SUPPLEMENTAL BACKGROUND MATERIALS

At the scale of a geologic map of eastern North America stark differences in southern Appalachian structures are clearly seen between the Tennessee-western Carolinas-northern Georgia and the Alabama segments of the orogen (Fig. 1). Eastern Tennessee contains the classic, thin-skinned, southern Appalachian foreland fold-and-thrust belt with as many as 13 different, generally coplanar, northwest-directed thrusts sheets. This thrust stack lies directly west of the Great Smoky and Hayesville thrusts (Fig. 1) that have respectively emplaced western (lower greenschist-facies in Alabama increasing to middle-amphibolite facies in North Carolina; Massey and Moecher, 2005) and eastern (middle-to-upper amphibolite- to eclogite-facies) Blue Ridge terranes upon the Laurentian platform (Fig. 1; Hatcher, 1987, 2010; Adams et al., 1996; Stewart and Miller, 2001). In sharp contrast, the Valley and Ridge of Alabama and west Georgia contains many fewer northwest-directed thrusts (see Figure 1). The Talladega-Cartersville fault is the frontal Blue Ridge fault in Alabama and west Georgia and, like its structural equivalent the Great Smoky fault, is the southern Appalachian master décollement (Cook et al., 1979). The Talladega-Cartersville fault, however, is a complex structure containing major 'decapitated' folds within klippen and fensters that do not follow 'conventional' foreland fold-and-thrust-belt 'rules' such as those documented in Tennessee (Fig. 2; Tull, 1984; Tull and Holm, 2005).

The Hollins Line fault is the basal eastern Blue Ridge fault in Alabama and it occupies a structural position equivalent to the Hayesville thrust, having emplaced amphibolite-facies (kyanite and sillimanite zone) rocks upon lower-greenschist-facies Talladega slate belt rocks to the northwest (Bentley and Neathery, 1970; Hatcher, 1978; Tull, 1978, 1980, 1982, 1984, 1995; Steltenpohl and Moore, 1988; McClellan et al., 2005, 2007; Tull et al., 2007). Contrary to thrust movement along the Hayesville fault, the Hollins Line is an oblique, right-slip transpressional fault (Mies, 1991). Tull (1995) called it the "Hollins Line transpressional duplex: Eastern-Western Blue Ridge terrain boundary," and the duplex is large enough to be seen in Figure 2 directly west-southwest of the town of Millerville. Therefore, right-slip movement in Alabama has encroached farther into the Appalachian foreland within Alabama than is documented anywhere else within the southern Appalachians. This observation led us to explore the next two hinterland-ward fault zones in Alabama, the Goodwater-Enitachopco and Alexander City fault zones (Figs. 1 and 2). These two fault zones are internal to the eastern Blue Ridge but lie toward the foreland from the Brevard fault zone, which is a fundamental, right-slip structure with both Neoacadian and Alleghanian movement histories and separates the eastern Blue Ridge from the Inner Piedmont belt to the southeast (Bobyarchick, 1983, 1999; Vauchez, 1987; Bobyarchick et al., 1988).

The Goodwater-Enitachopco fault is shown on earlier maps to extend from southwest of a major embayment in the Hollins Line fault at Millerville, Alabama into western Georgia, where its trace is uncertain but suggested to merge or coincide with the Allatoona fault (Fig. 2: Neathery and Reynolds, 1973; Tull, 1978; McConnell and Costello, 1980; Raymond et al., 1988; Tull and Holm, 2005). Rocks of the Ashland Group lie between the Hollins Line and the Goodwater-Enitachopco faults. The Ashland Group occurs within two regional sub-salients on either side of the Millerville structural embayment (Fig. 2). The structurally lower units of the Ashland Group consist of schist, gneiss, quartzite, and abundant amphibolite layers whereas the upper units comprise heterogeneous paragneiss, schist, calc-silicate, quartzite, and rare amphibolite (Bentley and Neathery, 1970; Tull, 1978; Steltenpohl 2005). The Goodwater-Enitachopco fault generally separates the Ashland Group to the northwest from the the Wedowee Group to southeast (Fig. 2; Neathery and Reynolds, 1973; Tull, 1978). Southwest of the Millerville reentrant (Fig. 2) the Goodwater-Enitachopco is depicted on some maps to die out (e.g., Osborne et al., 1988, and Tull and Holm, 2005), implying that displacement on the fault decreases toward the southwest (Tull, 2011), whereas other maps indicate either a fault or stratigraphic contact between the Ashland and the Wedowee groups (for example, compare Tull, 1978 to Allison, 1992).

Metamorphism of rocks in the eastern Blue Ridge and Inner Piedmont is documented to have occurred in two separate events ∼350 Ma (Neoacadian) and ∼330 Ma (early Alleghanian) with localized shearing ~300-285 Ma (late Alleghanian) (Gastaldo et al., 1993; Steltenpohl and Kunk, 1993; Dennis and Wright 1997; Carrigan et al. 2001; Kohn 2001; Bream 2002, 2003; Cyphers and Hatcher 2006; Merschat et al. 2006; Stahr et al. 2006; Hames et al. 2007; McClellan et al., 2007; McDonald et al. 2007).

Rocks of the eastern Blue Ridge in Alabama have been intruded by a host of felsic intrusions with timing relations that were only beginning to be understood as of this report (Russell, 1978; Stowell et al., 1996; Steltenpohl et al., 2003; Ingram et al., 2011; Schwartz et al., 2011a). The largest of these bodies is the Elkahatchee Quartz Diorite, a pre-metamorphic batholith (Fig. 2: Bentley and Neathery, 1970; Drummond and Guthrie, 1986; Osborne et al., 1988; Allison, 1992; Drummond et al., 1994, 1997). The age of igneous crystallization of the Elkahatchee Quartz Diorite was previously reported to be ~490 Ma based on U-Pb isotopic dating of multi-grain aliquots of zircons (Russell, 1978). Recent reconnaissance SHRIMP RG U-Pb dating of zircons from two samples assigned to the Elkahatchee, however, suggest igneous crystallization ages between ~388 and 370 Ma (Barineau, 2009; Tull et al., 2009). Other Neoacadian intrusions northwest of the Brevard zone in Alabama are lumped broadly into the Rockford and Bluff Springs granites (Deininger et al., 1973; Deininger, 1975; Russell, 1978; Defant, 1980; Defant and Ragland, 1981; Defant et al., 1987; Drummond, 1986; Osborne et al., 1988; Drummond et al., 1997), from which Schwartz et al. (2011a) recently reported U-Pb zircon dates of 376.6 +/- 2.8 Ma and 363.8 +/- 3.6 Ma, respectively. In contrast to the Neoacadian granites, which are K-felspar rich true granites and granodiorites, a suite of younger, early-Alleghanian trondhjemites are grouped within the Almond Trondhjemite (Bentley and Neathery, 1970; Neathery and Reynolds, 1975; Russell, 1978; Osborne et al., 1988; Drummond et al., 1997). Schwartz et al. (2011a) dated zircons from two of these plutons (i.e., the Wedowee pluton and Almond pluton) that yielded ages of 334.3 +/- 3.0 Ma and 340.5 +/- 2.7 Ma, respectively. Another sample, from the Blakes Ferry pluton, yielded complex results with rim ages ranging from ca 350 to 330 Ma (peak ages at 345.8 +/- 2.1 Ma and 336.6 +/- 2.4 Ma). Unpublished geologic mapping of the southern margin of the Elkahatchee batholith adjacent to the Alexander City fault zone by M.G. Steltenpohl documents that there are multiple intrusive phases within it. Recent U-Pb zircon dating of one of these phases - a large trondhjemite body that intrudes the Elkahatchee Quartz Diorite – reveals a range of ages from 350 - 335 Ma (a concordant grain as 335.9 +/- 6 Ma), documenting it as belonging to the suite of early-Alleghanian trondhjemites (i.e., Almond Trondhjemite: Schwartz et al., 2011a). Ongoing geologic mapping, geochemistry, and geochronology are aimed at better characterizing the magmagenesis and timing of Paleozoic intrusions in the Alabama Blue Ridge.

The Goodwater-Enitachopco fault is depicted on the Geologic Map of Alabama as a northwest-directed thrust (Osborne et al., 1988), and thrust motion was also suggested by previous workers for the extension of the fault in Georgia (i.e., Allatoona fault: Neathery and Reynolds, 1973; Tull, 1978; Bearce, 1979; Stow and Tull, 1979; McConnell and Costello, 1980; Higgins et al., 1988; Tull and Holm, 2005). Tull et al. (1985), however, noted the following characteristics of the Goodwater-Enitachopco fault in Alabama that make it difficult to reconcile as a thrust fault: 1) it presents a slight metamorphic discontinuity (medium grade upon high grade); 2) it has a steep regional dip; 3) it displays minimal stratigraphic control; 4) displacement decreases toward the southwest; and 5) it decapitates folds that deform the contractional Hollins Line fault (i.e., Millerville generation folds of Tull, 1984; see Figure 2). Combining the observation that the Goodwater-Enitachopco fault terminates to the southwest within a Devonian granite (Fig. 2), and the interpretation that the Hollins Line fault appears to be cut by it, Tull et al. (1985) suggested that the former "may" be a normal fault. Movement along the Hollins line fault is not tightly constrained but is bracketed between ~334 and 320 Ma (McClellan et al. 2007), which would place a maximum age for movement along the Goodwater-Enitachopco fault. The Goodwater-Enitachopco fault is reported to cut folds that deform Pennsylvanian strata in the footwall block (Tull, 1978, 1984; Tull et al., 1985; Mies, 1991), which would make it temporally compatible with latest Pennsylvanian to Permian, or even later, movement. Tull et al. (1985) suggested that this normal faulting might be related to either lateral extension during Alleghanian thrusting or to Mesozoic extension during rifting of Pangaea. Tull and Holm (2005), on the other hand, report that the Goodwater-Enitachopco is a thrust fault representing the southern continuation of the Alatoona fault. More recently, Tull (2011) suggested that the Goodwater-Enitachopco is a scissor fault associated with a late stage of orogenic collapse.

There is disagreement concerning the trace of the Goodwater-Enitachopco fault in the area northeast of Millerville, but most workers have inferred it along the dashed line in Figure 2 (e.g.: Neathery and Reynolds, 1975; Tull, 1978; Osborne et al., 1988; Mies, 1991). Mies (1991) reported that there is no evidence at all for the Goodwater-Enitachopco fault in the area of the Hightower reentrant (Fig. 2). Aeromagnetic and gravity surveys in this area conspicuously lack linear anomalies that might correspond to the Goodwater-Enitachopco fault (Wilson and Zietz, 2002). Stratigraphic control might explain the cryptic nature of the Goodwater-Enitachopco fault along this segment where exposure is not very good and a thin fault strand juxtaposing similar types of lithologies may make it difficult to recognize. Likewise, it may not be resolvable at the scales of the geophysical surveys.

The northeast-striking Alexander City fault zone emerges from underneath the Coastal Plain sediments in east-central Alabama and traces northeastward into west-central Georgia (Figs. 1 and 2). The Alexander City fault in most places separates the Wedowee Group from the Emuckfaw Group, the latter comprising lower-to-middle amphibolite-facies interlayered schist, metagraywacke, quartzite, and gneiss intruded by the Middle Ordovician Kowaliga Gneiss and Zana Granite (Neathery and Reynolds, 1973, 1975; Muangnoicharoen, 1975; Russell, 1978; Tull, 1978; Higgins et al., 1988;

Osborne et al., 1988; Raymond et al., 1988; Steltenpohl, 2005). Where we have studied it, the Alexander City fault is roughly coplanar with the Goodwater-Enitachopco fault to the northwest and with the Brevard zone to the southeast (see cross section in Figure 2). Historically, it too was thought to be a thrust fault (Bentley and Neathery, 1970; Neathery and Reynolds, 1973; Osborne et al., 1988). Later, Guthrie (1995) suggested that locally mylonites from the Alexander City fault zone indicate a dextral sense of shear, noting their resemblance to those defining major Alleghanian right-slip mylonite zones that lace the southernmost Appalachian internides (Secor et al., 1986; Steltenpohl, 1988).