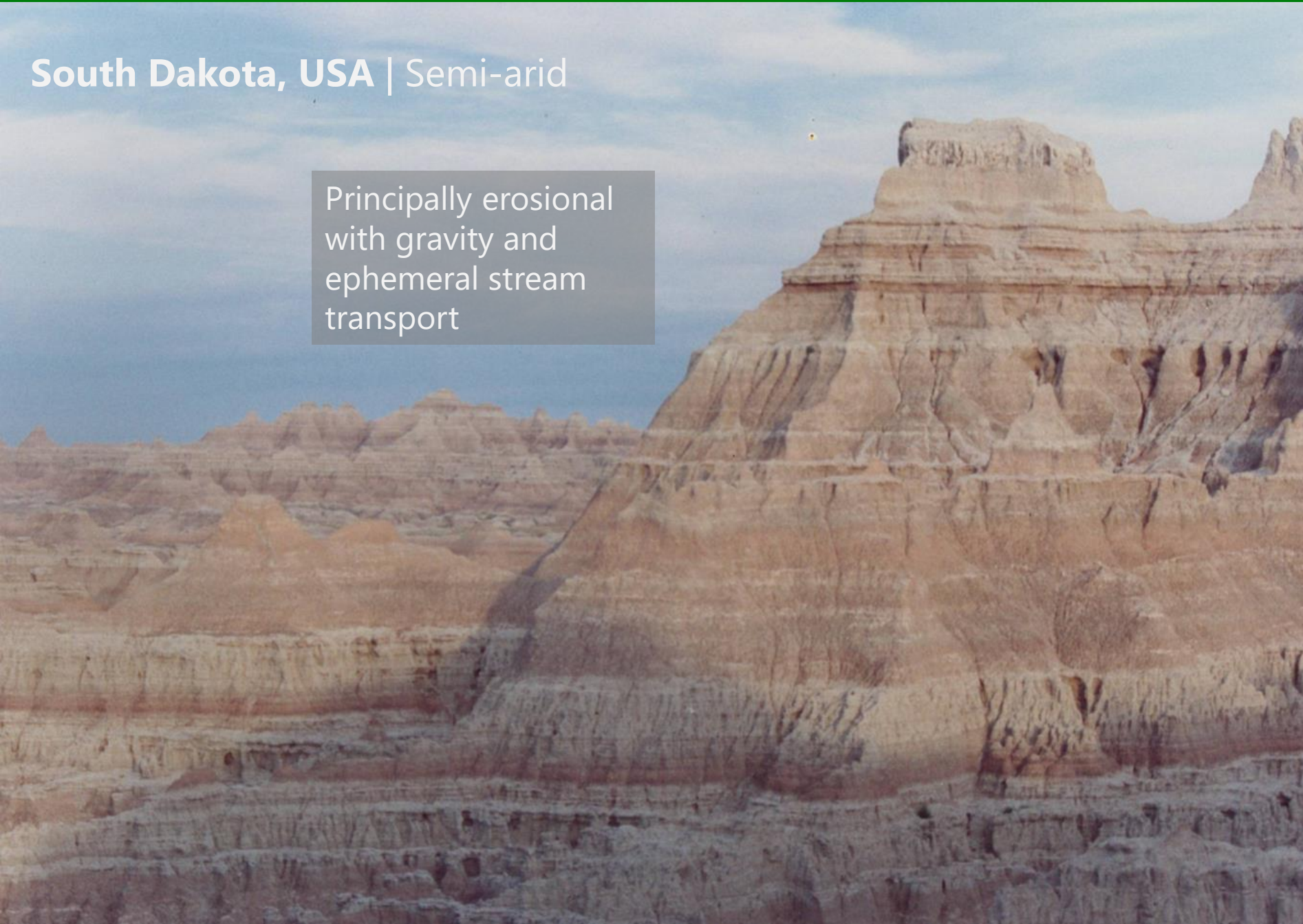


Sahara, Morocco | Arid



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



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

Photo A Grant

Torridonian, Scotland | Fanglomerate (Tonian)

Discontinuous
poorly-defined
layers



Torridonian, Scotland | Fanglomerate (Tonian)

Angular clasts



Sinai desert, Egypt | Hyper-Arid

Bare rock surfaces –
ample exposure

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

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

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

Well-sorted

Well-rounded

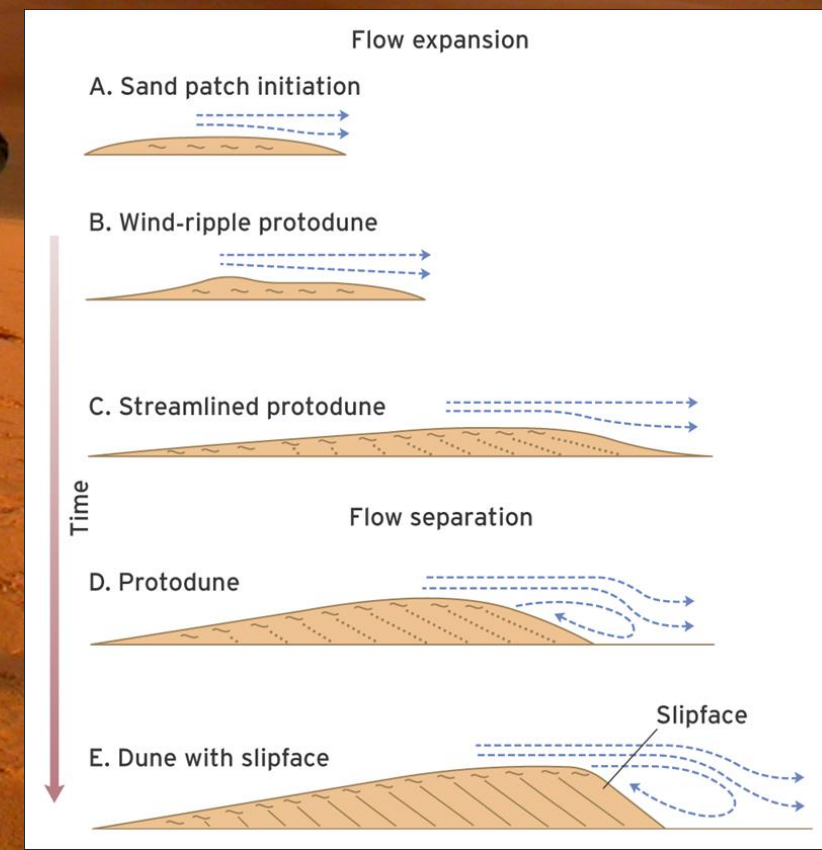
frosted

Iron-stained



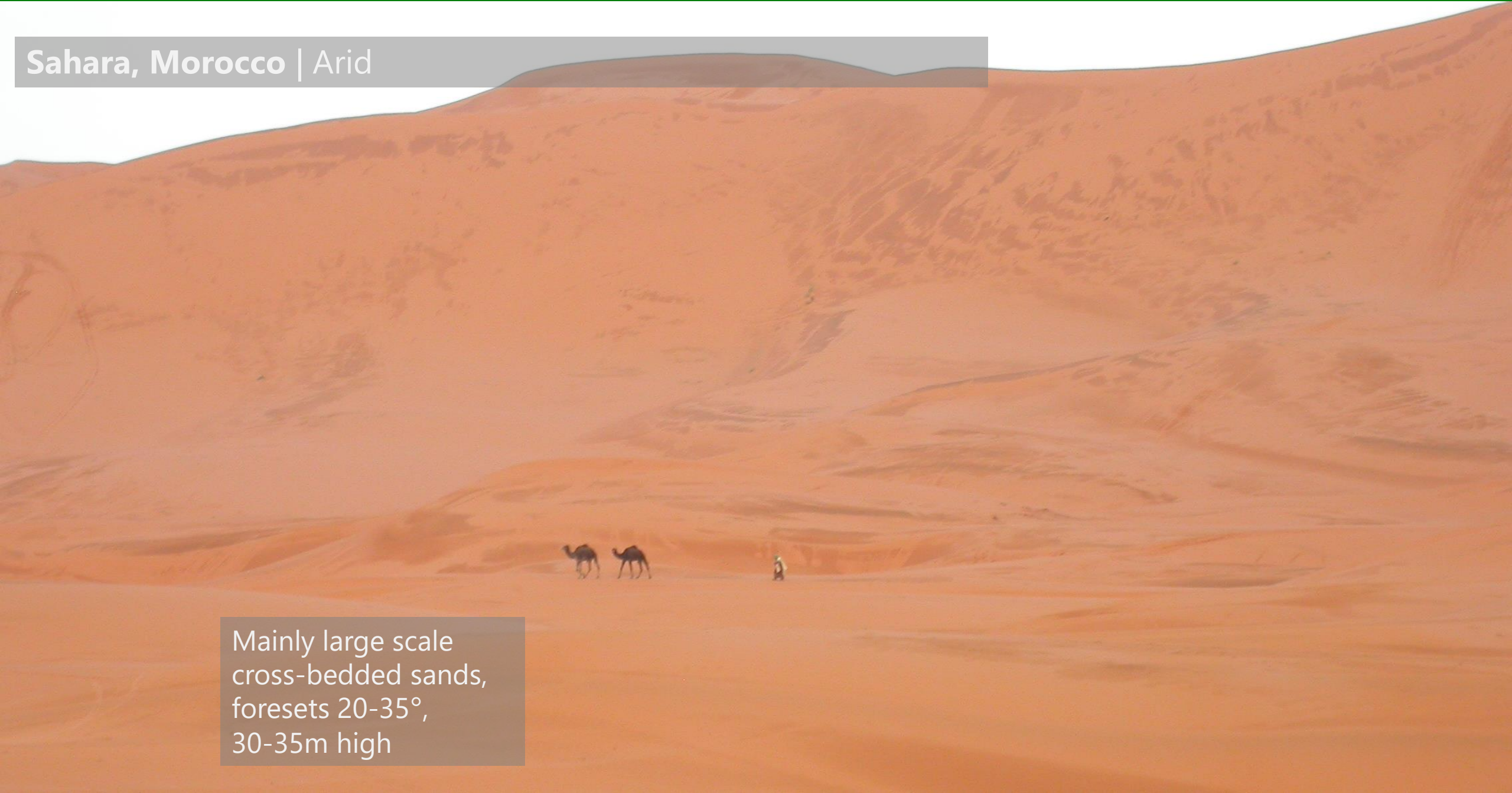
Sahara, Morocco | Arid

Dunes tend to
sigmoidal, asymptotic
base



Sahara, Morocco | Arid

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



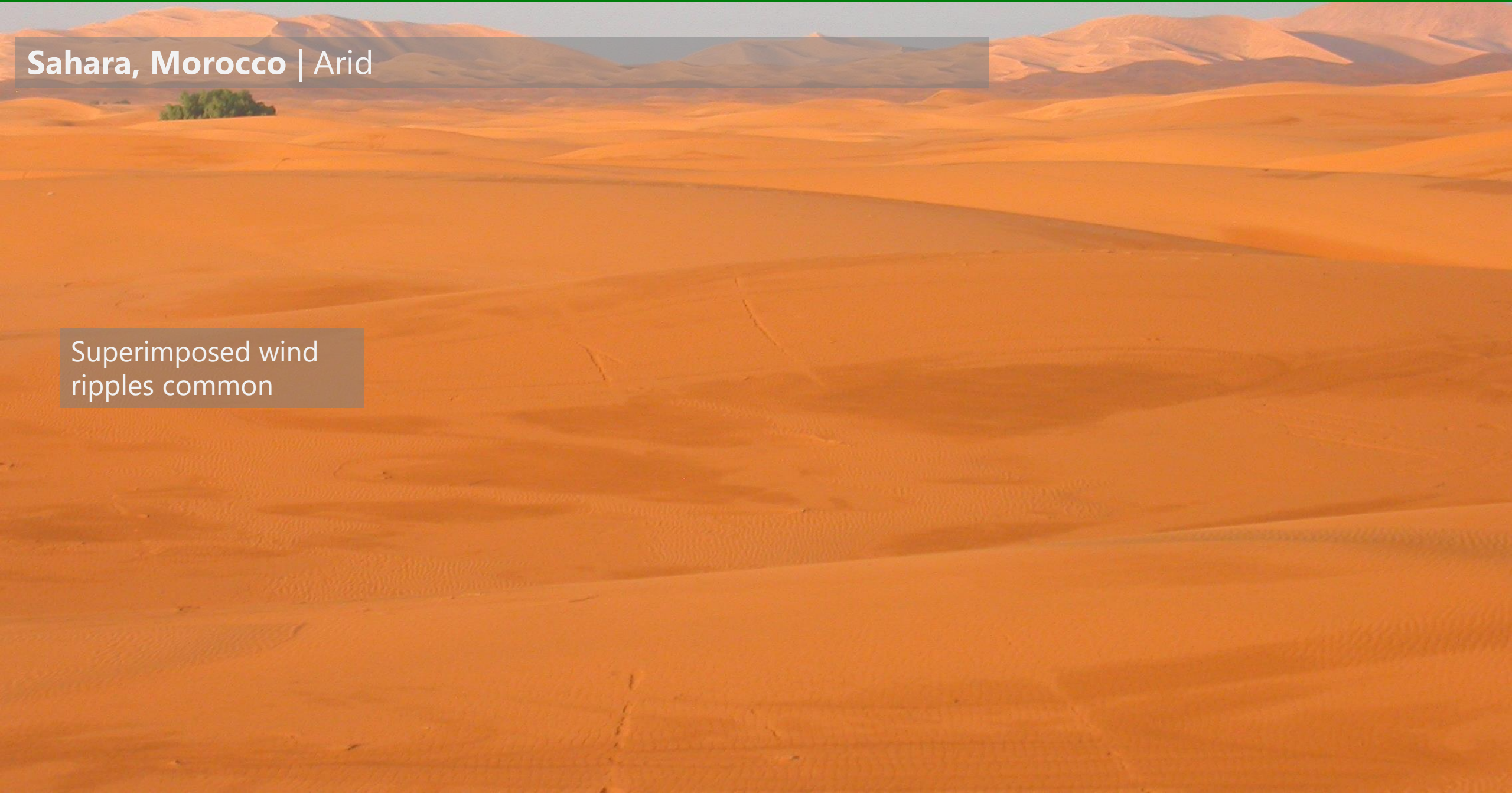
Northumberland, England | Arid (Permian/Triassic)



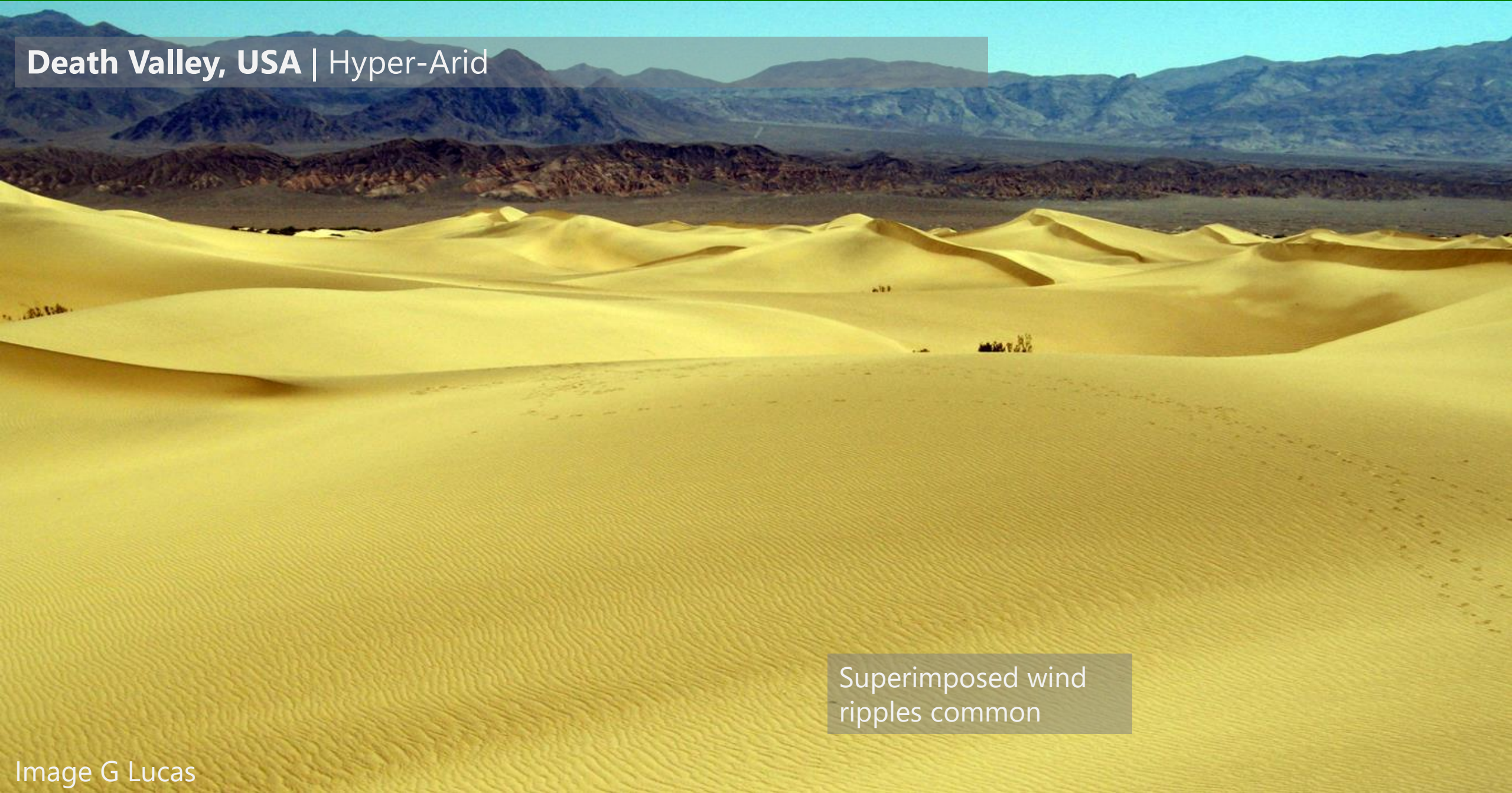
Dunes tend to
sigmoidal, asymptotic
base

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

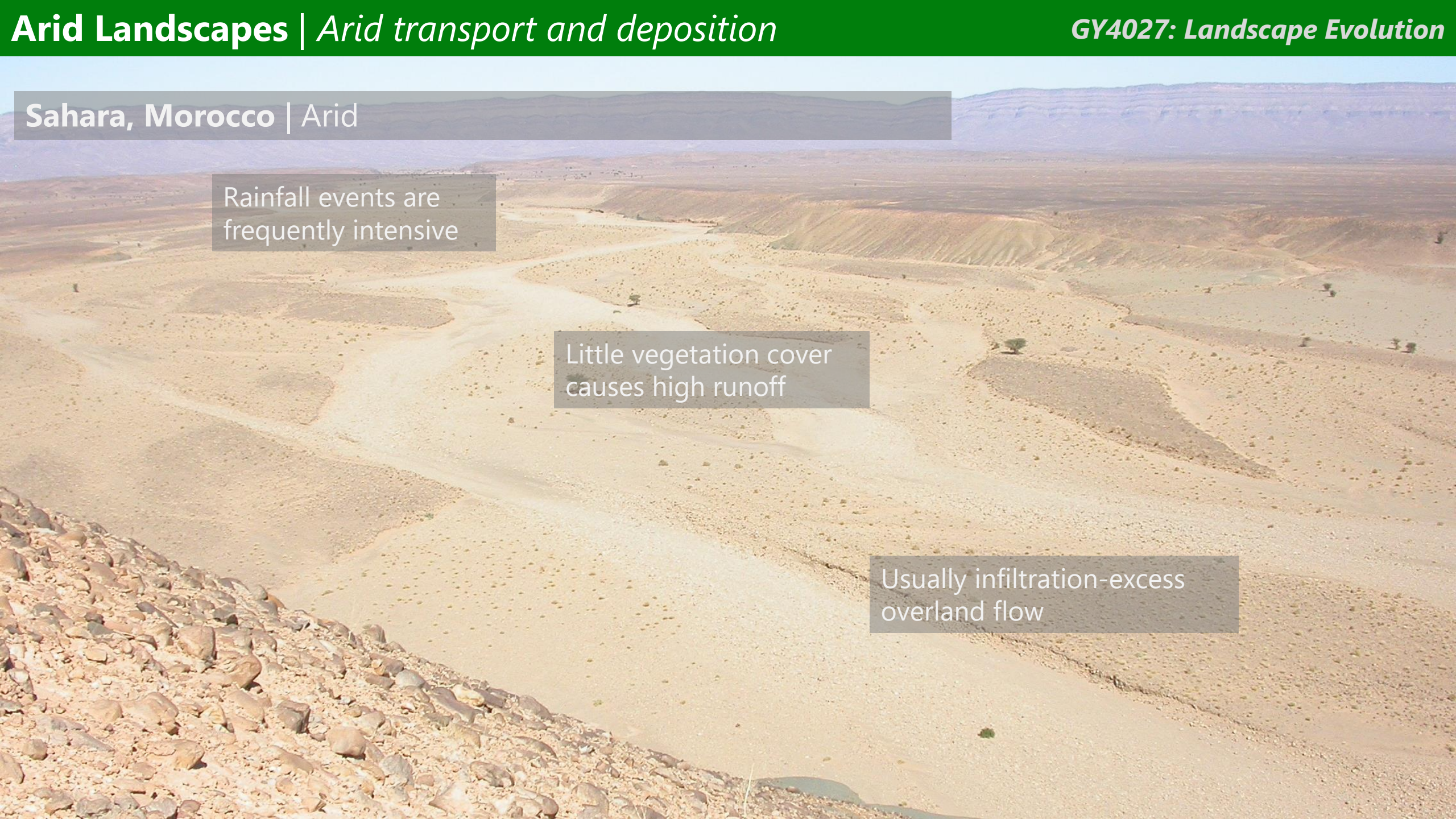


Sahara, Morocco | Arid

Rainfall events are frequently intensive

Little vegetation cover causes high runoff

Usually infiltration-excess overland flow



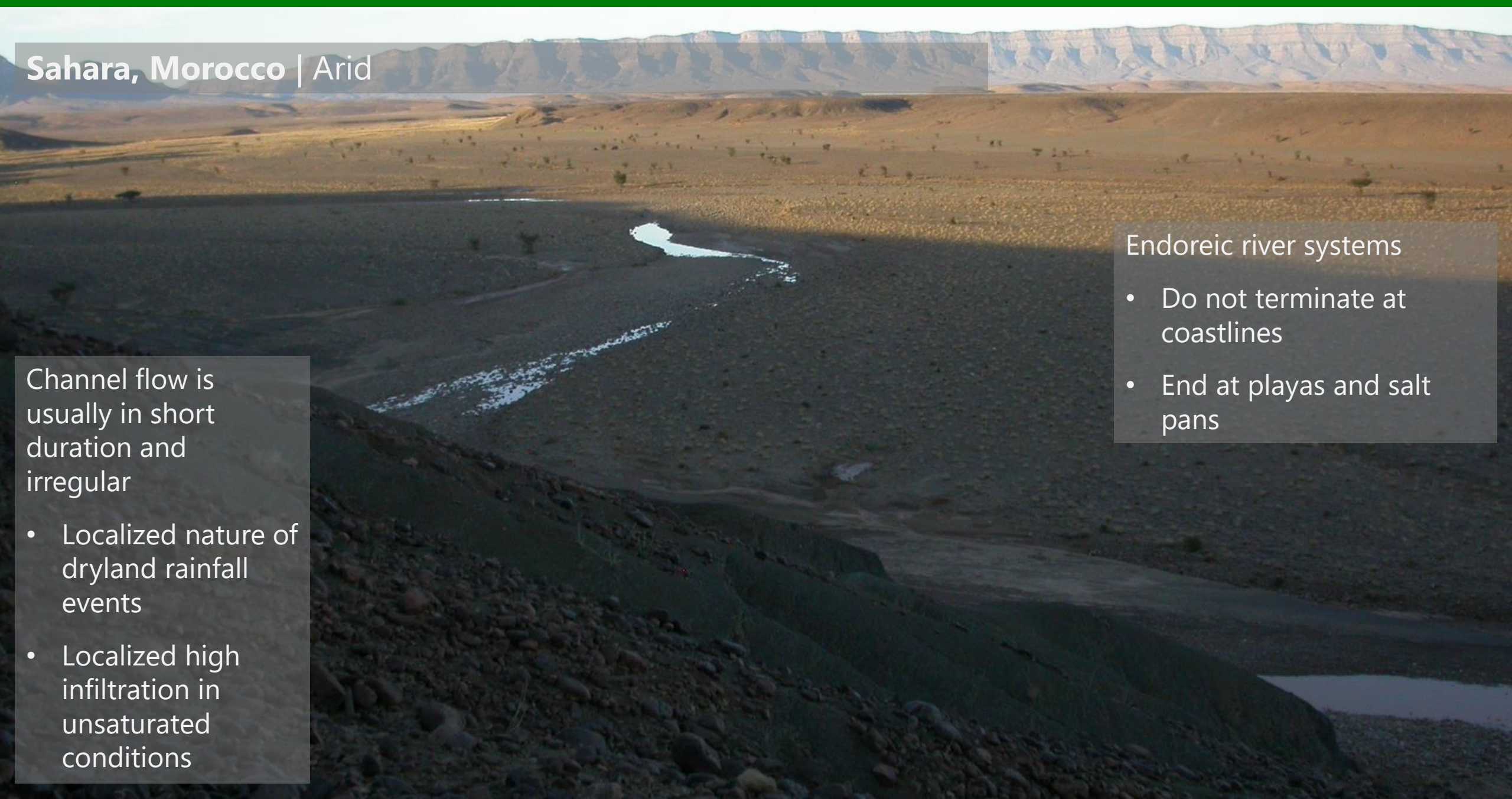
Sahara, Morocco | Arid

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

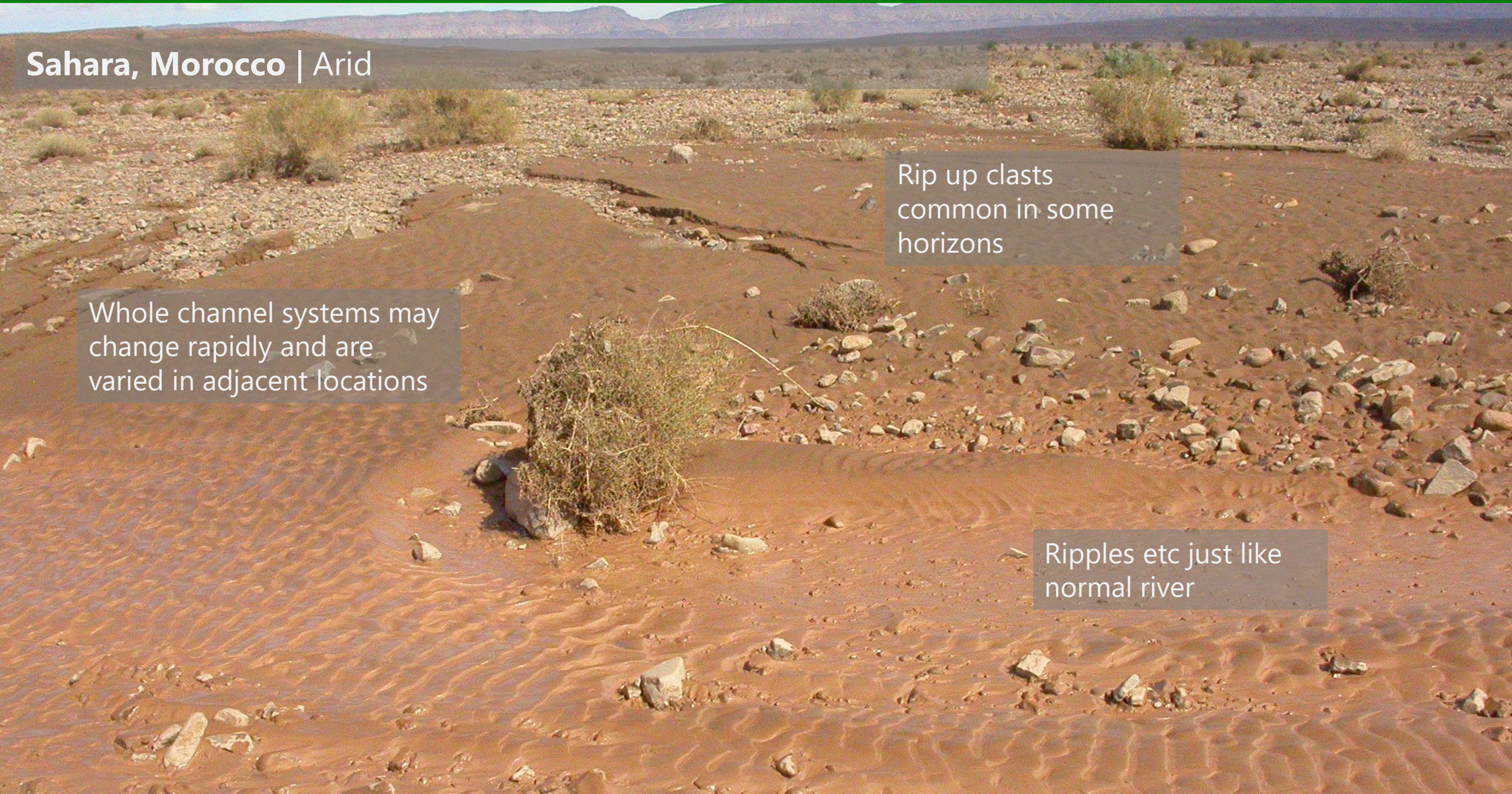


Sahara, Morocco | Arid

Rip up clasts
common in some
horizons

Whole channel systems may
change rapidly and are
varied in adjacent locations

Ripples etc just like
normal river



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



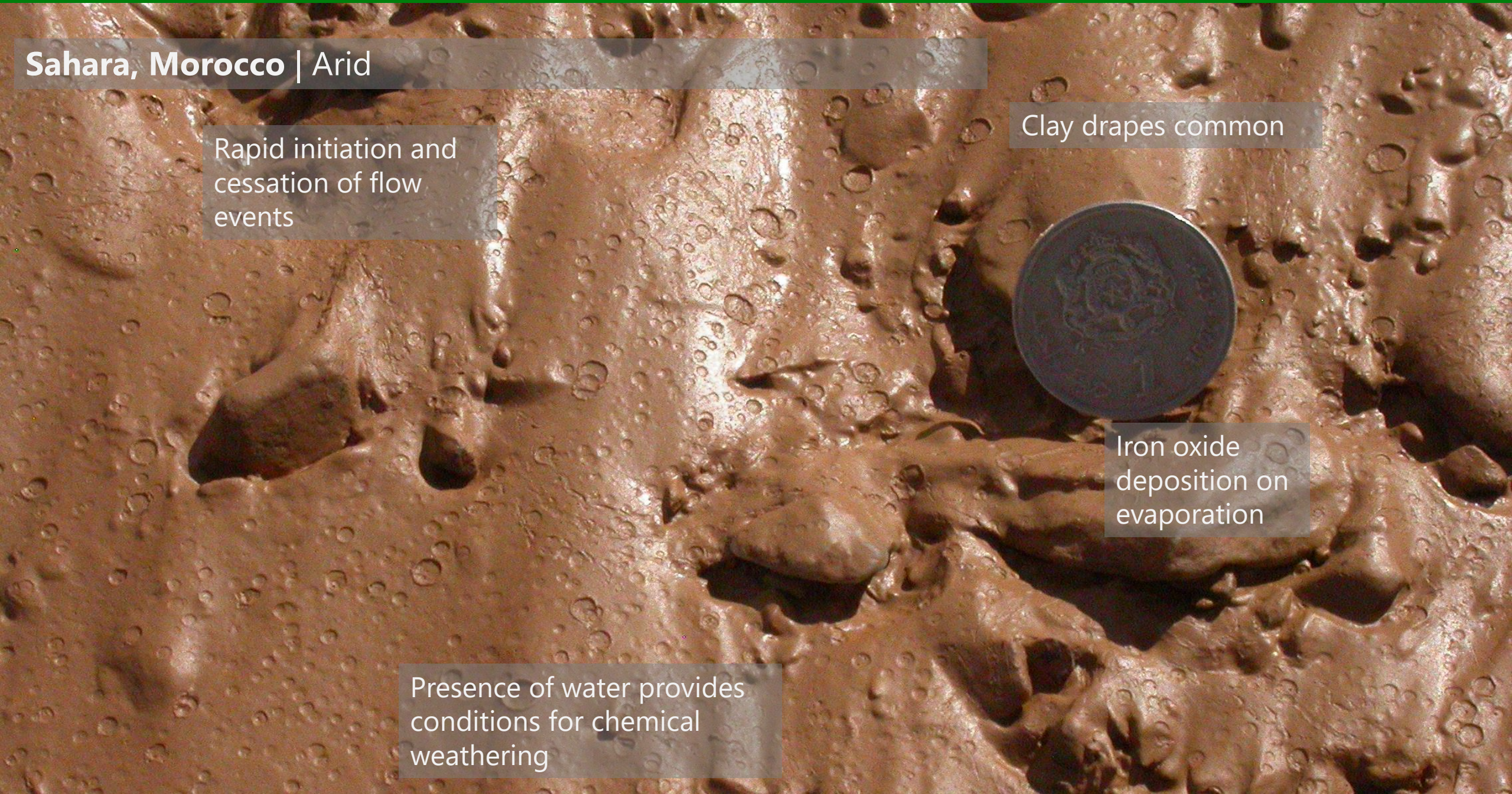
Sahara, Morocco | Arid

Rapid initiation and
cessation of flow
events

Clay drapes common

Iron oxide
deposition on
evaporation

Presence of water provides
conditions for chemical
weathering



Mallorca, Spain | Semi-Arid

Rubification
(of aeolian deposits)



Sahara, Morocco | Arid

Evaporation may lead
to salt weathering

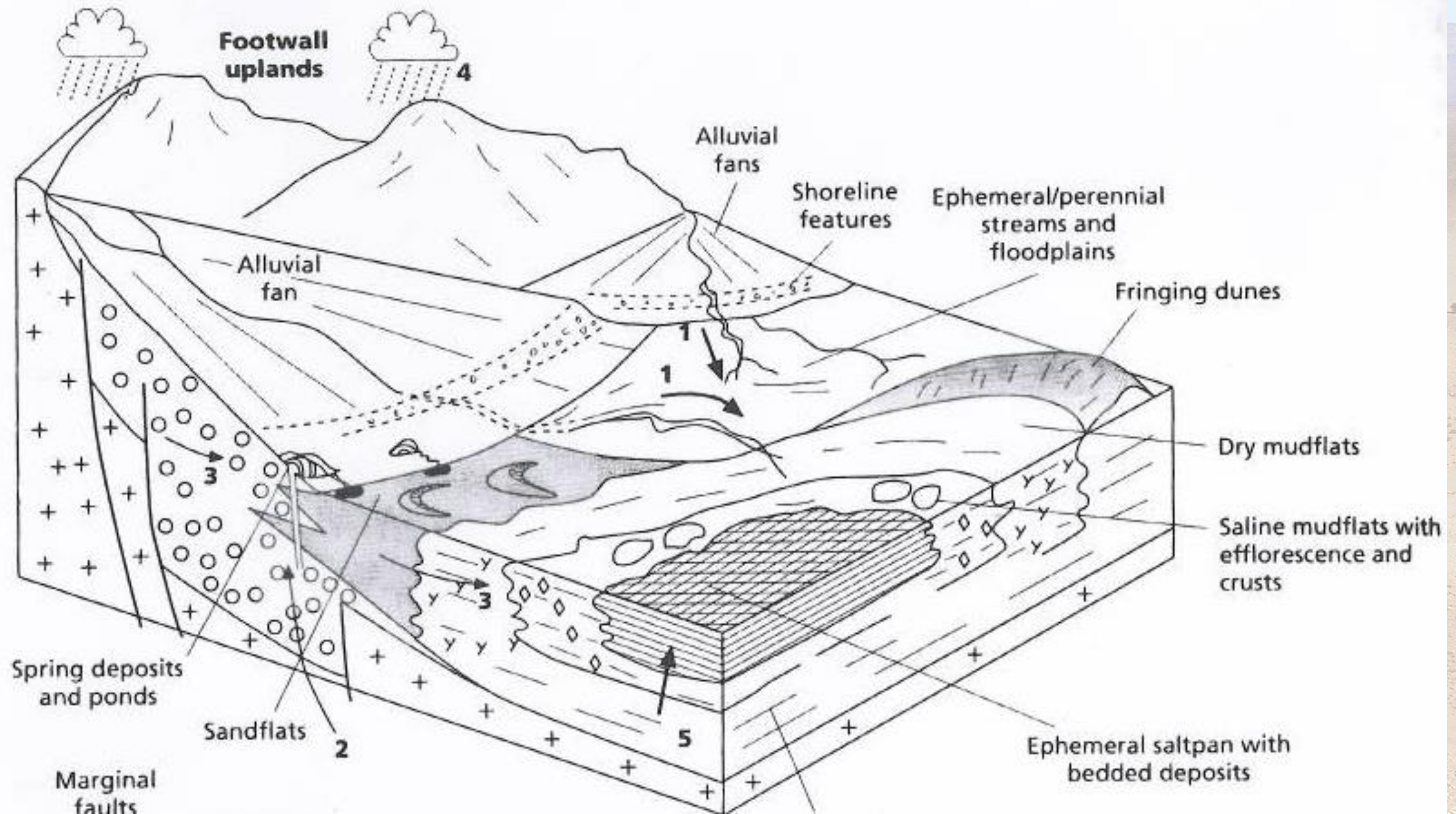


Laguna Colorado, Bolivia | Playa Lake



Uyuni, Bolivia | Salt flat







Traction and saltation across a beach





Traction and saltation across a beach





