



Integrating Petrography, U-Pb Detrital Zircon Geochronology, and X-Ray Fluorescence Geochemistry to Interpret Provenance of the Mississippian Hartselle Sandstone

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ABSTRACT

The Chesterian (Mississippian: Visean-Serpukhovian) Hartselle Sandstone is a tar sand exposed in the Black Warrior Basin and Appalachian fold belt in northern Mississippi and Alabama. Previous studies disagree about the delivery direction and relative contributions of sediment from the cratonic interior, the Appalachians, and the Ouachitas. We collected samples from the Hartselle along a west-to-east transect and integrated petrography, U-Pb detrital zircon geochronology, and X-ray fluorescence (XRF) geochemistry to investigate lateral trends in sedimentary and geochemical properties to provide new details about provenance of the unit. Point counting indicated a major cratonic interior source with a minor recycled orogen signal. Sillimanite in the easternmost sample narrows down the potential Appalachian sources to areas of high-grade metamorphism. Petrographic observations suggest both western and eastern sources. All of the samples had similar U-Pb detrital zircon age distributions except for the easternmost sample, which had statistically higher proportions of Paleozoic and Archean aged grains (K-S test <0.02). For the first time, Eo- and Paleoproterozoic grains were found in the Hartselle, indicating a likely sediment source from the Minnesota River Valley gneisses of the Superior craton prior to Grenvillian overprinting. XRF results showed high concentrations of Ti and Mo in the westernmost sample, which suggest a nearby terrigenous source. Based on integration of all data, we conclude that a large fluvial system draining the continental interior provided a substantial volume of sediment from the northwest. At the same time, a more dispersed drainage basin associated with the Appalachian front contributed recycled orogenic material from the northeast. Evidence for an Ouachita source is minimal at best.

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