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Lithologic Character of the Paleozoic Sandstone Succession, Southern Ozark Region, Arkansas, and Missouri

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Running Title: Paleozoic Sandstone Succession in Southern Ozark Region

Abstract

Sandstones comprise nearly half of the Paleozoic (Upper Cambrian-Middle Pennsylvania) lithostratigraphic succession in the southern Ozark region of northern Arkansas and southern Missouri. They record five distinct, but related intervals characterized by 1) Upper Cambrian arkoses resting unconformably on Precambrian granite; 2) Lower Ordovician reworked subarkoses, sublitharentites, and quartzites; 3) Lower Ordovician to Lower Mississippian reworked orthoquartzites; 4) Upper Mississippian first cycle sandstones with few metamorphic rock fragments (mrfs); 5) Lower Pennsylvanian (Morrowan) first cycle sandstones with common mrfs and Middle Pennsylvanian (Atokan) first cycle sandstones with common to abundant mrfs. These sandstones accumulated on a gently sloping cratonic platform reflecting transgressive-regressive, epeiric seas that eroded, transported, reworked and deposited more than 914.4m (3000ft) of terrigenous clastic sediments across what is now the south flank of the Ozark Dome.

Introduction

The Paleozoic record of the southern Ozark region, northern Arkansas, southern Missouri, and northeastern Oklahoma, accumulated on a gently sloping cratonic platform reflecting transgressive-regressive, epeiric seas that eroded, transported and reworked terrigenous clastic sediments (Zachry, 1979). The lithostratigraphic record recognizes at least 33 formations with a potential composite thickness of nearly 2438.4m (8000ft) (Howe and Koenig 1961, McFarland 2004, Fig. 1), although sea-level rise and fall produced regional surfaces of erosion; consequently, the preserved thickness is significantly less. Limestone and shale intervals dominate this composite thickness, but nearly 40% of the record is sandstone (Fig. 1).

Although there have been many excellent studies of the geologic history of the Arkoma Basin, the adjacent shelf, and Ozark Dome have never had a summary of similar comprehension. General papers on the southern Midcontinent, while useful, lack specific information applicable to the details of the geologic history and influence of the Ozark Dome on the region. Accurate analysis of the Arkoma basin fill, particularly the sandstones, has been limited because it is mostly in the subsurface. Perhaps oddly given its location, the Ozark Dome does not appear to have been a significant terrigenous clastic source for the surrounding region before the Mississippian. Its history has been apparently one of periodic uplift, and frequent cover, but there has been no recognition or evaluation of a tectonic signature preserved in the regional unconformities bounding the depositional sequences. The accepted regional geological history of the southern Midcontinent is interpreted as a cratonic platform through the Early Atokan Series with the actual formation of the Arkoma Basin beginning in the Middle Atokan.

Paleozoic Sandstone Succession, Southern Ozark Region

The Paleozoic sandstones represent five distinct, but related, intervals (Fig. 1): 1) the Upper Cambrian Lamotte Formation, an arkose, typically with a basal conglomerate, derived from the Precambrian granite of the Ozark Dome core; 2) sandstones of the Lower Ordovician Gasconade and Roubidoux Formations reflecting reworking of the Lamotte and contemporaneous intervals producing subarkoses, sublitharenites, and finally, quartzarenites; 3) continued reworking that produced well-rounded, well-sorted, orthoquartzites appearing in the Lower Ordovician Cotter Formation and extending to the Bachelor Sandstone, basal member of the St. Joe Formation, Lower Mississippian; 4) appearance of first cycle sandstones with a minimum of metamorphic rock

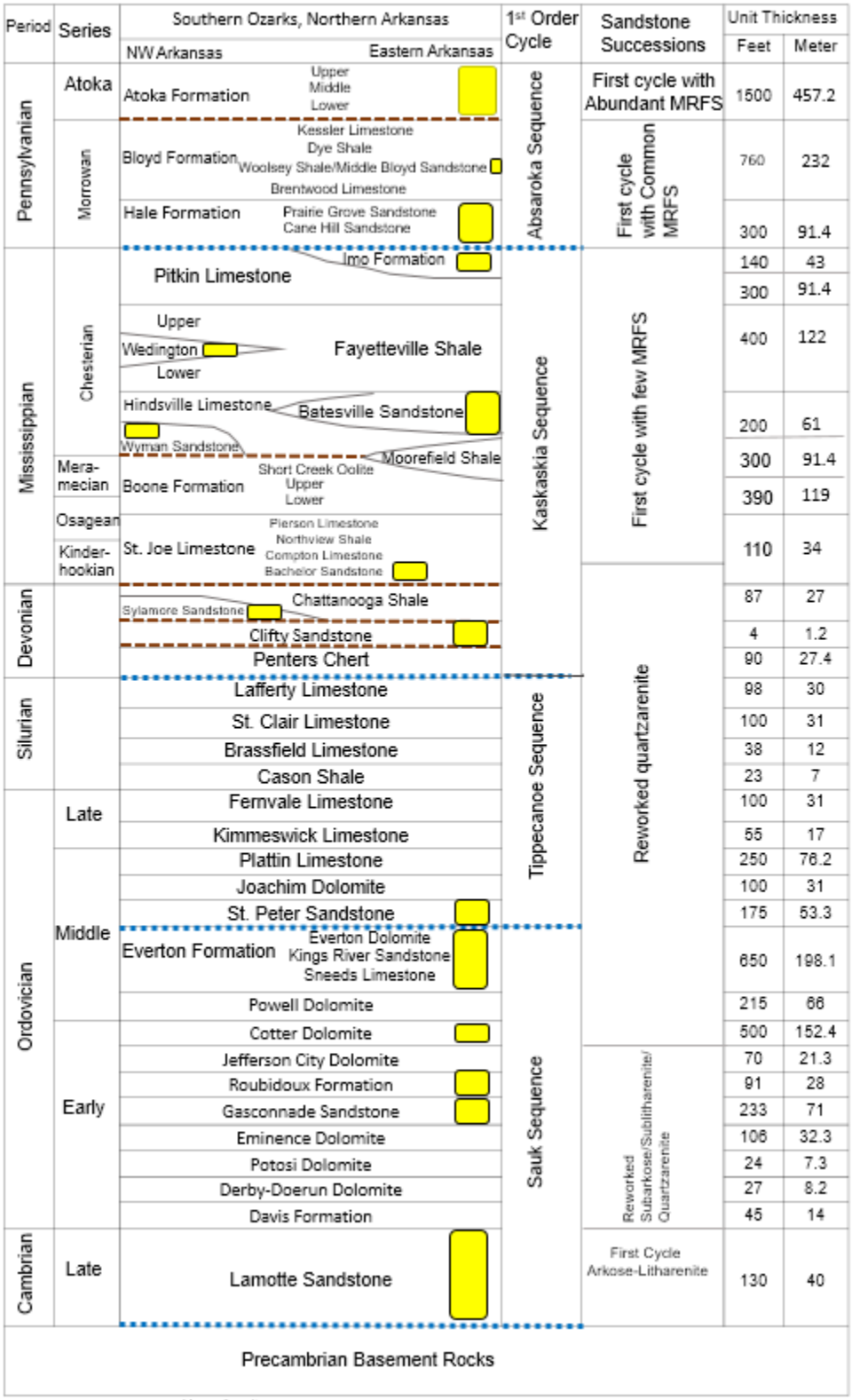

Fig. 1. Stratigraphic summary of Paleozoic northern Arkansas. Nomenclature, age assignments and average thickness compiled from and Howe and Koenig (1961), Haley and Frezon (1965), McFarland (2004) with some modification by the author. Total estimated thickness = 2033.3m (6671 ft); red and blue dotted lines represent craton-scale and local unconformities respectively. Yellow boxes denote formations that are entirely or partly sandstones.

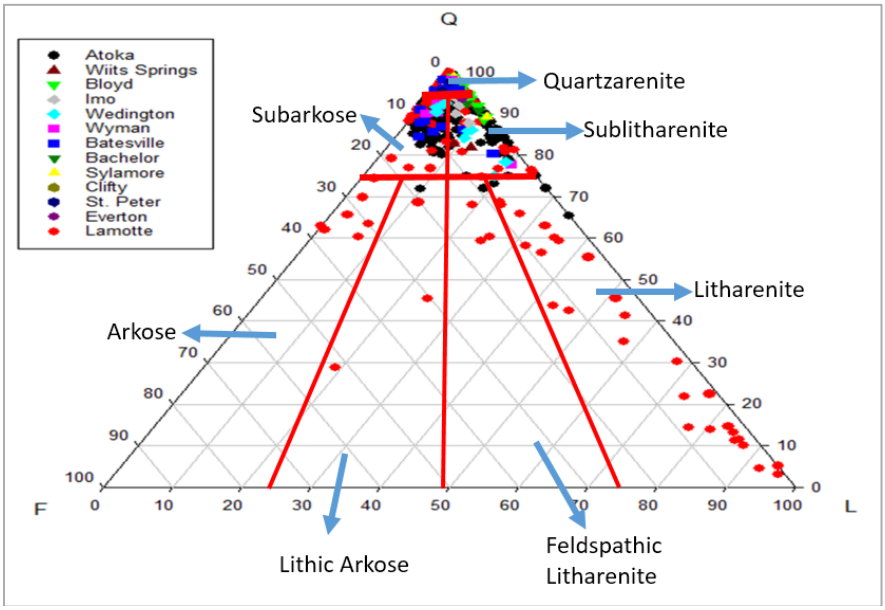

Fig. 2. Composite Plot of the Petrographic Analysis of the Paleozoic Sandstones of the Southern Ozark Region.

fragments (mrfs) beginning with the Upper Mississippian Batesville Sandstone Upper Mississippian, and appearing sporadically through the remainder of the Mississippian record to the base of the Pennsylvanian; 5) Pennsylvanian first cycle sandstones characterize the remainder of the record of the southern Ozarks, that can be subdivided into two categories: sandstones with common mrfs comprising the Morrowan interval, and sandstones with abundant mrfs capping the record as the Atoka Formation, Atokan Series, Middle Pennsylvanian, and the thickest Paleozoic unit in the southern Ozarks.

Petrographic Character of the Southern Ozark Sandstone Successions

Modal analyses plotted as ternary diagrams provide the evidence for the discrimination of the five groups of Paleozoic sandstones comprising the record of the southern Ozark Dome in Arkansas and Missouri (Fig. 2 and 3). As expected, the arkosic-litharenitic Lamotte Sandstone Interval 1 is distributed across the fields ranging from arkose to litharenite. The remainder of the sandstones is clustered in the sublitharenite-subarkose-quartzarenitic fields. All modal data have been separated and replotted on ternary diagrams for each of the sandstone intervals to further discriminate and characterize the five groups of Paleozoic sandstones identified in this study for the southern Ozark Dome in Arkansas and Missouri (Fig. 3).

Summary and Conclusions

Petrographic data for the Paleozoic sandstones of the southern Ozark Dome comprise five related, but distinct intervals: 1) first cycle arkose/litharenite, typically with a basal conglomerate, succeed by subarkose/ sublitharenite and finally to quartzarenite assigned to the Upper Cambrian Lamotte Formation; 2) after an interval of carbonate deposition, sandstones of the Lower Ordovician Gasconnade and Roubidoux Formations reflect continued reworking of the Lamotte interval producing subarkoses, sublitharenites, and finally quartzarenites; 3) well rounded, well sorted, quartzarenites and orthoquartzites that reflect reworking of the post-Lamotte quartz sandstones of the southern Ozarks and are represented by all or portions of the Lower Ordovician to Lower Mississippian Cotter-Everton-St.Peter-Clifty-Sylamore-Bachelor intervals. The Bachelor Sandstone, the basal member of the St. Joe Formation, Lower Mississippian, is the last orthoquartzite in the southern Ozark succession; 4) the Lower Mississippian Boone Formation, a chert-bearing limestone, is the thickest and most extensive post- Lower Ordovician and pre- middle Pennsylvanian interval in the southern Ozarks. This limestone interval limited significant reworking, and the Upper Mississippian records first cycle sandstones with few metamorphic rock fragments comprising the Batesville-Wyman-Wedington-Imo Sandstone interval; 5) first cycle sandstones with a major contribution by metamorphic rock fragments comprise

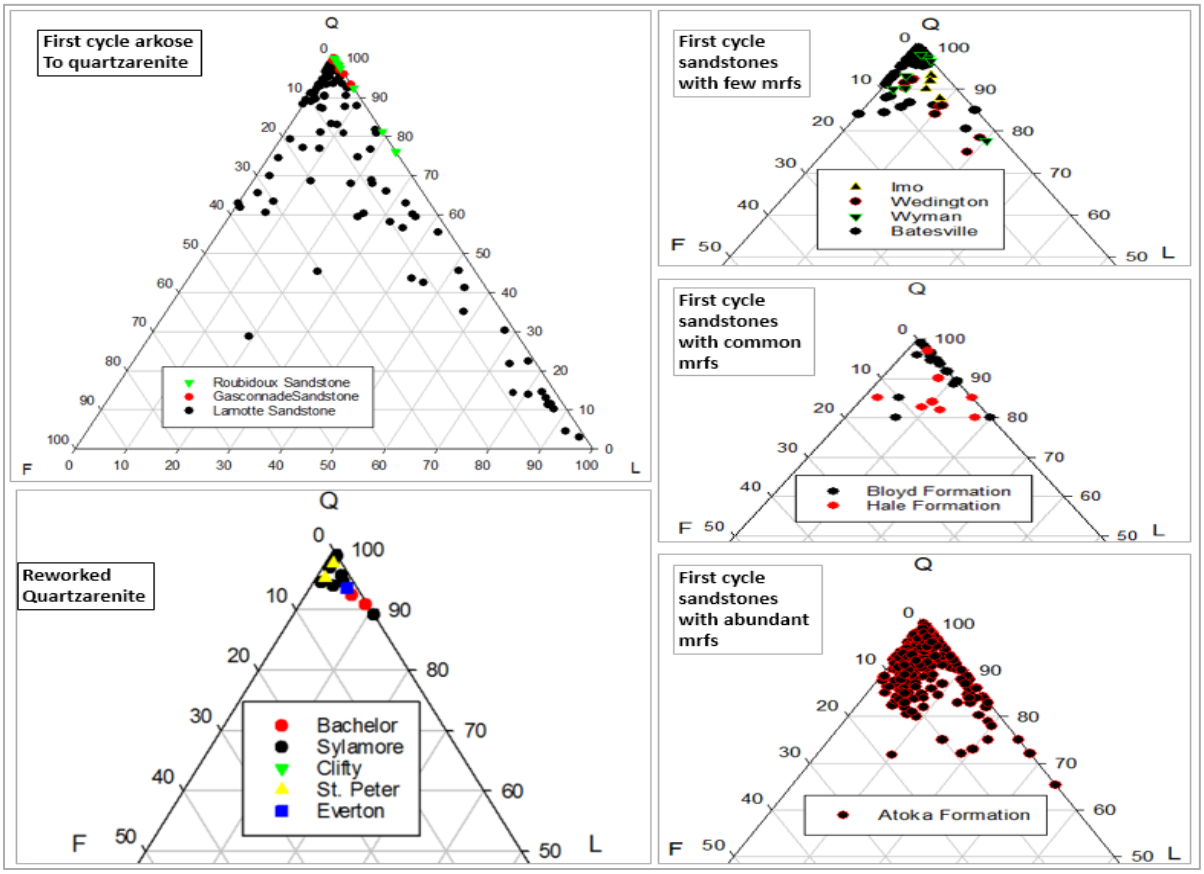

Fig. 3 - Plots of the Petrographic Analysis of the five Paleozoic Sandstone Groups Identified in the Southern Ozark Region. Thin sections provided by Angela Chandler and Richard Hutto, Arkansas Geological Survey; collections in Department of Geosciences, University of Arkansas, and data from Yesberger Jr. (1982) and Houseknecht (1975).

the Pennsylvanian portion of the succession. The Hale and succeeding Bloyd Formations, Morrowan, Lower Pennsylvanian, exhibit scattered to common metamorphic rock fragments, while the Atoka Formation, Middle Pennsylvanian, the thickest Paleozoic terrigenous clastic interval in the southern midcontinent unit and youngest stratigraphic unit in the Paleozoic succession of the southern Midcontinent preserves common to abundant metamorphic rock fragments

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