

DETRITAL HISTORY OF THE CONGLOMERATE MEASURES OF THE POTTSVILLE FORMATION IN THE CAHABA SYNCLINORIUM, SOUTHERN APPALACHIANS, ALABAMA

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ABSTRACT

The Cahaba Synclinorium of Alabama contains >2.5 km of Pennsylvanian synorogenic clastic wedge sediment in the Pottsville Formation. The upper 800 m of the formation consists of coarse conglomerate with lesser amounts of sandstone, shale, and coal. Known as the conglomerate measures, this magnafacies was deposited in a series of stacked braidplain-anastomosis cycles, possibly at the distal fringes of giant piedmont fans. Aggradation of widespread bedload-dominated fluvial systems may have led to the development of anastomosed fluvial systems with peatlands, which are represented by thick, low-sulfur coal seams. A total of 36 conglomerate and 10 sandstone samples were collected from cores. Petrographic analysis reveals the source of this coarse-grained, synorogenic sediment.

Clasts within the conglomerate units consist mainly of chert, sedimentary and metamorphic lithoclasts and lesser amount of volcanic lithoclasts. Medium-to-high grade metamorphic lithic fragments are dominant. Carbonate clasts are present, along with large fragments of chert that appear to be derived principally from the Cambrian-Ordovician Knox Group. Both rhyolite and basalt clasts are present in the conglomerate, as are argillaceous lithic fragments. Clast composition indicates a proximal orogenic source that includes elements of the Appalachian thrust belt and the crystalline core of the Appalachians. The low abundance of heavy minerals and abundance of ultra-stable minerals in the upper Pottsville sandstone reflects intense chemical weathering, which is consistent with an equatorial paleolatitude. The presence of rutile and garnet further suggests a medium- to high-grade regionally metamorphosed source in the southern Appalachians. Ongoing research on detrital geochronology and mineral chemistry will provide additional information on provenance of the upper Pottsville Formation.

INTRODUCTION

The Appalachian-Ouachita orogenic belt records three separate mountain-building events: *Taconic* orogeny of the Middle Ordovician; *Acadian* orogeny of the Devonian; and *Alleghenian* orogeny of the Pennsylvanian-Permian. The Pennsylvanian to Permian, Alleghenian orogeny is the youngest and most pervasive event that affects the central and southern Appalachian. The Pottsville Formation is one of the classic clastic wedges that was deposited in the Appalachian foreland basin during the Alleghenian orogeny in eastern US in response to the collision of Laurentia with the Gondwanaland.

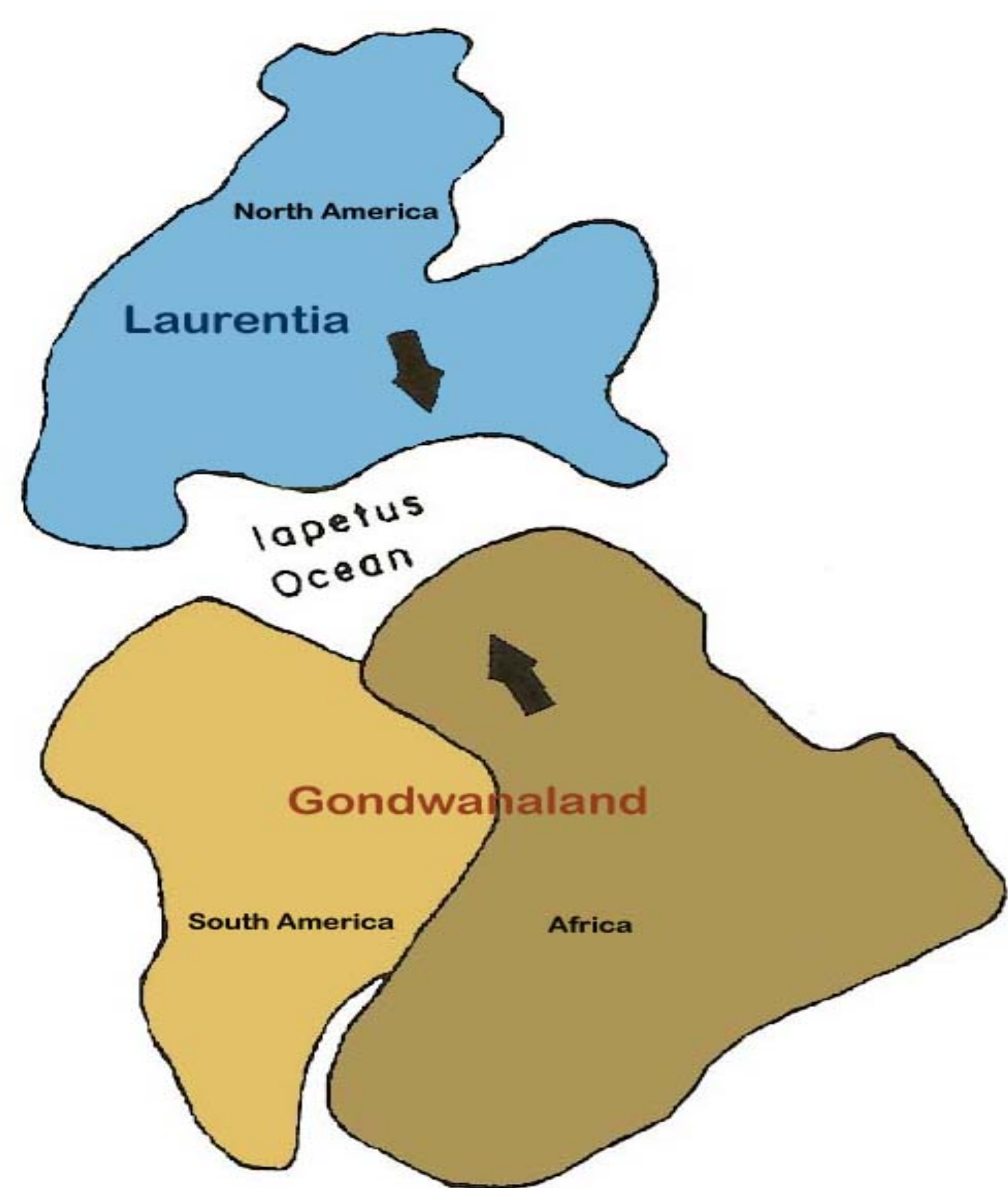


Figure 1: Early Pennsylvanian paleogeography prior the Alleghenian Orogeny. Gondwanaland and Laurentia were collided and formed a supercontinent called Pangaea. (modified from Mack et al., 1983).

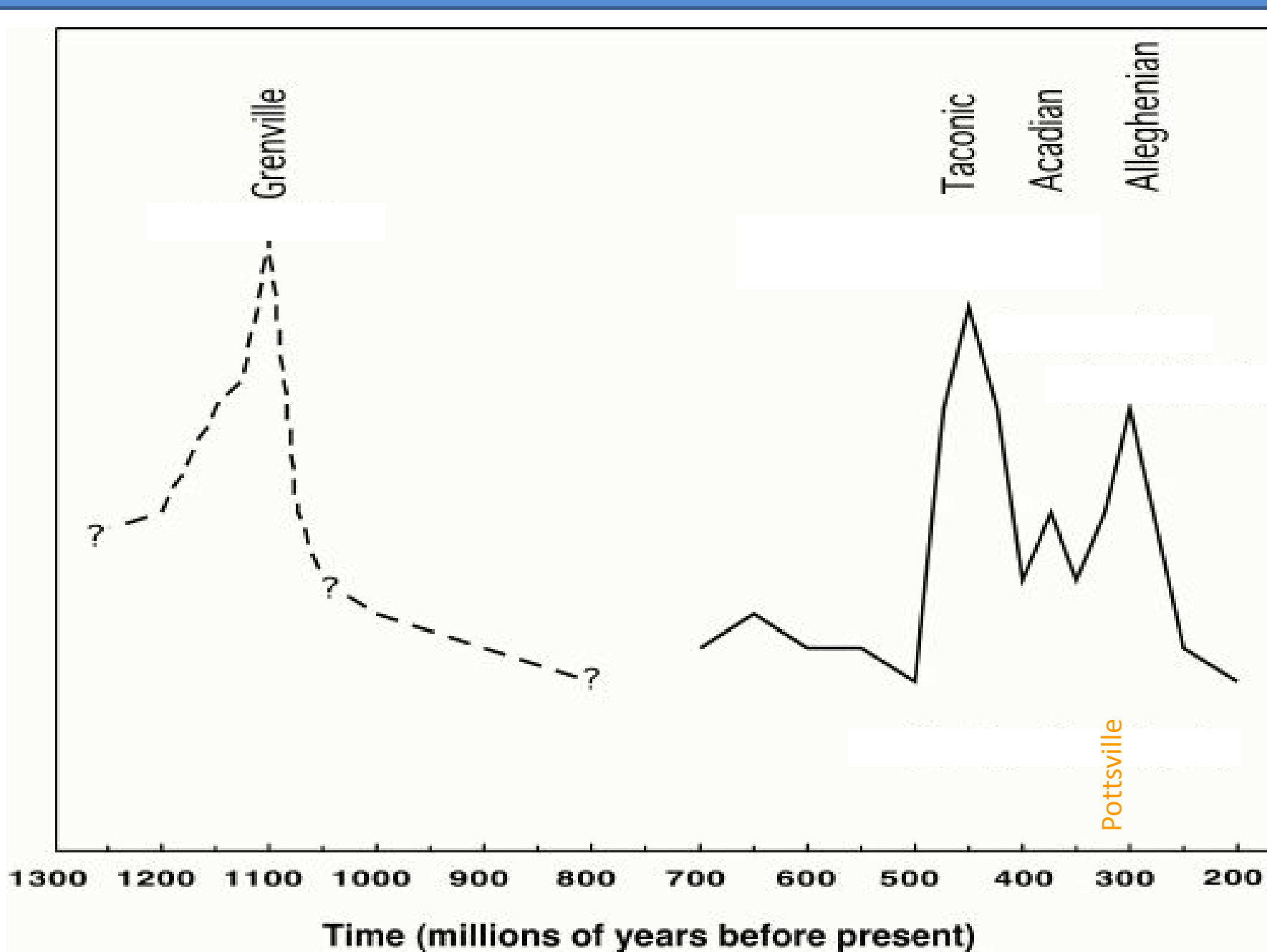


Figure 2: Sedimentation age of the Pottsville Formation. Pottsville Formation deposited during the Alleghenian orogeny due to the collision of part of Africa and Laurentia about 300 Mya (Pennsylvanian-Permian).



Figure 3: Paleogeographic reconstruction of southeastern USA during the Pennsylvanian. During the Alleghenian orogeny, rocks in the Appalachians Piedmont metamorphosed and rocks in the Valley and Ridge were severely folded and thrust. The sky-blue oval shape is the location of Cahaba Basin. (Source: USGS).

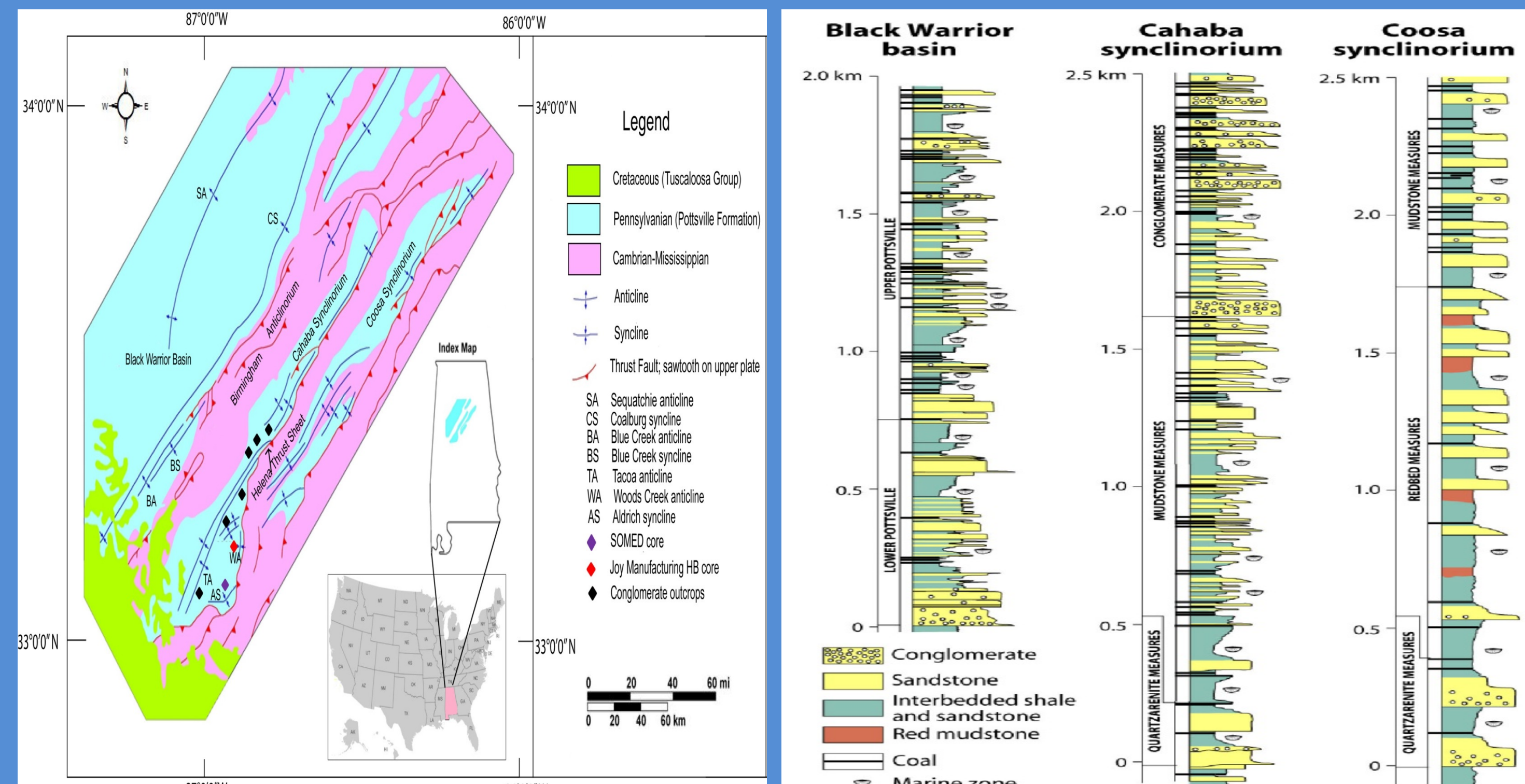


Figure 4: Generalized geologic map of the Cahaba and adjacent areas (modified from Osborne et al., 1989). Samples location for this study are shown.

Figure 5: Composite stratigraphic section of the Cahaba synclinorium and adjacent basin (modified from Pashin et al., 1995)

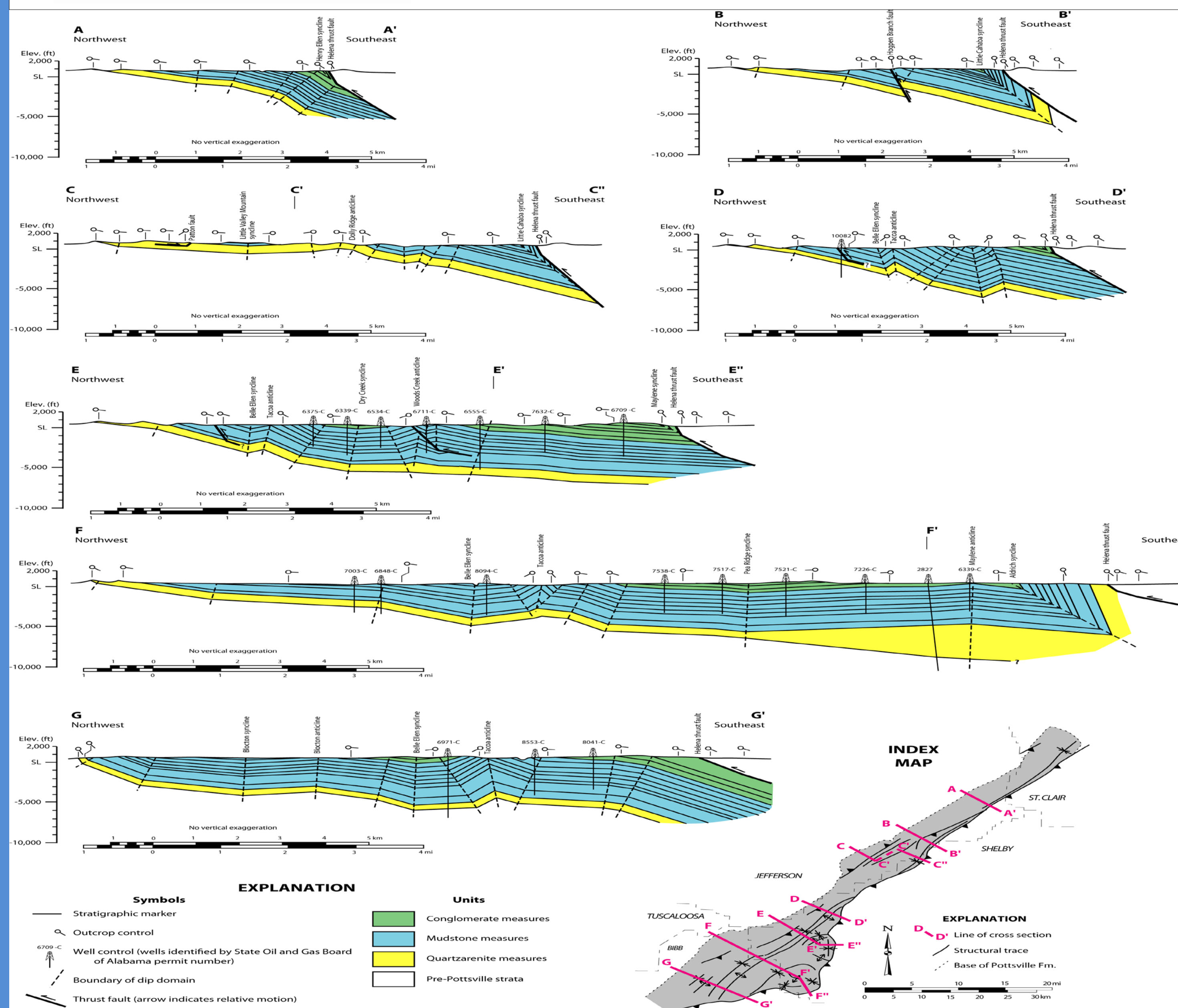
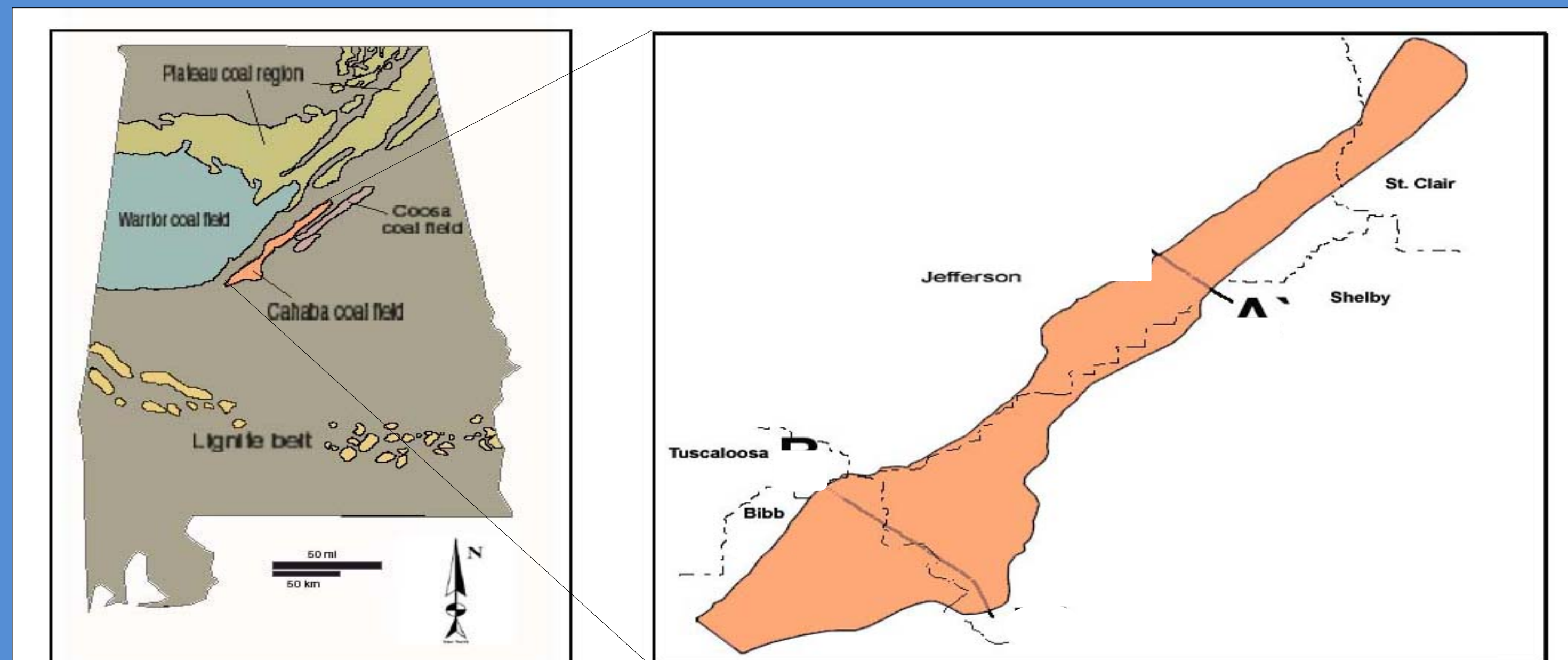


Figure 6: Location map of Cahaba Synclinorium within the Alabama. The basin is NE to SW oriented and extends for 65 miles. It is approximately 3 miles NW of the Coosa Synclinorium, and 6 miles SE of the Black Warrior Basin. Cross sections showing thickening towards southeast. (from Pashin and Carroll, 1999).

PREVIOUS STUDY

Different researchers suggested different source for the Pottsville Formation and have produced conflicting interpretations. Some researchers suggested Ouachita mountain belt as a source for the Pottsville Formation where as several recent works suggest that the Pottsville Formation of Alabama was derived from the deformed and uplifted southern Appalachians.

□ Mack et al. (1983) concluded that the source-rock province was a low-grade metamorphic and sedimentary fold and thrust belt.

□ (Osborne, 1988) concluded that granitic and metamorphic rocks of the Appalachian Inner Piedmont as a source of Straven conglomerate.

□ Robinson and Prave (1995) documented an abrupt change in sedimentation direction; older units display uniform northwest sediment transport whereas overlain younger units display southwest direction.

□ Pashin and Carroll (1999) using structural cross sections of the Pottsville Formation and provided further evidence for an Appalachian source.

□ Peavy (2008) and Moore (2012) report upper grade metamorphic source terranes and ⁴⁰Ar/³⁹Ar single-crystal muscovite age dates from several levels of the Pottsville suggest cooling ages reflecting all three orogenic events of the Appalachians.

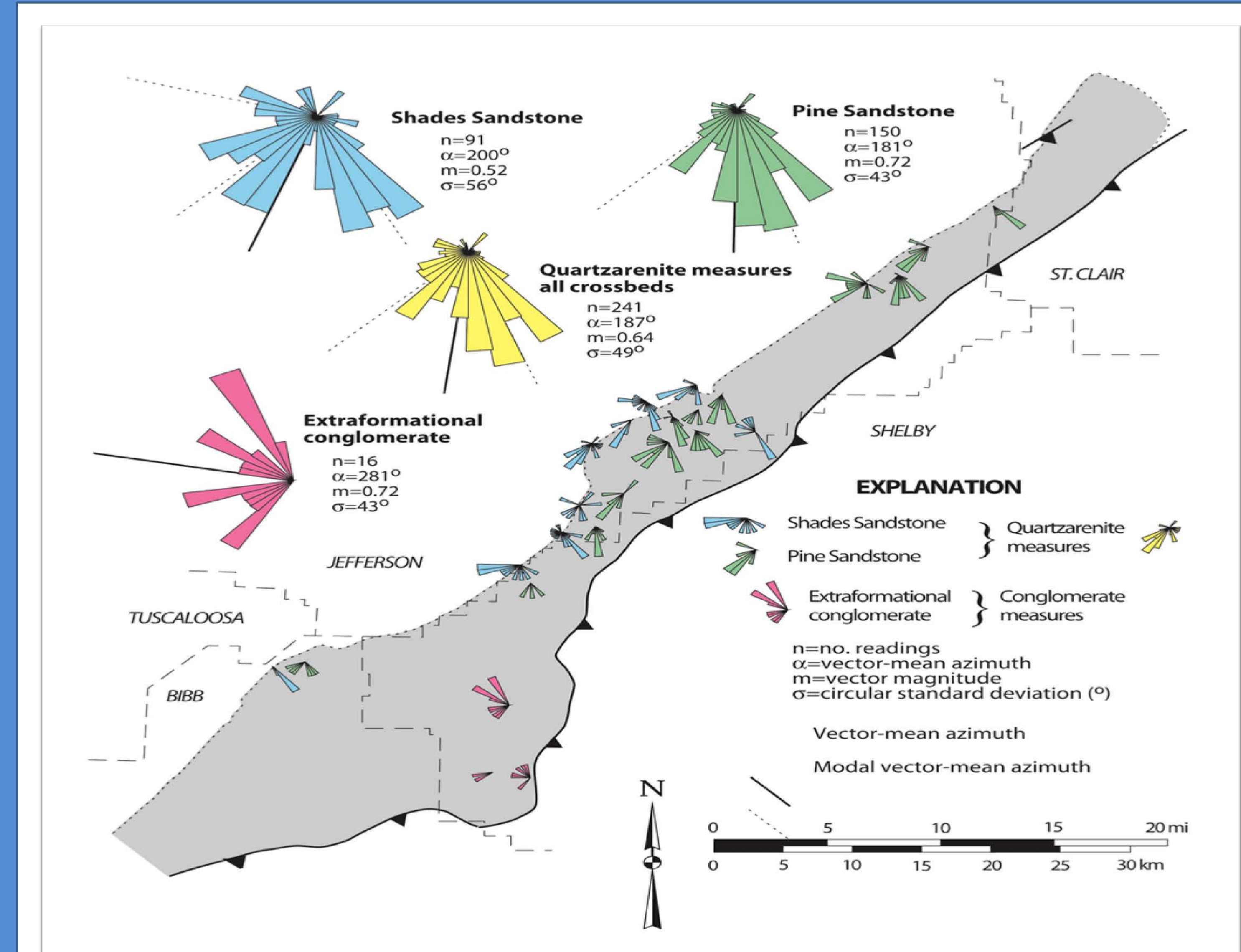


Figure 7: Results of paleocurrent analysis in the quartzarenite and conglomerate measures, after Pashin and Carroll (1999).

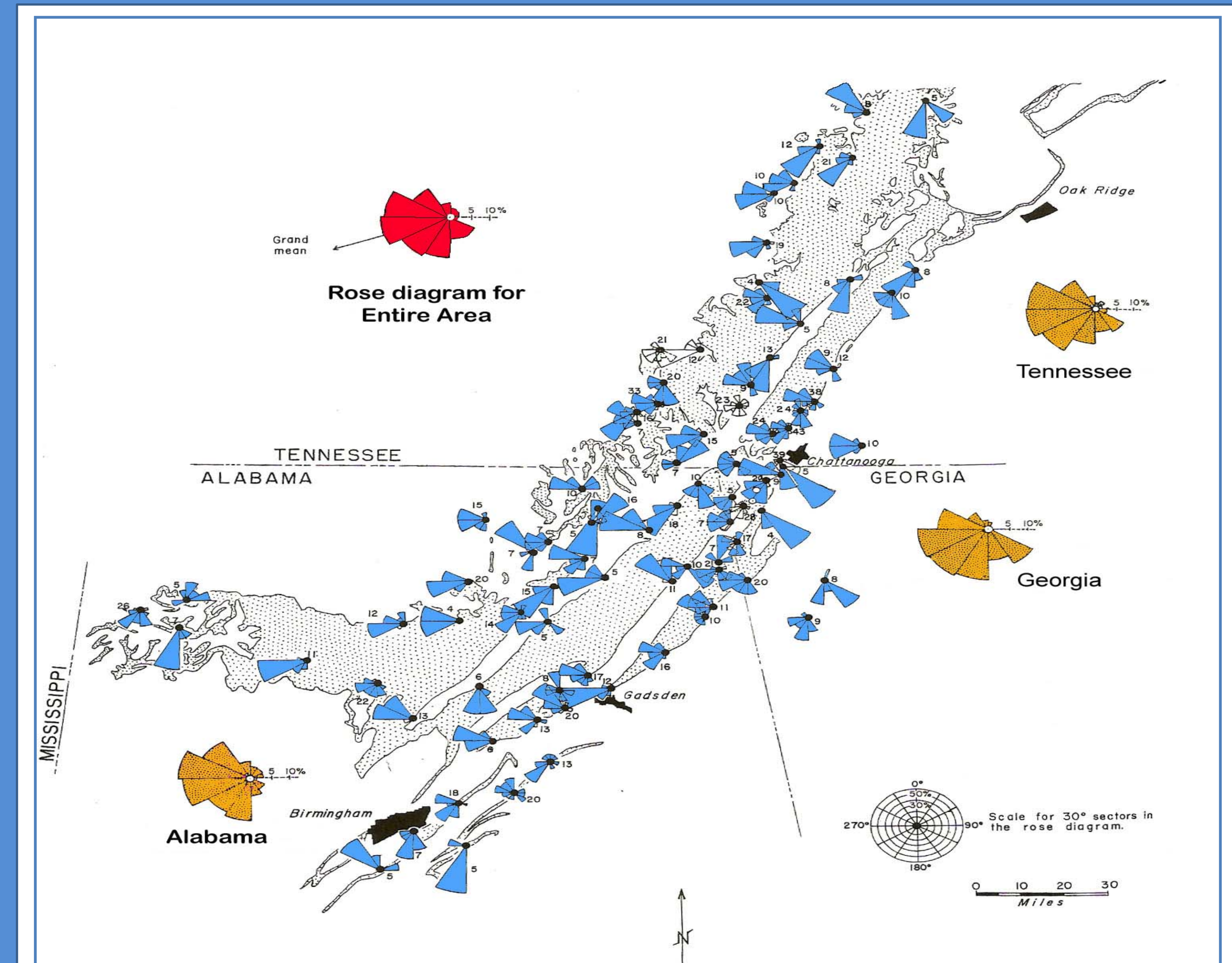


Figure 8: Measured cross-beds in basal Pottsville in AL, TN, GA, (modified from Schlee, 1963). Overall flow direction of the Pottsville sediments has been from east to northeast.