

# 14

## Physiographic Provinces

*Madley Deline*

### 14.1 INTRODUCTION

If you took a road trip across the continental United States of America you would see significant changes in the landscape in terms of the topography, rocks, soils, geological structures, and plant life that are evident even through the car window on the highway. Regions vary in their geologic history, from the rocky coastline of New England, to the flat plains of the Midwest, to the sharp peaks of the Rocky Mountains, to the volcanoes of the Pacific Northwest, these (and the many other) observable differences across the United States can be broken into **physiographic provinces**. Physiographic provinces are identifiable by their distinctive landforms, geologic features, and suites of rocks.

You can observe such diverse geologic characteristics across the state of Georgia from the foothills of the Appalachian Mountains in the North, to the iconic red clay of Middle Georgia, to the flat Coastal Plain. As we discuss the physiographic provinces of Georgia, we will also explore regional geologic resources that benefit the state as well as the major river systems that provide water for our state. Lastly, the tools and knowledge you have gained in this lab manual will aid your reconstruction of the various physiographic province geologies.

#### 14.1.1 Learning Outcomes

After completing this chapter, you should be able to:

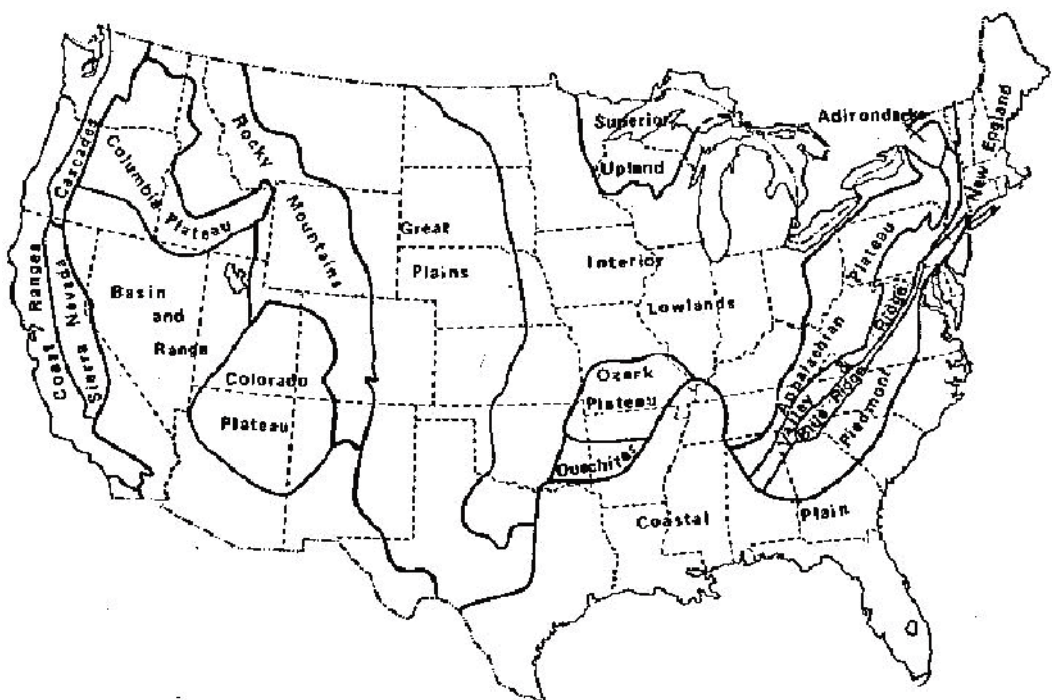
- Distinguish the different physiographic provinces of the United States based on their topography, geology, and other features
- Identify the physiographic features of the different geological provinces of Georgia
- Describe the major natural resources within Georgia including minerals, building rock, and water

### 14.1.2 Key Terms

- Adirondack Mountains Province
- Appalachian Plateau Province
- Basin and Range Province
- Blue Ridge Province
- Cascade Range
- Coastal Plain
- Colorado Plateau
- Columbia Plateau
- Fall Line
- Great Plains Province
- Interior Lowlands Province
- New England Province
- Physiographic Province
- Piedmont Province
- Rocky Mountains
- Sierra Nevada Range
- Valley and Ridge Province

## 14.2 PHYSIOGRAPHIC PROVINCES OF THE UNITED STATES OF AMERICA

The physiographic provinces of the United States of America can be broken into three different broad areas: Western, Central, and Eastern regions (Figure 14.1). Adjacent provinces will share features or will at least be affected by the geologic events that define the nearby region. The Western Provinces are shaped by relatively young events (Post-Paleozoic), which are mostly the result of an active plate tectonic margin (the edge of the continent is also the edge of a tectonic plate).



**Figure 14.1** | Physiographic provinces of the continental United States of America.

Author: User "Kbh3rd"

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The Eastern Provinces are a mix between young and old geologic events. Most of the individual provinces within this region result from the deformation of ancient mountain building as well as the recent passive sedimentary buildup observable today. Since the Central Provinces of the country has been largely shielded from tectonic activity, this area is flatter and less deformed than the United States' coasts. Before the individual provinces are discussed in depth, it will be helpful to review the geologic time scale that was presented in Chapter 1.

### 14.2.1 Western U.S.

The geologic provinces in the Western United States occupy roughly a third of the country and stretch from the Rocky Mountains to the Pacific Ocean. We can group this tectonically active area into four types of provinces: the Rocky Mountains, the Coastal Pacific Mountain System, Interior Plateaus, and the extensional Basin and Range.

The **Rocky Mountains** are an immense range that stretches from New Mexico to Northern Canada. The Rocky Mountains first started to form during the Late Paleozoic, but their main growth occurred during the Laramide Orogeny during the Late Mesozoic and Early Cenozoic. An orogeny is a large-scale deformational event that is the result of the interaction between tectonic plates, in short it is mountain building. The formation of this range differs from the Continent-Continent convergent boundaries, like the Himalayas you studied in Chapter 4. The Rocky Mountains are the result of low-angle subduction, which caused deformation in the overlying plate. This striking mountain range is no longer active nor growing and has since been glaciated and eroded, which has rounded its highest peaks.

The Pacific Coast Mountains stretch from Mexico to the Arctic Circle in Alaska. Not only do the Pacific Coast Mountains differ significantly from the Rocky Mountains, but the mountain ranges within the Coastal Pacific Mountain System as also differ amongst themselves. The **Sierra Nevada Range** runs 400 miles across the middle of California and contains iconic features such Yosemite's Half Dome, which is a mecca for mountain climbers (Figure 14.2). As with the Rocky Mountains, the Sierra Nevada Range is the byproduct of convergence and subduction. During the same time as the growth of the Rocky Mountains (Late Mesozoic), the subduction led to the formation of volcanoes and the intrusion of massive granite batholiths. The volcanoes have long since eroded away exposing the batholiths at the surface. The Sierra Nevada topography is relatively recent (within the last 5 million years), as these rocks have been deformed by extensional stress, creating large fault blocks that build the steep face of the range. The **Cascade Range**



**Figure 14.2** | Half Dome at Yosemite National Park, which is part of the Sierra Nevada Range.

**Author:** Arian Zwegers

**Source:** Wikimedia Commons

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is the northern portion of the Pacific Coast Mountain Range that spans an area from Northern California to Canada. The Cascade Range is the result of modern subduction of the Juan de Fuca and Gorda Plates under the North American Plate. Whereas the Sierra Nevada range is the eroded exposed core of a Mesozoic chain of volcanoes, the Cascade Range is modern and active. This chain encompasses thousands of volcanoes including well-known landmarks such as Mount Rainier and Mount Saint Helens.

Between the Rocky Mountains and the Pacific Coast Mountain Range is a large broad area containing a great diversity of geologic features. The Northernmost portion between the Cascades and the Rocky Mountains is the **Columbia Plateau**. The Columbia Plateau is a large igneous province dominated by Cenozoic volcanic rocks



**Figure 14.3** | Hot Spring in Yellowstone National Park within the Columbia Plateau Province.

**Author:** User "daveynin"

**Source:** Flickr

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that are a product of the Yellowstone Hotspot. This hotspot produced several massive, though infrequent, eruptions; the largest eruption covering over 50,000 square miles. The Yellowstone Hotspot is still active and supplies the heat that feeds the classic geysers and hot springs throughout Yellowstone National Park (Figure 14.3). Southeast of this province is the **Colorado Plateau**, which is a broad flat expanse that considering its neighboring provinces, is remarkably undeformed. The Colorado Plateau is mostly composed of horizontal Paleozoic and Mesozoic sedimentary rocks that contain abundant fossils, including the massive bone beds

of Dinosaur National Monument. During the Laramide Orogeny this area was dramatically uplifted, allowing rivers to erode downward thus producing immense canyons, such as Grand Canyon National Park. The southeastern portion of the expanse between the Mountain Ranges is called the **Basin and Range Province**. This area can easily be recognized by the abundant Horsts and Grabens. Which you may remember are series of elevated plateaus and low basins produced from the extensional deformation of abundant paired and mirrored normal faults. There are multiple hypotheses for the source of the extension, which range from heating from the mantle to movement along the San Andres Fault.

### 14.2.2 Eastern U.S.

The physiographic provinces that occupy the eastern third of the country range from New England to Texas, wrapping around the Gulf of Mexico. These provinces can easily be split into three regions, such as the provinces associated with the building of the Appalachian Mountains, provinces built by much older orogenies in the Northeast, and provinces created from more recent passive build-up of sediments along the coast.



The Appalachian Mountains are the product of multiple collisions with small island chains during the Paleozoic, culminating with a collision with the supercontinent of Gondwana during the formation of Pangaea. These ancient mountains have been significantly eroded down to rolling hills that span most of the Southeastern United States as seen in Great Smoky Mountains National Park (Figure 14.4). The Appalachian Mountains can be further divided into four distinctive physiographic provinces based on their topography and geology. The center of the Appalachian Mountains is called the **Valley and Ridge**



**Figure 14.4** | Appalachian Mountains within Great Smoky Mountains National Park, which contains multiple physiographic provinces.

**Author:** Ernest Duffo

**Source:** Flickr

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**Province**, which is composed of highly folded and faulted sedimentary rock. Fossils within these rocks indicate that they are Paleozoic in age with thick and resistant Pennsylvanian-age sandstones forming its ridges while weaker Devonian and Cambrian shales forming its valleys. To the east of the Valley and Ridge is the **Blue Ridge Province**, which was uplifted along with the Valley and Ridge but is composed of much older igneous and metamorphic rock. Absolute dating of these rocks indicates that the Blue Ridge was formed during the Proterozoic and later deformed during the Middle Paleozoic. The topography between these two provinces differs with the more uniform rocks in the Blue Ridge producing random peaks, valleys, and ridges as opposed to the resistant and non-resistant rocks of the Valley and Ridge, which produce more uniformly parallel ridges.



**Figure 14.5** | Stone Mountain within the Piedmont Province.

**Author:** User "kschlot1"

**Source:** Flickr

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Southeast of the Blue Ridge is the Piedmont Province, which is typified by much lower, rolling hills along with small isolated mountains such as Stone Mountain in Georgia (Figure 14.5). The Piedmont is composed of igneous and metamorphic rock from the cores of long eroded mountain chains ranging from the Proterozoic to the end of the Paleozoic period. On the adjacent west side of the Valley and Ridge province is the **Appalachian Plateau**, which is an uplifted and largely un-deformed region analogous to the Colorado Plateau. The rocks in this province are similar in age and lithology to those in the Valley and Ridge, but the preservation of fossils is enhanced because

of the absence of extensive folding and faulting. In addition, the Appalachian Plateau contains abundant geological resources, including coal in West Virginia and iron in Alabama.

The physiographic provinces in the northeastern United States are very similar to the Piedmont and Blue Ridge Provinces. The **New England Province** is similar to the Piedmont in that it is composed of Late Proterozoic and Paleozoic intrusive igneous and metamorphic rocks. The major difference between these two provinces is in their history following exposure, with the New England Province showing extensive weathering and erosion from glaciers that is absent from its southeastern counterpart. The **Adirondack Mountain Province** located in upstate New York is similar to the Blue Ridge in that they are both composed of igneous and metamorphic rock. However, the Adirondacks are fairly unique considering that they are a circular rather than linear range of mountains. The rocks themselves are billion year old remnants of the building of a Proterozoic supercontinent called Rodinia. The actual mountains in the range are quite young and represent Late Cenozoic uplift, which exposed these ancient rocks.

The last eastern physiographic province is the **Coastal Plain** that spans a vast area along the Atlantic Ocean and Gulf of Mexico from New England to Texas. This province is composed of the sediment that has accumulated since the rifting of Pangaea when the eastern edge of the continent became tectonically inactive. The sediment was derived from the continent and was deposited in shallow marine sedimentary environments with abundant, mature sediment and marine fossils.

### 14.2.3 Central U.S.

The central third of the country is mostly flat, un-deformed, and dominated by sequences of sedimentary rocks. We separate this broad expanse into two physiographic provinces based largely on the source of the sediment. The **Interior Lowlands Province** covers the Midwestern states and consists largely of un-deformed Paleozoic marine rock (limestones and shales) that have been since carved and shaped by the activity of glaciers and rivers. This description may not seem as geologically exciting as those



to the east or west, but spectacular cave developments can occur in these marine limestones, such as those from Mammoth Cave, Kentucky (Figure 14.6). To the west of the Interior Lowlands Province is the **Great Plains Province**, which is composed of sediments that eroded from the Rocky Mountains and are, therefore, substantially younger (Mesozoic and Cenozoic) with a higher proportion of clastic material. As with Interior Lowlands, the Great Plains have since been shaped by glaciers and rivers.

**Figure 14.6 |** Mammoth Cave National Park in Central Kentucky.

**Author:** Gary Tindale

**Source:** Flickr

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## 14.3 LAB EXERCISE

### Materials

We will explore the various physiographic provinces of the United States of America by looking closely at the National Parks that showcase iconic geologic and topological features within each region. For each park, examine the area using Google Earth. To get a better view of the features, making sure to zoom in and out and also click on multiple photographs posted (make sure that photos are checked in the layers box). More information about these and other parks can be found at [www.nps.gov](http://www.nps.gov).

This lab is also cumulative in that you may need to review the material presented in previous chapters to answer the following questions.

### Part A – National Parks

#### *Crater Lake National Park*

Crater Lake National Park (Figure 14.7) is located in southern Oregon and was established as a National Park in 1902. The main attraction at this park is Crater Lake which at almost 2,000 feet is one of the deepest lakes on Earth. Search for 42 50 33.15N 122 06 14.89W and zoom out to an eye altitude of 15 miles.



**Figure 14.7** | Crater Lake National Park, Southern Oregon.

**Author:** Ray Bouknight

**Source:** Flickr

**License:** CC BY 2.0

1. What type of volcano is Crater Lake?
  - a. Composite Volcano
  - b. Shield Volcano
  - c. Caldera
  - d. Cinder Cone
  
2. What is the origin of this volcano?
  - a. Subduction of an oceanic plate at a Convergent Boundary
  - b. Subduction of a continental plate at a Convergent Boundary
  - c. Development of a Hotspot
  - d. Continental Rifting

3. Crater Lake National Park is located in which of the following physiographic provinces?

- a. Rocky Mountains
- b. Sierra Nevada
- c. Cascades
- d. Columbia Plateau
- e. Colorado Plateau
- f. Basin and Range

*Theodore Roosevelt National Park*

Theodore Roosevelt National Park (Figure 14.8) is located in North Dakota and was established as a National Park 1978. This park was named after Theodore Roosevelt in honor of his conservation policies that led to the establishment of the National Park System. Following the death of his wife, Roosevelt spent several years in the area that would ultimately become the park, during which time he wrote extensively about the lonely beauty of the surrounding landscape. Search for 46 58 52.55N 103 32 13.91W and zoom out to an eye altitude of 30,000 feet.



**Figure 14.8** | Theodore Roosevelt National Park, North Dakota.

Author: User "stereogab"

Source: Flickr

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4. What is the prominent drainage pattern in this park?

- a. Radial
- b. Trellis
- c. Rectangular
- d. Dendritic

5. One of the main attractions at this park is a forest of large petrified trees. These trees were preserved by being replaced with silica from ash layers within the Triassic (Mesozoic) sandstones. Based on the geologic history and features of the area, which of the following statements about these sedimentary rocks is TRUE?

- a. The clastic sand that forms these rocks was weathered and eroded from the Appalachian Mountains.
- b. The ash was produced from volcanoes associated with the Yellowstone Hotspot.
- c. The clastic sand that forms these rocks was weathered and eroded from the Rocky Mountains.
- d. The clastic sand that forms these rocks was weathered and eroded from the Sierra Nevada Mountains.



6. Theodore Roosevelt National Park is located in which of the following physiographic provinces?

- a. Rocky Mountains
- b. Colorado Plateau
- c. Interior Lowlands
- d. Great Plains
- e. Basin and Range
- f. Columbia Plateau

#### *Acadia National Park*

Acadia National Park (Figure 14.9) is located in Southern Maine and was preserved as a National Park in 1916. This was the first park established east of the Mississippi River and helped Maine gain the nickname “Vacationland”. Search for 44 21 09.94N 68 13 23.22W and zoom out to an eye altitude of 3,000 feet.



**Figure 14.9** | Acadia National Park in Southern Maine.

**Author:** Ken Lund

**Source:** Flickr

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7. Based on the history of the region containing Acadia National Park and the color of the rocks, what type of igneous rock occur in this area?

- a. Gabbro
- b. Granite
- c. Rhyolite
- d. Andesite
- e. Diorite

8. What type of igneous body does this structure represent?

- a. Stock
- b. Dike
- c. Sill

9. Acadia National Park is located in which of the following physiographic provinces?

- a. Interior Lowlands
- b. Adirondacks
- c. Great Plains
- d. Appalachian Plateau
- e. New England
- f. Piedmont

*Congaree National Park*

Congaree National Park (Figure 14.10) is located in South Carolina and was recently established as a National Park in 2003. Unlike most National Parks, this area was preserved for reasons other than geology. Congaree contains the oldest tract of old growth hardwood forest left in the United States. This lush ecosystem contains a diverse assemblage of animals, fungi, and plants. Search for 33 47 57.63N 80 47 49.79W and zoom out to an eye altitude of 35,000 feet.



**Figure 14.10** | Congaree National Park in South Carolina.

**Author:** Miguel Vieira

**Source:** Flickr

**License:** CC BY 2.0

10. What is the maturity of the river in this area?
  - a. Youthful
  - b. Mature
  - c. Old Age
  
11. Zoom out to an eye altitude of 500 miles to see the source of the sediment that is accumulating in this area. This sediment is \_\_\_\_\_ and if lithified would be called \_\_\_\_\_.
  - a. Immature, Conglomerate
  - b. Intermediate, Sandstone
  - c. Mature, Shale
  
12. Congaree National Park is located in which of the following physiographic provinces?
  - a. Interior Lowlands
  - b. Blue Ridge
  - c. Piedmont
  - d. Coastal Plain
  - e. New England

*Shenandoah National Park*

Shenandoah National Park (Figure 14.11) is located in Virginia and was established as a National Park in 1935. This park, which is located close to Washington, D.C., is a favorite of hikers containing 101 miles of the Appalachian Trail, which runs from Northern Georgia to Maine. Search for 38 17 53.72N 78 40 26.42W and zoom out to an eye altitude of 25,000 feet.



**Figure 14.11** | Shenandoah National Park in Virginia.

**Author:** Beau Considine

**Source:** Flickr

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13. Look over the region and examine the mountains, note their shape, ground cover, and height. Then Search for 43 48 25.03N 110 50 26.19W to examine Grand Tetons National Park. How do the Shenandoah Mountains compare to the Rocky Mountains?

- a. The Shenandoah Mountains are shorter.
- b. The Shenandoah Mountains are more rounded.
- c. The Shenandoah Mountains have more vegetation.
- d. All of the above.

14. Based on these observations, we can conclude that the mountains in Shenandoah National Park have undergone \_\_\_\_\_ erosion and are \_\_\_\_\_ the Rocky Mountains.

- a. more, older than
- b. less, younger than
- c. the same amount of, the same age as

15. Shenandoah National Park is located in which of the following physiographic provinces?

- a. Blue Ridge
- b. Piedmont
- c. Appalachian Plateau
- d. Valley and Ridge
- e. Adirondack

*Black Canyon of the Gunnison National Park*

Black Canyon of the Gunnison National Park (Figure 14.12) is located in Western Colorado and was established as a National Park in 1999. This park is often overshadowed by the Grand Canyon, but is striking in its own right. The Gunnison River has a high gradient which has produced an incredibly steep canyon. In fact, it is called Black Canyon not because of the color of the rocks, but because of the dark shadows produced by the steep walls of the canyon. Search for 38 34 43.18N 107 43 43.74W and zoom out to an eye altitude of 30,000 feet.



**Figure 14.12** | Black Canyon of the Gunnison National Park in Colorado.

Author: User "daveynin"

Source: Flickr

License: CC BY 2.0

16. What type of weathering is primarily responsible for the formation of this canyon?
- Frost wedging
  - Chemical weathering
  - Mechanical weathering from air
  - Mechanical weathering from water
17. We can measure the rate of erosion in this canyon at about 0.01 inches/year. Based on this rate, when did the canyon start to erode? (Hint: Measure the difference in elevation from the bottom of the canyon at the latitude and longitude given above and the top, measured at the road on the edge of the canyon due south of the previous point. Then divide by the rate of erosion. Make sure to use the correct units.)
- 750,000 years
  - 1,200,000 years
  - 2,700,000 years
  - 3,500,000 years
18. Black Canyon of the Gunnison National Park is located in which of the following physiographic provinces?
- Blue Ridge
  - Colorado Plateau
  - Appalachian Plateau
  - Rocky Mountains
  - Basin and Range
  - Columbia Plateau

## 14.4 GEOLOGY OF GEORGIA

Georgia is a wonderful natural laboratory for the study of geology. The rocks within this state span over a billion years of history and through this lens we can study all of the topics presented within this lab manual. Within the state we have mountains, coastlines, folds, faults, earthquakes, fossils, a diversity of rocks, and evidence for ancient volcanic eruptions. As would be expected with this geologic diversity, Georgia contains multiple physiographic provinces (Figure 14.13) that have been discussed above.

The northwestern portion of the state is within the Valley and Ridge Province and shows the characteristic sandstone ridges with folded and deformed shale within valleys. As you might expect, the shale is relatively soft (which is why they show more deformation) and erodes quickly underneath the massive sandstones. This causes the sandstones to break and tumble



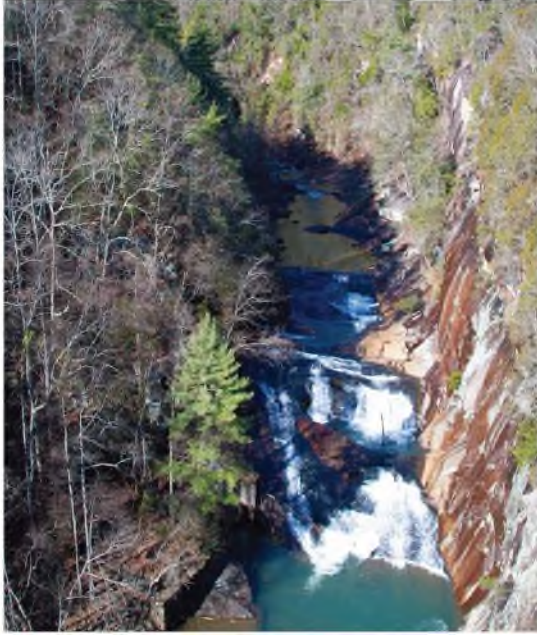
**Figure 14.13** | Physiographic provinces of Georgia.

**Author:** USGS

**Source:** Wikimedia Commons

**License:** Public Domain





**Figure 14.14** | Tallulah Falls State Park in Northern Georgia.

**Author:** Stanislav Vitebskiy

**Source:** Flickr

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downhill making the Rock Cities that are a tourist attraction surrounding Lookout Mountain. The sands are Pennsylvanian in age and interbedded within them are thick coal deposits of ancient forests. These deposits were mined in the past, but for the most part are not currently active. The northeastern corner of the state is in the Blue Ridge physiographic province, which contains mountains consisting of ancient igneous and metamorphic rock. This area of Georgia contains large protected areas that preserve its natural beauty (such as Chattahoochee National Forest) and contains spectacular waterfalls as seen at Tallulah Falls State Park (Figure 14.14).

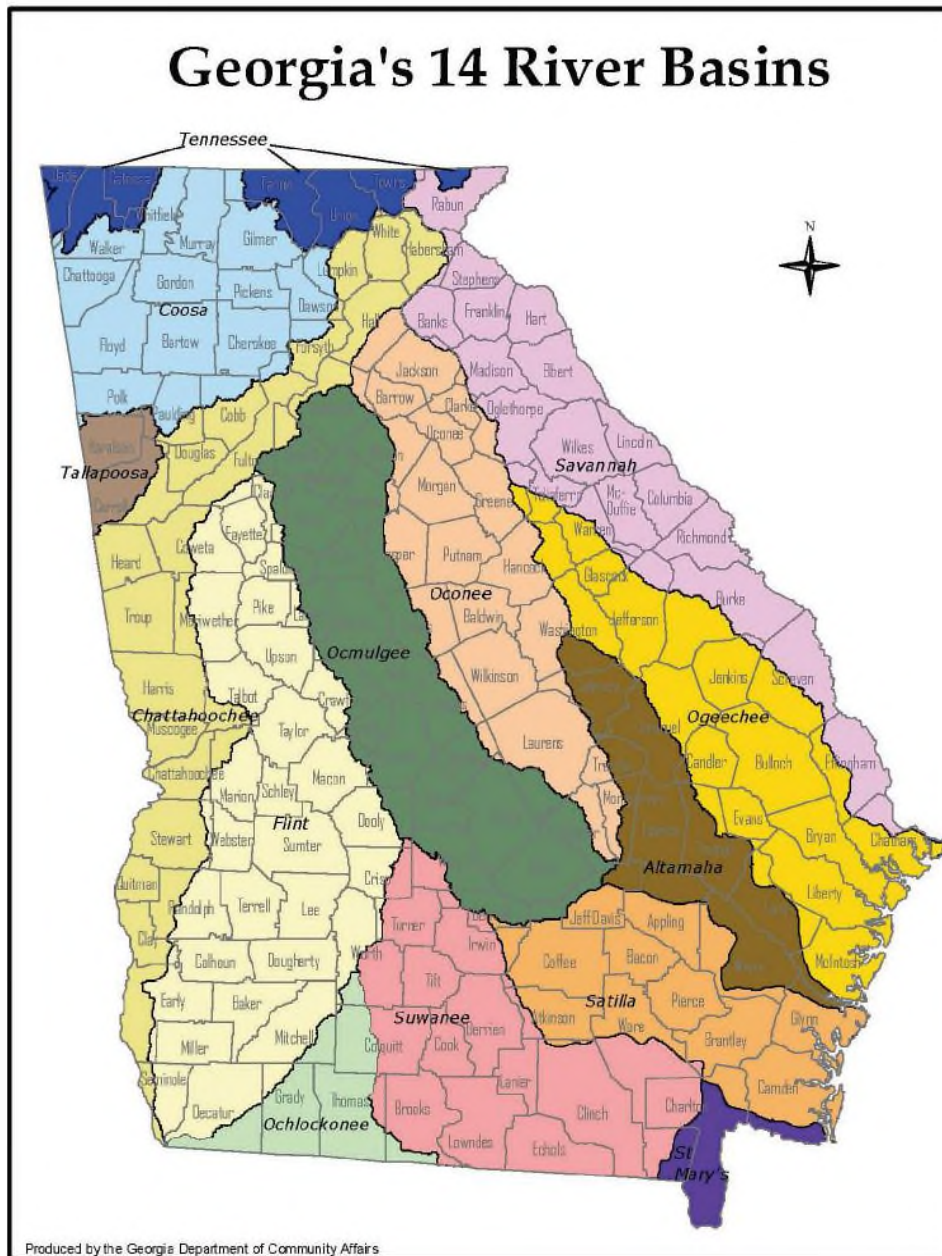
The central portion of the state is within the Piedmont Province that consists of rolling hills of igneous and metamorphic rocks punctuated with large batholiths. This re-

gion has several important geologic resources. First, the granite within the Piedmont has been mined for buildings, monuments, and memorial stones. The granite mining industry is one of the leading producers of granite within the United State, which is centered in Elberton, Georgia. The Piedmont Province has also produced gold, which can be found associated with quartz veins within saprolite (a soft and porous rock often formed by the weathering of granite). Starting around 1830, the discovery of gold in Dahlonega and Villa Rica, Georgia, led to the first major, though short-lived, gold rush.

The largest physiographic province within Georgia is the **Coastal Plain** in the southern half of the state. The transition from the Piedmont into the Coastal Plain is striking in that the topography dramatically changes from rolling hills to flat terrain. The boundary of the Coastal Plain is referred to as the **Fall Line**, which is a line of waterfalls along the boundary between the provinces caused by differences in the rate of erosion in the two provinces. The rocks and sediments in the Coastal Plain vary from Mid-Mesozoic in the central portion of the state to Late Cenozoic in the southern portion, tracking a fall in sea level through time. The Coastal Plain province has several useful geological resources. Foremost, its organic-rich soil and flat topography makes this region ideal for agriculture thus allowing for the abundant production of Georgia's staples such as peanuts, pecans, onions, cotton, and peaches. The mineral Kaolin, which is a product of the chemical weathering of feldspar, is also mined in this physiographic province. This white clay mineral is used in the production of many products including ceramics, toothpaste, cosmetics, and glossy paper—just to name a few.



However, one of the most important resources across Georgia is water. As with many parts of the country, Georgia has experienced steady population growth as well as droughts that have made discussions about water reservoirs and usage particularly vital to the future of the state. Georgia contains multiple river basins (Figure 14.15), many of which have been dammed to build large reservoirs, such as Lake Lanier. Study Figure 14.15, and identify the river basins that contain Georgia's major cities (such as Atlanta, Macon, and Savannah) as well as the river basin in which you live.



**Figure 14.15** | The major river basins within Georgia.

**Author:** Georgia Department of Community Affairs

**Source:** Upper Oconee Watershed Network

**License:** Public Domain

## 14.5 LAB EXERCISE

### Materials

Download the file “GA Geologic Cross Section N-S.gif” from your course web-site. This cross section runs north to south through the state of Georgia showing the subsurface geology across the Valley and Ridge, Piedmont, and Coastal Plain physiographic provinces. This cross section will be used to answer question 25-28. This cross-section was provided for use with permission from Geological Highway Map, Southeastern Region, American Association of Petroleum Geologists. Also, download the “Chart of Surface Time and Rock Units” legend that gives a key to the symbols and rock units included in the cross-section. We will examine the physiographic provinces of Georgia by examining a couple of Georgia’s State Parks.

### Part B – Georgia Provinces

#### *Cloudland Canyon State Park*

Cloudland Canyon State Park (Figure 14.16) is located in Dade County and was established as a park in 1938. Many of the roads and civil infrastructure within Dade County were built following the designation of this area as a state park in order to allow access to the park. Cloudland Canyon State Park has multiple waterfalls as well as some of the most scenic overlooks within Georgia, especially in autumn. Search for 34 50 44.57N 85 28 40.92W in google earth and zoom out to an eye altitude of 5,000 feet.



**Figure 14.16** | Cloudland Canyon State Park,

Dade County, Georgia.

**Author:** Moultrie Creek

**Source:** Flickr

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19. Examine the walls of Cloudland Canyon, what type of rock makes up the rim of the canyon?
  - a. Granite
  - b. Shale
  - c. Sandstone
  - d. Gneiss
  
20. Zoom out to an eye altitude of 20 miles and examine the valley 6 miles to the southeast (34 43 10.37N 85 24 55.74W at the same eye altitude). What major geologic structure can be seen in this valley?
  - a. Normal Fault
  - b. Dome
  - c. Horizontal Fold
  - d. Reverse Fault
  - e. Plunging Fold

21. Cloudland Canyon State Park is located in which of the following physiographic provinces?

- a. Blue Ridge                      b. Valley and Ridge                      c. Piedmont                      d. Coastal Plain

*High Falls State Park*

High Falls State Park (Figure 14.17) is a small park located in Butts County and was designated as a state park in 1966. This park, located between Macon and Atlanta, has the largest waterfalls in central Georgia and sits on the Fall Line. The Fall line is a line of waterfalls that is caused by differences in rock strength between two physiographic provinces. Search for 33 10 42.13N 84 01 01.11W zoom out to an eye altitude of 2,500 feet.



**Figure 14.17** | High Falls State Park, Butts County, Georgia.

**Author:** B A Bowen Photography

**Source:** Flickr

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22. Notice that the Towaliga River Flows south based on the position of the waterfalls, the rocks upstream are \_\_\_\_\_ to weathering while the rocks downstream are \_\_\_\_\_ to weathering.

- a. more resistant, less resistant                      b. less resistant, more resistant

23. Which physiographic province is located upstream of these waterfalls?

- a. Blue Ridge                      b. Valley and Ridge                      c. Piedmont                      d. Coastal Plain

24. Which physiographic province is located downstream of these waterfalls?

- a. Blue Ridge                      b. Valley and Ridge  
c. Piedmont                      d. Coastal Plain

*Georgia North to South Cross-Section*

Reminder: the following questions are based on the cross-section and legend provided on your courses website.

25. Examine the Cartersville Fault that is the boundary between the Valley and Ridge and Piedmont Geological Provinces. Which type of fault is the Cartersville Fault?

- a. Reverse                      b. Normal                      c. Strike-Slip

26. Which of the following statements regarding the four major faults within the Piedmont are true?
- a. The faults are all reverse like the Cartersville Fault.
  - b. The faults are all normal like the Cartersville Fault.
  - c. The faults are all strike-slip like the Cartersville Fault.
  - d. With one exception, the faults are all similar in type to the Cartersville Fault.
  - e. With two exceptions, the faults are all similar in type to the Cartersville Fault.
27. Which geologic province has abundant plutons?
- a. Valley and Ridge
  - b. Piedmont
  - c. Coastal Plain
28. What is the dip direction of the sedimentary layers in the Coastal Plain Province in Peach County?
- a. North
  - b. South
  - c. East
  - d. West

### **Part C – Georgia's Natural Resources**

Search for 33 18 32.95N 82 26 08.55W and zoom to an eye altitude of 8,000 feet.

29. What natural resource is being mined in this area?
- a. Gold
  - b. Granite
  - c. Kaolin
  - d. Coal
30. This mine is located in which of the following physiographic province?
- a. Blue Ridge
  - b. Valley and Ridge
  - c. Piedmont
  - d. Coastal Plain
31. The mineral that was weathered to produce these large deposits likely originated from which of the following physiographic province?
- a. Blue Ridge
  - b. Valley and Ridge
  - c. Piedmont
  - d. Coastal Plain

Search for 33 27 11.53N 84 56 12.56W and zoom out to an eye altitude of 5,000 feet. To answer the following questions also refer to Figure 14.15.

32. Rainfall in this forest would be part of which of the following Georgia River Basins?
- a. Flint                      b. Tallapoosa                      c. Coosa                      d. Ocmulgee
  - e. Oconee                      f. Chattahoochee                      g. Suwanee
33. Zoom out to at least an eye altitude of 15 miles and examine the major river in this drainage basin. What overall direction does this river flow?
- a. Northeast to Southwest                      b. Southwest to Northeast
  - c. Northwest to Southeast                      d. Southeast to Northwest
34. Follow this river downstream, into what body of water does this basin ultimately flow?
- a. Atlantic Ocean                      b. Lake Lanier                      c. Lake Martin                      d. Gulf of Mexico
35. How many times has this river been dammed to produce reservoirs that are most likely used for drinking water, power, or recreation?
- a. Once                      b. Twice                      c. Three times                      d. Greater than three times



## 14.6 STUDENT RESPONSES

1. What type of volcano is Crater Lake?
  - a. Composite Volcano
  - b. Shield Volcano
  - c. Caldera
  - d. Cinder Cone
2. What is the origin of this volcano?
  - a. Subduction of an oceanic plate at a Convergent Boundary
  - b. Subduction of a continental plate at a Convergent Boundary
  - c. Development of a Hotspot
  - d. Continental Rifting
3. Crater Lake National Park is located in which of the following physiographic provinces?
  - a. Rocky Mountains
  - b. Sierra Nevada
  - c. Cascades
  - d. Columbia Plateau
  - e. Colorado Plateau
  - f. Basin and Range
4. What is the prominent drainage pattern in this park?
  - a. Radial
  - b. Trellis
  - c. Rectangular
  - d. Dendritic
5. One of the main attractions at this park is a forest of large petrified trees. These trees were preserved by being replaced with silica from ash layers within the Triassic (Mesozoic) sandstones. Based on the geologic history and features of the area, which of the following statements about these sedimentary rocks is TRUE?
  - a. The clastic sand that forms these rocks was weathered and eroded from the Appalachian Mountains.
  - b. The ash was produced from volcanoes associated with the Yellowstone Hotspot.
  - c. The clastic sand that forms these rocks was weathered and eroded from the Rocky Mountains.
  - d. The clastic sand that forms these rocks was weathered and eroded from the Sierra Nevada Mountains.

6. Theodore Roosevelt National Park is located in which of the following physiographic provinces?
- a. Rocky Mountains                      b. Colorado Plateau                      c. Interior Lowlands
- d. Great Plains                      e. Basin and Range                      f. Columbia Plateau
7. Based on history of the region containing Acadia National Park and the color of the rocks, what type of igneous rock occur in this area?
- a. Gabbro                      b. Granite                      c. Rhyolite                      d. Andesite                      e. Diorite
8. What type of igneous body does this structure represent?
- a. Stock                      b. Dike                      c. Sill
9. Acadia National Park is located in which of the following physiographic provinces?
- a. Interior Lowlands                      b. Adirondacks
- c. Great Plains                      d. Appalachian Plateau
- e. New England                      f. Piedmont
10. What is the maturity of the river in this area?
- a. Youthful                      b. Mature                      c. Old Age
11. Zoom out to an eye altitude of 500 miles to see the source of the sediment that is accumulating in this area. This sediment is \_\_\_\_\_ and if lithified would be called \_\_\_\_\_.
- a. Immature, Conglomerate                      b. Intermediate, Sandstone                      c. Mature, Shale
12. Congaree National Park is located in which of the following physiographic provinces?
- a. Interior Lowlands                      b. Blue Ridge
- c. Piedmont                      d. Coastal Plain
- e. New England

13. Look over the region and examine the mountains, note their shape, ground cover, and height. How do these mountains compare to the Rocky Mountains (search for 43 48 25.03N 110 50 26.19W to examine Grand Tetons National Park)?

- a. The Shenandoah mountains are shorter.
- b. The Shenandoah mountains are more rounded.
- c. The Shenandoah mountains have more vegetation.
- d. All of the above.

14. Based on these observations, we can conclude that the mountains in Shenandoah National Park have undergone \_\_\_\_\_ erosion and are \_\_\_\_\_ the Rocky Mountains.

- a. more, older than
- b. less, younger than
- c. the same amount, the same age as

15. Shenandoah National Park is located in which of the following physiographic provinces?

- a. Blue Ridge
- b. Piedmont
- c. Appalachian Plateau
- d. Valley and Ridge
- e. Adirondack

16. What type of weathering is primarily responsible for the formation of this canyon?

- a. Frost wedging
- b. Chemical weathering
- c. Mechanical weathering from air
- d. Mechanical weathering from water

17. We can measure the rate of erosion in this canyon at about 0.01 inches/year. Based on this rate, when did the canyon start to erode? (Hint: Measure the difference in elevation from the bottom of the canyon at the latitude and longitude given above and the top, measured at the road on the edge of the canyon due south of the previous point. Then divide by the rate of erosion. Make sure to use the correct units.)

- a. 750,000 years
- b. 1,200,000 years
- c. 2,700,000 years
- d. 3,500,000 years

18. Black Canyon of the Gunnison National Park is located in which of the following physiographic provinces?
- a. Blue Ridge                      b. Colorado Plateau                      c. Appalachian Plateau  
d. Rocky Mountains              e. Basin and Range                      f. Columbia Plateau
19. Examine the walls of Cloudland Canyon, what type of rock makes up the rim of the canyon?
- a. Granite                      b. Shale                      c. Sandstone                      d. Gneiss
20. Zoom out to an eye altitude of 20 miles and examine the valley 6 miles to the southeast (34 43 10.37N 85 24 55.74W at an eye altitude of 20 miles). What major geologic structure can be seen in this valley?
- a. Normal Fault                      b. Dome  
c. Horizontal Fold                      d. Reverse Fault  
e. Plunging Fold
21. Cloudland Canyon State Park is located in which of the following physiographic provinces?
- a. Blue Ridge                      b. Valley and Ridge                      c. Piedmont                      d. Coastal Plain
22. Notice that the Towaliga River Flows south, based on the position of the waterfalls, the rocks upstream are \_\_\_\_\_ to weathering while the rocks downstream are \_\_\_\_\_ to weathering.
- a. more resistant, less resistant                      b. less resistant, more resistant
23. Which physiographic province is located upstream of these waterfalls?
- a. Blue Ridge                      b. Valley and Ridge                      c. Piedmont                      d. Coastal Plain
24. Which physiographic province is located downstream of these waterfalls?
- a. Blue Ridge                      b. Valley and Ridge                      c. Piedmont                      d. Coastal Plain
25. Examine the Cartersville Fault that is the boundary between the Valley and Ridge and Piedmont Geological Provinces. Which type of fault is the Cartersville Fault?
- a. Reverse                      b. Normal                      c. Strike-Slip

26. Which of the following statements regarding the four major faults within the Piedmont are true?
- a. The faults are all reverse like the Cartersville Fault
  - b. The faults are all normal like the Cartersville Fault
  - c. The faults are all strike slip like the Cartersville Fault
  - d. With one exception, the faults are all similar in type to the Cartersville Fault
  - e. With two exceptions, the faults are all similar in type to the Cartersville Fault
27. Which geologic province has abundant plutons?
- a. Valley and Ridge
  - b. Piedmont
  - c. Coastal Plain
28. What is the dip direction of the sedimentary layers in the Coastal Plain Province in Peach County?
- a. North
  - b. South
  - c. East
  - d. West
29. What natural resource is being mined in this area?
- a. Gold
  - b. Granite
  - c. Kaolin
  - d. Coal
30. This mine is located in which of the following physiographic province?
- a. Blue Ridge
  - b. Valley and Ridge
  - c. Piedmont
  - d. Coastal Plain
31. The mineral that was weathered to produce these large deposits likely originated from which of the following physiographic province?
- a. Blue Ridge
  - b. Valley and Ridge
  - c. Piedmont
  - d. Coastal Plain
32. Rainfall in this forest would be part of which of the following Georgia River Basins?
- a. Flint
  - b. Tallapoosa
  - c. Coosa
  - d. Ocmulgee
  - e. Oconee
  - f. Chattahoochee
  - g. Suwanee



33. Zoom out to at least an eye altitude of 15 miles and examine the major river in this drainage basin. What overall direction does this river flow?
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34. Follow this river downstream, into what body of water does this basin ultimately flow?
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  - c. Lake Martin
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35. How many times has this river been dammed to produce reservoirs that are most likely used for drinking water, power, or recreation?
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  - c. Three times
  - d. Greater than three times