# PRELIMINARY TECTONOSTRATIGRAPHIC TERRANE MAP OF THE CENTRAL AND SOUTHERN APPALACHIANS

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## INTRODUCTION

A tectonostratigraphic terrane is a fault-bounded geologic entity of regional extent characterized by an internally homogeneous stratigraphy and geologic history that is different from that of contiguous terranes (Jones and others, 1983a, 1983b; see also Irwin, 1972). Coney and others (1980, p. 329) note that "... the identification of a terrane is based primarily on its stratigraphy and need not carry any genetic or even plate tectonic implication. At the start of investigations, the identified terranes are simply considered as domains in the descriptive sense."

Tectonostratigraphic terranes that constitute parts of the Appalachian orogen appear to have evolved independently of Proterozoic North America (Laurentia) and to have been accreted at various times during the Paleozoic. This map of the central and southern segments of the orogen shows a preliminary interpretation of the locations and boundary relationships of these accreted terranes as well as fault-bounded native terranes that were originally probably part of Laurentia. Native terranes, as defined by Gray (1986, p. 1043) are those "whose origins can be tied to a known cratonic area and which are autochthonous or parautochthonous with respect to that area." The term native terrane, therefore, is an antonym of accreted terrane. Post-accretionary plutons and pre-Middle Jurassic overlap sequences are also indicated. Terranes are interpreted and classified as: (1) Laurentia (ancestral North America) and probable related native terranes (not accreted); (2) disrupted terranes; (3) possible oceanic crustal remnants; (4) volcanic-arc terranes; (5) continental crust of undetermined affinity; (6) metamorphic complexes of undetermined affinity; and, (7) the Suwannee terrane. Rocks of undetermined origin located along, south, and east of the Alleghanian suture are also shown, as are selected geophysical anomalies.

We hope that this interpretive map will stimulate discussion and research on critical problems so that future maps of this type will be better constrained.

## LAURENTIA AND PROBABLE RELATED TERRANES

The large unit represented on the map as Laurentia (**L**) (undivided) encompasses Middle Proterozoic (Grenvillian and older) basement (whether autochthonous, or exposed within allochthonous external massifs), rift-related Late Proterozoic clastic and volcanic sequences, and Paleozoic shelf and platform strata deposited on Laurentian continental basement. External massifs are present in the Blue Ridge tectonic province, the Reading Prong, and the Honey Brook Upland. Rocks of the Talladega block in Alabama and Georgia appear to have been stratigraphically tied to and have been interpreted as part of Laurentia (e.g. Tull and others, 1988), with the possible exception of the Hillabee greenstone (Horton and others, 1989a).

Offshore deep-water, post-rift deposits of the Hamburg (**ah**) and Westminster (**aw**) terranes in Pennsylvania and Maryland are shown separately because they are stratigraphically and structurally isolated from other parts of Laurentia. These are native (not accreted) terranes.

The internal continental terranes of the Appalachian orogen are isolated massifs of Middle Proterozoic (Grenvillian) continental basement and their cover sequences that are located within the metamorphic core of the orogen and now exposed within structural windows. These terranes include the Baltimore terrane (**ib**) in Maryland and Pennsylvania, the Sauratown terrane (**is**) in North Carolina and southern Virginia, and the Pine Mountain terrane (**ip**) in Alabama and Georgia. They could represent either outliers, possibly themselves allochthonous, of Laurentia, or microcontinental fragments of Laurentian crust displaced by rifting or transcurrent faulting and later reassembled.

## DISRUPTED TERRANES

Disrupted terranes in the central and southern Appalachians contain melange complexes as well as more coherent terrane fragments (volcanic, ophiolitic, or continental) intermingled with the melange complexes. Those identified include the Jefferson terrane (**dje**) which extends along the eastern Blue Ridge Province from Virginia to Alabama, the Potomac composite terrane (**dp**) which extends from New Jersey to Virginia, the Smith River terrane (**ds**) in North Carolina and Virginia, the Inner Piedmont composite terrane (**di**) which extends from North Carolina to Alabama, the Falls Lake terrane (**df**) in North Carolina, and the Juliette terrane (**dju**) in Georgia.

## POSSIBLE OCEANIC CRUSTAL REMNANTS

Possible oceanic crustal remnants occur as mafic and ultramafic complexes in all of the disrupted terranes (see above), but most are too small to consider as separate terranes. Two terranes identified as possibly oceanic crustal remnants on the map are the Bel Air-Rising Sun terrane (**ob**) in Maryland, Pennsylvania, and Delaware, and the Sussex terrane (**os**), which is covered by Coastal Plain sediments in eastern Virginia and Maryland.

## VOLCANIC-ARC TERRANES

Volcanic-arc terranes include the Chopawamsic terrane (**vcp**) in Virginia, Maryland, and Delaware, the Carolina and Albemarle volcanic arcs (**vca**) in the Carolinas and adjacent states, the Spring Hope (**vs**) and Roanoke Rapids (**vr**) terranes in the Eastern slate belt of the Carolinas, and the Charleston terrane (**vch**) beneath the Coastal Plain in South Carolina and Georgia.

## CONTINENTAL CRUST OF UNDETERMINED AFFINITY

Continental terranes of undetermined affinity include the Crabtree terrane (**cc**) in the eastern Piedmont of North Carolina, the

Goochland terrane (**cg**) in Virginia and North Carolina, and the Wilmington terrane (**cw**) in Delaware and Pennsylvania.

## METAMORPHIC COMPLEXES OF UNDETERMINED AFFINITY

Metamorphic complexes of undetermined affinity are terranes that could not be classified on the basis of available data. These include the Gaffney terrane (**ug**) in South Carolina, the Hatteras terrane (**uh**) which is covered by Coastal Plain sediments in easternmost North Carolina, the Milton terrane (**um**) in Virginia and North Carolina, the Savannah River terrane (**us**) in the eastern Piedmont of South Carolina and Georgia, and the Uchee terrane (**uu**) in Georgia and Alabama.

## PRE-MESOZOIC TERRANES BENEATH THE ATLANTIC AND GULF COASTAL PLAINS FROM FLORIDA TO SOUTHEASTERN MISSISSIPPI

The nature of pre-Mesozoic rocks beneath the Atlantic and Gulf Coastal Plains of the southeastern United States has been partly revealed by deep oil test drilling. Buried extensions of Appalachian elements (including the Valley and Ridge Province, Talladega slate belt, and various Piedmont terranes) extend about 50–60 km southeast of the exposed Coastal Plain unconformity. These are bordered to the south by fault-bounded Mesozoic basins containing continental clastic rocks as well as diabase sheets and basalt flows. Pre-Mesozoic rocks south of these basins include (see map): (1) an amphibolite facies metamorphic complex (**wg**) and a zone of phyllite (**wp**) in the Wiggins uplift of southwestern Alabama and southeastern Mississippi; (2) a suite of contrasting igneous rocks (**sc**) in southwestern Alabama; and, (3) the Suwannee terrane (discussed below).

### Suwannee Terrane

The Suwannee terrane (Horton and others, 1987, 1989a; Thomas and others, 1989a, 1989b) is an extensive, apparently coherent tectonic element comprising undeformed granite, low-grade felsic metavolcanic rocks, a suite of high-grade metamorphic rocks (gneiss and amphibolite), and a succession of generally undeformed, albeit faulted, Lower Ordovician to Middle Devonian sedimentary rocks. Late Paleozoic tectonothermal effects are generally absent except in close proximity to the Alleghanian suture (Dallmeyer, 1989a).

#### *Paleozoic Sedimentary Rocks (s1)*

A succession of generally undeformed sedimentary rocks occurs in several separate areas. The base of the section is marked by Lower Ordovician littoral quartz sandstones (Carroll, 1963), which are overlain with presumed conformity by Ordovician to Middle Devonian shales with locally significant horizons of siltstone and sandstone. A nearly continuous succession appears to be present, although the absence of Lower Silurian fauna may indicate a disconformity (Cramer, 1973). A stratigraphic thickness of about 2.5 km is suggested for the subsurface Paleozoic sequence in peninsular Florida (Wicker and Smith, 1978). The sequence appears to be markedly thicker (about 10 km) in the Florida panhandle (Arden, 1974a). Cold water, Gondwanan paleontological affinities are indicated by all fauna throughout the entire Paleozoic sequence (Whittington, 1953; Whittington and Hughes, 1972; Andress and others, 1969; Goldstein and others, 1969; Cramer, 1971, 1973; Pojeta and others, 1976).

#### *Osceola Granite (s2)*

The undeformed Osceola Granite of Thomas and others (1989a, 1989b) constitutes a large part of the pre-Mesozoic crystalline basement of central Florida. The pluton is heterogeneous and composed dominantly of biotite granodiorite, leucocratic biotite quartz monzonite, and biotite granite (Dallmeyer and others, 1987). Most of the samples examined by Dallmeyer and others (1987) were composed dominantly of oligoclase, quartz, perthitic alkali feldspar, and biotite.

Bass (1969) reported Rb-Sr analytical results from several density fractions of feldspar from two parts of a core from a well in Osceola County. The data were scattered and tentatively interpreted by Bass to reflect a crystallization age of about 530 Ma[1]. Dallmeyer and others (1987) reported five $^{40}Ar/^{39}Ar$ plateau ages ranging from about 527 to 535 Ma for biotite concentrates from the Osceola Granite. They suggested that these ages closely date emplacement of the pluton in view of its high level petrographic character and apparently rapid post-magmatic cooling.

#### *Felsic Volcanic-Plutonic Complex (s3)*

A felsic volcanic-plutonic complex has been penetrated in separated areas of the Coastal Plain pre-Mesozoic basement. Lithologic variants include felsic vitric tuff, felsic ash-flow tuff, and tuffaceous arkose with subordinate andesite and basalt. Epizonal felsic plutons occur within some wells and are likely subvolcanic equivalents of the volcanic sequences. Mueller and Porch (1983) presented geochemical analyses which suggest calc-alkaline affinities. The rocks are generally undeformed but nearly everywhere display low-grade metamorphic assemblages.

The felsic igneous complex appears to be unconformably overlain by Lower Ordovician sandstone in one well in central Peninsular Florida, and on this basis Chowns and Williams (1983) suggest a Late Proterozoic-early Paleozoic age. This is consistent with stratigraphic relationships inferred from seismic characteristics in northwestern Florida by Arden (1974a, 1974b). Whole-rock, K-Ar ages for the igneous complex (summarized by Chowns and Williams, 1983) range from about 165 Ma to 480 Ma. A representative suite of seven volcanic samples have been analyzed with whole-rock, $^{40}Ar/^{39}Ar$ incremental-release techniques (R.D. Dallmeyer, unpublished data). All samples have markedly discordant age spectra indicating widespread disturbance of initial intracrystalline argon systems. These results suggest that the published K-Ar whole-rock ages should not be used to constrain either the time of magmatic or metamorphic events.

The COST GE-1 well, about 100 km off the northernmost Florida coast (see map), penetrated about 600 m of low-grade metasedimentary rocks (argillite) overlying variably metamorphosed trachyte and sandstone (Scholle, 1979). The relationship of this sequence to the mainland felsic igneous complex is uncertain. Whole-rock K-Ar ages of 374 and 346 Ma were reported for metasedimentary rocks recovered from the well (Simonis, *in* Scholle, 1979). A slate sample from 11,600 feet displays an internally discordant $^{40}Ar/^{39}Ar$ age spectrum defining a total-gas age of about 341 Ma (R.D. Dallmeyer, unpublished data). Felsic metavolcanic rock from 12,350 feet also displays an internally discordant age spectrum; however, intermediate- and high-

[1]All ages discussed in this report are based upon the isotopic abundance ratios and decay constants listed in Steiger and Jäger (1977).

temperature increments correspond to a plateau date of about 375 Ma. This is generally similar to a 363 ± 7 Ma Rb-Sr whole-rock isochron reported for seven samples from the COST well by Simonis (*in* Scholle, 1979). These Devonian ages are more likely related to metamorphic overprinting than to initial magmatic events.

### *St. Lucie Metamorphic Complex (s4)*

The St. Lucie Metamorphic Complex of Thomas and others (1989a, 1989b), earlier termed the "Cowles metamorphic rocks" by Chowns and Williams (1983), is a suite of high-grade metamorphic rocks and variably deformed igneous rocks southeast of the Osceola Granite. Predominant rock types include amphibolite, biotite-muscovite schist and gneiss, and quartz diorite. The complex has a distinctive aeromagnetic signature (Taylor and others, 1968; Klitgord and others, 1984), with marked northwest-trending magnetic lineations. Thomas and others (1989a) suggest these may reflect structural strike.

Bass (1969) reported isotopic ages for the high-grade complex, including a 503 Ma K-Ar date for a hornblende concentrate from amphibolite and a 530 Ma Rb-Sr model age for a biotite concentrate from interlayered gneiss. $^{40}Ar/^{39}Ar$ plateau ages of about 511 and 513 Ma for hornblende (Dallmeyer, 1989b) are interpreted to date post-metamorphic cooling at about 500°C.

### *Possible Correlations between the Suwannee terrane and rocks in West Africa*

Pre-Mesozoic rocks beneath the Atlantic and Gulf Coastal Plains were initially correlated with successions in the Valley and Ridge and Piedmont Provinces of the Appalachians (e.g., Campbell, 1939; Milton and Hurst, 1965). On the basis of the Gondwanan paleontological affinities of the Paleozoic sedimentary section, however, correlations with West African sequences have been suggested by most recent workers (e.g., Wilson, 1966; Rodgers, 1970). Even more recent field and geochronologic studies in the Mauritanide, Bassaride, and Rokelide orogens of West Africa have helped resolve the tectonothermal evolution of these areas, thereby permitting direct correlation with counterparts beneath Coastal Plain sediments of the Southeastern United States (e.g., Villeneuve, 1984; Villeneuve and Dallmeyer, in press; Dallmeyer and Villeneuve, 1987; Dallmeyer, 1987; Dallmeyer and others, 1987)

Correlation of the subsurface Paleozoic sequence (**s1**) in the North Florida basin with sequences of similar age in the Bové basin of Senegal and Guinea is suggested by similarities in fauna and stratigraphic successions (Chowns and Williams, 1983; Villeneuve, 1984). In addition, a 505 Ma $^{40}Ar/^{39}Ar$ plateau age for detrital muscovite from subsurface Ordovician sandstone in Marion County, Florida, suggests a metamorphic source similar in age to rocks of the Bassaride and Rokelide orogens, which yield $^{40}Ar/^{39}Ar$ muscovite ages of about 500–510 Ma (Dallmeyer, 1987). Opdyke and others (1987) reported 1650-1800 Ma U-Pb ages for detrital zircons from Ordovician-Silurian sandstone in Alachua County, Florida, suggesting a source similar in age to the basement of the West African craton. Paleomagnetic results from the same sandstone core suggest a paleolatitude of about 49°, in contrast to a 28° Ordovician-Silurian paleolatitude suggested for Laurentia, supporting a Gondwana linkage (Opdyke and others, 1987).

The felsic igneous complex (**s3**) may correlate with a calc-alkaline, variably deformed and metamorphosed igneous sequence (e.g. Niokola-Koba Group) that occurs along western portions of the Mauritanide, Bassaride, and northernmost Rokelide orogens (Dallmeyer and Villeneuve, 1987; Dallmeyer and others, 1987). This sequence includes felsic volcaniclastic units together with associated, hypabyssal subvolcanic plutons. Radiometric ages suggest that the west African calc-alkaline igneous sequences developed between about 650 and 700 Ma (Lille, 1969; Bassot and Caen-Vachette, 1983; Dallmeyer and Villeneuve, 1987; Dallmeyer and Lecorche, 1989).

Dallmeyer and others (1987) proposed a correlation of the Osceola Granite (**s2**) and the post-tectonic Coya Granite in the northern Rokelide orogen in Guinea. Both have crystallization ages of about 530 Ma and display similar petrographic characteristics (Dallmeyer and others, 1987). They also proposed that the two plutons were initially part of a sequence of post-kinematic, relatively high level plutons emplaced along the northwestern margin of Gondwana following the Pan African II tectonothermal event at about 550 Ma.

Correlation of the St. Lucie Metamorphic Complex (**s4**) and parts of the Rokelide orogen was initially suggested by Chowns and Williams (1983). The penetrative effects of a 550 Ma Pan African II tectonothermal event are recorded throughout the Rokelide orogen. There, components of a western exotic gneiss complex are imbricated with cover sequences and with mylonitic and retrogressed basement of the West African Shield (Allen, 1967, 1969; Williams, 1978; Thorman, 1976). Hornblende from northern parts of the Rokelide orogen records K-Ar and $^{40}Ar/^{39}Ar$ plateau ages from about 550 to 580 Ma (Allen and others, 1967; Beckinsale and others, 1980; Dallmeyer, 1989b). These have been interpreted to date post-metamorphic cooling through about 500°C. Post-metamorphic cooling appears to have been younger in the southern Rokelides where hornblende records K-Ar and $^{40}Ar/^{39}Ar$ plateau dates between about 485 and 530 Ma (Hurley and others, 1971; Hedge and others, 1975; Dallmeyer, 1989b). The 510–515 Ma $^{40}Ar/^{39}Ar$ plateau ages of hornblende from the St. Lucie Metamorphic Complex suggest a linkage with central parts of the Rokelide orogen.

## Wiggins Uplift

The Wiggins uplift is a subsurface structural horst of pre-Mesozoic crystalline rocks bounded by Mesozoic faults beneath the Gulf Coastal Plain in southwestern Alabama and southeastern Mississippi. Suites of rocks recovered by drilling include the Wiggins terrane (**wg**), a metamorphic complex of gneiss and amphibolite intruded by granite, and a lower-grade unit (**wp**) of phyllite (see Description of Map Units). K-Ar whole-rock ages ranging from about 275 and 300 Ma have been reported for rocks of both units (Cagle and Khan, 1983). $^{40}Ar/^{39}Ar$ incremental-release ages for units in the Wiggins uplift (Dallmeyer, 1989c) are discussed in the Description of Map Units. The relationship of rocks in the Wiggins uplift to the Suwannee terrane is uncertain, but the former have been extensively overprinted by late Paleozoic ductile strain and metamorphism (Dallmeyer, 1989c).

# HISTORY OF TERRANE AMALGAMATION AND ACCRETION

The Penobscottian, Taconian, Acadian, and Alleghanian Paleozoic compressional events collectively assembled the various terranes into what is now the central and southern Appalachian orogen. The Penobscottian orogeny, about 550 to 490 Ma, amalgamated the Potomac composite terrane (**dp**), the Chopawamsic terrane (**vcp**), probably the Bel Air-Rising Sun terrane (**ob**), and possibly other exotic terranes at an unknown distance from Laurentia. In northern Virginia, the age of the Penobscottian event is bracketed between the Early Cambrian(?) Chopawamsic Formation and the Occoquan Granite (**p1**; about 494 Ma); the latter unit stitches the boundary between the Chopawamsic and Potomac terranes. Evidence for Penobscottian orogenesis has not been described south of Virginia; however, potential tectonic linkages among the Potomac composite (**dp**), Smith River (**ds**), Inner Piedmont composite (**di**), and Milton (**um**) terranes cannot be ruled out.

The Penobscottian event was followed by the Taconian orogeny, between about 480 and 435 Ma (Glover and others, 1983), which accreted previously amalgamated terranes as well as other terranes to Laurentia. The younger age limit for the Taconian event is partly constrained by Middle to Late Ordovician faunal assemblages in successor basin deposits of the Arvonia Slate (**O1**) and Quantico Formation (**O2**). All suspect terranes west of the Carolina and Albemarle volcanic arcs, including those amalgamated during the Penobscottian event, were accreted to the Laurentian native terranes and initially deformed and metamorphosed together during the Taconian orogeny. The time of accretion of the Carolina and Albemarle volcanic arcs (**vca**) is in dispute but evidence for Ordovician regional metamorphism suggests that the Albemarle volcanic arc was also accreted during the Taconian orogeny.

The significance of the Acadian orogeny is uncertain in the central and southern Appalachians. In the Talladega block of Alabama and Georgia, an Early to Middle Devonian dynamothermal event is tentatively bracketed between Early Devonian fossils in the metamorphosed Jemison Chert and conventional K-Ar whole-rock slate and phyllite ages which appear to indicate a thermal peak no later than Early to Middle Devonian (Tull, 1982). A regional tectonothermal event of approximately this age is also suggested by isotopic studies in terranes to the east (Dallmeyer and others, 1986). The Salisbury and Concord Plutonic Suites are dated at about 400 Ma. Otherwise, this poorly defined Devonian event, about 380 to 340 Ma (Glover and others, 1983), appears to be younger than the Acadian orogeny in New England (about 400 to 380 Ma; Naylor, 1971; Rankin and Hon, 1987).

The late Paleozoic (Alleghanian) continental collision between Laurentia and Gondwanaland, which formed the supercontinent Pangea, marks the final stage of accretionary history in the Appalachian-Caledonide orogen. Effects evident in the central and southern Appalachian region include: (1) the accretion of the Suwannee terrane, a probable Gondwana fragment, and perhaps the Charleston terrane to Laurentia; (2) slicing and shifting of terranes along dextral strike-slip faults, particularly in the eastern Piedmont (Gates and others, 1986); (3) westward transport of previously accreted terranes in the western Piedmont and Blue Ridge as part of a composite crystalline thrust sheet; and, (4) imbricate thrusting and folding of the Appalachian foreland in the Valley and Ridge Province. The strike-slip faulting may have been caused by dextral plate motion between Laurentia and Gondwanaland during the late stages of continental collision (Secor and others, 1986). The age of the Alleghanian event was about 330–270 Ma (Glover and others, 1983).

Based upon the aforementioned lithologic correlations of subsurface rocks (map units **s1**, **s2**, **s3**, and **s4**) with those in west Africa, the nonmetamorphosed state of the Ordovician to Devonian platform cover sequence, and faunal character, the Suwannee terrane is thought to represent a part of Gondwanaland, which became sutured to Laurentia during the Alleghanian orogeny and which remained attached to North America after Mesozoic opening of the present Atlantic Ocean.

Available basement penetrations in conjunction with aeromagnetic surveys (Zietz and Gilbert, 1980; Higgins and Zietz, 1983) allow delineation of the boundary between Appalachian sequences and the Suwannee terrane. This part of the Alleghanian suture has been called the Suwannee suture (Dallmeyer, 1987; 1989a). Interpretations of this boundary by Chowns and Williams (1983), Horton and others (1989a), and Thomas and others (1989b) are shown on the terrane map. These interpretations of the boundary coincide approximately (but not exactly) with the trace of the Brunswick (Altamaha) magnetic anomaly in Alabama. Nelson and others (1985b) suggested that the anomaly everywhere marks the suture between Appalachian elements and the Suwannee terrane. The anomaly and most interpretations of the subsurface terrane boundary diverge, however, when traced eastward across Georgia (see map). Chowns and Williams (1983) suggested on the basis of these relationships, that although the anomaly may mark the deep crustal expression of the suture, it is likely that at shallower crustal levels the Suwannee terrane has been thrust northward.

To the north, in the area of the Chesapeake Bay, Lefort (1989) and Lefort and Max (1989) suggest that the mafic rocks here assigned to the arcuate Sussex terrane are oceanic crust preserved along the Alleghanian suture (their "Chesapeake Bay suture"). They suggest that the deep curvature concave to the east is the result of the indenting of the Carboniferous margin of Laurentia by a projection of the west African craton. Pre-Mesozoic plate reconstructions place the Reguibat uplift of northwest Africa opposite Chesapeake Bay in an orientation appropriate for the indenter. This geometry, of course, could also result from the accommodation of "the indenter" into a pre-existing embayment in the continental margin. Lefort and Max (1989) suggest that part of the indenter remained behind during the Mesozoic opening of the present Atlantic Ocean and became part of modern North America. Thus, the continental rocks here assigned to the Chesapeake block (**ch**), in the subsurface between the Sussex terrane and the present continental margin, could include Archean to Middle Proterozoic basement of the Reguibat uplift and/or Pan-African supracrustal rocks of the Mauritanide orogen.

The position of other parts of the Alleghanian suture between the Suwannee suture and the Chesapeake Bay suture (if that indeed is a segment of the Alleghanian suture) is uncertain. The Suwanee suture is shown on the map as extending offshore to intersect the continental margin (taken to be the East Coast magnetic anomaly) roughly at the Blake Spur fracture zone. The present (and Mesozoic) continental margin is interpreted on this map to roughly follow the Alleghanian suture to the northeast. An alternative is that the Alleghanian suture is the northwestern boundary of the Hatteras terrane. If that were the case, a line of sharp magnetic and gravity anomalies that extends from Cape Fear, North Carolina, toward the northwest end of the Blake Spur fracture zone may be Mesozoic plutons localized in part along part of the Alleghanian suture.

Initial phases of Alleghanian tectonothermal activity occurred between about 315 and 295 Ma, and involved folding, metamorphism, and emplacement of felsic plutons at middle crustal levels (Dallmeyer and others, 1986). A second episode of Alleghanian activity was associated with crustal uplift and resultant rapid post-metamorphic cooling between about 295 and 285 Ma. This was accompanied by westward-vergent folding as crystalline nappes moved over ramps during thrust transport (Secor and others, 1986). Regional post-metamorphic cooling appears to have occurred slightly earlier (500–350°C between about 335 and 305 Ma) in the eastern Blue Ridge and western Piedmont allochthons (Dallmeyer, 1988). These sequences were likely maintained at elevated temperatures following earlier Paleozoic metamorphism which probably accompanied their initial accretion to Laurentia (Dallmeyer, 1989a). Final cooling is interpreted to have occurred during transport to higher crustal levels as the allochthonous units were thrust onto the North American margin. The final phase of Alleghanian deformation resulted in development of dextral shear zones in the eastern Piedmont between about 290 and 268 Ma (Dallmeyer and others, 1986; Gates and others, 1986). This strain has been interpreted to have developed as a result of relative rotation between Gondwana and Laurentia during final stages of Pangea amalgamation (Secor and others, 1986). Recent continental reconstructions (e.g., Ross and others, 1986; Rowley and others, 1986) suggest that final amalgamation of Laurentia and Gondwana resulted in a Pangea configuration similar to that portrayed by Keppie and Dallmeyer (1989). Fragments of Gondwana continental crust (Suwannee terrane and perhaps the basement underlying Chesapeake Bay) were stranded during Mesozoic opening of the Gulf of Mexico and the Atlantic Ocean.

## SIGNIFICANCE OF THE BAHAMAS FRACTURE ZONE

The southern boundary of the Suwannee terrane in Florida is defined by the Jay fault of Smith (1983), which is likely a projection of the Bahamas fracture zone (Klitgord and others, 1984). The fault may connect northwestward with the Pickens and Gilbertown fault systems (Smith, 1983), which can be traced into the midcontinent.

A Mesozoic volcanic sequence southwest of the Jay fault probably developed in response to opening of the present Atlantic Ocean (Mueller and Porch, 1983), and is interpreted by Ross and others (1986) to have developed on older continental crust. Several fault-bounded blocks of crystalline basement having characteristics similar to those of the Suwannee terrane appear to underlie southern Florida (Thomas and others, 1989a, 1989b). On the basis of geophysical characteristics, Klitgord and others (1984) have also suggested that several tracts of fault-bounded continental crust occur in the Gulf of Mexico west of Florida. In addition, continental crust having Pan African age affinities was penetrated by two Deep Sea Drilling Project holes drilled in the Gulf of Mexico northeast of Yucatan (Dallmeyer, 1984).

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