AN INTRODUCTION TO THE GEOLOGY OF THE SOUTHERN APPALACHIANS

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Gatlinburg is located at the eastern border of Tennessee near the heart of the classic Southern Appalachians. This resort city, the gateway to the Great Smoky National Park, is situated in the foothills region of the Blue Ridge. The Blue Ridge physiographic province is flanked on the west by the Valley and Ridge and on the east by the Piedmont. West of the Valley and Ridge, in Tennessee and adjacent states, is the Cumberland Plateau, and the Piedmont is bounded eastward by the Atlantic Coastal Plain (Figure 1).

Each physiographic region has a characteristic and rather distinctive topographic expression which reflects in part the geologic features of the underlying rocks. For the most part the boundaries between these regions are sharp and easily identifiable. A west to east traverse at the latitude of Gatlinburg (line A-A' Figure 1), beginning on the Cumberland Plateau reveals a tableland some 2000 feet in elevation. At the Plateau-Valley and Ridge boundary an abrupt escarpment, whose crest is 1000 feet above the general level of the Valley and Ridge, is quite conspicious. The nearly parallel ridges and intervening valleys of the Valley and Ridge are striking. Abruptly, at the southeast margin of this province the Blue Ridge front rises 1000 to almost 2000 feet. The Blue Ridge foothills in the vicinity of Gatlinburg at elevations of

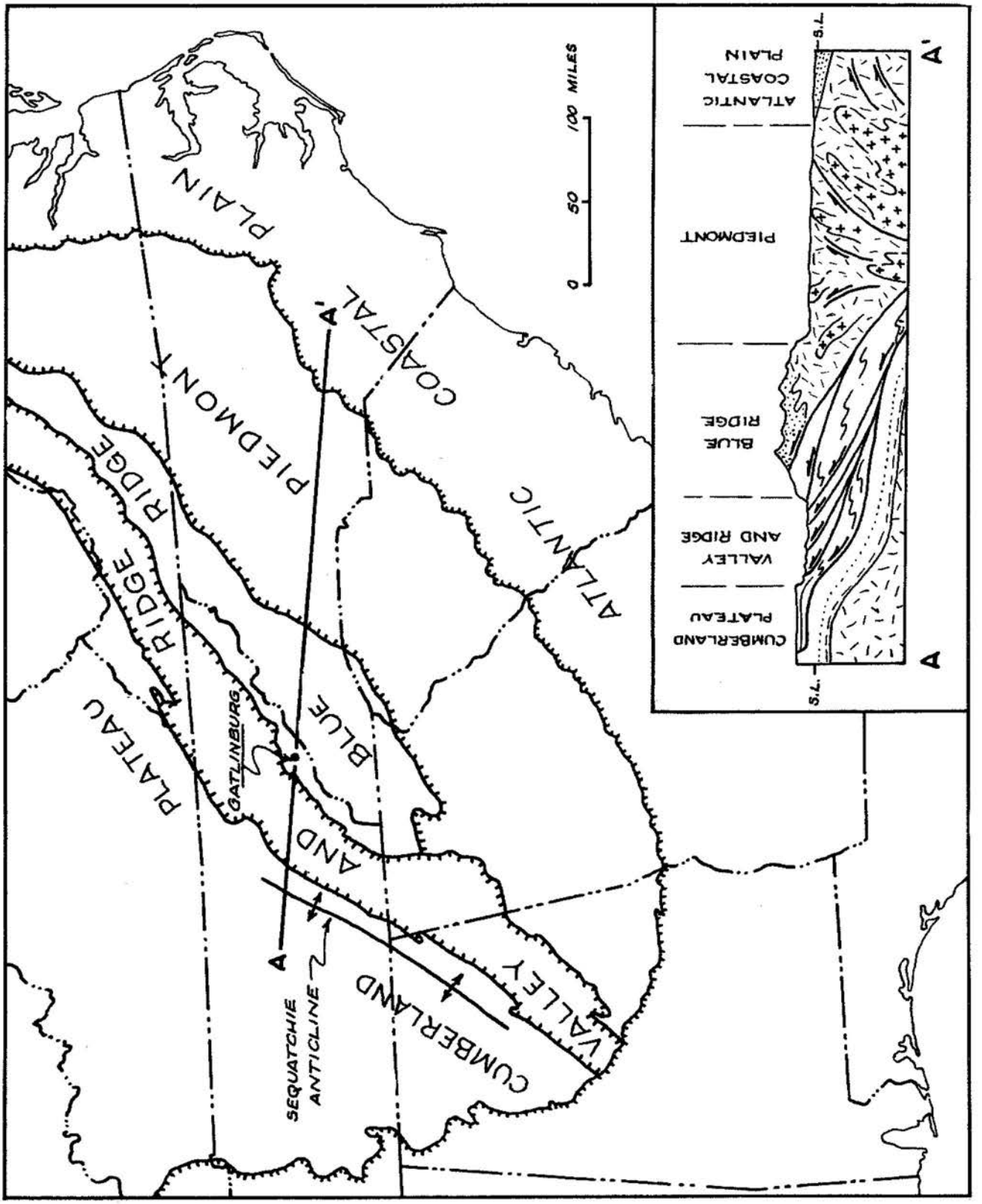

Fig. 1 · Major physiographic elements of the Southern Appalachians with diagrammatic geologic cross section.

generally 2000 to 3000 feet give way, less than 5 miles southeastward, to the higher and more rugged terrain of the Blue Ridge crestal mountains. Mt. LeConte 6 miles southeast of Gatlinburg is 6593 feet in elevation, Clingmans Dome 10 miles south of Gatlinburg is at an elevation of 6642 feet. These peaks are among the highest in the Southern Appalachians being succeeded only by Mount Mitchell north of Asheville, N. C. whose top is at 6684 feet. The mountainous Blue Ridge extends eastward from Gatlinburg some 80 miles where its eastern border is marked by a sharp descent of some 2000 feet to the floor of the Piedmont. The Piedmont plain slopes gradually eastward, from an average elevation of 1000 feet at the foot of the Blue Ridge, to the Atlantic Coastal Plain.

Unfortunately, the geology of several provinces which constitute the Southern Appalachians is not as readily understood as are the physiographic elements. In general our knowledge is more detailed and complete in the Plateau, Valley and Ridge and western Blue Ridge than in the eastern Blue Ridge and Piedmont regions. This is due in part to the availability of detailed topographic maps, more abundant bedrock exposures and the presence of fossiliferous and less metamorphosed rocks in the western areas. Because of these factors the western areas have been studied more intensively than those to the east and as a result our knowledge is more complete.

Geologic Setting

The Appalachian Mountain System, the dominant tectonic element of the Southeastern U. S. extends from the Cumberland

Plateau eastward to the Atlantic Coastal Plain. Composed of miogeosynclinal deposits to the west and eugeosynclinal rocks eastward many of the structural features of this system are generally inferred to have resulted from the presumably late Paleozoic "Appalachian revolution." However, the sedimentary and deformational history of this region is quite lengthy, and also quite complex, extending from late Precambrian throughout the Paleozoic. Evidence for Precambrian diastrophism and later periods of deformation including plutonism, vulcanism and metamorphism is found in the metamorphic and plutonic rocks as well as in the sedimentary sequences. After the late Paleozoic deformation the mountain system was extensively eroded, peneplaned (perhaps 3 times) and the present landforms carved by differential erosion.

Description of Tectonic Units

Cumberland Plateau

West of the Valley and Ridge this province is mainly comprised of relatively flat-lying Pennsylvanian and older sediments totaling a mile or more in thickness. The main structural features are the Pine Mountain and Cumberland overthrusts along which upper layers of the sedimentary sequence have moved short distances westward. A spectacular faulted anticline (Sequatchie) occurs near the middle of the region extending over 150 miles in Tennessee and Alabama. Its axis is nearly straight, paralleling the main structural lineament of the Appalachians, and is essentially horizontal. The fold is breached by erosion resulting in

a valley, 3 miles or so wide, whose floor is 1000 feet or more below the general level of the Plateau.

Valley and Ridge

In this province, 40 or more miles across in Tennessee, is a generally comformable sequence of Paleozoic (Cambrian to Pennsylvanian) sediments of varying thickness but which probably averages 3 or so miles. Imbricate thrusts, mainly southeast dipping, repeat segments of the sequence across the province. These faults are of large stratigraphic throw and some extend for hundreds of miles along the structural grain of the Appalachians. The faults in the southeastern portion of the province have in their thrust blocks clastic sediments which coarsen and thicken southeastward in marked contrast to the generally carbonate sequence to the northwest. The Valley and Ridge rocks although folded tightly in places and locally strongly crushed, are relatively unmetamorphosed. Weak fracture cleavage is present in select rock types near the middle and eastern portions of the region but slaty cleavage has not been observed in the rocks of this province.

Blue Ridge

This province can be conveniently divided into two northeast trending segments, one dominantly sedimentary in the northwest and the second, dominantly crystalline, to the southeast. The crystalline segment, about 30 miles wide at the latitude of Gatlinburg, is composed chiefly of mica, hornblende and other types of gneisses and schists plus granitic and

ultramafic intrusives. These rocks are considered mainly Precambrian and at least in part constitute the basement complex upon which the sediments of the eastern Blue Ridge were deposited. The dominantly sedimentary portion of the Blue Ridge, near Gatlinburg, is Precambrian (with but minor early Cambrian rocks). Two sequences of chiefly clastic rocks are present, the Lower Cambrian Chilhowee Group, about a mile thick, which extends for several hundred miles along the eastern Blue Ridge, and the underlying Ocoee sediments which are areally quite restricted. The Ocoee clastics are at least five miles thick and possibly twice this amount. They are, in contrast with the overlying Chilhowee, metamorphosed to slates, phyllites, and locally schists, and have obviously been deposited in quite a different environment than the overlying Paleozoic rocks.

The structural features of this portion of the Blue Ridge are world famous, this being the classic Appalachian area of tremendous overthrusts as evidenced by several fenster areas and klippen. The Grandfather Mountain Window, 75 miles northeast of Gatlinburg, is evidence of the 30 mile westward transport of the Blue Ridge. Near Gatlinburg the limestone-floored cove areas (Tuckaleechee, Cades, Wears and others) are windows in the Blue Ridge thrust sheet and indicate westward horizontal movements approximating 10 miles.

Piedmont

This province, over 150 miles across, is the least deciphered of the Southern Appalachians. The surficial distri- of its rocks is generally known but their ages, stratigraphic,

structural and metamorphic relationships are poorly understood. The Piedmont is commonly divided into somewhat linear belts which generally parallel the northeast strike of the Appalachians. From the Atlantic Coastal Plain westward to the Blue Ridge the more conspicious of these belts are:

(1) The Carolina slate belt, some 50 miles wide and having a strike length of over 400 miles. The rocks of this area are characteristically felsic and mafic volcanics intercalated with partly tuffaceous siltstones and slates. Their thickness is unknown but is probably over 2 miles. These rocks are but slightly dynamically metamorphosed but near plutons are strongly altered. Their age is unknown but they are presumably Precambrian or early Paleozoic.

(2) The Charlotte plutonic belt west of the slates is about 30 miles across and typified by rocks of approximately granitic composition. These intrusives are believed to be of Paleozoic age, possibly spanning several periods of that era.

(3) The Kings Mountain belt, a narrow dejective zone of Late Precambrian or Early Paleozoic quartzite, marble, conglomerate and schist, separates the slate belt and the Inner Piedmont.

(4) The Inner or Western Piedmont, 50 miles wide, is dominated by mica gneisses and schists. Here the regional metamorphism of the Appalachians peaks in the sillimanite-garnet zone. The age of the rocks of this area was long believed to be Precambrian but the possibility of a Paleozoic age is now

entertained. Granitic rocks are also present here as well as significant ultramafic plugs and dikes.

(5) The Brevard belt separates the Inner Piedmont and Blue Ridge. This belt, a narrow zone of phyllite, schist and locally limestone, is characterized by its rocks being less metamorphosed than those in adjacent belts. Some workers surmise that this belt is a major fault zone; others believe it is synclinal.

Selected General References

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