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EARTH SCIENCE

Tarbuck ◆ Lutgens

Chapter 7

Glaciers, Desert, and Wind

7.1 Glaciers

Types of Glaciers

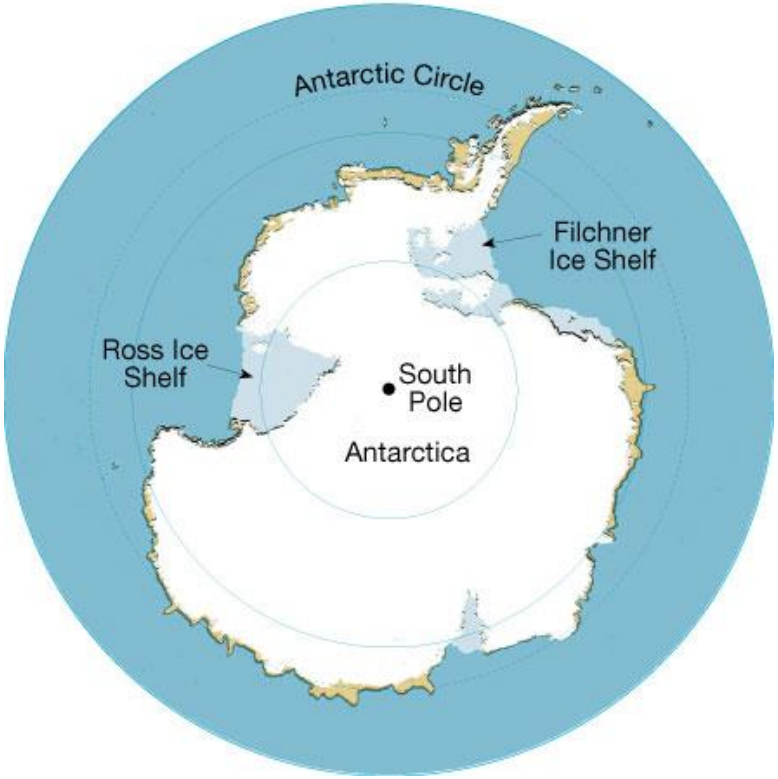
- A **glacier** is a thick ice mass that forms above the **snowline** over hundreds or thousands of years.
  - The **ice age** was a period of time when much of the Earth was covered in glaciers.
- **Valley Glaciers**
  - Ice masses that slowly advance down mountain valleys originally occupied by streams.
  - A stream of ice that flows between steep rock walls from near the top of the mountain valley.

7.1 Glaciers

Types of Glaciers

- Ice Sheets
  - **Ice sheets** are enormous ice masses that flow in all directions from one or more centers and cover everything but the highest land.
  - Ice sheets are sometimes called continental ice sheets because they cover large regions where the climate is extremely cold.
  - They are huge compared to valley glaciers.
  - They currently cover Greenland and Antarctica.

Currently Continental Ice Sheets Cover Greenland and Antarctica



7.1 Glaciers

How Glaciers Move

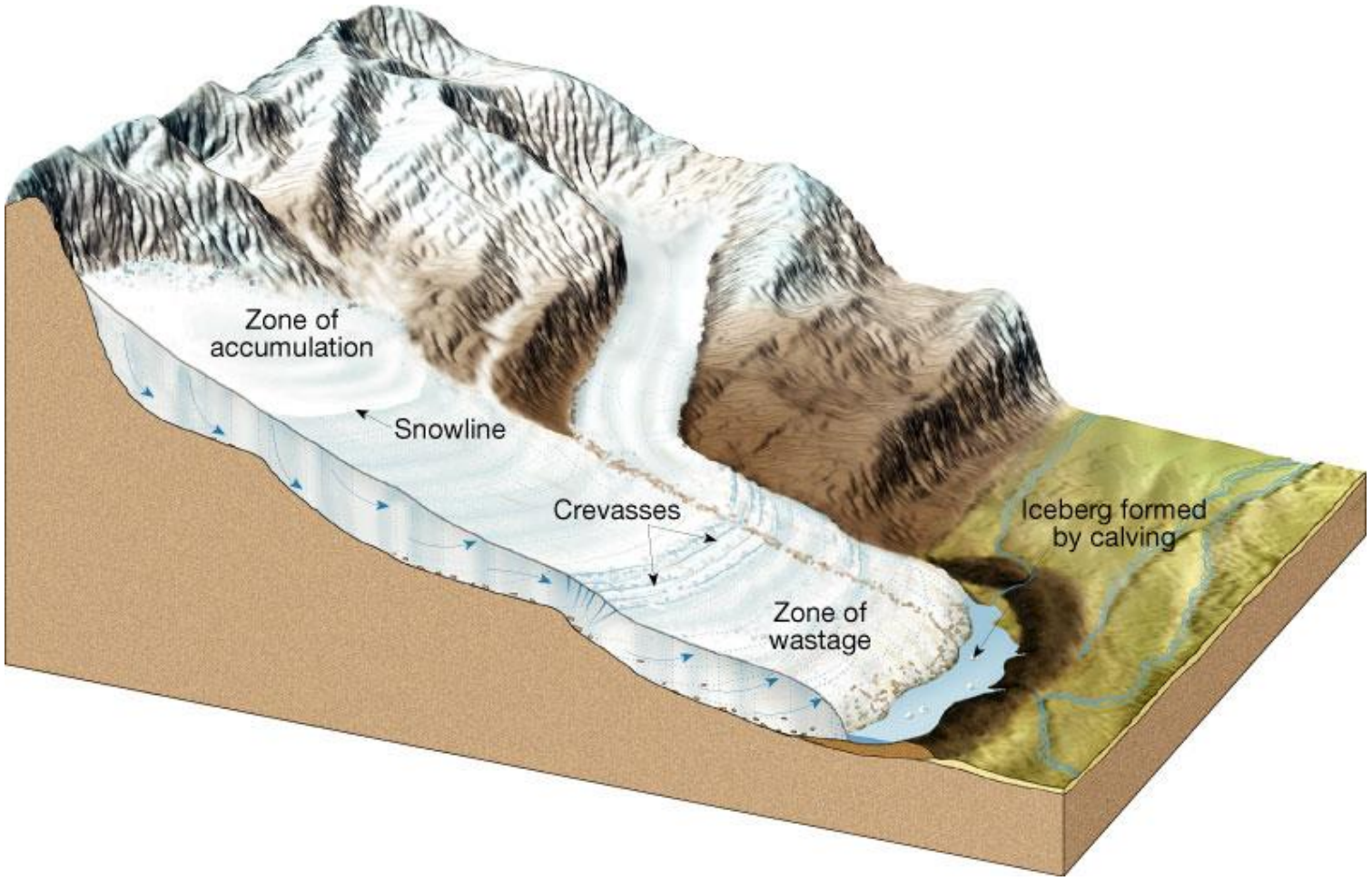
- The movement of glaciers is referred to as flow, and it happens in two ways.

1. Plastic flow—involves movement within the ice

2. Basal slip—slipping and sliding downward due to gravity

- Budget of a Glacier
  - The glacial budget is the balance, or lack of balance, between accumulation at the upper end of a glacier and loss, or wastage, at the lower end.

How a Glacier Moves



Calving

7.1 Glaciers

Glacial Erosion

- Many landscapes were changed by the widespread glaciers of the recent ice age.
- How Glaciers Erode
  - Plucking—lifting of rock blocks
  - Abrasion
    - Rock flour (pulverized rock)
    - Striations (grooves in the bedrock)

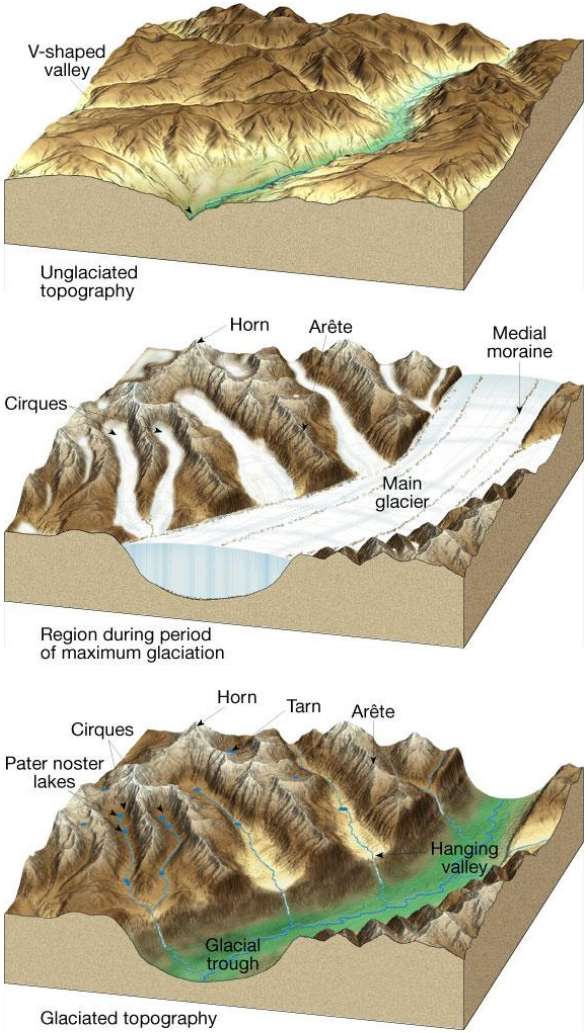
7.1 Glaciers

Landforms Created by Glacial Erosion

- Glaciers are responsible for a variety of erosional landscape features, such as glacial troughs, hanging valleys, cirques, arêtes, and horns.

- Glaciated Valleys
  - A **glacial trough** is a U-shaped valley that was once V-shaped but was deepen by a glacier.

Erosional Landforms Caused by Valley Glaciers



7.1 Glaciers

Landforms Created by Glacial Erosion

- A cirque is a bowl-shaped depression at the head of a glacial valley.
- Arêtes and Horns
  - Snaking, sharp-edged ridges called arêtes and sharp pyramid-like peaks called horns project above mountain landscapes.

Cirque

7.1 Glaciers

Glacial Deposits

Types of Glacial Drift

- Glacial drift applies to all sediments of glacial origin, no matter how, where, or in what form they were deposited.
- There are two types of glacial drift.

1. **Till** is material deposited directly by the glacier.
2. **Stratified drift** is sediment laid down by glacial meltwater.

7.1 Glaciers

Moraines, Outwash Plains, and Kettles

- Glaciers are responsible for a variety of depositional features, including
  - **Moraines**—layers or ridges of till
    - Lateral
    - Medial
    - End
    - Terminal end
    - Recessional end
    - Ground

Medial Moraine

7.1 Glaciers

Moraines, Outwash Plains, and Kettles

- Glaciers are responsible for a variety of depositional features, including
  - outwash plains—sloping plains consisting of deposits from meltwater streams in front of the margin of an ice sheet
  - kettles—depressions created when a block of ice becomes lodged in glacial deposits and subsequently melts

7.1 Glaciers

Moraines, Outwash Plains, and Kettles

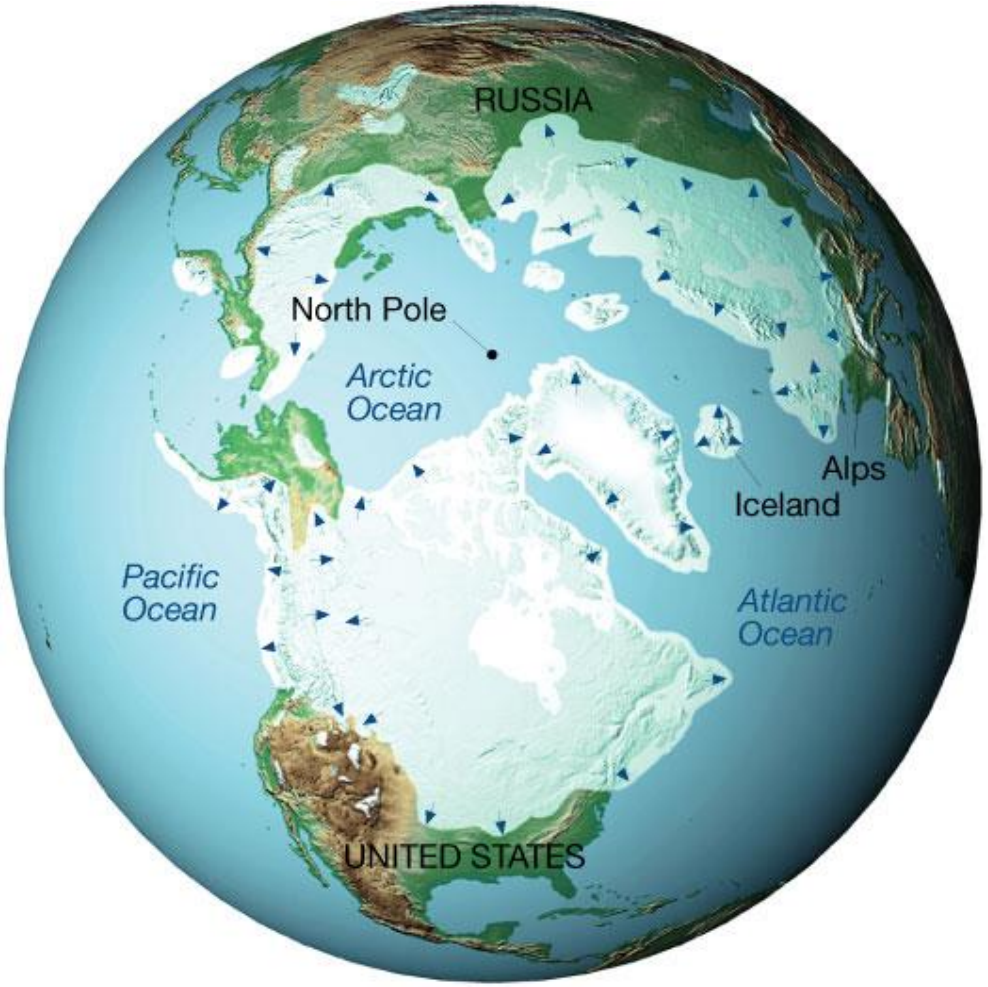
- Glaciers are responsible for a variety of depositional features, including
  - drumlins—streamlined, asymmetrical hills composed of glacial dirt
  - eskers—ridges composed largely of sand and gravel deposited by a stream flowing beneath a glacier near its terminus

7.1 Glaciers

Glaciers of the Ice age

- Ice Age
  - Began 2 to 3 million years ago
  - Division of geological time is called the Pleistocene epoch
  - Ice covered 30% of Earth's land area.
  - Greatly affected drainage

Extent of the Northern Hemisphere Ice Sheets



7.2 Deserts

Geologic Processes in Arid Climates

- Weathering
  - Much of the weathered debris in deserts results from mechanical weathering.
  - Chemical weathering is not completely absent in deserts. Over long time spans, clay and thin soils do form.
  - Not as effective as in humid regions
- The Role of Water
  - In the desert, most streams are ephemeral—they only carry water after it rains.

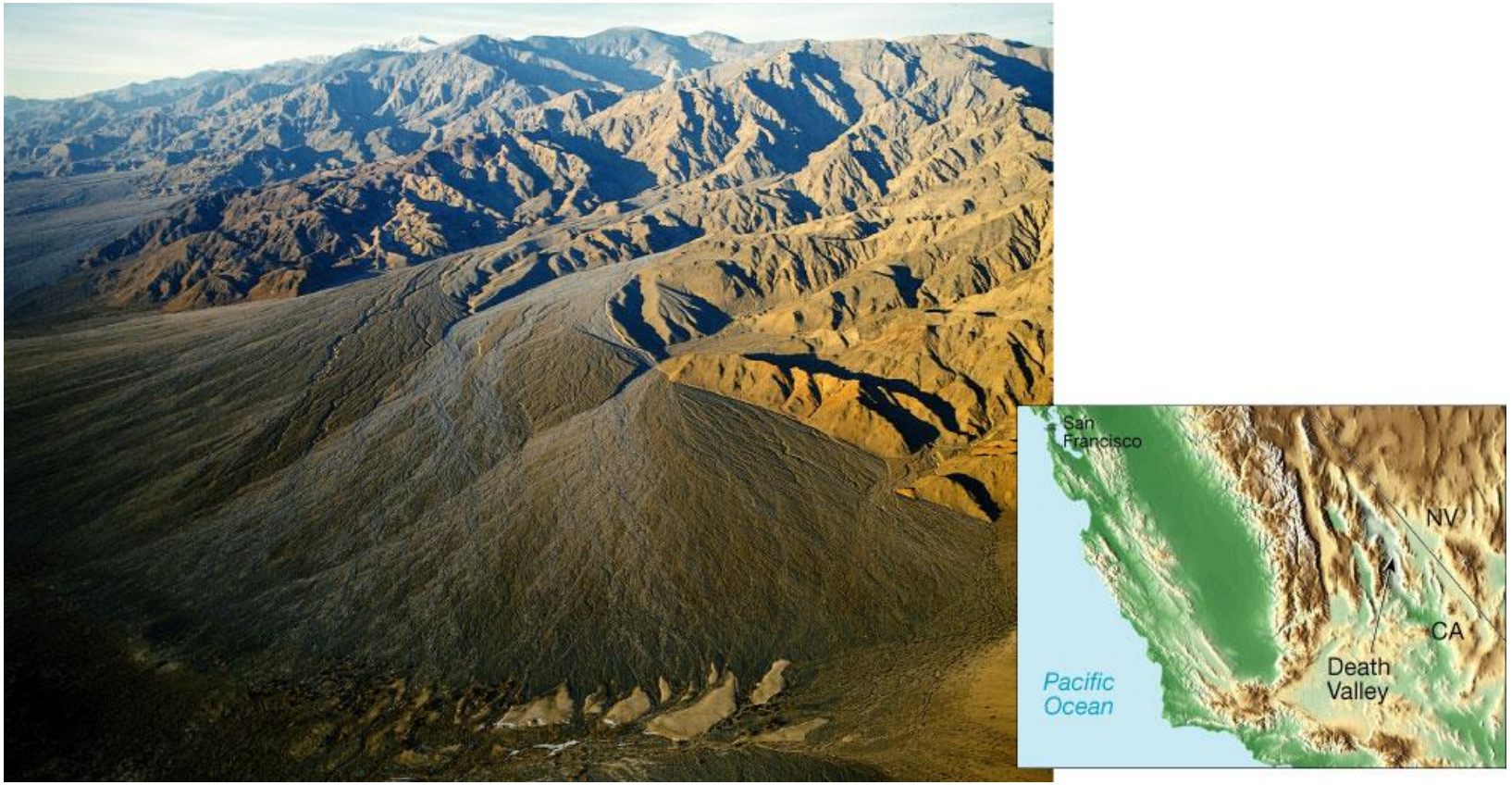
A Dry Stream Desert Channel Before and After a Heavy Rainfall

7.2 Deserts

Basin and Range: A Desert Landscape

- Most desert streams dry up long before they ever reach the ocean. The streams are quickly depleted by evaporation and soil infiltration.
- Interior drainage into basins produces
  - **alluvial fan**—a fan-shaped deposit of sediment formed when a stream's slope is abruptly reduced
  - **playa lake**—a flat area on the floor of an undrained desert basin (playa) that fills and becomes a lake after heavy rain

Alluvial Fans



7.2 Deserts

Basin and Range: A Desert Landscape

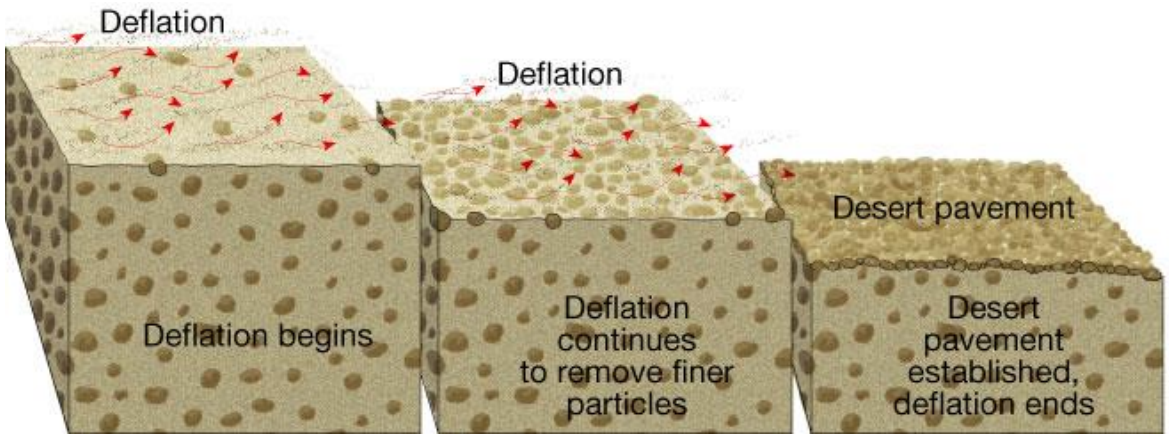
- Most desert erosion results from running water. Although wind erosion is more significant in deserts than elsewhere, water does most of the erosional work in deserts.

7.3 Landscapes Shaped by Wind

Wind Erosion

- Wind erodes in the desert in two ways.
  1. **Deflation** is the lifting and removal of loose particles such as clay and silt. It produces
     - blowouts
     - **desert pavement**—a layer of coarse pebbles and gravel created when wind removed the finer material
  2. Abrasion

Desert Deflation



7.3 Landscapes Shaped by Wind

Wind Deposits

- The wind can create landforms when it deposits its sediments, especially in deserts and along coasts. Both layers of loess and sand dunes are landscape features deposited by the wind.
- **Loess**
  - Deposits of windblown silt
  - Extensive blanket deposits
  - Primary sources are deserts and glacial stratified drift.

7.3 Landscapes Shaped by Wind

Wind Deposits

- Sand Dunes
  - Unlike deposits of loess, which form blanket-like layers over broad areas, winds commonly deposit sand in mounds or ridges called **dunes.**
  - Characteristic features
    - Slip face is the leeward slope of the dune
    - Cross beds are the sloping layers of sand in the dune.

A Dune in New Mexico's White Sands National Monument

Cross Beds Are Part of Navajo Sandstone in Zion National Park, Utah.

7.3 Landscapes Shaped by Wind

Wind Deposits

- Types of Sand Dunes
  - What form sand dunes assume depends on the wind direction and speed, how much sand is available, and the amount of vegetation.
    - Barchan dunes
    - Transverse dunes
    - Barchanoid dunes
    - Longitudinal dunes
    - Parabolic dunes
    - Star dunes

Types of Sand Dunes