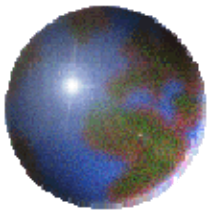
Chapter 10
Weathering, Karst Landscapes, and Mass Movement



Elemental Geosystems 5e

Robert W. Christopherson
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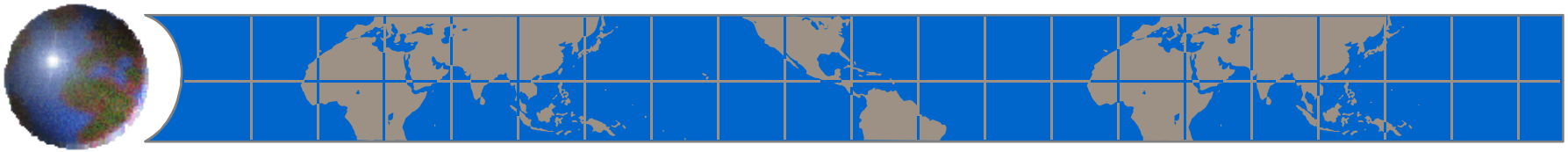
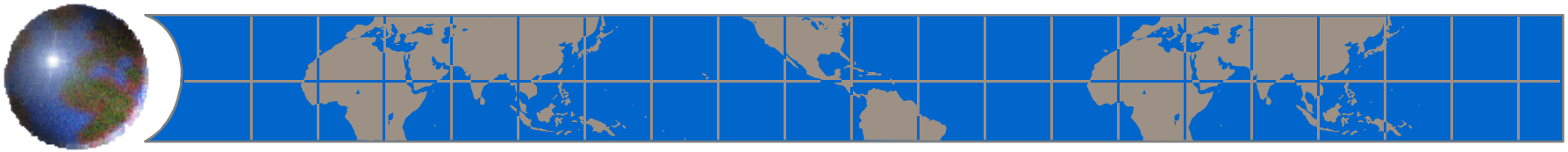


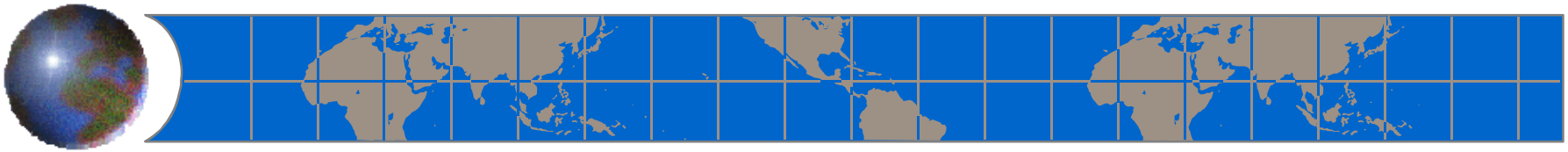
Weathering, Karst Landscapes, and Mass Movement

- **Landmass Denudation**
- **Weathering Processes**
- **Karst Topography and Landscapes**
- **Mass Movement Processes**



Weathering

- Geomorphology - Science of landforms
- Weathering – breaking up of landscape
- Erosion is transport of weathered material
- Endogenic – Forces within Earth
- Exogenic – Forces outside Earth



Dynamic equilibrium model

- Landscape is balanced
  - Endogenic vs. Exogenic
  - Uplift vs. Weathering & Erosion
  - Gravity vs. Friction & Cohesion
  - Weathering vs. Resistance of rock
- Balance changes
- Landscape changes in response
- Landscape is balanced

Slope Mechanics and Form

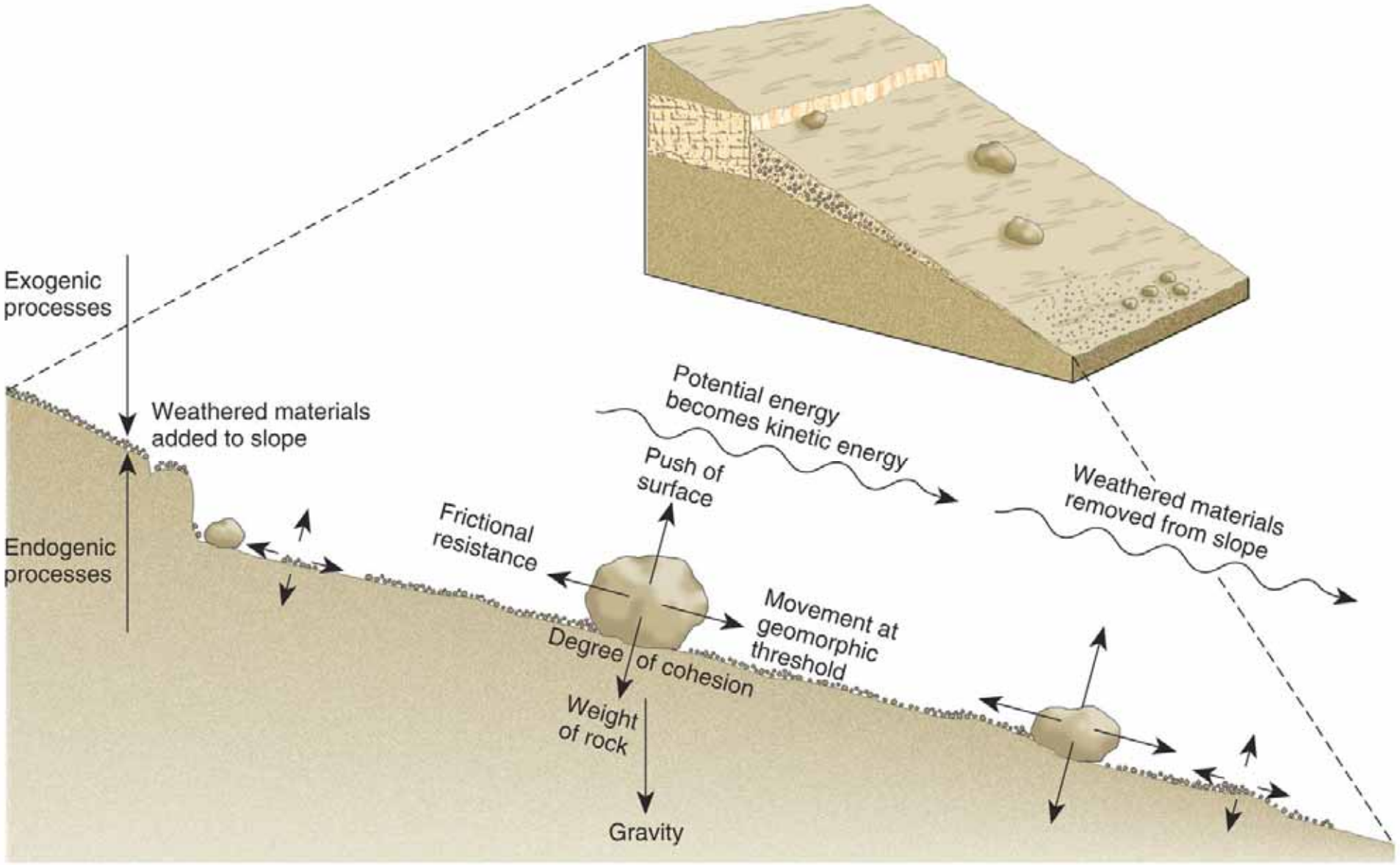


Figure 10.3

Slope Mechanics and Form

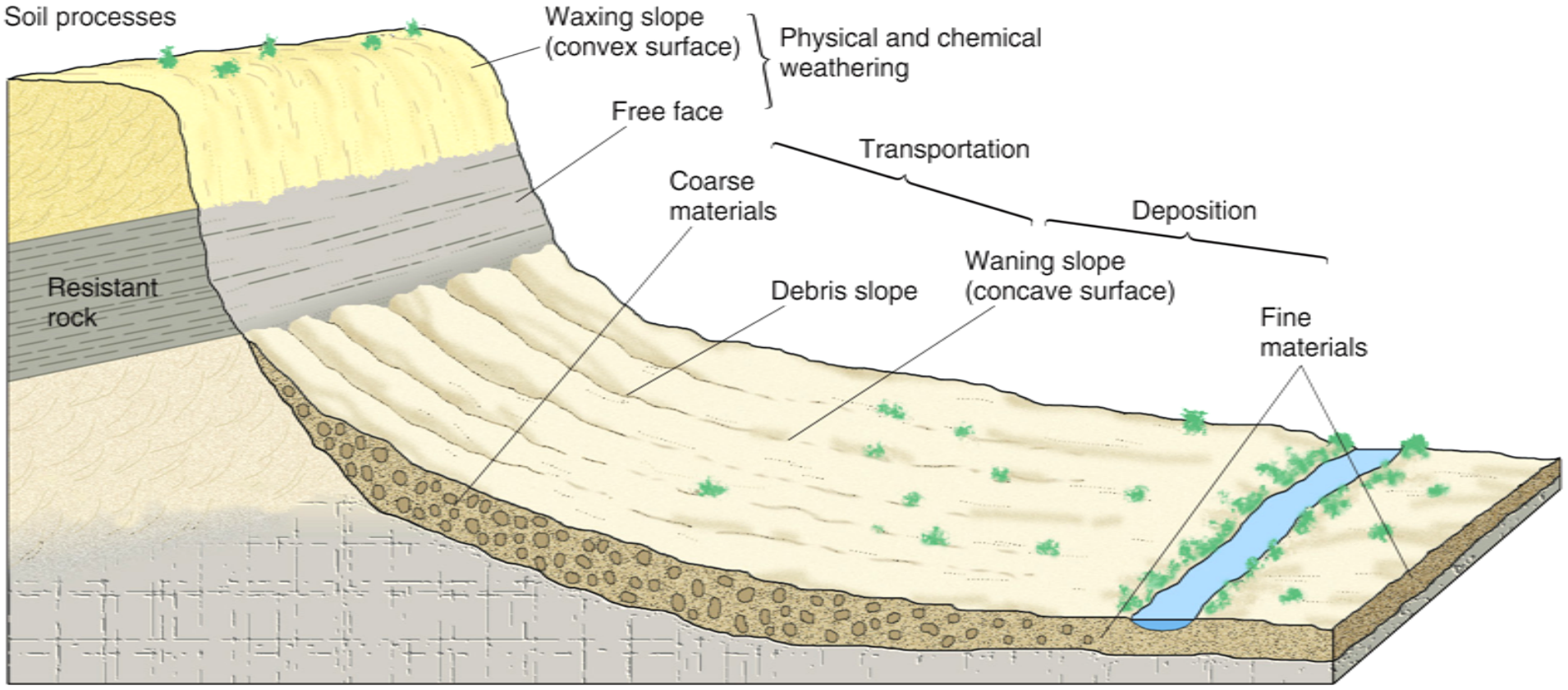
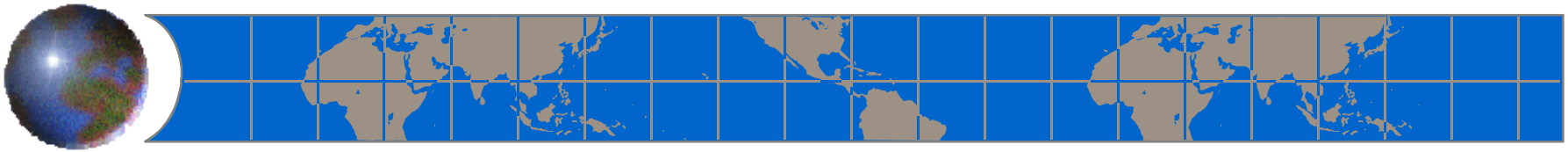
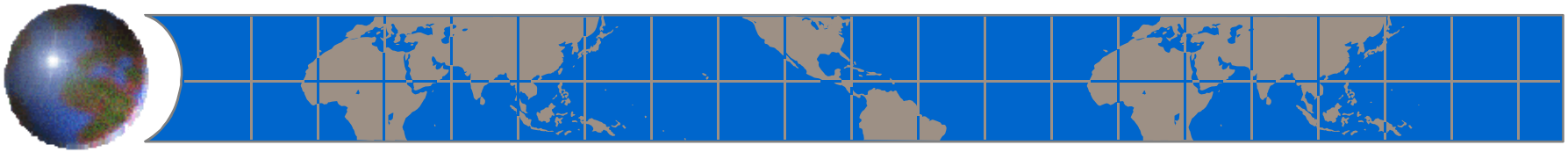


Figure 10.3



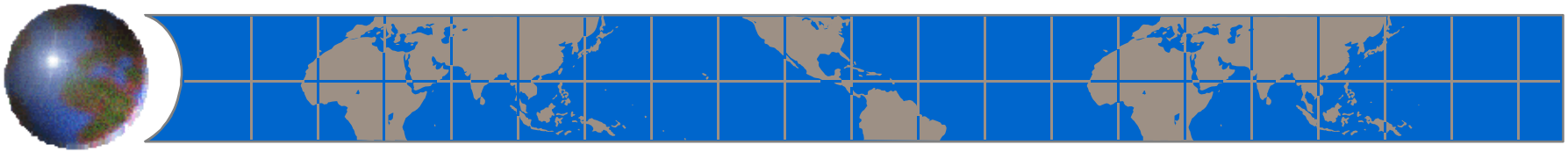
Weathering

- Physical weathering **disintegrates** material
- Chemical weathering **dissolves** material



Weathering Processes

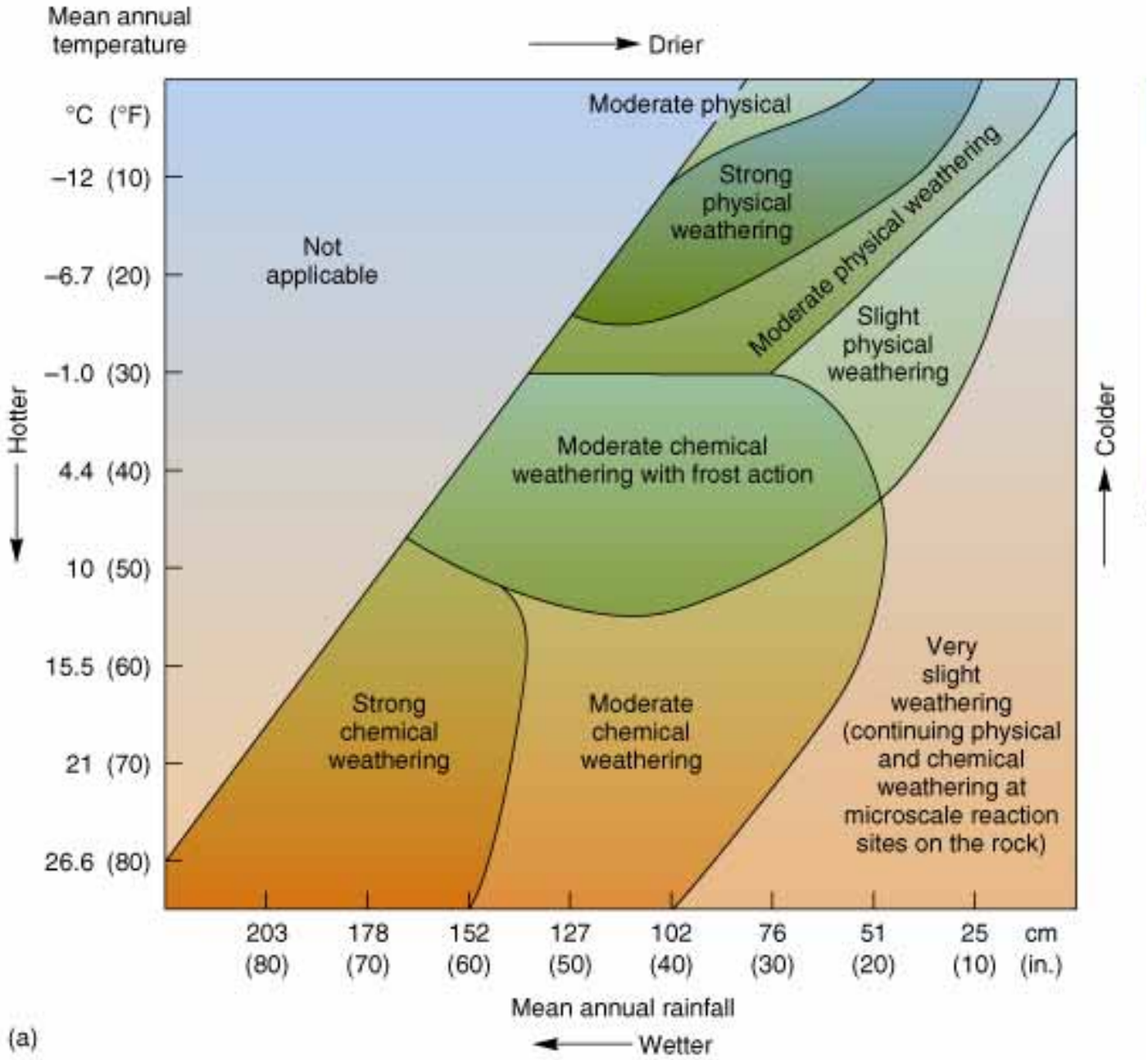
- Factors Influencing Weathering Processes
- Physical Weathering Processes
  - Frost action
  - Crystallization (salt-crystal growth)
  - Pressure-release jointing
- Chemical Weathering Processes
  - Hydration and hydrolysis
  - Oxidation
  - Carbonation and solution



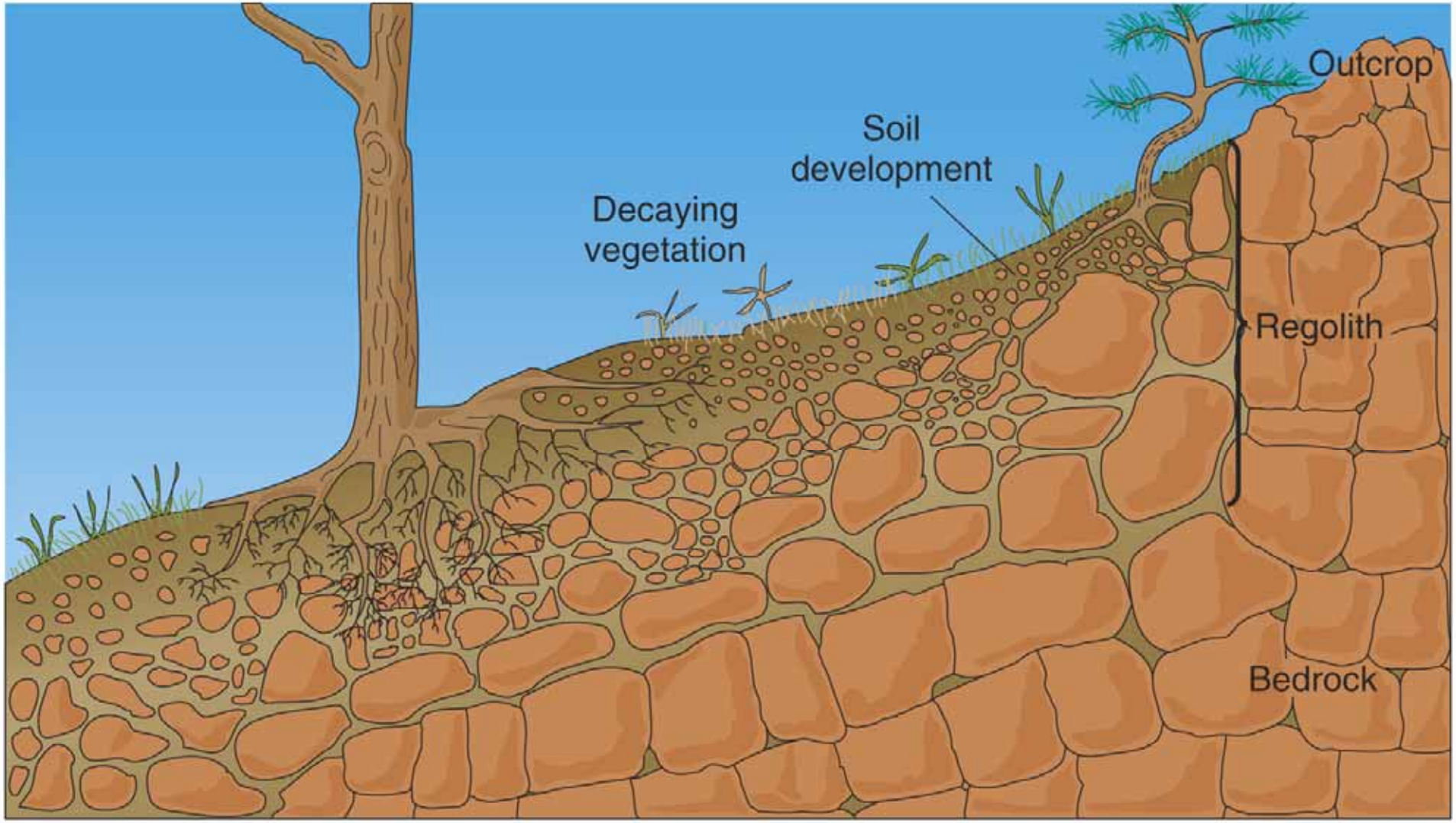
Weathering

- Influenced by climate
  - Temperature
  - Water
- Physical composition and structure
  - Joints
  - Chemicals of rock

Climate and weathering regimes

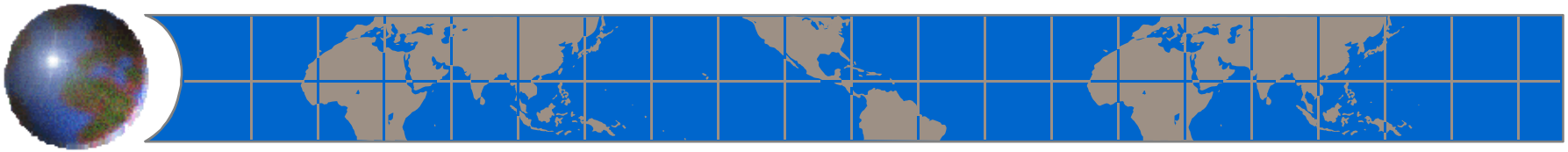


Regolith, Soil, and Parent Materials



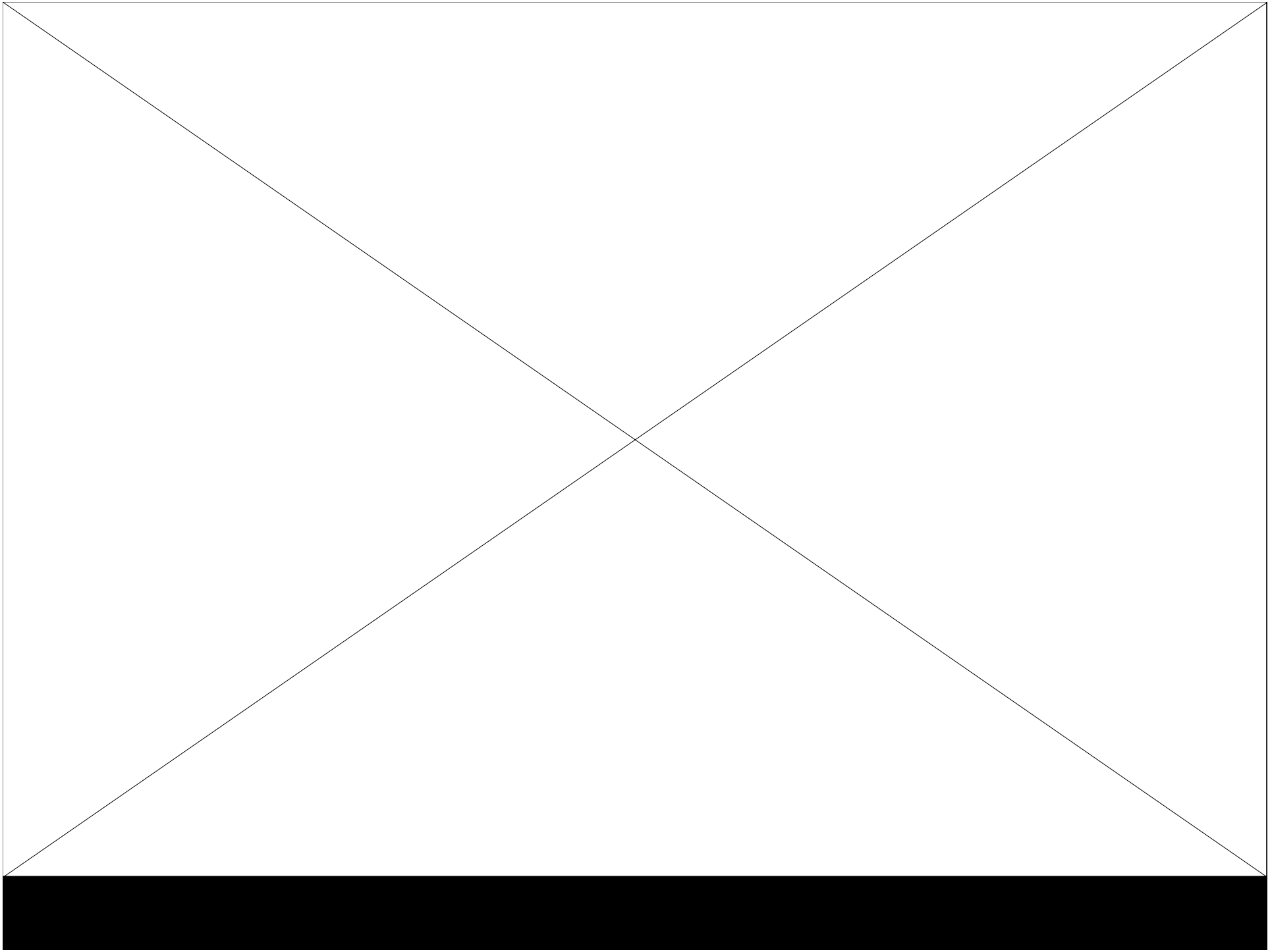
(a)

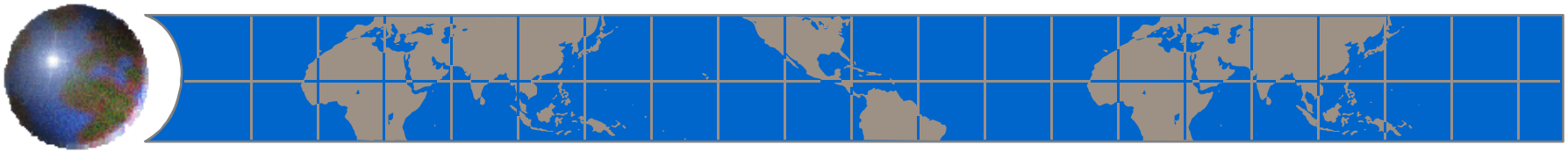
Figure 10.4



Physical weathering

- Disintegrates material
  - Mechanical processes
- Frost action
- Crystallization
- Pressure release jointing





Frost Action

- Water expands up to 9% when it freezes

Physical Weathering

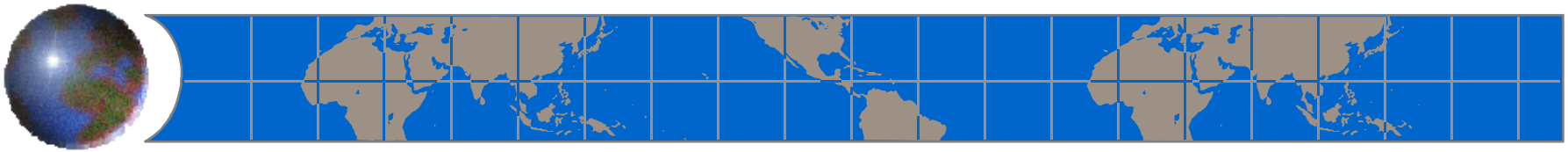
Figure 10.6

Joint-block Separation

Figure 10.6

Rockfall

Figure 10.7



Crystallization

- Salt crystals grow as water evaporates
- Crystals force apart grains in rock

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ng in
stone

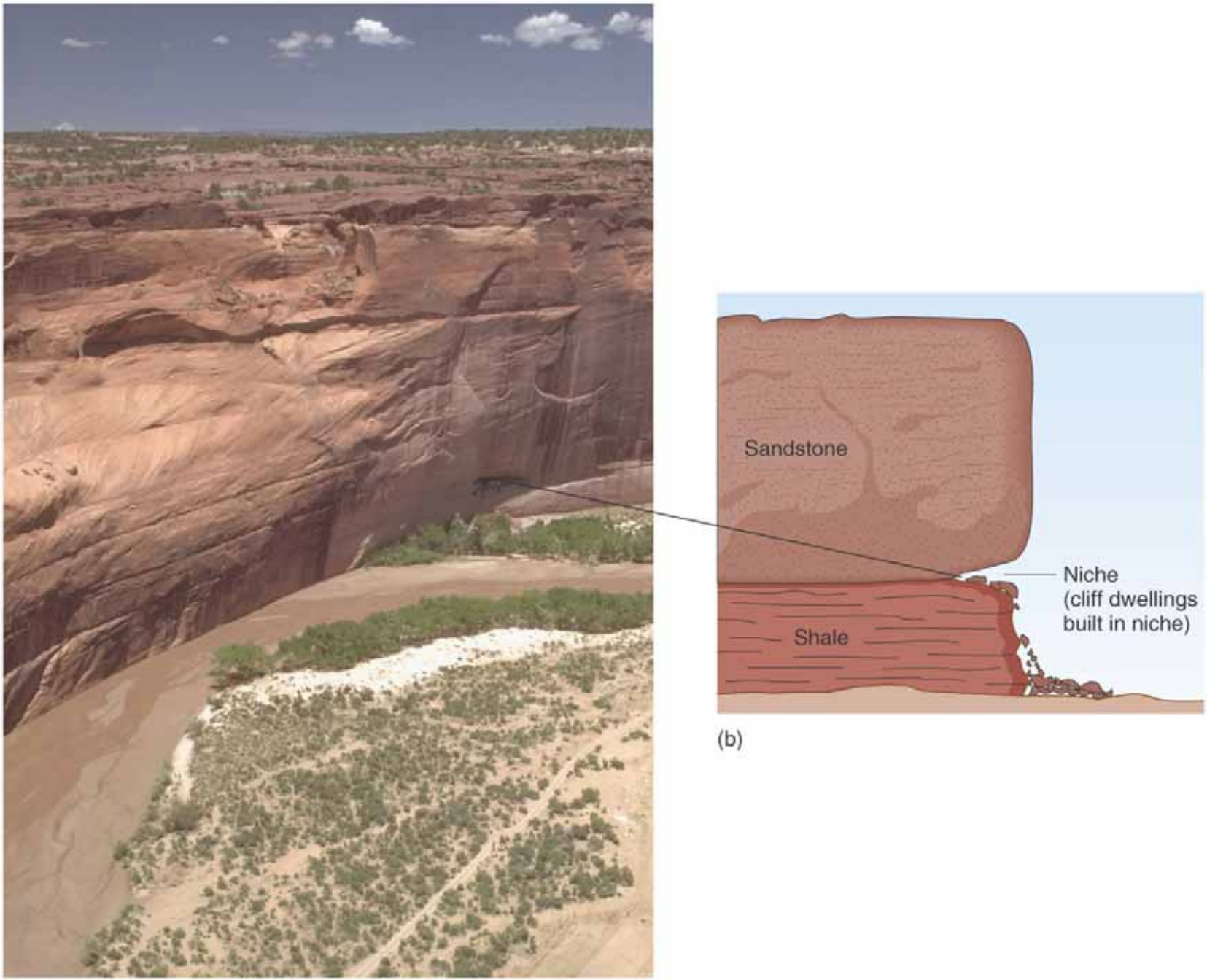
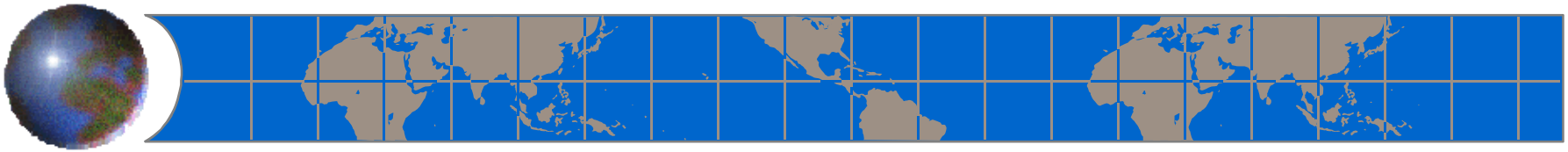


Figure 10.8



Pressure release

- Exfoliation occurs as pressure is released
- Sierras cooled 7 km under ground
- When material above is removed they expand and break apart

Exfoliation in Granite

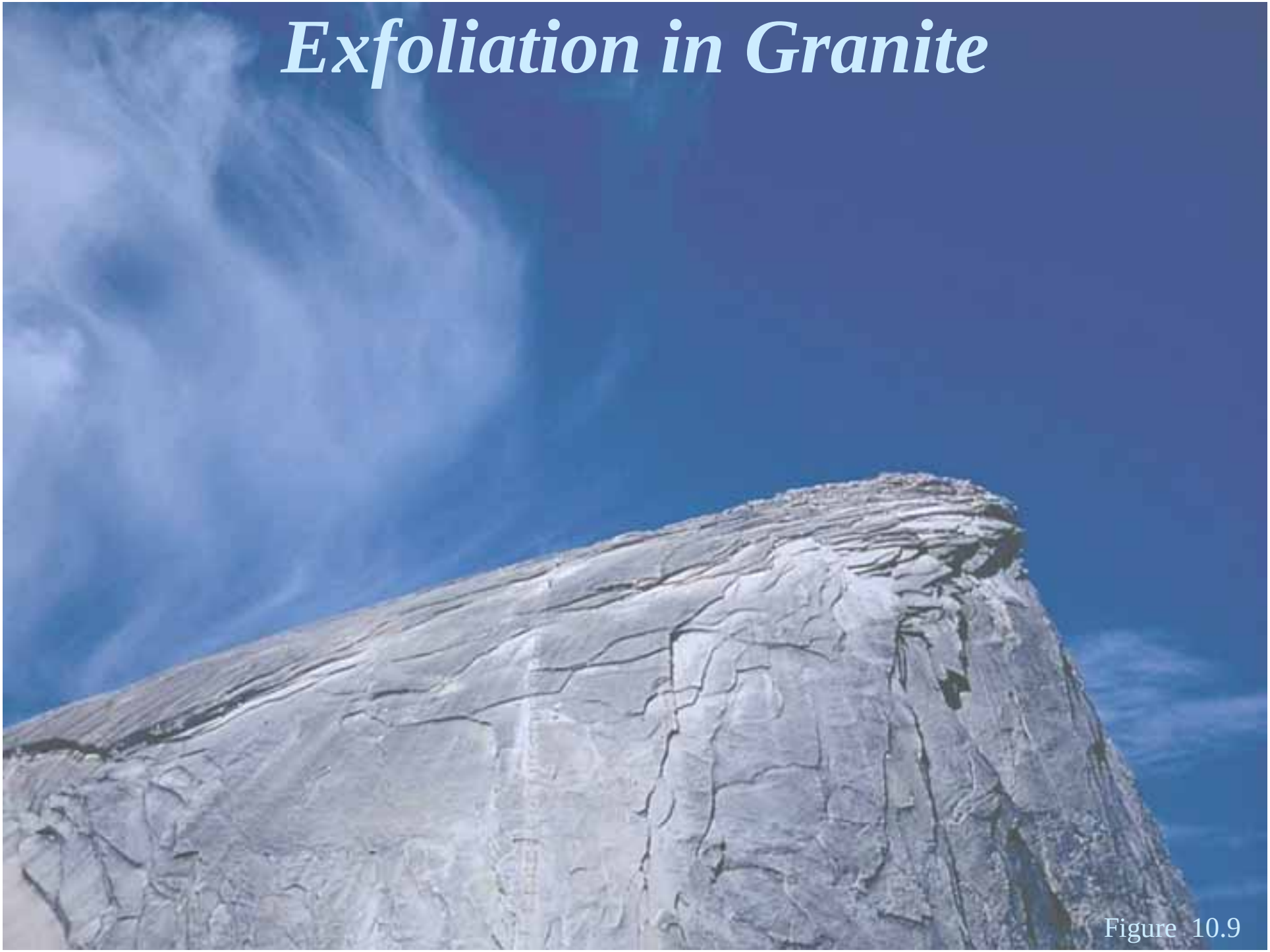


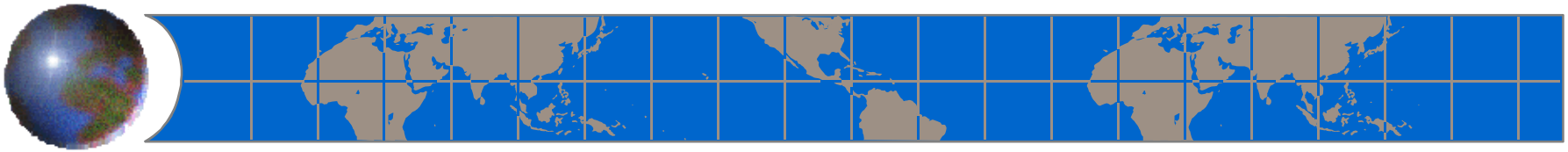
Figure 10.9

Exfoliation in Granite

Figure 10.9

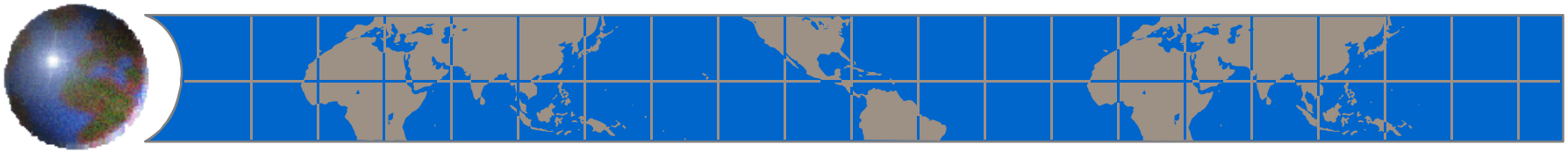
Exfoliation in Granite

Figure 10.9



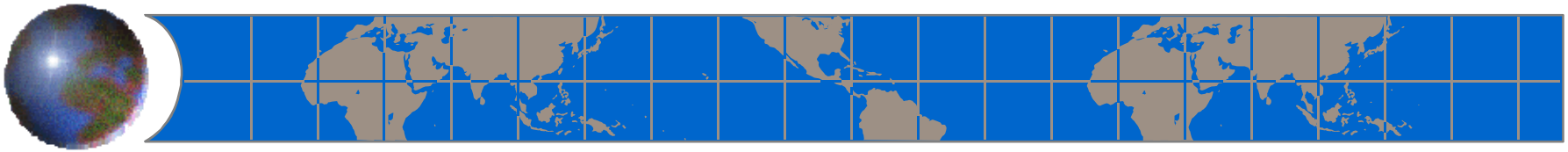
Chemical weathering

- Dissolves material
- Spheroidal weathering
- Hydration and hydrolysis
- Oxidation
- Carbonation



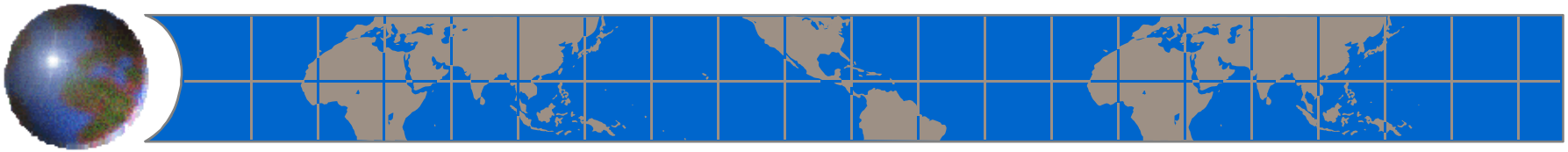
Spheroidal weathering

- Corners dissolve first
- Creates rounded landscape



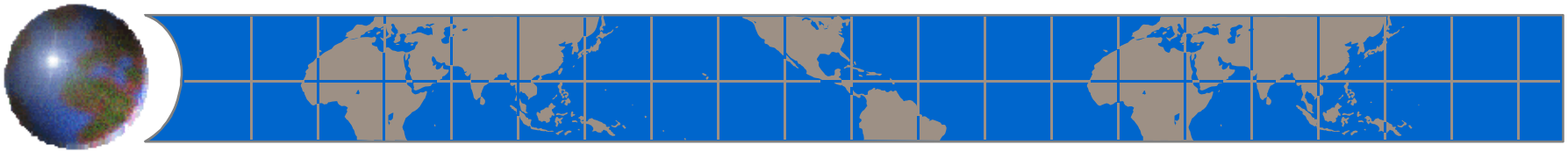
Hydrolosis

- Chemicals combine with water
- Water dissolves chemicals



Hydration

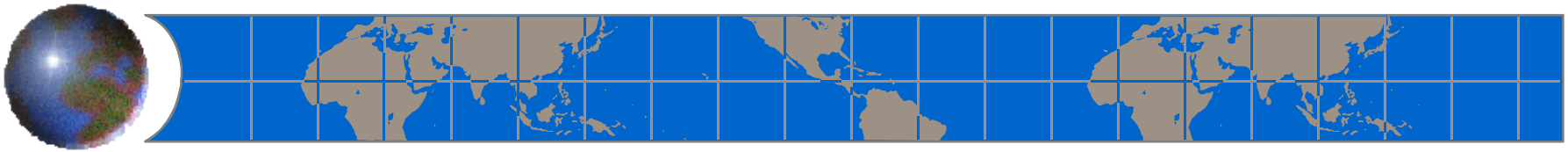
- Chemicals within rock absorb water and expand
- Internal stress forces apart rock



Carbonation

- Water combined with CO_2 makes carbonic acid
- Carbonic acid dissolves calcium
- Limestone is calcium rich and creates Karst topography
- Karst needs 80% Ca with abundant joints

Chemical Weathering



Oxidation

- Chemicals combine with oxygen
- Oxygen + chemicals = rust

Figure 10.12

Chemical Weathering

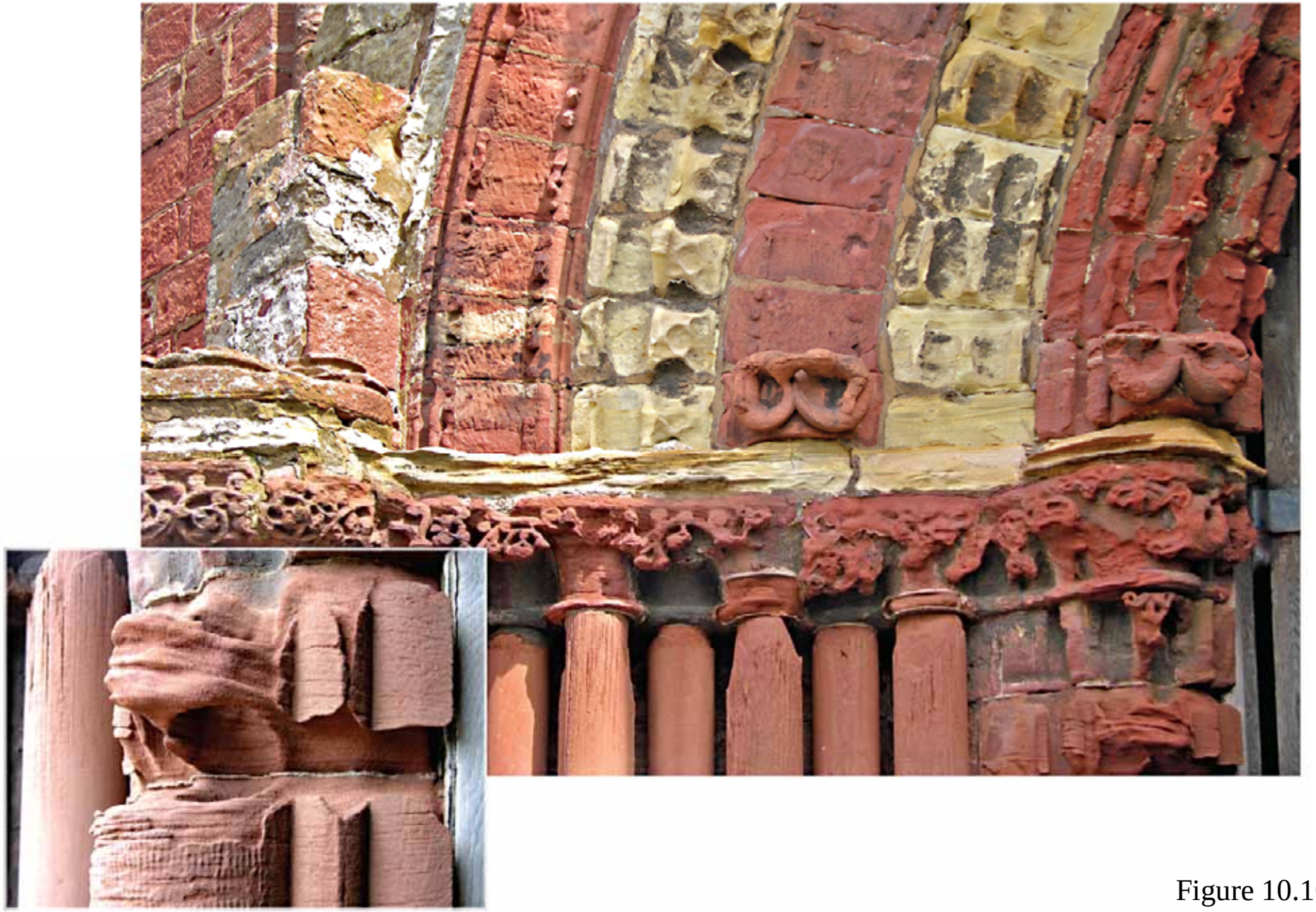
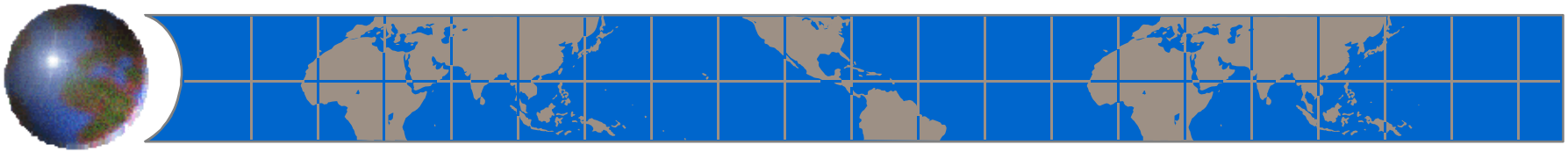


Figure 10.10



Karst Topography and Landscapes

- Formation of Karst
- Lands Covered with Sinkholes
- Caves and Caverns

Karst and Limestone Regions

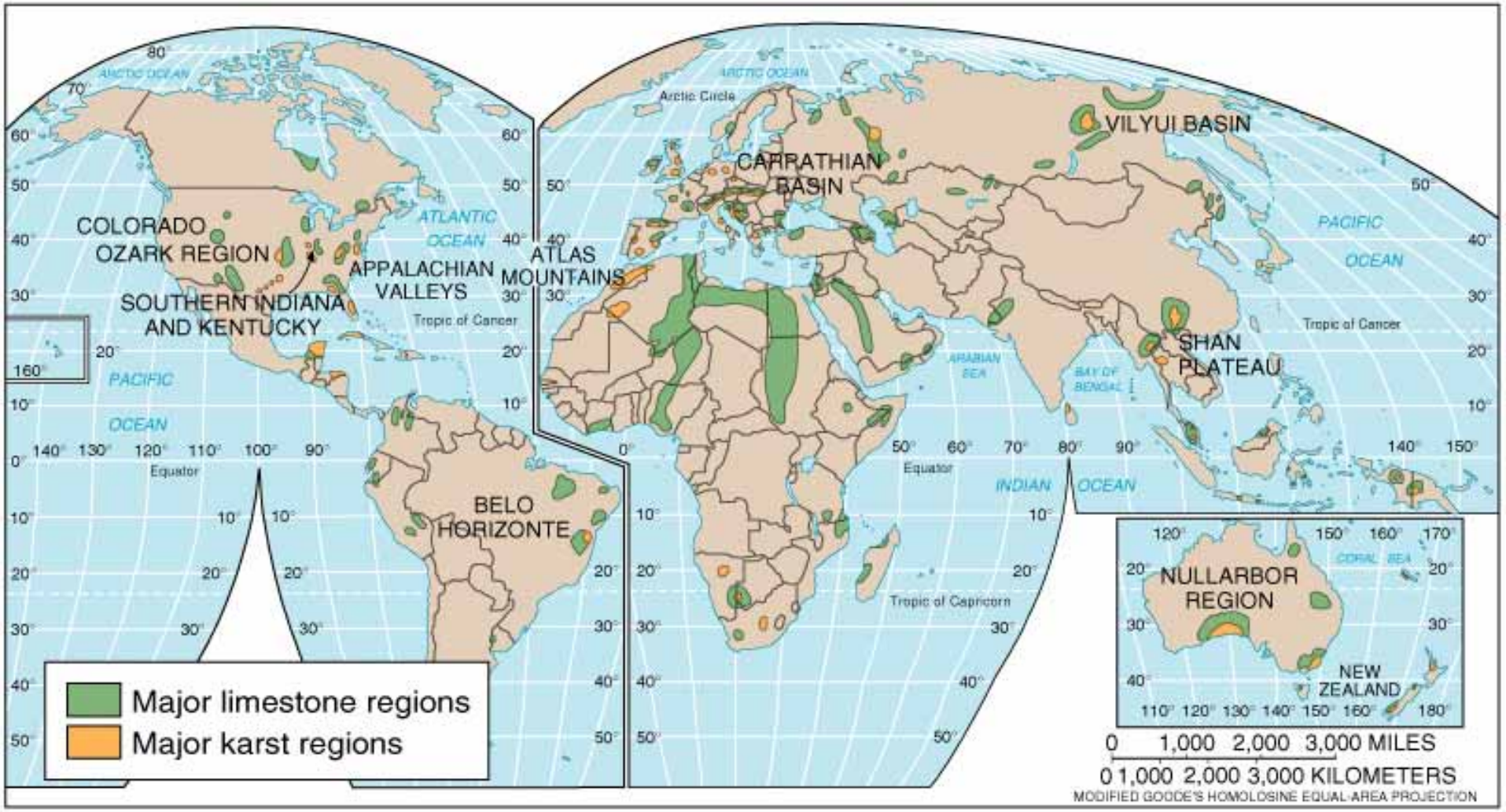


Figure 10.13


(a)
Sinkholes
Karst valley
Disappearing streams
Deeply entrenched permanent stream
Karst valley
Limestone
Shale
(b)
Indiana
Orleans
0 50 100 MILES
0 50 100 KILOMETERS
(c)
(d)
(e)

Figure 10.14

Sinkholes

Figure 10.15

Cavern Features

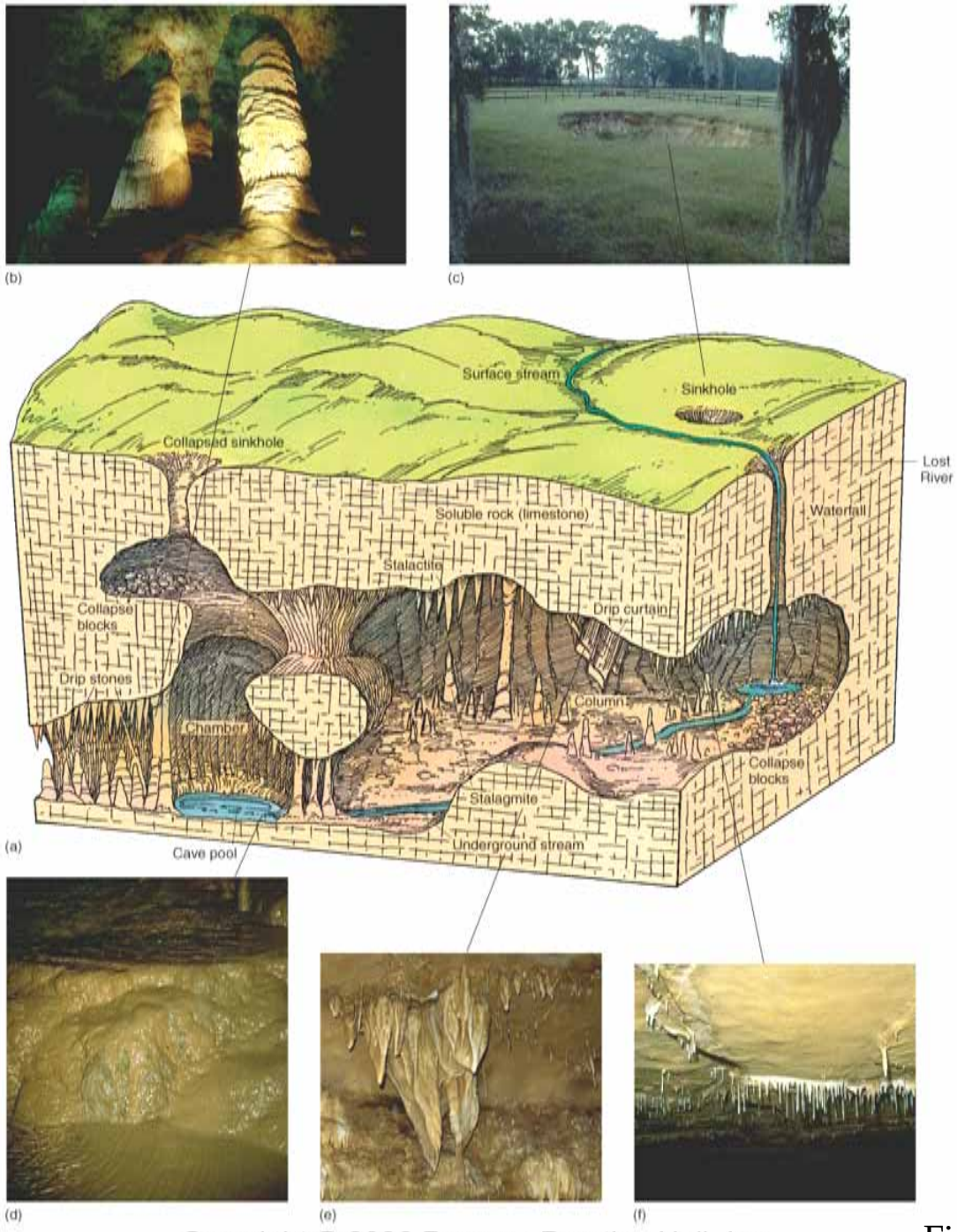
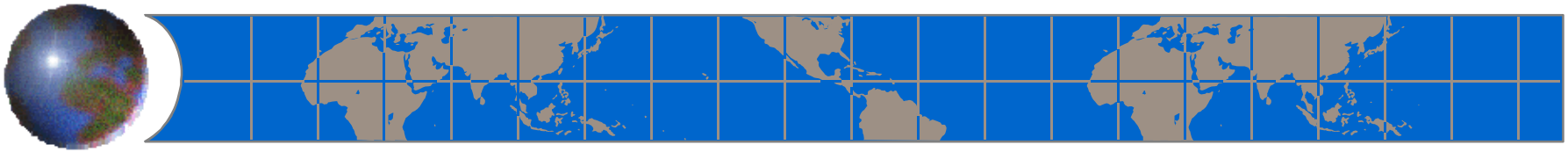


Figure 10.17



Mass Movement Processes

- Mass Movement Mechanics
  - The role of slopes
- Classes of Mass Movements
  - Falls and avalanches
  - Landslide
  - Flow
  - Creep
- Human-Induced Mass Movements

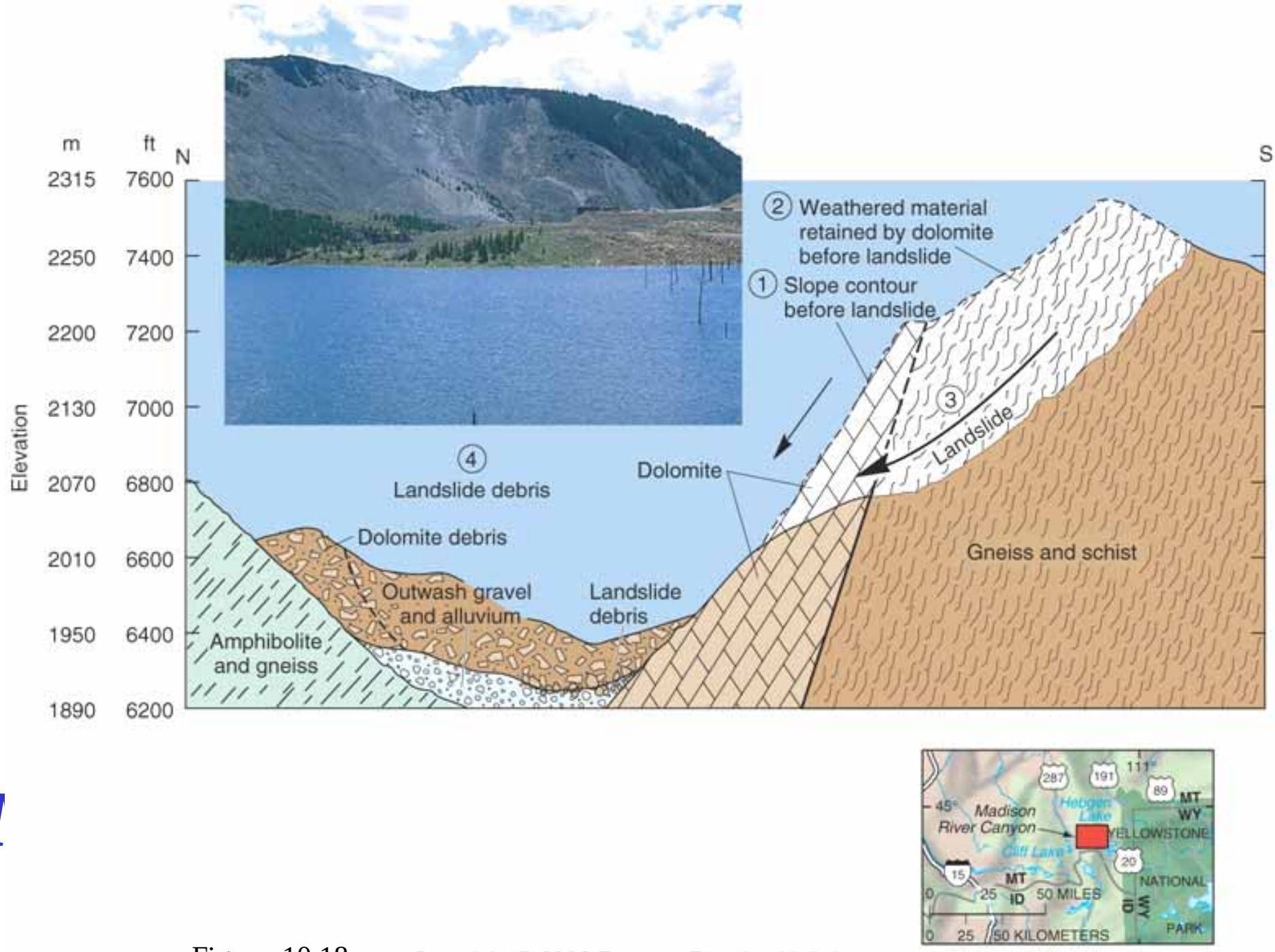


Figure 10.18

Mass Movement Classes

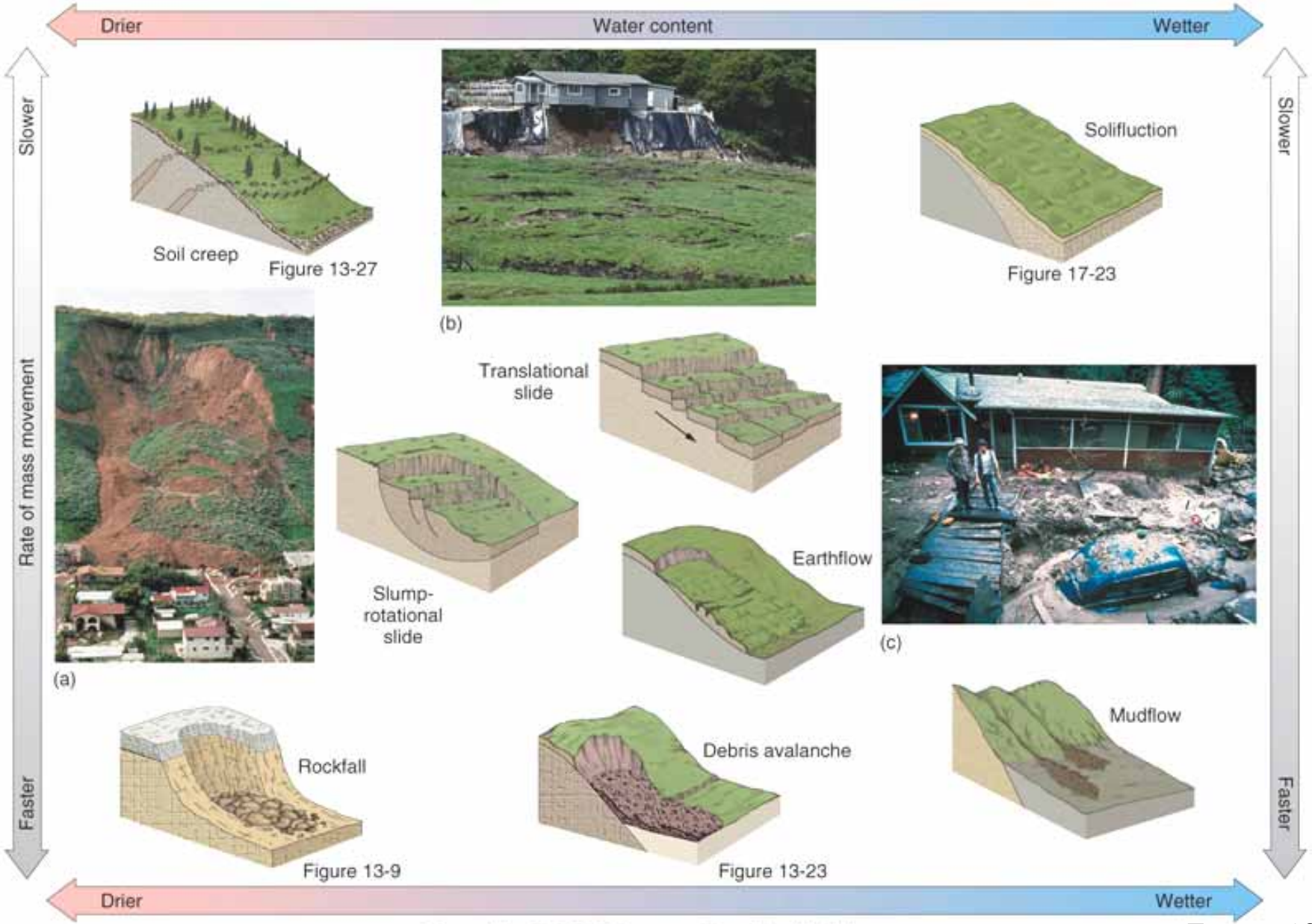
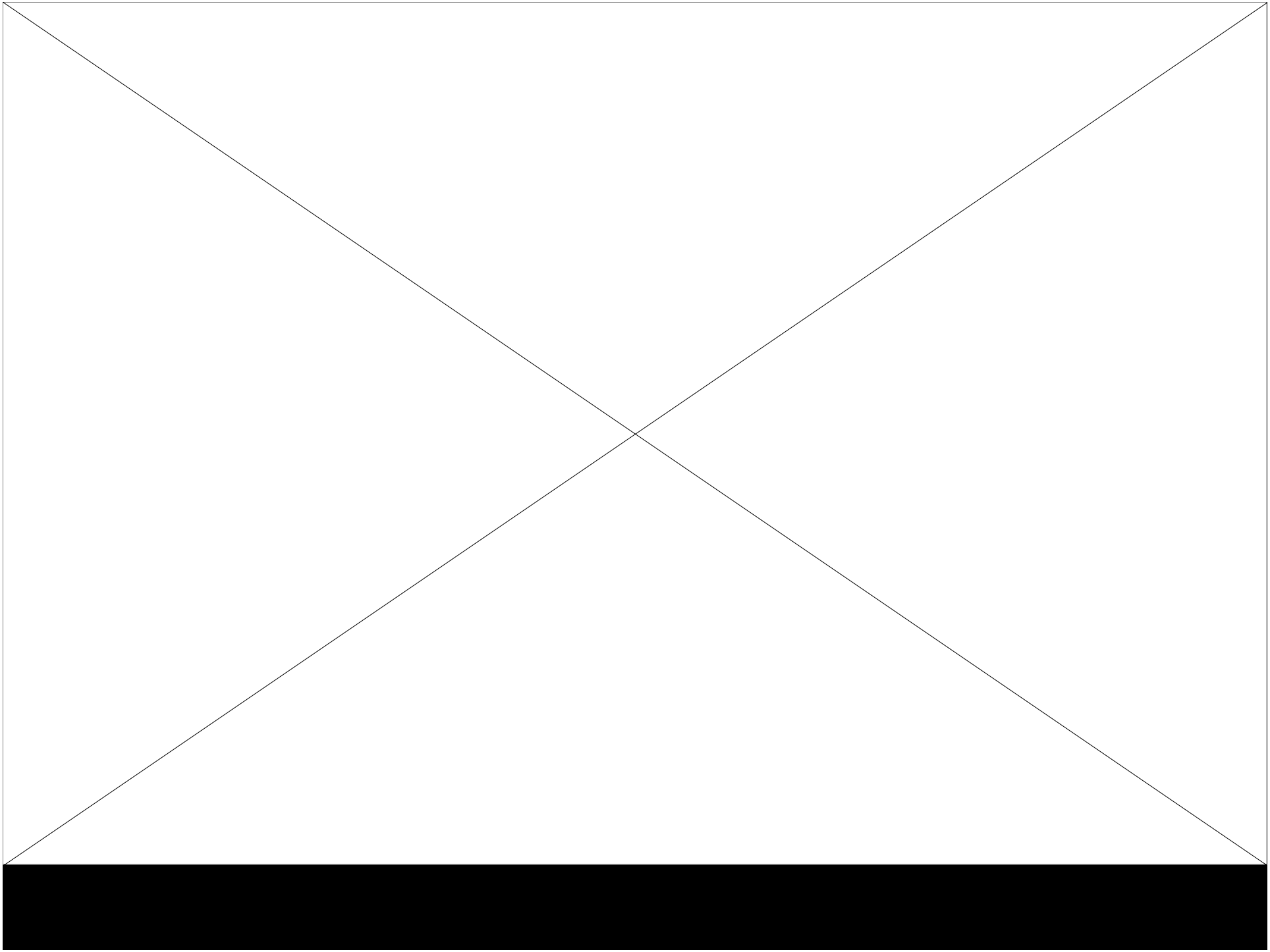
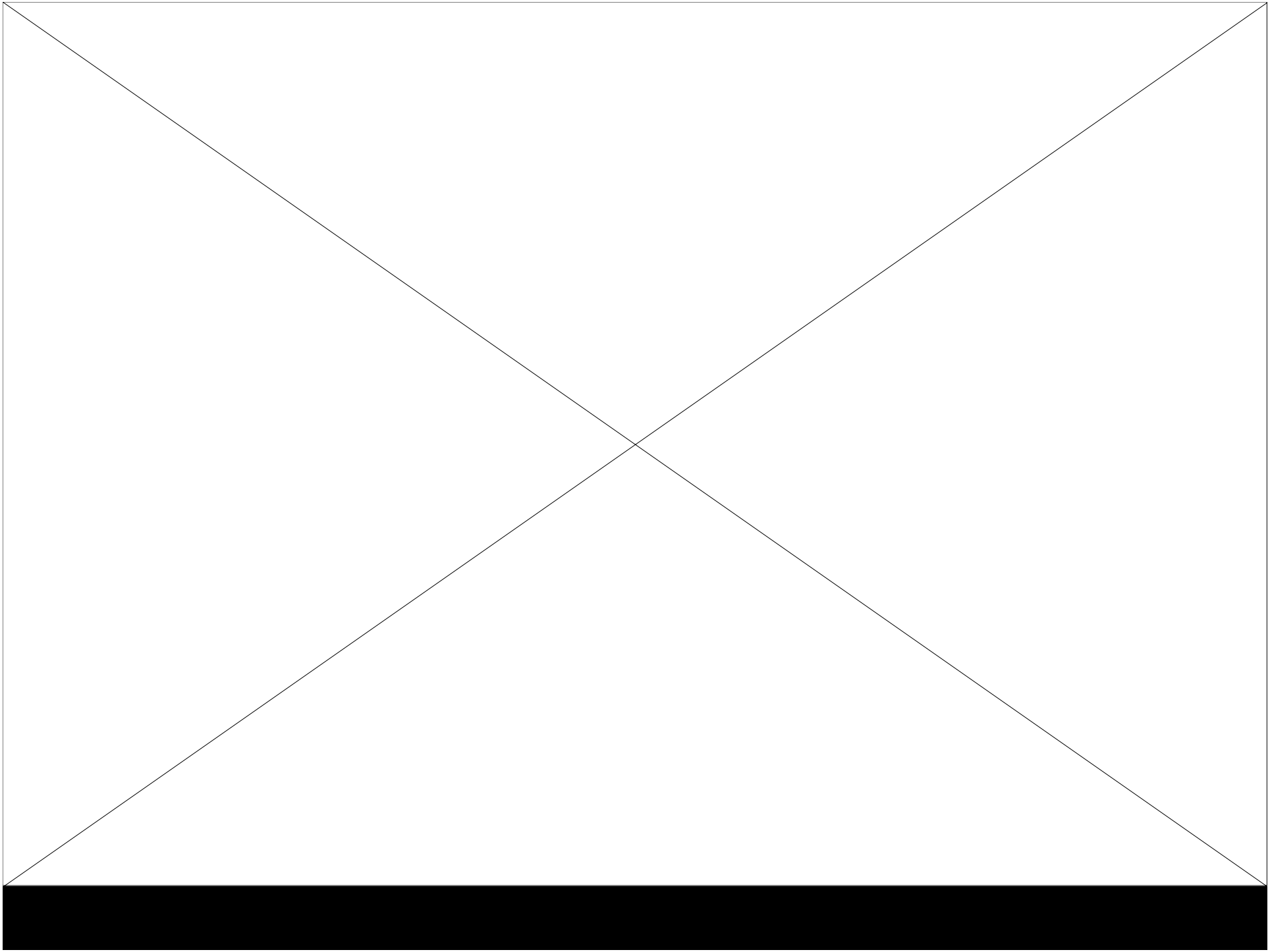


Figure 10.19





Talus Slopes

Figure 10.20

Debris Avalanche, Peru

Figure 10.21

Debris Avalanche

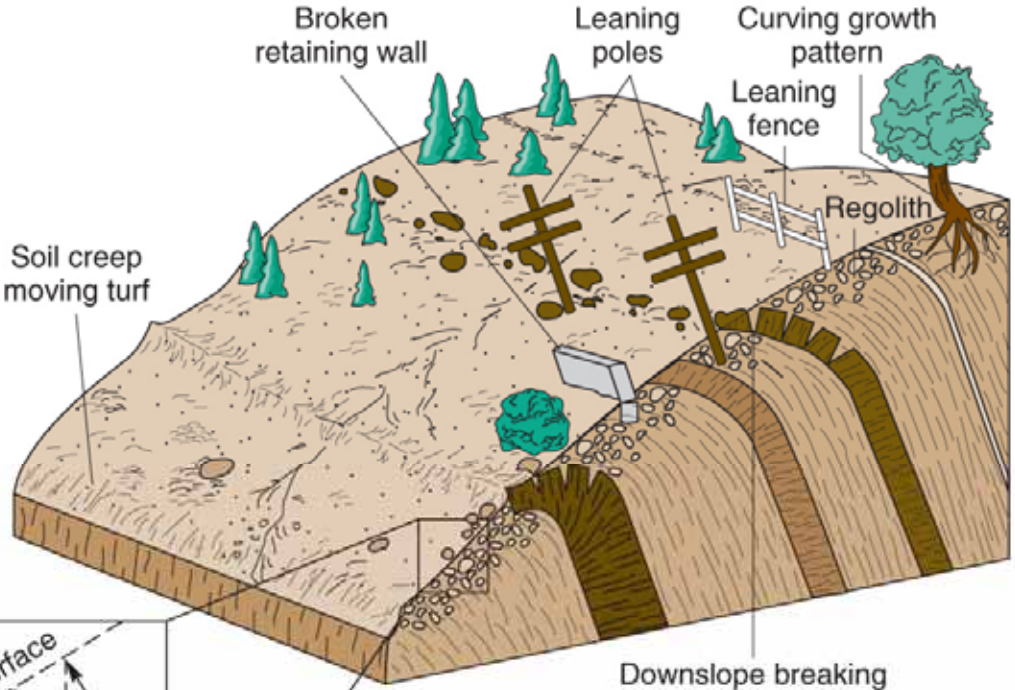
Figure 13.24

Gros Ventre Slide, Wyoming

Figure 10.22

Soil Creep

(b)



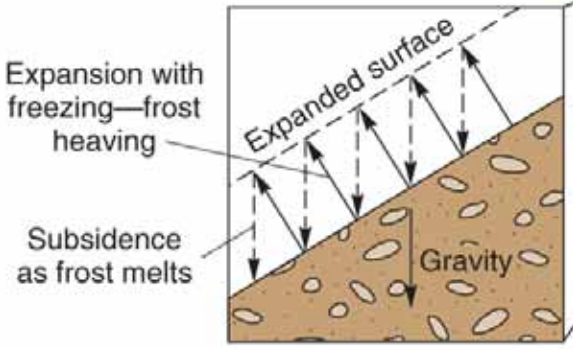


Figure 10.23

Solifluction

Figure 17.23

Scarification

(a)

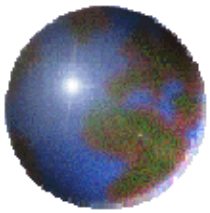
(b)

(c)

(d)

Figure 10.24

End of Chapter 10



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