

Accretion of terranes and growth of continental crust along the southern margin of Laurentia during assembly of Pangaea [and modifications by opening of the Gulf of Mexico]

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Two significant accreted continental terranes within the late Paleozoic southern Appalachian-Ouachita orogen document growth of continental crust of southern ENAM (Fig. 1). Around the Ouachita embayment of the rifted margin, the late Paleozoic Ouachita orogen includes a forearc complex and accretionary prism associated with southward subduction of Laurentia beneath the Sabine continental terrane (affinity unknown) and continental-margin arc. On the corner of the Alabama promontory, the Suwannee-Wiggins suture truncates Laurentian continental crust, reflecting continent-continent collision of Laurentia with the Suwannee (Africa) terrane. The Suwannee-Wiggins suture trends westward toward the Sabine terrane; however, the possible relationships between the Sabine and Suwannee terranes are unknown. Are these terranes components of a single larger terrane, or are they distinct separate continental blocks? Does accretion of these terranes reflect a unified event or separate events of plate convergence? Regardless, terrane accretion contributed significantly to late Paleozoic growth of Laurentian/North American continental crust. Mesozoic rifting, leading to opening of the Gulf of Mexico, somewhat extended parts of the accreted terranes, and established a new continental margin on the south. Did the fabric of late Paleozoic accretion significantly constrain Mesozoic extension? Critical information to be gained from Transportable Array and Flexible Array densification includes thickness and nature of the crust from continental Laurentia across the terrane boundaries, terranes, and Mesozoic extensional faults. Resolution of subducted slabs and sutures is necessary to discriminate the Sabine accretionary prism from the Suwannee-Wiggins suture. The area, where the two terranes are traced to a near intersection, will be critical in comparing and contrasting the crustal structure of the terranes, as well as the nature of the accretionary fabrics. How did the accreted terranes affect Mesozoic extension? And how has the accreted continental crust been modified by Mesozoic extension?

Sedimentary deposits in the Ouachita embayment record rift initiation and evolution, as well as subduction-related processes. The Ouachita embayment, bounded by the orthogonal northeast-striking Ouachita rift and northwest-striking Alabama-Oklahoma transform, was formed in Cambrian time by the rifting of the Argentine Precordillera away from Laurentia (Thomas and Astini, 1996). Sedimentary deposits record the new continental margin and evolving oceanic crust, including a Cambrian-Mississippian carbonate facies on the passive-margin shelf and a temporally equivalent, mud-dominated continental-slope-and-rise prism and abyssal plain on oceanic crust, parts of which are now incorporated in the Ouachita thrust belt (summary in Thomas, 2011). An abrupt increase in sedimentation rate in the Middle Mississippian indicates the change from passive-margin deposition to early synorogenic deposition, indicating the initial approach of the Sabine terrane. Subsequent Upper Mississippian–Middle Pennsylvanian forearc-basin deposits and an accretionary prism are associated with a continental-margin arc on the leading edge of the Sabine terrane. A Middle Pennsylvanian synorogenic clastic wedge in the Ouachita foreland records rapid foreland crustal subsidence as a

result of tectonic loading on the southern margin of Laurentian continental crust. Deformed synorogenic deposits are overlain by an undeformed Upper Pennsylvanian–Middle Permian shallow-marine fill of a successor basin, indicating the termination of orogenic contraction and terrane accretion within the Ouachita embayment at ~309 Ma (Nicholas and Waddell, 1989).

The orthogonal intersection of the northwest-striking Alabama-Oklahoma transform fault with the northeast-striking southern segment of the Blue Ridge rift outline the Alabama promontory of Laurentian crust (Fig. 1). Late Paleozoic continent-continent collision with the Suwannee terrane truncated and obliterated part of the corner of the Alabama promontory (Fig. 1); therefore, the rift and post-rift history of the margin must be reconstructed from projections from other areas. Northeast along strike, synrift sedimentary and volcanic accumulations indicate the time of opening of Iapetus and continental rifting to be latest Precambrian (543 Ma) (summary in Thomas, 1991). Repeated episodes of Appalachian orogenesis have obliterated any possible off-shelf continental slope-and-rise deposits; however, a robust Cambrian-Ordovician passive-margin carbonate-shelf facies documents the early post-rift history of the Alabama promontory. Palinspastic restoration of the passive-margin carbonates now in the Appalachian thrust belt shows that the original extent of the shelf was somewhat greater than the presently preserved extent of shallow Laurentian crust, thereby documenting truncation of Laurentian crust during continent-continent collision with the Suwannee terrane (Thomas, 2011). Diachronous elements of foreland synorogenic clastic wedges indicate episodic orogenesis at different places around the margin of the Alabama promontory. Although foreland subsidence and clastic-wedge progradation began earlier to both the west (Ouachita) and northeast (Appalachian), foreland subsidence and clastic-wedge progradation did not begin on the corner of the Alabama promontory until middle Early Pennsylvanian (315 Ma), signifying initiation of continent-continent collision with the Suwannee terrane. A wide band of metamorphic lithons, interlaced with mylonites, marks the suture between Laurentian continental crust and the African crust and cover of the Suwannee terrane (summary in Thomas, 2010); metamorphism along the Suwannee-Wiggins suture is as young as ~300 Ma (Steltenpohl et al., 2008), indicating later convergence than along the leading edge of the Sabine terrane.

The Mesozoic Bahamas fracture zone of the Atlantic mid-ocean ridge projects into southern North America diagonally across the area of the uncertain relationship between the Sabine and Suwannee terranes. Orientation of gravity anomalies suggests that the western part of the Suwannee-Wiggins suture may have been rotated counter-clockwise by Bahamas transform motion. This region offers an excellent opportunity to understand the growth of continental crust by accretion of terranes, as well as modification of crust by later supercontinent breakup.

Both the Sabine and Suwannee terranes are adequately documented by data from deep wells, seismic reflection profiles, and potential-field and seismic-velocity models; however, the characterization of these terranes, especially the lower crust and lithosphere remains inadequate. Currently active and proposed EarthScope projects will address the boundaries between Laurentian crust and the accreted Sabine and Suwannee terranes. The relationship between the two terranes, however, remains a first-order tectonic question and is a prime target for EarthScope and GeoPRISMS research in the unknown area between the documented terranes.

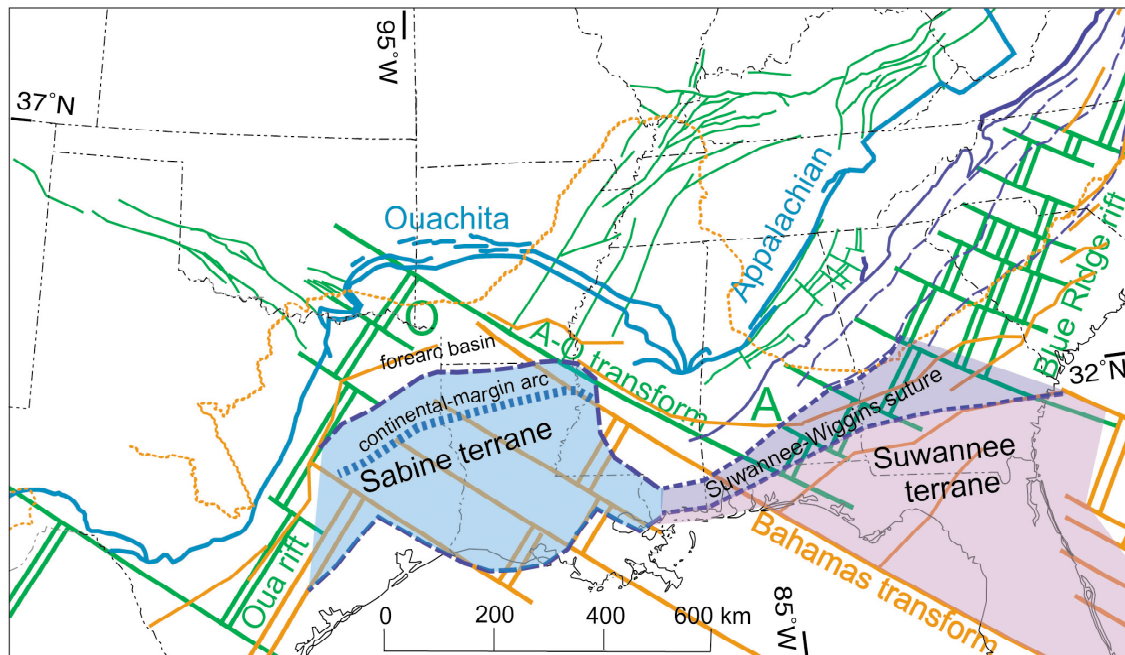


Figure 1. Map of Iapetan rifted margin of Laurentia (green lines), trace of Appalachian-Ouachita thrust front (blue lines), accreted Sabine and Suwannee terranes and related structures, and Atlantic-Gulf rifted margin of North America (orange lines). Abbreviations: O—Ouachita embayment, A—Alabama promontory, A-O transform—Alabama-Oklahoma transform, Oua rift—Ouachita rift.

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