GEOLOGY

The Cahaba basin, a northeast-southwest orientated sub-basin of the Greater Black Warrior Basin. This was a foreland basin during the Pennsylvanian and Permian period which holds a maximum of 2.5 km Pottsville Formation. This formation overlies the Upper Mississippian – Lower Pennsylvanian Parkwood Formation throughout the Cahaba synclinorium and underlain by the Cretaceous Tuscaloosa Formation.

The sequences in Pottsville Formation are cyclothemic and consist of alternating sandstone, siltstone, claystone, shale and several coal beds with quartzose sandstone and conglomerates (Mack et al., 1983). Pashin and Carroll (1999) subdivided these cyclothemic clastic wedges into three major magnafacies, the lower Quartzarenite/Sandstone Measure, the middle Mudstone Measure, and the upper is Conglomerate Measure. (Figure 5) shows the composite stratigraphic column of the Pottsville Formation in the Cahaba synclinorium and adjacent areas. The upper 800 meters of the Pottsville Formation consist mainly of coarse conglomerate, sandstone, shale and coal.

Figure 9: Shows the core samples from Joy Manufacturing H.B. core. Inside the core repository of the Alabama Geological Survey the conglomerate core samples.

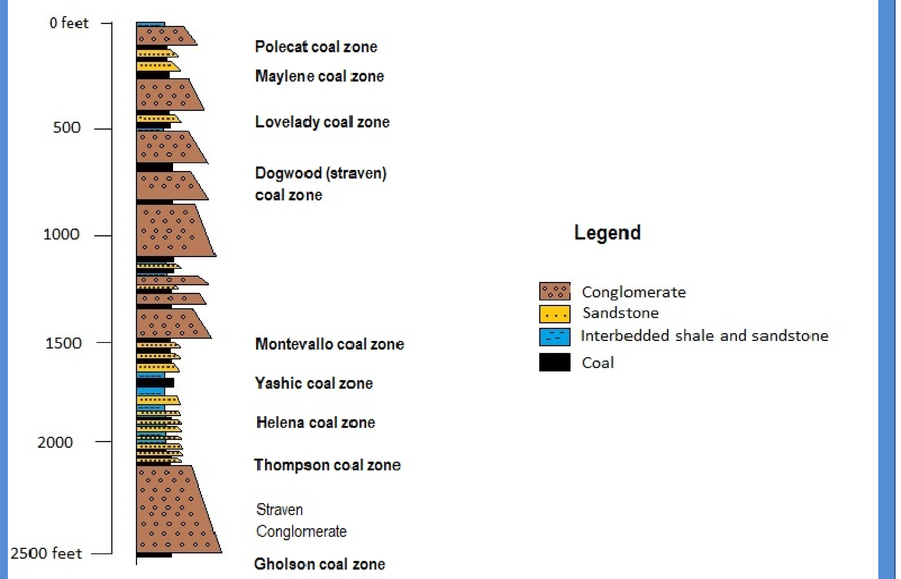
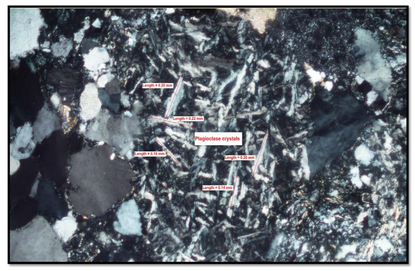


Figure 10: Generalized lithologic column of the Conglomerate Measure of Pottsville Formation, Cahaba Basin.

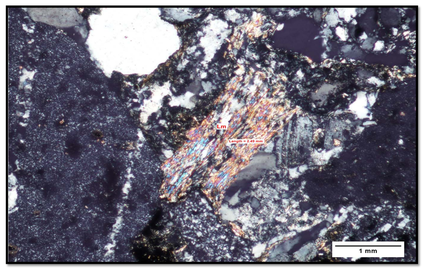
METHODS

Conglomerate samples were collected from two separate bore holes named the Joy Manufacturing H.B. and SOMED (School of Mine and Energy Division) cores from the core repository of the Geological Survey of Alabama in Tuscaloosa. The location of the bore holes are shown in the (figure 4). All the samples were collected from the upper Conglomerate magnafacies defined by Carroll and Pashin (1995). The constituting lithic fragments and mineral grains were counted as percentages. The following compositional parameters were distinguished and counted; Qt = total quartz, Qm = monocrystalline quartz, Qp = polycrystalline quartz, Ls = sedimentary lithics, Lm = metamorphic lithics, Lv = volcanic lithics, plagioclase, k-feldspar, and chert. To determine the provenance field, modal conglomerate compositions were plotted on standard ternary diagrams (Qt-F-L, Qm-P-K, Ls-Lv-Lm, Ls-Lm_1-Lm_2, etc.), following the approach of Dickinson and others (Dickinson, 1985) for sandstones. Heavy minerals were also separated from the sandstone samples and identified.

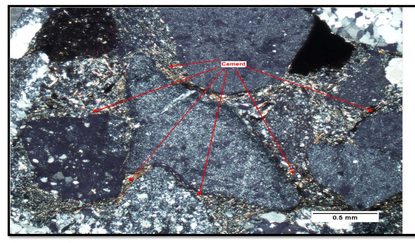
RESULTS



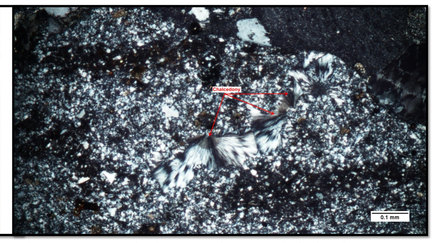
Photomicrograph showing plagioclase crystals within a volcanic fragments in sample ZH-11.



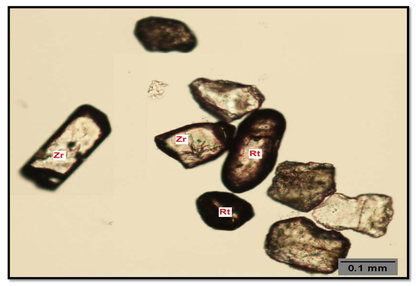
Photomicrograph showing chert, monocrystalline quartz and metamorphic clast.

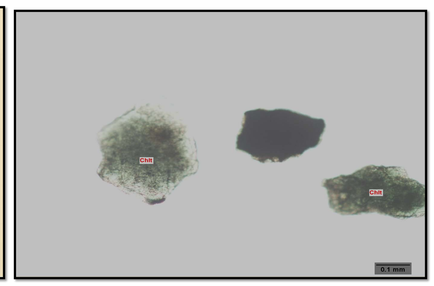


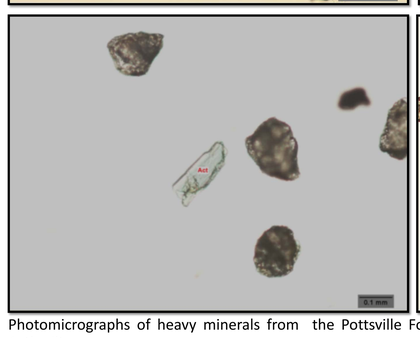
Photomicrograph showing chert, and calcite cement

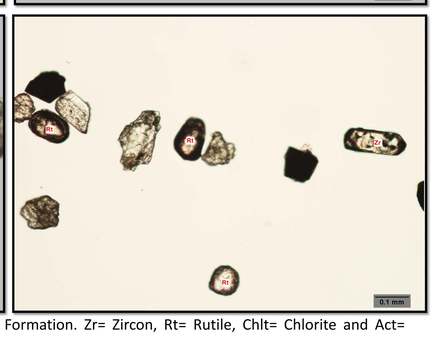


Photomicrograph showing chert, and chalcedony.









Photomicrographs of heavy minerals from the Pottsville Formation. Zr= Zircon, Rt= Rutile, Chlt= Chlorite and Act= Actinolite

Figure 11: Photomicrographs from the Pottsville Conglomerate Measure showing different constituting grains and clasts in conglomerates, and heavy minerals in sandstones.

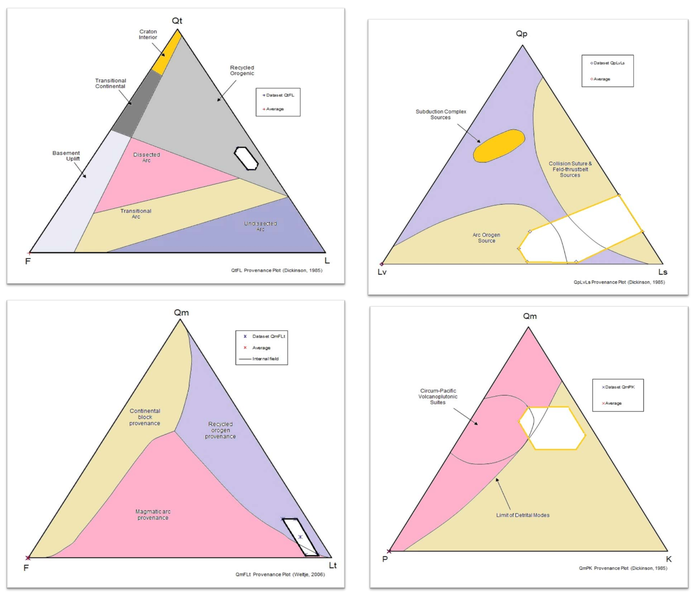


Figure 15: Ternary diagrams of QtFL, QmFLt, QpLvLs and QmPK showing recycled orogen to mix provenance fields.

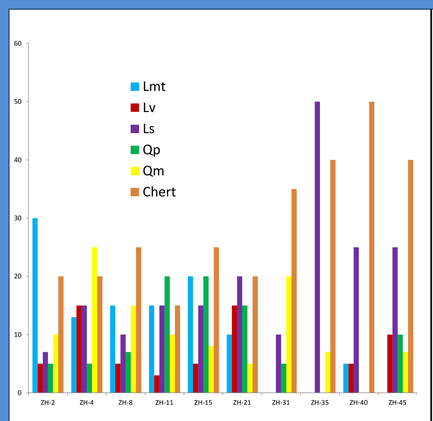


Figure 13: A bar graph showing the percentages of different clast in different depth conglomerate samples.

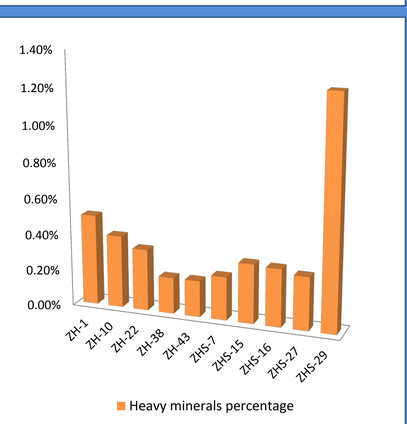


Figure 14: A bar graph showing the percentage of heavy minerals in different depth sandstone samples from the Conglomerate Measure.

DISCUSSION

Conglomerates of the upper Pottsville Formation mainly consists of chert, metasedimentary and sedimentary lithic fragments, with little amount of schist and volcanic clasts. The composition of Pottsville conglomerates varies with depth. Chert and sedimentary lithic fragments (>50%) are the dominant clast types and the abundance of these increases with depth. The abundance of metamorphic clasts (about 5-15%) increases upsection. The percentage of volcanic clasts (3-5%) remain almost consistent throughout the depth column of the Conglomerate Measure. The lithic fragments are usually large and sub-rounded to well-rounded.

The percentage of heavy minerals in the sandstones of Conglomerate Measure is low. Among the heavy minerals, stable minerals like zircon, rutile, garnet are common.

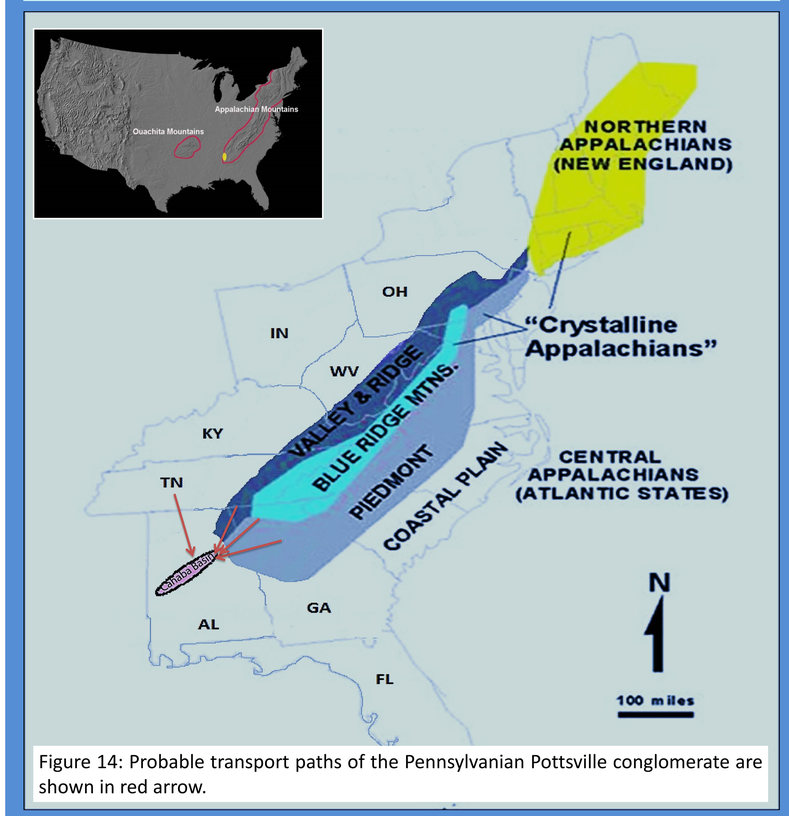


Figure 14: Probable transport paths of the Pennsylvanian Pottsville conglomerate are shown in red arrow.

SUMMARY

Conglomerates from J.M and SOMED cores mainly consist of chert, metamorphic, sedimentary and volcanic lithic fragments. Carbonate clasts also are present, along with large fragments of chert that appear to be derived principally from the Cambrian-Ordovician Knox Group. So the most prominent source of chert might be Cambrian-Ordovician carbonate rocks, lower part of the Copper Ridge Dolomite, which is the basal unit of the Knox Group in Tennessee. The abundance of sedimentary and metasedimentary rock fragments suggest a collisional orogen provenance. Furthermore, the presence of rutile and garnet suggests a medium- to high-grade regionally metamorphosed source in the southern Appalachians. The large size of sedimentary and metasedimentary clasts suggest an adjacent source of the conglomerates. The presence of quartzite, volcanic rock fragments, and schists suggest the source containing metamorphic and volcanic rocks. The QtFL, QmPK, QmFLt and QpLvLs plots suggest a collisional orogen to recycled orogenic belt provenance. Thus, the petrographic analysis of conglomerates suggests a part of the sediments were derived from the source terranes in the Appalachian Mountains to the east and northeast.

REFERENCES

Dickinson, W.R., 1985, Interpreting provenance relations from detrital modes of sandstones, in Zuffa, G.G., ed., Reading Provenance from Arenites: Dordecht, The Netherlands, Riedel, p. 333-361.

Mack, G.H., Thomas, W.A., Horsey, C.A., 1983, Composition of Carboniferous Sandstone and Tectonic Framework of Southern Appalachian-Ouachita Orogen: Journal of Sedimentary Petrology, v. 53, p. 0931-0946.

Moore, F. Moore., 2012, 40Ar/39Ar Dating of Detrital Muscovite and Sediment Compositional Analysis of the Pottsville Formation in the Black Warrior basin in Alabama: Implications for Tectonics and Sedimentation, a Master's thesis, Auburn University, p. 142.

Osborne E, Terry, 1988, Provenance and depositional environment of the Straven conglomerate Member, Pottsville Formation (Pennsylvanian), Cahaba Synclinorium, Central Alabama, A Master's thesis, The University of Alabama

Pashin, J. and Carroll, R.E., 1999, Geology of the Cahaba Coalfield: A Guidebook for the 36th Annual Field Trip of the Alabama Geological Society.

Pashin, J., 2006, Stratigraphy and Depositional Environments of the Pottsville Formation at the Union Chapel Track Site: Abstracts with Programs - Geological Society of America, v. 38, p. 71.

Peavy T, 2008 Provenance of Lower Pennsylvanian Pottsville Formation, Cahaba synclinorium, Alabama, a Master's thesis, Auburn University, p. 123

Robinson A. J. Ruth and Prave R. Anthony, 1995, Cratonal contributions to a ''classic'' molasse: The Carboniferous Pottsville Formation of eastern Pennsylvania revisited

Schlee, J., 1963, Early Pennsylvanian currents in the southern Appalachian Mountains: Geological Society of America Bulletin, v. 74, p. 1439-1452.

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