GEORGIA FROM SPACE—
AN EXPLANATION OF THE NASA LANDSAT 1 SATELLITE IMAGE COLOR MOSAIC OF THE STATE OF GEORGIA

Prepared in cooperation with the Georgia Department of Natural Resources, Geologic and Water Resources Division

GEOLOGICAL SURVEY CIRCULAR 787

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An Explanation of the NASA Landsat 1 Satellite Image Color Mosaic of the State of Georgia

By Sam M. Pickering, Jr., and Michael W. Higgins

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PREFACE

In its continuing program of monitoring the Nation's natural resources and understanding the land we live on, the U.S. Geological Survey has now published six Landsat satellite color mosaics at scales suitable to show large areas such as entire States. More of these mosaics are planned, and with each new one the techniques and our ability to interpret the features seen on the mosaics are improving. We have chosen one mosaic, that of the State of Georgia, as an example of what can be seen and of some of the more general uses of these "pictures" from space. Both this circular and the mosaic were prepared as a joint effort of the U.S. Geological Survey and the Geologic and Water Resources Division of the Georgia Department of Natural Resources.

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GEORGIA FROM SPACE—

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INTRODUCTION

Just a few years ago the prospect of a single view of an entire State the size of Georgia seemed science fiction. With the launching of the Landsat 1 (formerly called ERTS 1) satellite into orbit around the Earth and the technological developments that have allowed its images to be successfully pieced together into a mosaic, this "science fiction" has become reality. The new Landsat color mosaic of Georgia (U.S. Geological Survey, 1973–74) is an excellent example of what we can now see from space.

Landsat images and mosaics are valuable to geologists, soil scientists, foresters, ecologists, land-use planners, mapmakers, and the general public. They allow us to see things too large and too widespread to be seen accurately and inexpensively by other techniques. Until the 1600's scientists could study only objects that could be seen with the naked eye. Then, in 1632, the microscope was invented, and a whole new world of microscopic life was revealed. The ability to see clearly the very large features of our Earth has given us similar opportunities for new discoveries about our planet.

This circular illustrates many of the uses and details of the Georgia Landsat mosaic. It gives examples of how Landsat images can help people understand the areas in which they live, work, and travel. One of the basic problems today is keeping pace with the changes we make on the face of the Earth. We build, harvest, mine, clear, reclaim, impound, and channelize without an overall view of what we are doing. We never before had a comprehensive look at our natural resources and their development until Landsat provided such an overview.

This circular is keyed directly to the large color mosaic of Georgia. To use the circular, refer to the indicated areas on the large mosaic. Addresses for obtaining the large mosaic, a more detailed, interpretative space atlas of Georgia, and other maps that are helpful in understanding the State are listed inside the back cover of this circular.

WHAT IS LANDSAT?

The Landsat 1 satellite, launched by the National Aeronautics and Space Administration July 23, 1972, circles the Earth in an orbit that passes approximately over the North and South Poles. At an altitude of 570 miles, it orbits over any point on Earth once every 18 days. The instruments on Landsat 1 ceased functioning January 6, 1978. While still functioning, instruments aboard the satellite continuously scanned the land and water beneath in four color bands and transmitted the signals back to receiving stations on Earth. Thus Landsat 1 functioned somewhat like a detailed television broadcast from space. At the present time (1978) Landsats 2 and 3 are functioning. When the signals reach Earth they are converted into black and white film images. Two of the four multispectral scanners on a satellite detect infrared radiation or light (bands 6 and 7). This type of light is not visible to the human eye, but shows differences in ground moisture and terrain. The remaining two scanners detect visible light (green, band 4, and red, band 5) and show patterns of vegetation and cultural development.

[1] Georgia Department of Natural Resources.

Individual black and white images or combinations of the images in different color bands show forests, cities, wetlands, cultivated fields, superhighways, and many other features. Each image transmitted by the satellite covers an area of 13,500 square miles. Fourteen images are needed to cover all of Georgia.

WHAT DO THE COLORS ON THE GEORGIA MOSAIC MEAN?

The Georgia mosaic is a color combination of red (band 5) and infrared (band 7) images. These combined images of each scene were tinted in shades of blue, black, and red to resemble a color-infrared photograph. This method shows cultural features and vegetation more clearly than a single black and white or a natural-color image. Forest and vegetative cover show as red, and cleared land is white or bluish. The reddest patterns on this mosaic are evergreen forest or winter pasture: the hardwood trees were leafless and summer crops had been harvested when these late fall or winter scenes were made. Woodland that had been clearcut recently shows as light bluish purple. Clear water shows as black; muddy or turbid water is light blue. Cities appear as white or light blue-gray. Surface mines show as white areas. Mountains and ridges are cast in high relief by their shadows. In all images, the sun was in the southeast, so shadows are on the northwest side of the terrain. The fine lines almost east-west across the mosaic are scan lines produced when the image was transmitted back to Earth. These scan lines distinguish the *image* from a *photograph,* which is not produced by scanning.

HOW WAS THE MOSAIC MADE?

Although two or three separate Landsat scenes can be fitted accurately together, the assembly of large groups of scenes into a single, precise mosaic demands an elaborate control system. The Georgia mosaic is one of the first to have control provided by computer processing. Several indices at the bottom of the mosaic show how the 14 separate satellite images are fitted together and the dates of the coverage. Some detail has been lost in the printing, but the mosaic is remarkably accurate. High-contrast features as small as 25 acres can be seen.

WHAT CAN BE SEEN ON THE MOSAIC?

CULTURE

One of the first things most people want to know about a map such as the Georgia mosaic is where they live and where some of the places and features they are familiar with are located. The Landsat mosaic of Georgia (fig. 1) shows many of the towns and cities, reservoirs, and major highways. One of the unusual cultural features is the circular woodland area in South Carolina along the State line. This area surrounding the Savannah River Nuclear Plant is government-owned land that has not been farmed for many years and has grown up in heavy forest. Another prominent man-caused feature on the mosaic is the white circular area in Tennessee near the State line. This is an area where the forest was killed many decades ago by overcutting and smelter fumes at the Ducktown-Copper Hill mining district. Although much reclamation work has been done recently, the area still shows as 80 square miles of barren ground (fig. 2).

LAND USE AND LAND COVER

The mosaic allows an informative new look at Georgia's complex patterns of land cover (figs. 1 and 2). These patterns of woodland, timbered areas, cultivation, and pasture land reflect a long history of productive but changing agriculture and forestry. The patterns are continually in the process of adjusting to current economics, farming practices, land ownership, and other variables. Knowledge of the local area will greatly aid users in interpreting the subtle patterns on the mosaic. Changes may be identified by comparing this mosaic with earlier Landsat images or aerial photographs.

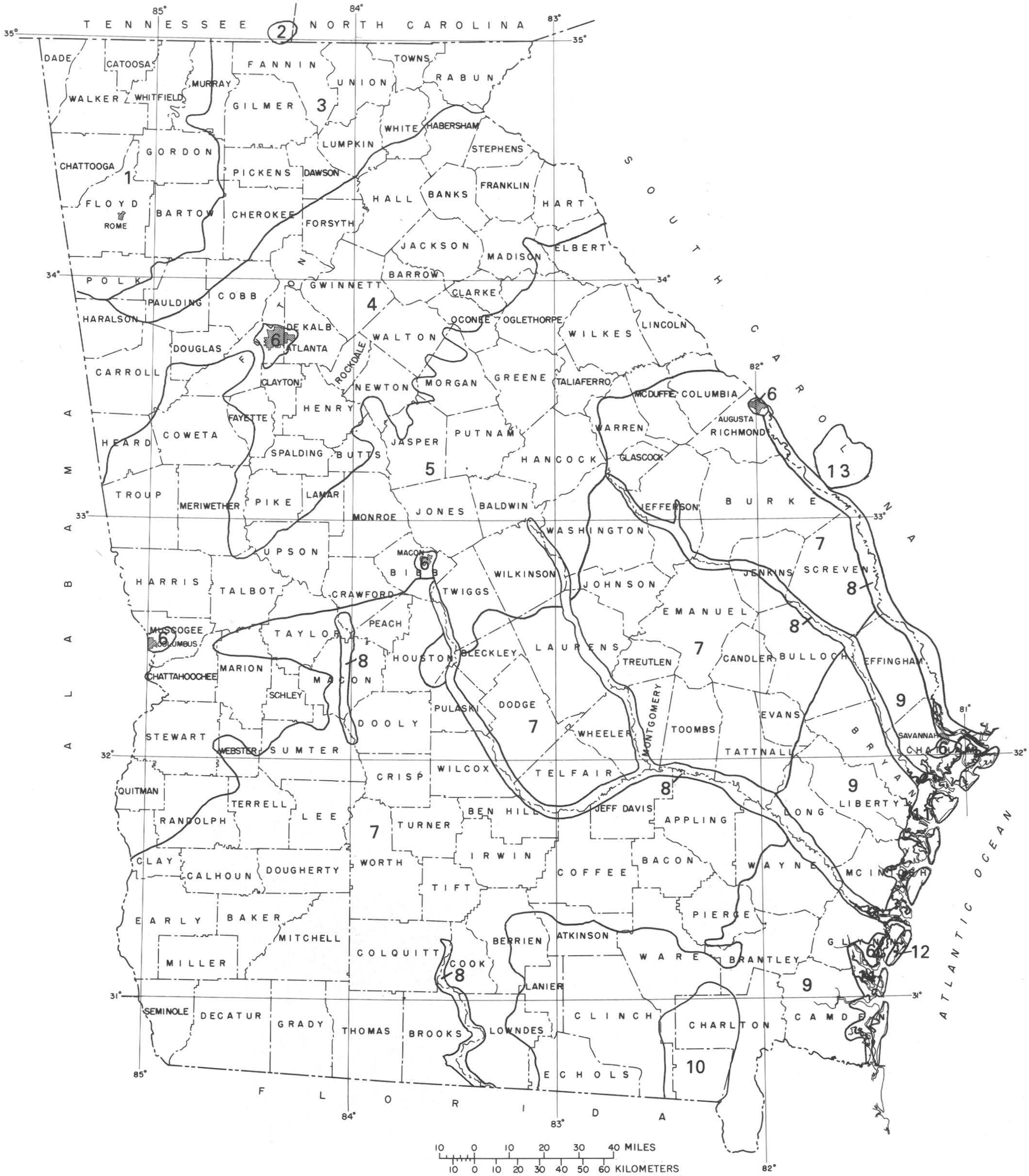
VALLEY AND RIDGE

The northwestern corner of Georgia is often called the Valley and Ridge area. The valleys are extensively cleared and cultivated, and the ridges are heavily forested. In this November image, the valleys contain many patches of white that indicate freshly cultivated bare soil. The well-drained valleys of this area have no extensive swamps or wetlands.

To the east of the Valley and Ridge area is the rugged southern end of the Blue Ridge Mountains. The sharp shadows cast in the early morning (eastern) sun by the mountains show

FIGURE 1.—Band 5 Landsat mosaic of Georgia. Areas outlined are shown in other figures as indicated by the numbers.

the rugged relief of the area. The steep slopes are heavily forested, with small farms in rare flat stream valleys. The lack of vegetation at the tops of some high mountains gave them the name "bald." Patterns of clearcut timbering can be seen in parts of the mountains. The evergreen understory beneath leafless hardwoods and the sides of mountains toward the sunlight (east and southeast facing slopes where reflectance is greatest) show as lighter red areas.



EXPLANATION

1 Agriculture Valleys and Forested Ridges
2 Copperhill Barren Land
3 Northern Forested Mountain Region
4 Piedmont Region of Mixed Pasture, Forest, and Cultivation
5 Central Forested Region
6 Major Urban Areas
7 Coastal Plain Region of Mixed Pasture, Cultivation, and Forest
8 Swampy Forested Flood Plains along Major Rivers
9 Coastal Forested Region
10 Okefenokee Swamp
11 Coastal Salt Marsh
12 Sea Islands
13 Forested Savannah River. Plant Area

PIEDMONT

South of the Valley and Ridge area and the Blue Ridge Mountains, the Piedmont province extends across the State. Woodland, unimproved pasture, and cultivated land in the Piedmont appear as a mixture of red, gray, and white patches on the mosaic. Atlanta and other cities appear as complex patterns of white and pale blue. The dense commercial area along Peachtree Street in Atlanta appears bluest.

COASTAL PLAIN

South of the Piedmont is a band of low, sandy hills which are heavily forested. Between the Piedmont and these sand hills is the Fall Line zone, where the wide Coastal Plain swamps begin. These hardwood swamps show as dark bands along most of south Georgia's rivers and are as much as 6 miles wide. The dozens of bright white areas east of Macon are large open-pit kaolin clay mines, which produce more than $200 million worth of valuable industrial clay each year.

South of the Fall Line hills is the middle Coastal Plain. Most of the upland of this area is cultivated, and the moist stream valleys are wooded. A myriad of small dark-blue specks are farm ponds, sinkholes in limestone and Carolina Bays (water-filled depressions of debatable origin).

COASTAL AREA

A 50- to 75-mile-wide zone of dense, poorly drained pine forest extends along the Georgia coast and inland to well beyond the Okefenokee Swamp. Standing out white against the red-appearing woodland, Interstate 95 parallels the coast just inland from the dark brown-gray-appearing salt marsh. Scattered along either side of the interstate highway is a double row of blue specks that are water-filled dredge pits from which sand has been removed for road-fill material. Northwest of Savannah, clear examples of raised shorelines and beach ridges show as bands of parallel red and white patterns. The Okefenokee Swamp appears as blue, black, and red swirls of wetlands, open-water bodies, and forest.

LANDFORMS

Figure 3, keyed to the color mosaic, shows the primary landform divisions from the Physiographic Map of Georgia (Clark and Zisa, 1976). Most of these divisions are closely related to the slope of the land, which is clearly shown on the 1975 Slope Map of Georgia. The terrain features are interpreted extensively in "Georgia, A View from Space" by Clark, Zisa, and Jones (1976). Because landforms and slope are chiefly the result of the rock formations which underlie the land, the 1976 Geologic Map of Georgia is also a valuable tool for understanding what can be seen on the mosaic.

FIGURE 2.—Generalized land-cover map of Georgia.

GREAT SMOKY FAULT

The escarpment of the Great Smoky Fault is strikingly apparent on the Landsat mosaic, individual Landsat enlargements, and the Slope Map of Georgia. It is the boundary fault between the folded limestones, shales, and sandstones of the Valley and Ridge province (figs. 4 and 5) and the steep, rounded peaks formed on granites, schists, and gneisses of the Blue Ridge and Cohutta Mountains.

BLUE RIDGE MOUNTAINS

Figure 4 (also see fig. 5) shows most of northeast Georgia and parts of Tennessee and North Carolina. The southern end of the Blue Ridge Mountains stands out clearly in contrast to the gentler slopes of the Piedmont to the south. The edge of the mountains, called the Blue Ridge Front, is an area of spectacular waterfalls such as Amicalola Falls.

Winding southward between the Blue Ridge and Cohutta Mountains is a lowland with low ridges: the deep downfold of the Murphy Syncline. This enormous downfold contains extensive deposits of valuable white, orange, and gray marble, which is more easily eroded than the gneisses, schists, granites, and quartzites which surround it. Thus, a natural valley—a transportation corridor through the mountains has been formed, and marble quarries have been developed extensively along the syncline.

BREVARD FAULT ZONE

In addition to the previously mentioned Great Smoky Fault, other ancient faults can be seen on this image (fig. 4). A zone of crushed rock (known as a cataclastic zone), several miles wide, marks a portion of the Brevard Fault Zone. The Warwoman Shear Zone cuts a series of parallel knife-sharp valleys across the Blue

EXPLANATION

A. Lookout Mountain District
B. Chickamauga Valley District
C. Armuchee Ridges District
D. The Great Valley District
E. Cohutta Mountains District
F. McCaysville Basin District
G. Blue Ridge Mountains District
H. Cherokee Upland District
I. Dahlonega Upland District
J. Hightower-Jasper Ridges District
K. Central Uplands District
L. Gainesville Ridges District
M. Winder Slope District
N. Washington Slope District
O. Greenville Slope District
P. Pine Mountain District
Q. Fall Line Hills District
R. Fort Valley Plateau District
S. Dougherty Plain District
T. Tifton Upland District
U. Vidalia Upland District
V. Bacon Terraces District
W. Okefenokee Basin District
X. Barrier Island Sequence District

Ridge Front and the Brevard Zone. At the southern edge of this image, the Chattahoochee River zigzags across the edge of the Brevard Fault Zone in the Palisades area.

FALL LINE

The Fall Line, the boundary between the harder granites, gneisses, schists, and quartzites of the Piedmont and the more or less flat-lying soft sedimentary rocks of the Coastal Plain, shows as the boundary between gentle slopes and low linear ridges and the low sandy Coastal Plain hills. North of the Fall Line, the rivers flow over crystalline granites and metamorphic rocks. Here they are relatively straight and flow in rapids and riffles over a rocky bed. Immediately at the Fall Line, the rivers flow onto the soft sand, clay, and limestone of the Coastal Plain. At this line (figs. 6 and 7) the rivers immediately start to meander in snakelike bends across swampy, forested flood plains several miles wide.

ARMUCHEE RIDGES

Figure 8 (also see fig. 9) is an enlargement of a very clear Landsat image of the Armuchee Ridges area (Taylor Ridge, Johns Mountain, Horn Mountain, and so on) of northwest Georgia. The sinuous ridgelike mountains are made up of sandstone that has resisted erosion. The flat valleys between the ridges are underlain by shale and limestone that are more easily eroded. The contorted, hairpin-shape of the terrain is the result of folding and faulting of the Earth's crust (fig. 10). One of the most unusual features is the oval shape of the Rock Mountain–Lavender Mountain area (figs. 8 and 9). The semicircular rims are formed by a syncline (downward fold, fig. 10). Hard sandstone formations form a nearly perfect oval, almost like an enormous ancient castle, standing high because they have resisted erosion. On the west of the image another synclinal sandstone ridge, Pigeon Mountain (figs. 8 and 9), is a spur at the eastern edge of the Cumberland Plateau. East–west fractures, which have been enlarged to form a network of caverns deep beneath the surface, can be traced across the ridge.

FIGURE 3.—Map showing landform divisions of Georgia (modified from the Physiographic Map of Georgia by Clark and Zisa, 1976).

PELHAM ESCARPMENT

In the southwestern part of Georgia (fig. 11), on the Coastal Plain, is a long escarpment as much as 100 feet high. This feature, called the Pelham Escarpment, separates a low limestone plain from a higher loamy upland for almost 100 miles. The clay formation underlying the upland allows very little rainfall to soak into the ground; thus there is a well-developed system of streams and rivers. In contrast, the low plain west of the escarpment is underlain by limestone honeycombed with water-filled caverns and passageways that have collapsed locally to form sinkholes. Thus, most of the rainfall drains into and saturates the limestone. There are few surface streams.

WATER BODIES

Reservoirs and lakes on the color mosaic show as various shades of light blue to black. The blue tones indicate how muddy the water was when the satellite passed over and scanned the scene. Black indicates clear water; the lighter the blue tone, the more suspended sediment was in the water. Areas of rapid erosion can be identified along some small streams draining into some of the reservoirs. An especially interesting example of the distribution of muddy water in reservoirs is that of Lake Seminole in the southwest corner of Georgia. A great difference in the two source rivers, the Chattahooche and the Flint, can be seen particularly well in an enlargement of a Landsat image (fig. 12).

The Chattahoochee River has a rather normal course in comparison to the Flint which flows through extensive upstream swamps and then drains the limestone country of the Dougherty Plain (fig. 3). The swamps act as natural biological purifiers and settling basins, and drainage from the limestone adds clear water to the river. Thus, the Flint River has been purified naturally, is very clear, and shows as black on the image. However, the Chattahoochee is muddy and shows as gray. Note that the waters from the two rivers do not mix in the reservoir but remain separate to the dam. The many ponds and lakes miles from the reservoir were created when damming the river caused the water table to rise and fill the limestone sinkholes with water.

FIGURE 4.—Enlarged Landsat band 7 image of parts of northern Georgia, North Carolina, and Tennessee. The Great Smoky Fault cuts across the left edge of the image.

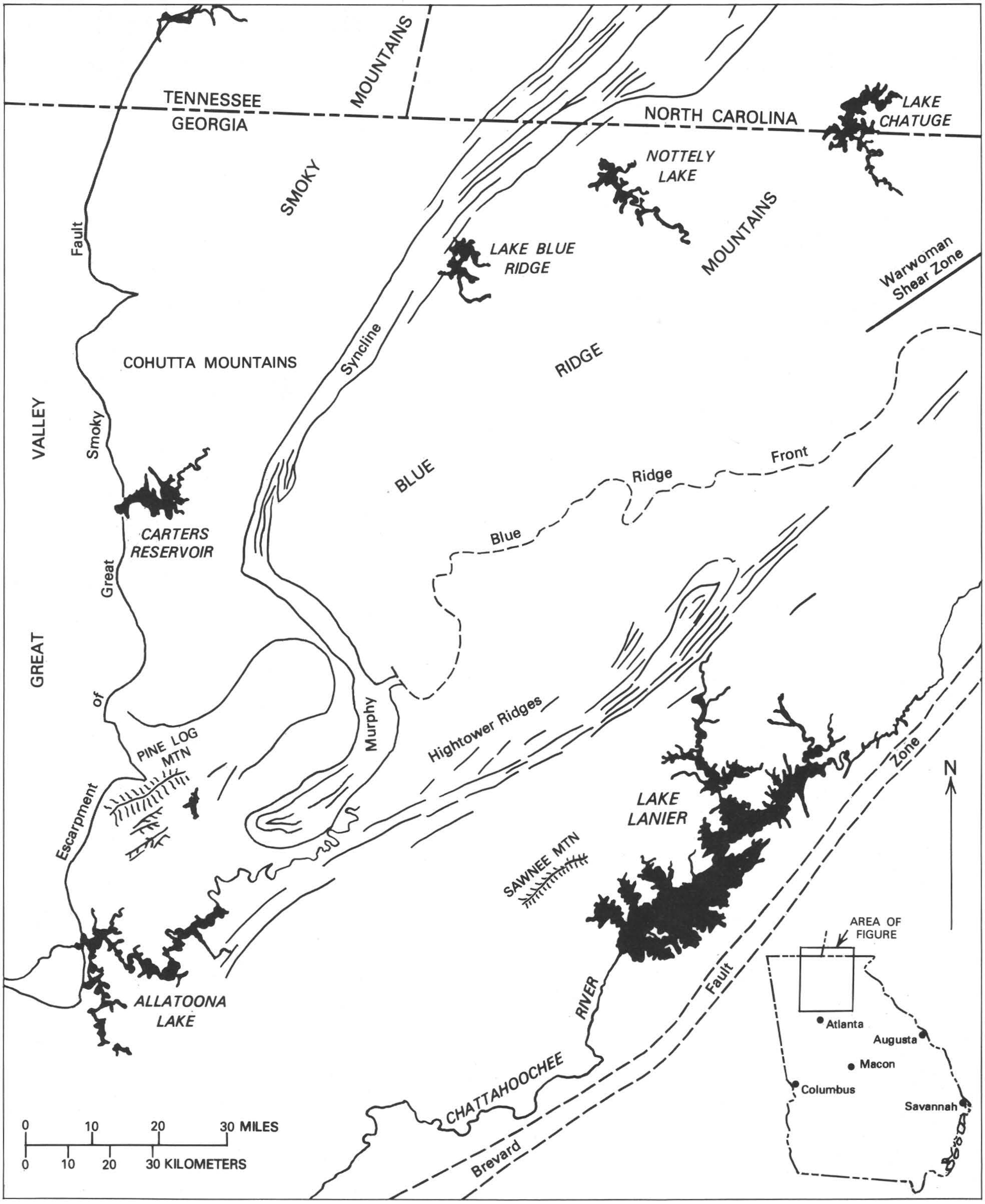


FIGURE 5.—Map showing interpretation of figure 4.

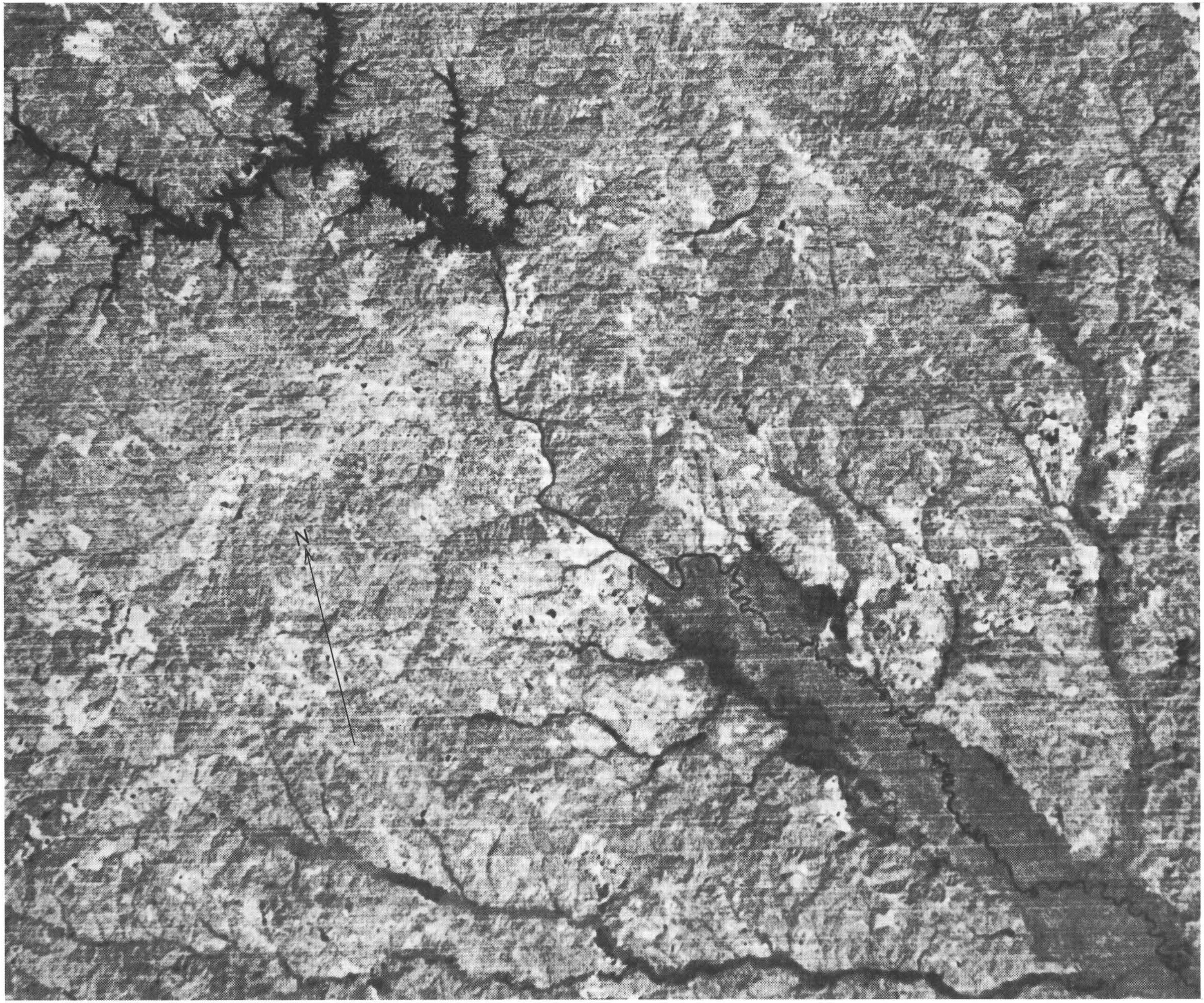


FIGURE 6.—Enlarged Landsat band 7 image showing development of hardwood-forested wetland on swampy flood plains along major rivers at the Fall Line.

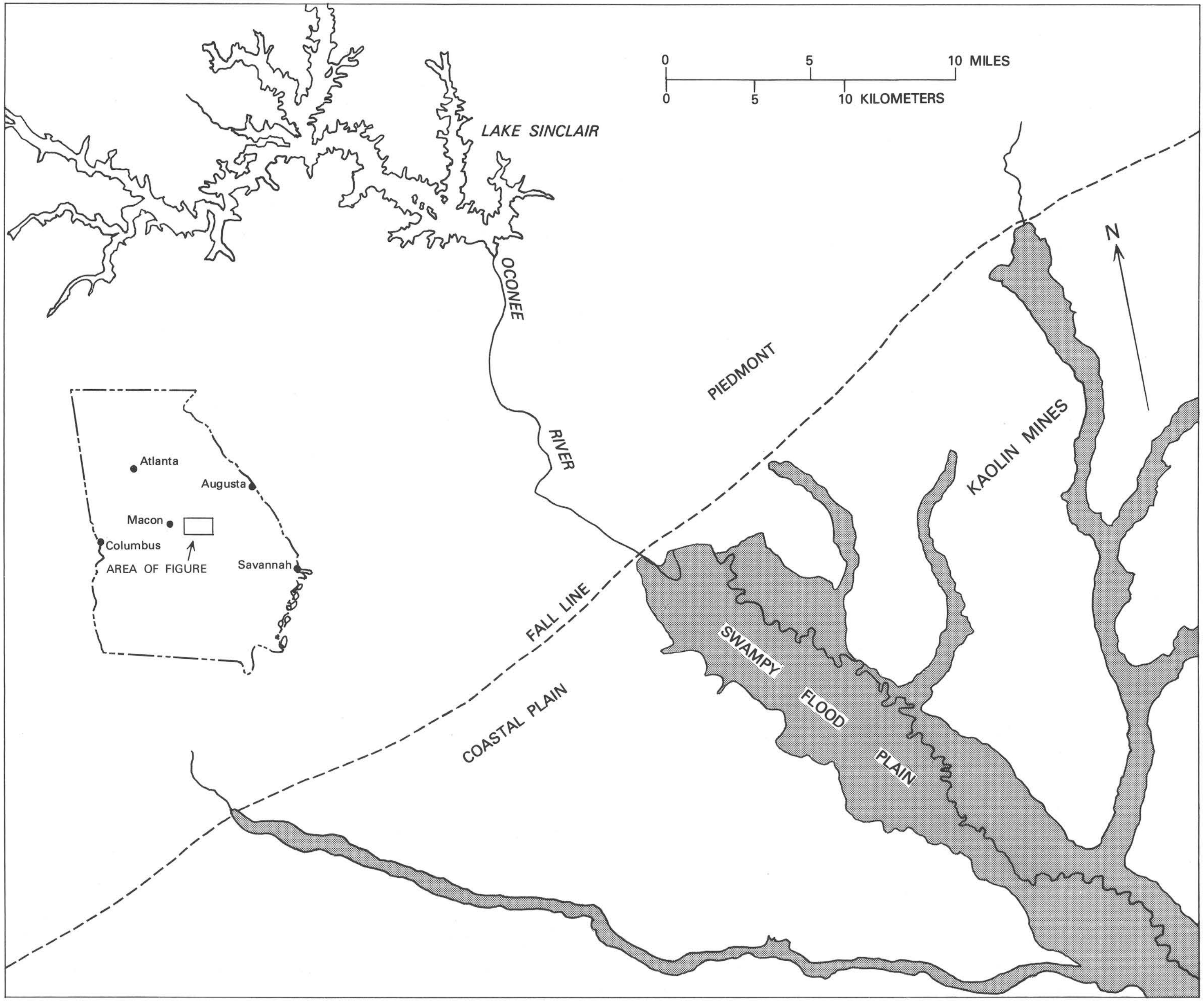


FIGURE 7.—Map showing interpretation of figure 6.

FIGURE 8.—Enlarged Landsat band 7 image of part of the Armuchee Ridges area of northwestern Georgia.

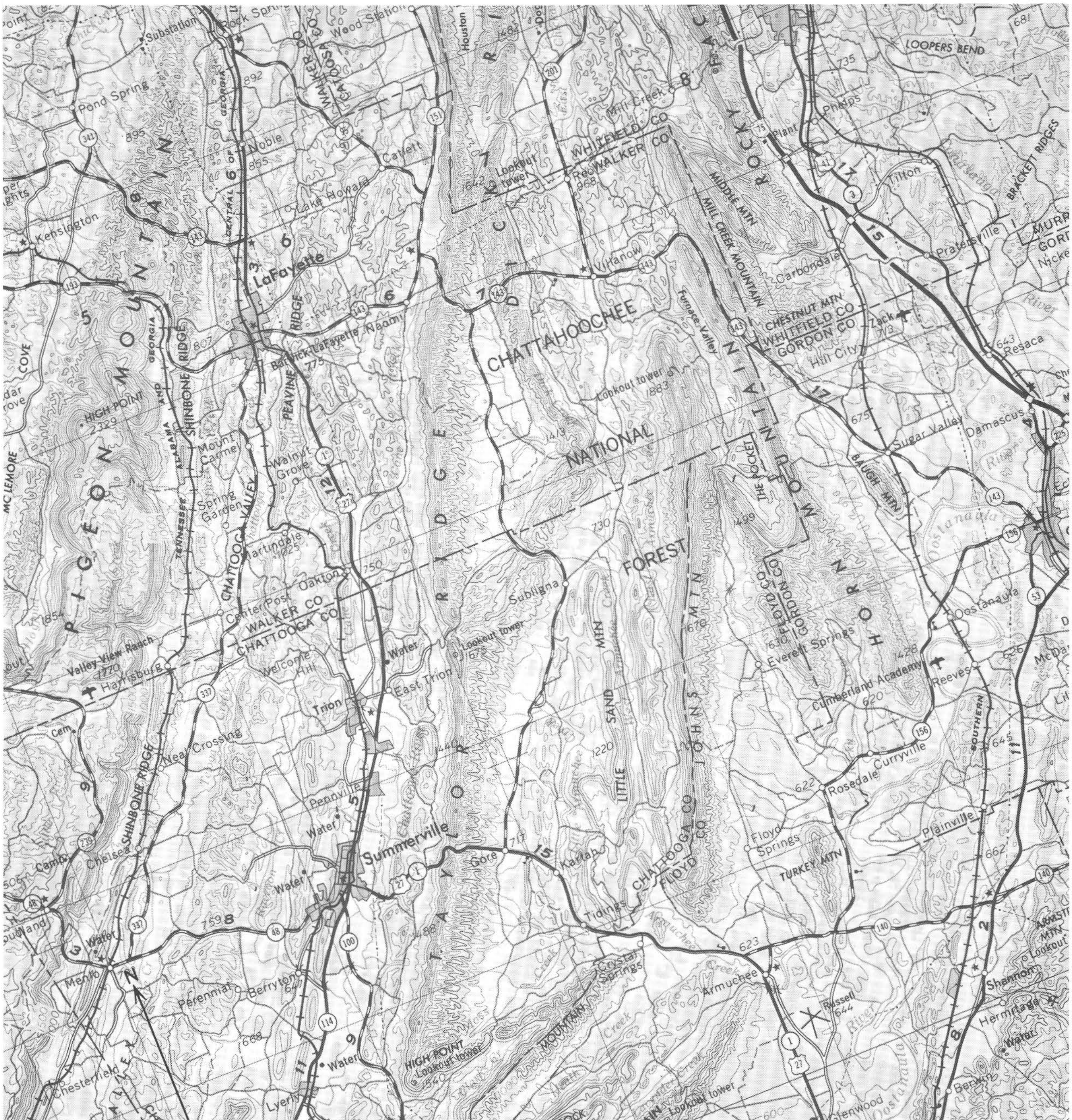


FIGURE 9.—Topographic map of the area of figure 8. (U.S.G.S. National Topographic Maps 1:250,000-scale series.)

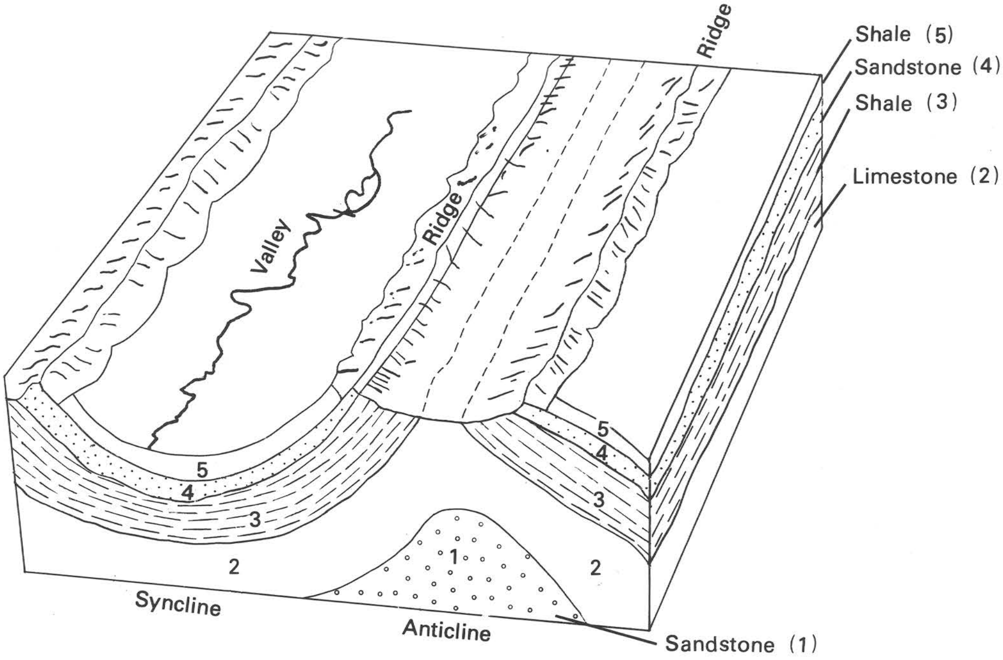


FIGURE 10.—Block diagram illustrating general relation of ridges and valleys to anticlines and synclines. Rock units are numbered from oldest (1) to youngest (5). This diagram essentially represents a slice through a folded section of the very upper part of the Earth's crust. Note that the most resistant rock unit holds up the ridges. Unit 4 is a hard sandstone layer.

OKEFENOKEE SWAMP

The complex pattern of drainage and vegetation of the Okefenokee Swamp includes more than 700 square miles of wetlands and is the largest swamp in the United States (figs. 14 and 15). At a time of former higher sea level many thousands of years ago, this swamp was a shallow arm of the sea. A long barrier island was built across the east edge and remains today to prevent drainage to the Atlantic Ocean. Known as Trail Ridge, it shows clearly on both the enlarged image (fig. 14) and the mosaic. The old island is now a drainage divide between the Gulf of Mexico to the southwest and the Atlantic Ocean to the east.

GEORGIA COAST

Figure 16 shows identical scenes from two of the Landsat scanners, band 5 (red light) and band 7 (infrared light). Band 7 shows open water as black, the extensive salt marshes as dark gray, and high, dry ground as shades of light gray. Drainage of rivers and estuaries is clearly shown. Band 5, however, shows a very different picture. Clear water and forested land show black. Beaches and sand spits, roads, and cities show as white and light gray. The gray plumes diffusing seaward from the marshes and estuaries and into the open ocean are suspended sediment. This sediment is largely derived from the salt marshes and is very rich in nutrient material from decomposed marsh grass. These nutrients make marine life unusually prolific along Georgia's coast, and the salt marshes serve as breeding grounds for many valuable fish, shrimp, and shellfish.

GEOLOGY

For detailed geologic interpretations the reader should obtain a copy of the 1976 Geologic Map of Georgia (see inside back cover), which is at the same scale as the Landsat mosaic.

Culture, physiography, slope, drainage, soils, land use, land cover, and geology are all so intricately interrelated that it is impossible to consider one without the others. Nevertheless, the Earth is made up of rocks, even where they are covered by soils or other materials. Thus, the most important factor in determining why the terrain features of a region are where they are is the geology. For example, one limiting factor for successful farming is soil. Soils are

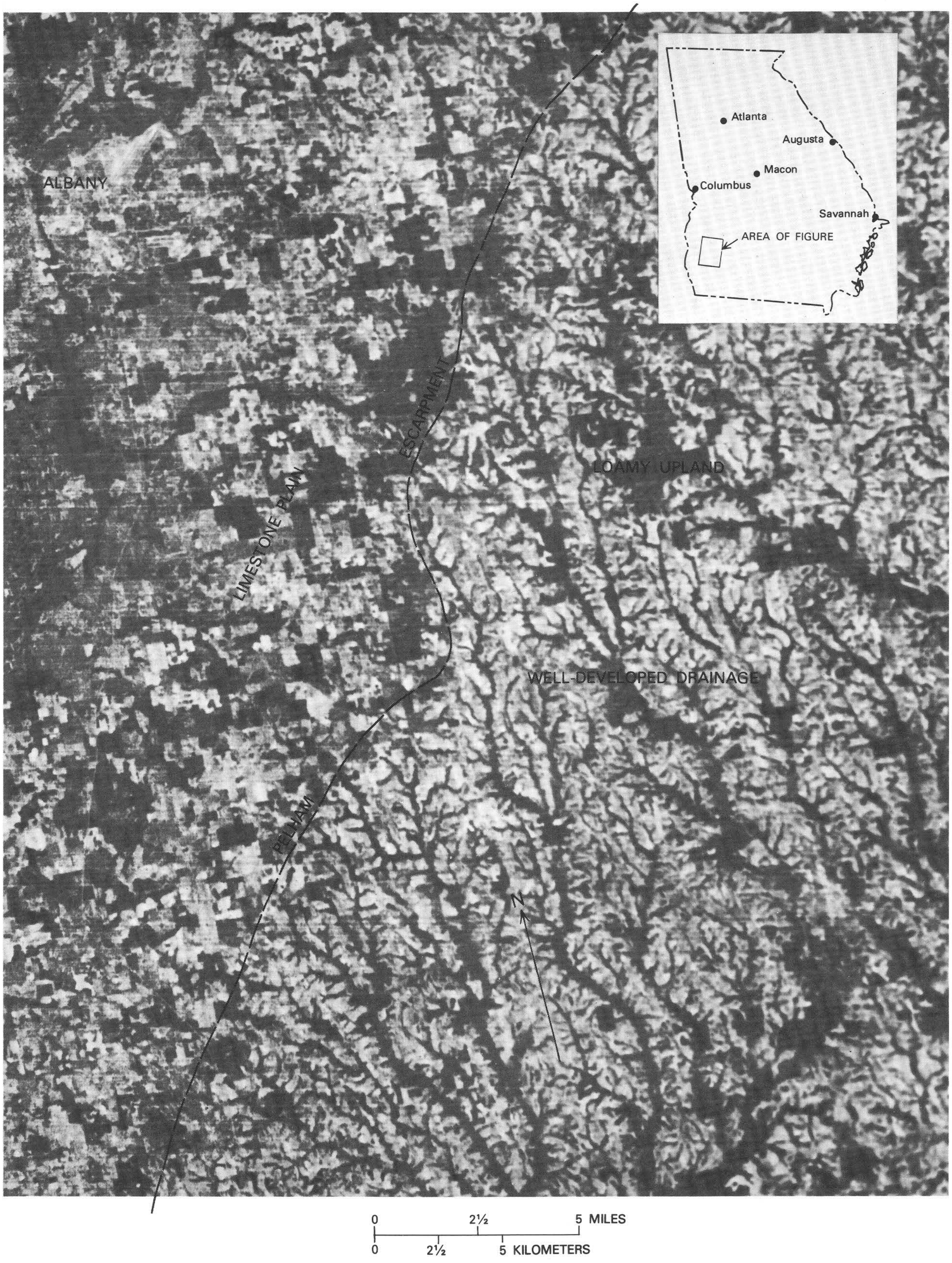


FIGURE 11.—Enlarged Landsat band 5 image illustrating the abrupt change in drainage at the edge of the Pelham Escarpment.

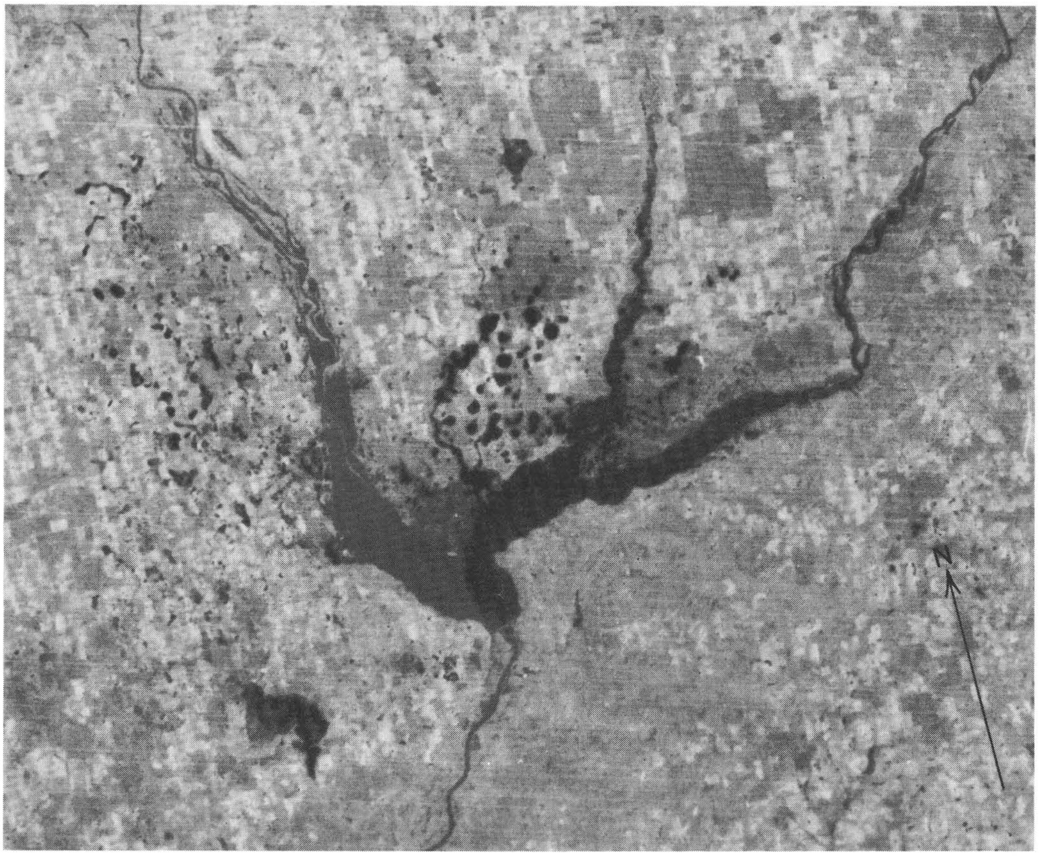


FIGURE 12.—Enlarged Landsat band 7 image and interpretation of Lake Seminole, showing sharp separation between muddy and clear water.

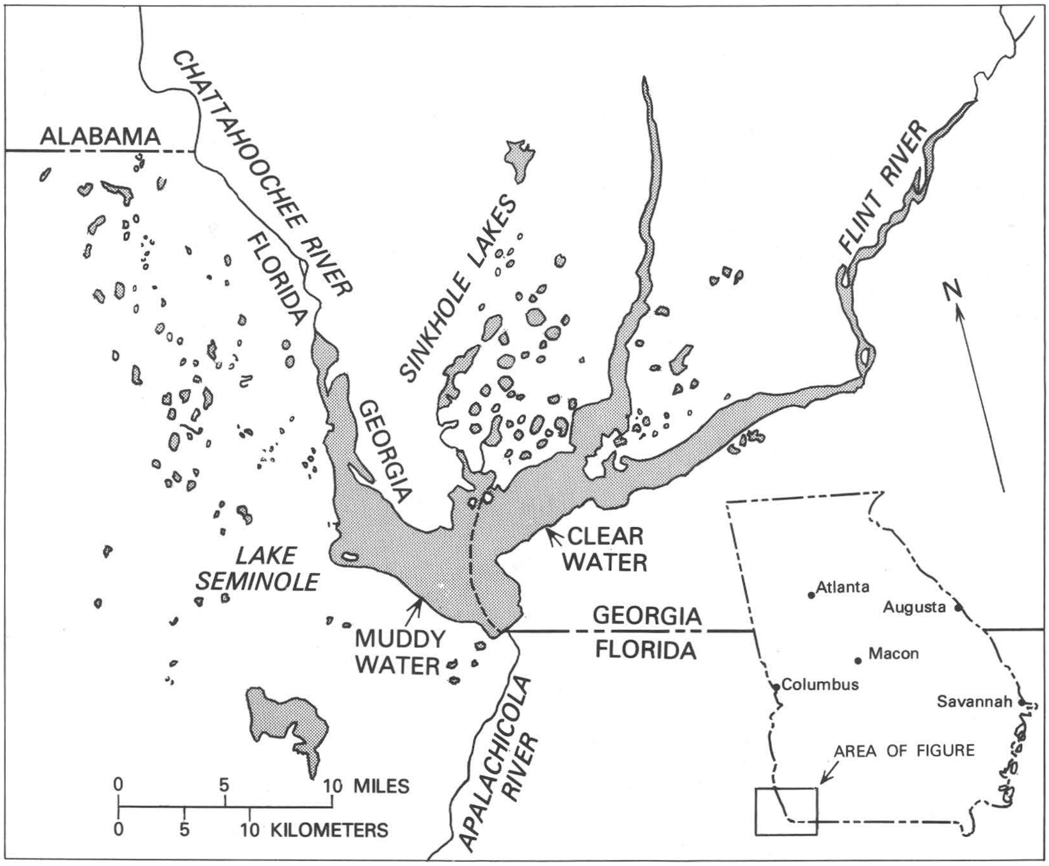


FIGURE 13.—Explanation and location map for figure 12.

FIGURE 14.—Enlarged Landsat band 7 image of the Okefenokee Swamp.

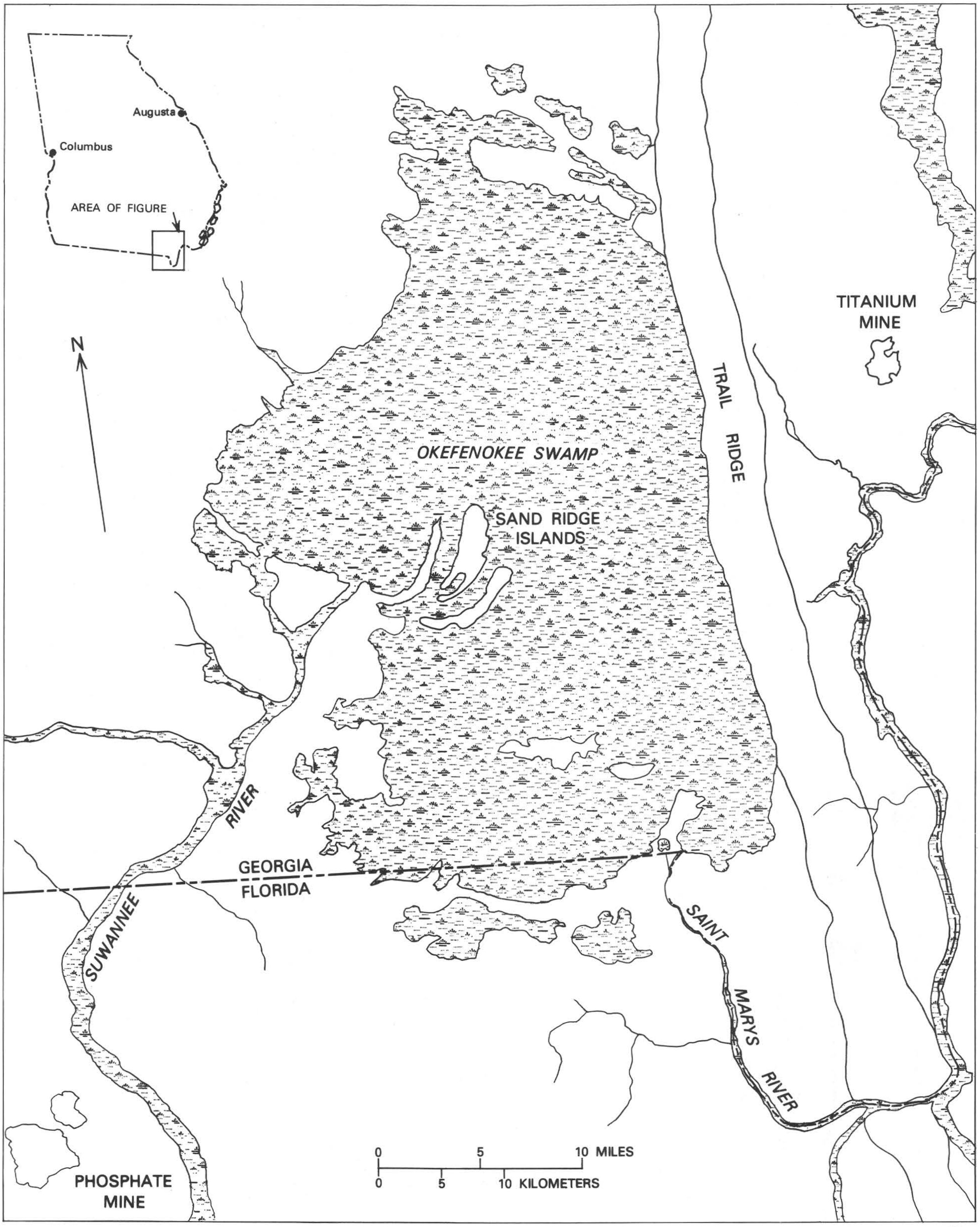


FIGURE 15.—Map showing interpretation of figure 14.

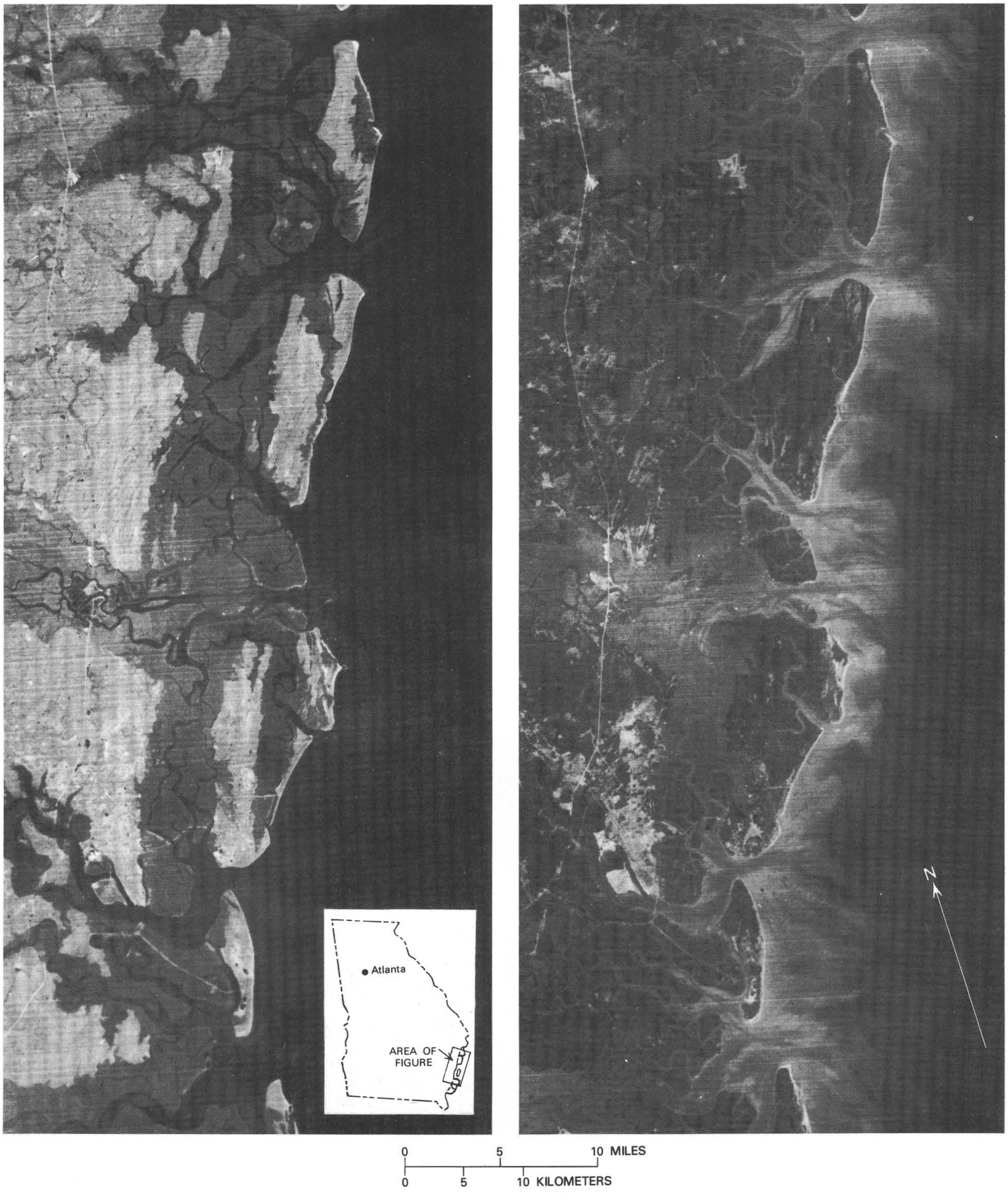


FIGURE 16.—Landsat band 7 image (left) of the area from Jekyll Island to St. Catherines Island showing the extent of salt marshes (gray); and Landsat band 5 image (right) of the same area showing muddy, nutrient-rich water being washed from the marshes and estuaries by a falling tide.

derived from the slow decomposition of rock. Thus, the type of rock determines the type of soil, which in turn partly determines suitability for agriculture. Slope, which is a factor of the relative resistance of erosion of the rocks, must also be considered. Given the same soil, one slope may be ideal for agriculture, whereas another may be too steep. Drainage, intimately related to geology and slope, is also an important factor. Some areas with perfectly good agricultural soils may be too poorly drained for crops.

Other examples of how geology has affected land use in Georgia can be seen along the Fall Line. With the exceptions of Atlanta and Charlotte, North Carolina, all of the major inland cities on the Atlantic seaboard from New York south are located along the Fall Line. From the Landsat mosaic, one can see that Columbus, Macon, and Augusta are all Fall Line cities. The cities were built here largely because the Fall Line is generally the upper limit for river navigation by all but small boats. In addition, the rapids and waterfalls formed by the southeasternmost exposures of the crystalline rocks of the Piedmont supplied waterpower for mills and other industry. Thus, these Fall Line rapids determined the location of the cities.

Geology and its resulting topography determined the location of cities such as Atlanta in a different way. Atlanta grew up as a railroad center. The high, rugged Blue Ridge and Great Smoky Mountains form a natural northeast-trending barrier from north Georgia to Pennsylvania. Bordering this mountain barrier on the southeast is the much flatter Piedmont. The railroad companies laid their rails from the industrial northeast southwestward through the Piedmont, and many Piedmont cities owe their existence to the geologic and topographic difference between the Blue Ridge and Piedmont. Atlanta was doubly fortunate, however. Located just south of the southwestern end of the high Blue Ridge Mountains, it was also a logical location for railroad lines to the West and Midwest. Moreover, the Chattahoochee River provided a good water supply for a rapidly growing town.

These are just a few examples of how geology has affected development in Georgia. Close examination of the mosaic and the State geologic map will show many others.

SUMMARY

The Landsat 1 satellite circles the Earth in a nearly north–south orbit at an altitude of 570 miles, passing over any point once every 18 days. While functioning, the instruments aboard the satellite transmitted images, each covering 13,500 square miles. Fourteen scenes were precisely joined by computer to make the mosaic of Georgia. On the mosaic, high-contrast features as small as 25 acres can be seen. The mosaic shows the cultural features of the State such as cities, roads, and other developments. It shows land use and land cover—woodlands, wetlands, cultivated areas, reservoirs, and so forth. Landforms and geologic features are easily seen. Thus, this image from space allows us to look at the State of Georgia from a vantage point we never had before. It allows us to see features too large and widespread to be seen any other way.

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Clark, W. Z., Jr., and Zisa, A. C., 1976, Physiographic map of Georgia: Georgia Department of Natural Resources, Geologic and Water Division, scale 1:500,000.

Clark, W. Z., Jr., Zisa, A. C., and Jones, R. C., 1976, Georgia, a view from Space—An atlas of Landsat-1 imagery: Georgia Geological Survey, 33 p.

U.S. Geological Survey, in cooperation with the National Aeronautics and Space Administration and the Georgia Department of Natural Resources, Geologic and Water Resources Division, 1973–1974, Georgia Satellite Image Mosaic: U.S. Geological Survey, scale 1:500,000.

☆ U.S. Government Printing Office: 1979—281-359/4

OTHER MAPS AND PRODUCTS TO AID IN UNDERSTANDING THE LANDSAT MOSAIC

The following five maps and reports can be ordered from:

Georgia Dept. of Natural Resources
Geologic and Water Division
19 M. L. King, Jr. Drive SW.
Atlanta, Georgia 30334

1. Geologic Map of Georgia, 1976, scale 1:500,000.
2. Slope Map of Georgia, 1975, scale 1:50,000.
3. Clark, W. Z., Jr., and Zisa, A. C., 1976, Physiographic Map of Georgia, scale 1:500,000.
4. Clark, W. Z., Jr., Zisa, A. C., and Jones, R. C., 1976, Georgia, a view from Space—An atlas of Landsat-1 imagery: Atlanta, Georgia Geological Survey, 33 p.
5. Individual images at 1:250,000 scale on band 7 of the Georgia Blue Ridge, Valley Ridge, Okefenokee Swamp, and Coastal area, 1977.

The following U.S. Geological Survey maps are available from:

Branch of Distribution
U.S. Geological Survey
1200 South Eads Street
Arlington, Va. 22202

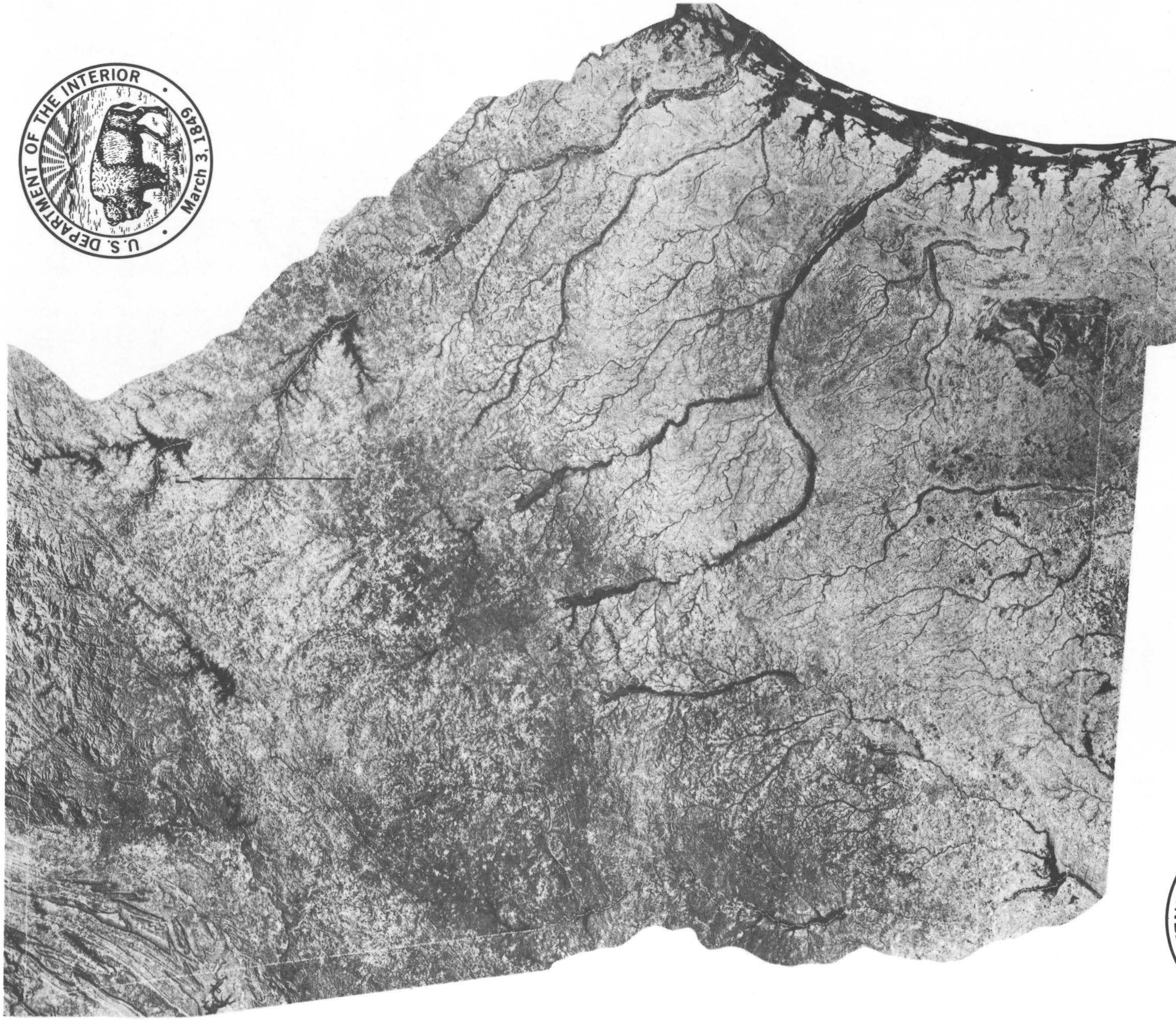
1. Georgia Satellite Image Mosaic, 1973–1974, U.S. Geological Survey in cooperation with NASA and the Georgia Department of Natural Resources, scale 1:500,000.
2. Topographic base map of the State of Georgia (showing rivers, cities, railroads, counties, National and State parks and forests, highways and contours—generally at 200-ft intervals, locally at 100-ft intervals, 1970, scale 1:500,000.
3. U.S. Geological Survey National Topographic maps 1:250,000-scale series.
4. U.S. Geological Survey, Greater Atlanta Region Topographic Map, 1974, scale 1:100,000.
5. U.S. Geological Survey 7.5-minute topographic maps, various dates, scales 1:24,000.

Individual Landsat images at various scales are available from:

User Services Unit
EROS Data Center
U.S. Geological Survey
Sioux Falls, South Dakota 57198

Prices of the above maps are available on request from the sources listed.

U.S. DEPARTMENT OF THE INTERIOR
March 3, 1849



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