




1  **Deserts and Winds****Earth – Chapter 19**2  **Chapter 19 – Deserts & Winds**3  **Distribution and Causes of Dry Lands**


- What Is Meant by *Dry*?
 - A dry climate is one where yearly precipitation is not as great as the potential for evaporation
 - Dry regions cover 30 percent of Earth's land surface
 - Two water-deficient climatic types are commonly recognized
 - Desert (or arid) regions, and
 - Steppe (or semiarid) regions
- Desertification: the persistent degradation of dry-land ecosystems—desert-like conditions are expanding worldwide

4  **Dry Climates**5  **Distribution and Causes of Dry Lands**



- Subtropical Deserts and Steppes
 - Lie between the Tropics of Cancer and Capricorn
 - Virtually unbroken desert environment stretching for more than 9300 kilometers
 - Subsiding air masses
 - The basic cause of bands of arid and semi-arid areas
 - Regions of high pressure (sinking air that is compressed and warmed)
 - Few chances for cloud formation and precipitation

6  **Subtropical Deserts**7  **Subtropical high pressure belts and dry regions**8  **[Global Wind Patterns with Hadley Cells](#)**9  **Distribution and Causes of Dry Lands**

- Subtropical Deserts and Steppes
 - West Coast Subtropical Deserts
 - Cold ocean current cools air and prevents it from rising
 - Few chances for cloud formation and precipitation
 - Often foggy areas
 - » Atacama Desert, South America
 - » Namib Desert, south-western Africa

10  **Distribution and Causes of Dry Lands**

- Middle-Latitude Deserts and Steppes
 - Sheltered in deep interiors of large landmasses
 - Far-removed from ocean moisture
 - Gobi Desert, central Asia
 - Mountain barriers
 - As prevailing winds meet mountains, the air is forced to ascend where it rises, expands and cools, producing clouds and precipitation
 - Air flowing over the leeward side of the mountain is dry and forms a rainshadow
 - Coast Ranges, Sierra Nevada and Cascades, North America

11  **Rain Shadow Deserts**12  ***Rainshadow desert***13  ***Rainshadow Deserts are the Result of Major Mountain Ranges***14  ***Rainshadow Deserts are the Result of Major Mountain Ranges***15 16  **Precipitation in Washington State**17 18  **Geologic Processes in Arid Climates**

- Weathering
 - Chemical weathering processes not as prominent
 - Mechanical weathering more prominent
 - Some chemical weathering does occur over long spans of time
 - Produces clay, thin soils, and oxidation of iron-rich sediments

19 **Geologic Processes in Arid Climates**

- The Role of Water
 - Water still plays an important role in shaping dry landscapes
 - Most streambeds are dry most of the time
 - Ephemeral streams (intermittent streams) only carry water in response to specific periods of rainfall
 - May only flow a few days or hours a year
 - When rain falls, it is too much to soak in and most of it flows as runoff into the streambeds
 - Desert floods arrive suddenly and subside quickly

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21 **Ephemeral Stream**

22 **Canyon Country: might be raining elsewhere!**

23 **Antelope Canyon**

24 **And you won't know until you hear a roaring sound...**

25 **The Importance of Running Water**

26 **Geologic Processes in Arid Climates**

- Different names are used for ephemeral streams in various regions
 - *Wash* and *arroyo* (western United States)
 - *Wadi* (Arabia and North Africa)
 - *Donga* (South America)
 - *Nullah* (India)

27 **Wadi in North Africa**

28 **Geologic Processes in Arid Climates**

- The Role of Water
 - Some permanent streams do cross arid regions
 - Originate *outside* the desert in well-watered mountains
 - Must contain enough water to compensate for loss from evaporation in arid region
 - Example: Colorado and Nile Rivers
 - While infrequent, running water does *most* of the erosional work in deserts

29 **Basin and Range: The Evolution of a Desert Landscape**


















- Arid regions typically have interior drainage because the intermittent streams do not flow to the ocean
 - *Basin and Range* province has basins, local base levels, so erosion occurs without reference to the ocean
- Landscape evolution
 - Uplift of mountains
 - Running water erodes and transports materials to the basin

30 **Landscape Evolution in the Basin and Range**

31 **Basin and Range: The Evolution of a Desert Landscape**


- Landscape Evolution
 - Sediment-laden rivers from sporadic rains deposit debris at the mouth of a canyon
 - Runoff spreads out over gentler slopes and quickly loses velocity
 - This fan-shaped sediment deposit is called an alluvial fan
 - Coarsest material deposited first
 - A bajada forms from the coalescing of multiple fans

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- 33  **Basin and Range: The Evolution of a Desert Landscape**
- Landscape Evolution
 - During heavy rainfall, streams flow across the bajada to form a shallow, short-lived playa lake
 - The dry, flat lake bed left after the water evaporates is called a playa
 - Continued erosion diminishes the mountains to a few isolated bedrock knobs called inselbergs
- 34  **Basin and Range**
- 35  **Playa in Death Valley**
- 36  **Death Valley**
- 37  **Death Valley**
- 38 
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- 40  **Inselbergs in southern California**
- 41  **Transportation of Sediment by Wind**
- Differs from that of running water in two ways:
 - Wind is lower density and less capable of picking up and transporting coarse materials
 - Wind is not confined to channels and can spread sediment over large areas
- 42  **Transportation of Sediment by Wind**
- Bed Load
 - The bed load is carried by wind close to the surface
 - Consists mostly of sand grains
 - Sand moves across the surface in a process called saltation (by bumping and skipping)
 - Height of the bed load rarely exceeds one meter above the surface, generally no higher than 0.5 meters
- 43  **Transporting Sand**
- 44  **Transportation of Sediment by Wind**
- Suspended Load
 - The suspended load is carried high into the atmosphere
 - Consists mostly of silt-sized particles
 - Surface area must be high compared to weight
 - Example: flat clay particles
 - Hard to move fine particles unless they have been disturbed on the surface
 - Example: a clay road with and without a car driving over it
 - The suspended load can be transported far distances
 - Dust from the Sahara can reach the Caribbean
- 45  **Wind's Suspended Load**
- 46  **Wind Erosion**
- Compared with glaciers and running water, wind is an insignificant erosional agent
 - More effective in arid regions
 - Dryness and scant vegetation are important for wind to be effective at eroding
 - Example: Dust Bowl in 1930s
- 47  **Wind Erosion**
- Deflation and Blowouts
 - Deflation is the lifting and removal of loose material
 - Hard to notice because the entire surface is being lowered
 - During the Dust Bowl, vast areas were lowered by one meter in a few years
 - Deflation also produces blowouts (shallow depressions)
 - Can range from small dimples to depressions that are 50 meters deep and several kilometers across
- 48  **Blowouts**
- 49  **Formation of a desert blowout**

- 50 **Wind Erosion**
- Desert Pavement
 - Many deserts have a veneer of pebbles and cobble called desert pavement
 - Forms from an initial surface of coarse pebbles
 - Fine, windblown grains are trapped between the pebbles
 - Gravity and infiltrating rainwater move the fine sediments beneath the cobbles
- 51 **Desert Pavement**
- 52 **Formation of Desert Pavement**
- 53
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- 55 **Wind Erosion**
- Ventifacts and Yardangs
 - Wind also erodes by abrasion (scraping)
 - Windblown sand *cuts and polishes* rock surfaces
 - Creates interestingly shaped stones called ventifacts
 - Wind also creates streamlined landforms oriented parallel to the prevailing wind direction called yardangs
- 56 **Shaped by the Wind**
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- 59 **Wind Deposits**
- Two types of depositional landforms are created by wind
 - Dunes
 - mounds and ridges of sand from the wind's bed load
 - Loess
 - extensive blankets of silt once carried in suspension
- 60 **Wind Deposits**
- Sand Deposits
 - Sand will accumulate wherever an obstruction blocks wind flow, creating a dune
 - Dunes often form around a clump of vegetation or rocks
 - Most dunes have an *asymmetrical profile*
 - Windward slope is gently inclined and the steeper leeward slope is called the slip face
 - » The slip face typically maintains an angle of 34 degree (the angle of repose for sand)
- 61 **White Sands National Monument**
- 62 **Wind Deposits**
- Sand Deposits
 - As sand is deposited on the slip face, layers form *inclined to prevailing wind direction*, creating cross bedding
 - Moving sand can be troublesome for permanent structures like roads and buildings
- 63 **Cross Bedding**
- 64 **Formation of Cross Bedding**
- 65 **Moving Sands**
- 66
- 67
- 68 **Kelso Dunes, Mojave National Preserve**
- 69
- 70
- 71
- 72
- 73 **Wind Deposits**


- Types of Sand Dunes
 - Dunes are classified into six basic types *based on their size and shape*
 - Barchan dunes are solitary sand dunes shaped like crescents
 - Form where sand supplies are limited and the surface is flat, hard, and lacking vegetation
 - Transverse dunes are a series of long ridges oriented at right angles to prevailing winds
 - Form where sand is plentiful and vegetation is sparse
 - Most coastal beach dunes are transverse dunes
 - Barchanoid dunes are an intermediate form of dune between barchan and transverse dunes

74  **Wind Deposits**

- Types of Sand Dunes
 - Longitudinal dunes form parallel to prevailing winds where sand supplies are moderate
 - Parabolic dunes form when vegetation partially covers the sand
 - Star dunes are isolated hills of sand that develop when wind directions are variable

75  **Types of Sand Dunes**76  **Wind Deposits**

- Loess (Silt) Deposits
 - Windblown silt deposits
 - Material is deposited by storms over thousands of years
 - Sources of sediments come from deserts and glacial outwash deposits
 - Loess in China originates from desert basins in central Asia
 - Loess in the United States and Europe is the product of glacial material

77  **Loess**78 79  **End of Chapter**