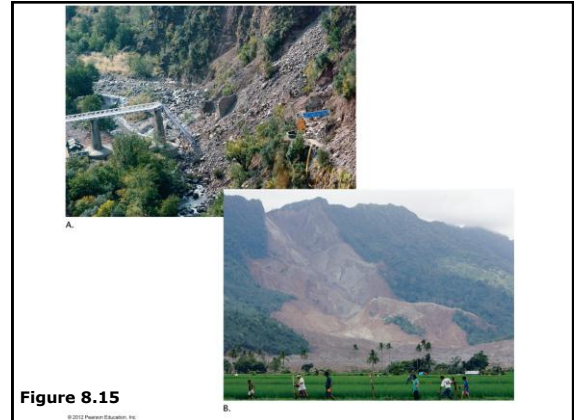


# Essentials of Geology, 11e

## Mass Wasting: The Work of Gravity Chapter 8

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### Mass Wasting and Landform Development

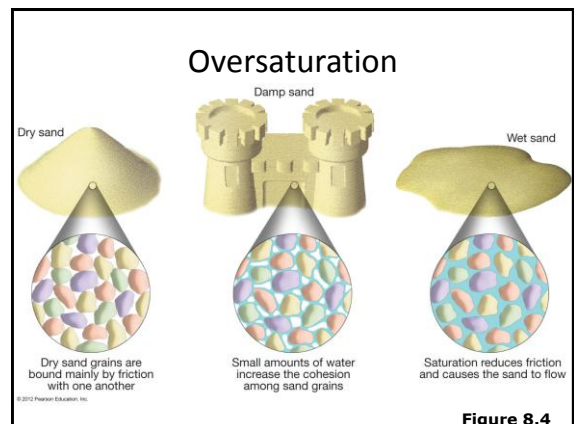
- **Mass wasting** refers to the downslope movement of rock, regolith, and soil under the direct influence of gravity
  - Does not require a transporting medium
- Role of mass wasting
  - Geologic process that often follows weathering
  - Combined effects if mass wasting and running water produce stream valleys

### Mass Wasting and Landform Development

- For mass wasting to occur, there must be a **slope angle**
  - Most rapid events occur in areas of rugged, geologically young mountains
  - As a landscape ages, less dramatic downslope movements occur

### Controls and Triggers of Mass Wasting

- **Gravity** is the controlling force
- A '**trigger**' is the event that initiates movement
  - Something has caused the slope to cross the threshold from stable to unstable
- 4 Important triggers include
  - **Saturation** of the material with water
    - Diminishes particle cohesion
    - Water adds weight



## Hurricane Mitch – Honduras, 1998



Figure 8.3

## Controls and Triggers of Mass Wasting

- 4 Important triggers include
  - **Oversteepening** of slopes
    - Stable slope angle (**angle of repose**) is different for various materials
    - Oversteepened slopes are unstable
  - **Removal of anchoring vegetation**
    - Root systems bind soil and regolith
    - Wildfires are serious risks

## Controls and Triggers of Mass Wasting

- 4 Important triggers include
  - **Ground vibrations** from earthquakes
    - May cause extensive property damage
    - Can cause **liquefaction** – water saturated surface materials behave as fluid-like masses that flow



Figure 8.8

## Classification of Mass Wasting Events

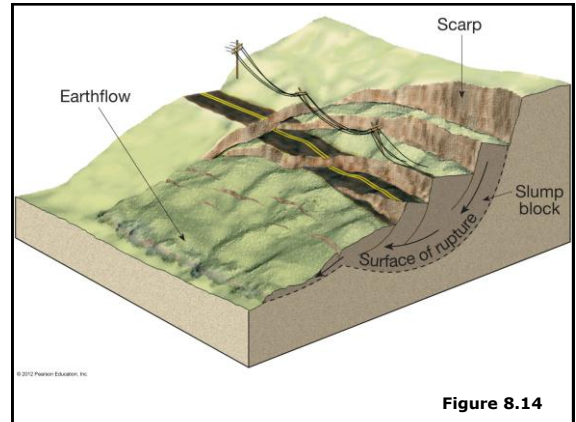
- Landslides without triggers
  - Slope materials weaken over time
  - Random events that are unpredictable
- Look at 4 processes
  - **Slump, rockslide, debris flow, and earthflow**
- Generally each event is classified by
  - Type of material involved
  - Kind of motion displayed
  - Velocity of the movement

## Classification of Mass Wasting Events

- Generally each event is classified by
  - Type of material involved
    - **Debris** – large amount of water
    - **Mud** – more water, finer grained
    - **Earth** – regolith/soil
    - **Rock**

## Classification of Mass Wasting Events

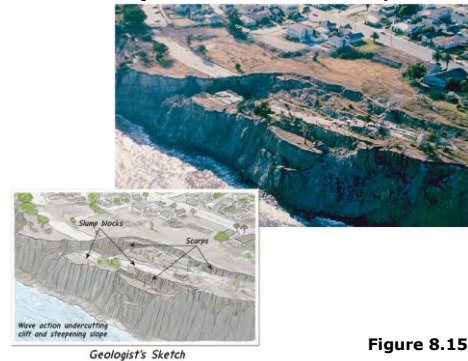
- Generally each event is classified by
  - **Type of motion**
    - **Fall** (free-falling pieces)
    - **Slide** (material moves along a surface as a coherent mass)
    - **Flow** (material moves as a chaotic mixture)
  - **The velocity of the movement**
    - Fast - rockslide
    - Slow - creep



## Forms of Mass Wasting

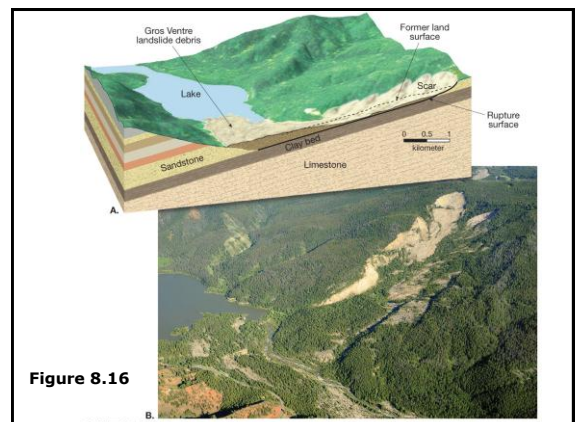
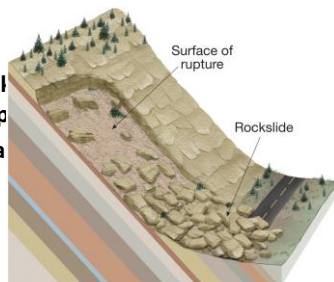
- **Slump**
  - Movement of a mass of rock or unconsolidated material as a unit along a curved surface
    - Crescent-shaped **scarp** (head)
    - Occurs along oversteepened slopes
      - Anchor material at the base is removed
    - Occurs along overloaded slopes
      - EX - Clay-rich material underlies sandstone

## A Slump at Point Fermin, CA



## Forms of Mass Wasting

- **Rockslide**
  - Blocks of bedrock slide down a slope
  - Generally very fast and destructive



## Forms of Mass Wasting

- **Debris flow (mudflow)**
  - Consists of soil and regolith with water
  - Often confined to channels
  - Serious hazard in dry areas with heavy rains
  - Debris flows composed mostly of volcanic materials on the flanks of volcanoes are called **lahars**
- **Mudflow**
  - Also soil and regolith with larger amount of water
  - Also confined to channels

## Debris Flow (Mudslide)

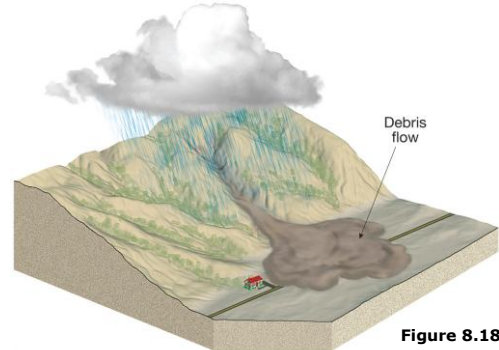
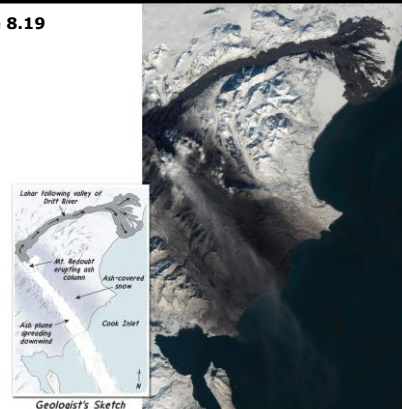


Figure 8.18



Photo by D. R. Crandell, U.S. Geological Survey

Figure 8.19



Geologist's Sketch

## Forms of Mass Wasting

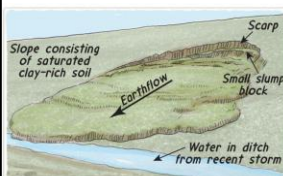


Figure 8.20a

Geologist's  
Sketch

### flow

m on hillsides in  
mid regions  
ter saturates the

- Commonly involve materials rich in clay and silt



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Figure 8.20

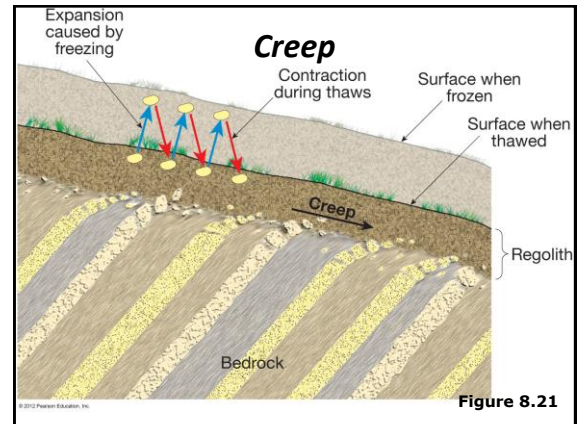


## Forms of Mass Wasting

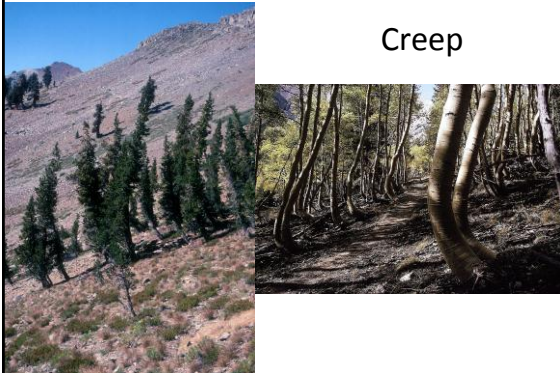
### • Slow movements

#### – Creep

- Gradual movement of soil and regolith downhill
- Aided by the alternate expansion and contraction of the surface material



### Creep



## Forms of Mass Wasting

### • Slow movements

#### – Solifluction

- Promoted by a dense clay hardpan or impermeable bedrock layer
- Common in regions underlain by permafrost
- Can occur on gentle slopes

