An analysis of sediment provenance for Carboniferous sandstones in the Ouachita-Arkoma Basin based on detrital muscovite $^{40}Ar/^{39}Ar$ geochronology and sediment composition

by

Jacob Taylor Thompson

A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Master of Science

Auburn, Alabama
December 14, 2019

Keywords: Provenance, Carboniferous, Ouachita, Arkoma

(jtt0026@auburn.edu)

Approved by:

Dr. Willis Hames, Chair, Professor of Geosciences
Dr. Ashraf Uddin, Professor of Geosciences
Dr. Mark Steltenpohl, Professor of Geosciences
Dr. David L. Barbeau Jr., Professor of Geosciences,
University of South Carolina

Abstract

The Arkoma-Ouachita Basin of southeast Oklahoma and central Arkansas, part of the vast Appalachian-Ouachita foreland system, evolved from a passive margin deep-water remnant ocean basin (Ouachita) between Laurentia and Gondwana into a peripheral foreland basin (Arkoma) driven by the collision of the two supercontinents during the assembly of Pangaea. Basin evolution is recorded by deposition of intermittent carbonate and siliciclastic strata in the Mississippian followed by an influx of syn-tectonic clastic sediment in the Pennsylvanian deposited in traditional sand/shale cycles attributed to flexural evolution from the ongoing collisional tectonics and glacioeustasy fluctuation. Carboniferous sediment deposition along with sediment dispersal patterns is directly connected and influenced by tectonic activity, regional climate, global eustatic cycles, and unroofing events. Carboniferous sandstones from the Ouachita deep-water basin and Arkoma foreland basin present the opportunity to investigate possible source terranes and sediment transport histories throughout the Mississippian to Pennsylvanian using detrital geochronology and sandstone compositional analysis. Fourteen Carboniferous sandstones ranging from the Mississippian Stanley Group to the middle Pennsylvanian Krebs Group were collected for $^{40}Ar/^{39}Ar$ detrital muscovite geochronology and sandstone compositional analysis, resulting in over 1,500 new detrital grain ages for Carboniferous strata in the Ouachita region. Detrital muscovite grain ages

range from Paleoproterozoic to early Pennsylvanian and 98% of the grain ages are Paleozoic. The overall age distribution presents a prominent Middle Ordovician to Early Silurian (ca. 465 Ma to 435 Ma) mode with two subordinate modes that are Early Devonian (ca. 420 Ma to 380 Ma) and Late Devonian to early Mississippian (ca. 380 Ma to 340 Ma), respectively. In addition to the dominant Middle Ordovician to Early Silurian and Early Devonian modes, the Mississippian Stanley Group provides a slightly older age distribution with a significant Cambrian (ca. 540 Ma to 490 Ma) component. The Pennsylvanian samples from the Jackfork Group, Atoka Formation, and Krebs Group yield muscovite with abundant Late Ordovician ages and subdued peaks at ca. 400 Ma and ca. 380 to 365 Ma. Overall, the detrital muscovite ages are characteristic of the multiple Appalachian tectonic episodes, predominantly the Taconic and Acadian-Neoacadian events. The Ordovician ages are interpreted to represent sediment derived from Taconic terranes, while the two subordinate Devonian peaks appear to represent Acadian-Neoacadian source terranes. The detrital muscovite record in these samples from Late Mississippian and Early to Middle Pennsylvanian strata are compatible with sediment routing systems that delivered sediment via multiple complex axial and transverse drainage pathways, principally from Laurentian sources. Continental-scale drainage networks adjacent to the uplifting Appalachian Mountains and an interior longitudinal system both contributed sediment to the southern Appalachian-Ouachita foreland. Minor input of older Cambrian to Middle Ordovician detrital muscovite grains are attributed to fluvial systems traversing through accreted peri-Gondwanan terranes and perhaps a lesser secondary western source connected to the Ancestral Rocky Mountains.

Acknowledgments

The following thesis represents the effort and sacrifice of numerous individuals spanning from the conception of this project during my time as an undergraduate through the successful completion of my master's work. First, I would like to thank my thesis advisor, Dr. Willis Hames, for developing my young scientific career and providing me with a wealth of knowledge both in geology and in everyday life. Second, I would like to thank the faculty and staff of the Department of Geosciences at Auburn University for their support and help in order to strengthen my research project and graduate experience. I would like to send a sincere thank you to the Advisory Board who provided funding and valuable career insight to me and many other graduate students in the department. I am grateful to the American Association of Petroleum Geologists for providing a research grant to help support laboratory analysis. Also, I will point out two individuals who are responsible for the inception and continuation of this research at Texas A&M University, Dr. Brent Miller and Harold Johnson. Dr. Miller granted me an opportunity to become involved in geologic research and provided me with important and valuable laboratory/instrument experience. Harold Johnson is responsible for the birth of this project and taking me under his wing to build my research skillset. Lastly, and most importantly, I would like to thank my family and friends for supporting me over the years. Without their support none of this would have been possible.

Table of Contents

List of Tables

List of Figures

Chapter I: Introduction and Geologic Background

Introduction

Analysis of sediment provenance and transport concentrates on the history of sediment from its initial source area to its present resting position in a catchment area, hence the common discipline label, 'source-to-sink geology' (Allen, 2008). Orogenic sedimentary basins are filled with thick accumulations of sedimentary strata sourced from orogenic highlands that travelled via sediment-routing systems and were eventually deposited into structurally low areas (Dickinson, 1988; DeCelles and Giles, 1996). To accurately understand the evolution of sedimentary basins, a wide-ranging knowledge of sediment provenance, transport, and depositional history is paramount in order to grasp the implications and relationships that tectonic activity, climate, eustacy cycles, and erosional events have on basin deposition (Flemings and Jordan, 1989; DeCelles, 2004; Uddin et al., 2016).

Alterations in sediment deposition and transport directly reflect large sea-level fluctuation (Boardman and Heckel, 1989) and regional tectonic activity (Greb et al., 2008). Foreland basins chronicle changes in facies, sedimentation rate, depositional environment, drainage patterns, and ultimately sediment source areas. These variations are recorded by orogenic sediment depozones that accumulate extensive amounts of sedimentary strata in response to the regional tectonic activity (Ver Straeten, 2010). Flexural subsidence associated with the increasing topographic load from an emerging orogenic belt is the leading driver of sediment accumulation into the Appalachian-Ouachita foreland, but other controls such as sea level and erosional rates of uplifted orogenic wedges play an important role in basin fill (DeCelles and Giles, 1996).

Orogenic basin analysis and sediment provenance have long been studied through the eyes of foreland basin sediment using compositional analysis (Dickinson and Suczek, 1979), regional facies interpretation (Archer and Greb, 1995), paleocurrent directions (Briggs and Cline, 1967), and detrital geochronology (Becker et al. 2005; Uddin et al., 2016). The evolution of provenance studies transcends multiple geologic disciplines to tell a complete story of the interconnectedness of large-scale tectonics, climate, orogenic uplift, paleogeography, depositional systems, and ancient surface processes. The present study is an endeavor to use detrital geochronology and compositional analysis to address questions of sediment sources into the southern Appalachian-Ouachita foreland and evaluate the role of longitudinal versus transverse drainage systems in the broader Appalachian-Ouachita foreland.

Geologic Background

Appalachian-Ouachita Orogeny

The Appalachian Orogenesis occurred during the Paleozoic through three major mountain building episodes: the Taconic (Ordovician-Silurian), the Acadian-NeoAcadian (Devonian-Mississippian), and the Alleghanian (Mississippian-Permian). The Appalachian Mountains formed on the eastern Laurentian margin spanning from modern day Newfoundland to central Alabama and are a vast multifaceted mountain chain that spans a complete Wilson Cycle

(Hatcher, 2010). The evolution of the Laurentian margin and accretionary Appalachian orogen began with the initial assembly and breakup of supercontinent Rodinia at around 750 Ma (Cawood and Nemchin, 2001) and ended with the assembly and breakup of supercontinent Pangaea (Figure 1; Hatcher et al., 1989; Thomas, 2006). The multiple building phases of the Appalachians are associated with repeated complex arc, microcontinent, and exotic terrane collisions leaving behind sutured and accreted terranes (Williams and Hatcher, 1983; Hibbard, 2000). Their complex nature leads many workers to divide the Appalachians into Northern, Central, and Southern Appalachian regions. The extent of the Appalachian Mountains and the arrangement of embayments and promontories that define these regions, as well as presence of Appalachian clastic wedges are represented in Figure 1 (Thomas, 2006). The Northern Appalachian segment, from the New York Promontory to Newfoundland Embayment, is represented by Iapetan realm Peri-Laurentian arc terranes and Peri-Gondwanan Avalonia and Ganderia terranes (Hibbard et al., 2007). A Silurian tectonic event (Salinic) is also observed in the Northern Appalachians that is not represented in the Central or Southern Appalachians (van Staal et al., 1998). The Central and Southern Appalachian segments occur from the Pennsylvanian Embayment down through the Alabama Promontory and are represented by the Iapetan Central Piedmont, the Laurentia Blue Ridge to the west, and the peri-Gondwanan Carolina superterrane to the east (Hibbard, 2000; Hibbard et al., 2007; Merschat et al., 2012).

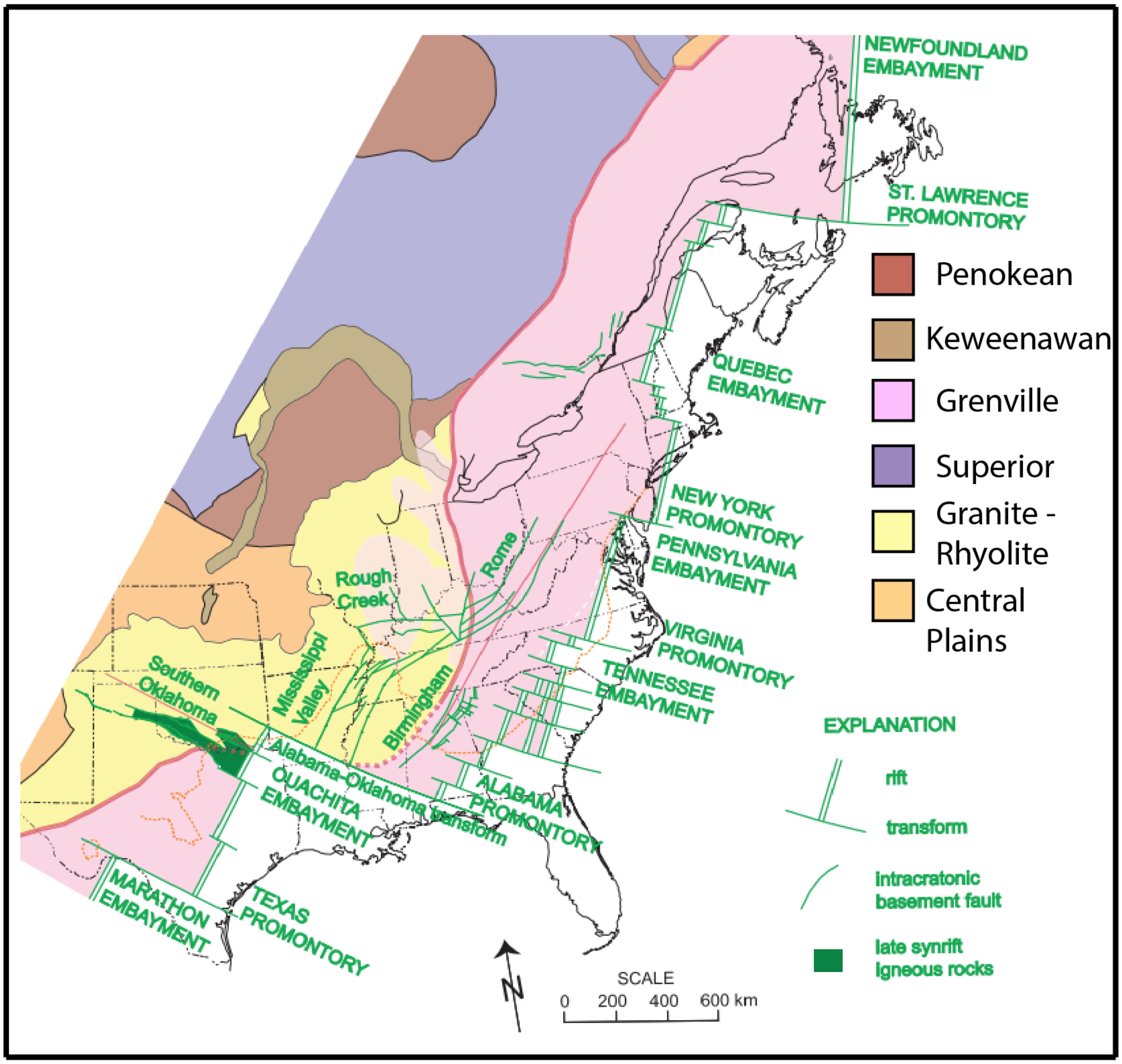


Figure 1: Assembly of Rodinia and Pangaea through two Wilson Cycles from Thomas (2006) to show tectonic inheritance and locations of Embayment and Promontories associated with the Laurentian margin. Figure 1 shows breakup of Rodinia and opening of the Iapetus Ocean.

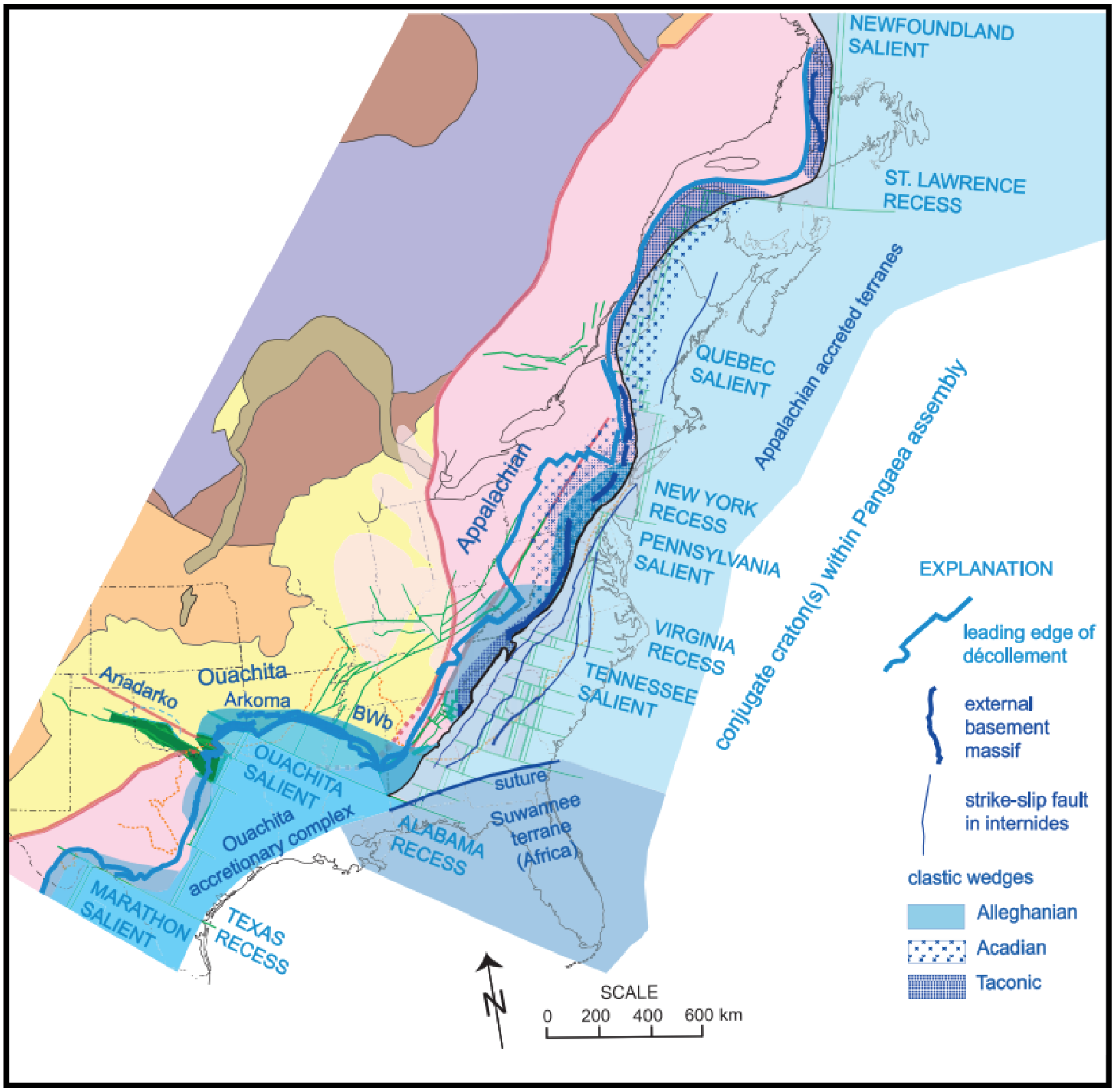


Figure 1 (continued): The assembly of Pangaea and arrangement of Appalachian sediment catchment areas along with the extents of the Taconic, Acadian, and Alleghenian clastic wedges (Thomas, 2006).

Ouachita orogenesis is associated with continent-continent collision between the southern Laurentian margin and the encroaching Gondwanan continent. The collision between the North American craton and approaching Gondwanan terranes is thought to be a relatively soft collision as much of the Paleozoic margin strata is preserved (Keller, 2012). An Ouachita uplift began to form in the Carboniferous in response to the intruding supercontinent Gondwana and a possible leading volcanic arc-trench system (Graham et al., 1975). Peri-Gondwanan microcontinents collided with the Laurentian margin and ended oceanic basin deposition as Gondwana approached and consequently closed the Theic Ocean (Viele and Thomas, 1989; Miall and Blakey, 2008). The collision of the arc-trench system and microcontinents resulted in northward thrusting of deep-water remnant ocean basin strata over the southern edge of the Laurentian continent (Graham et al., 1975). Complex folding and thrusting along the margin uplifted existing oceanic basin sediment as part of the southern Laurentian suture belt. The Ouachita orogen extends from the topographic uplift of the Ouachita Mountains in Arkansas and Southeastern Oklahoma to the Marathon uplift in West Texas and Northern Mexico (Figure 2; Viele and Thomas, 1989). The Ouachita region is separated into multiple areas including the Ouachita Mountains, the Ouachita Frontal Range, and the Arkoma Basin, which expose large amounts of uplifted Paleozoic strata in each of these regions.

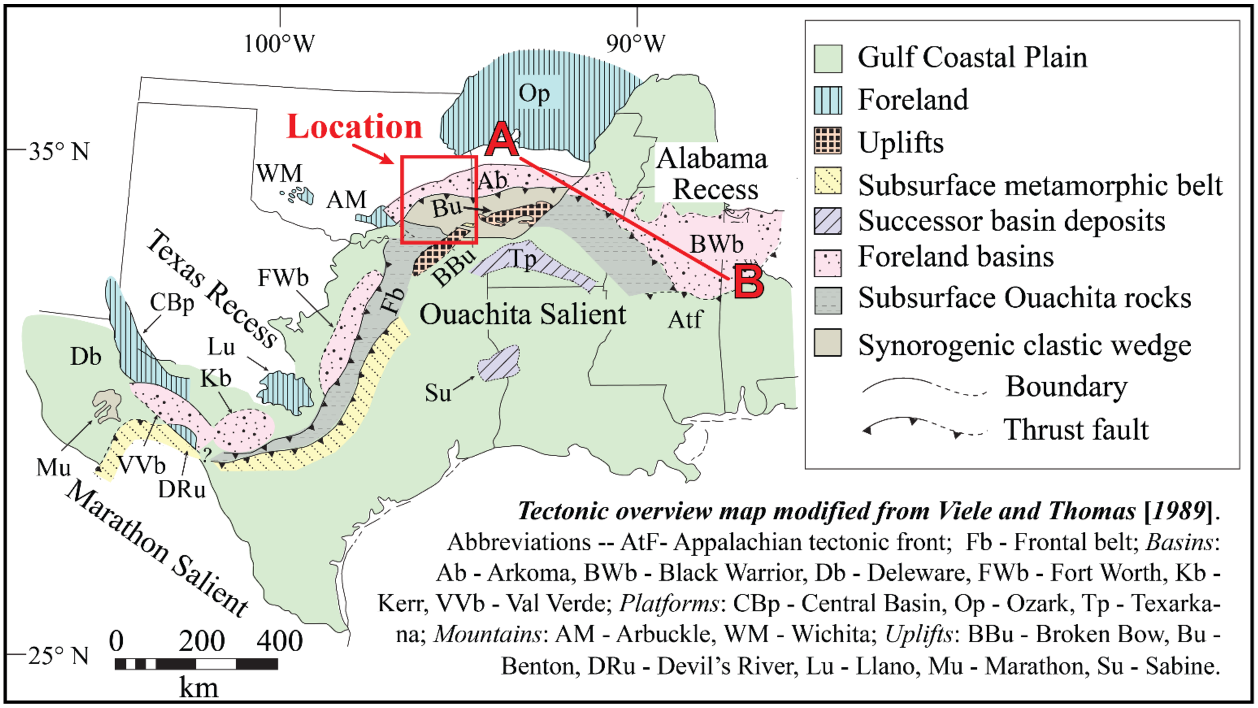


Figure 2: Tectonic overview map of the Ouachita region modified from Viele and Thomas (1989) displaying the extent of the Ouachitas from the Alabama Recess to the Marathon Salient in Southwest Texas. The red box indicates the investigation area of the present study along with an A to B correlation line that is represented in Figure 7.

Taconic Orogeny

The Taconic orogeny, from the Middle Ordovician to Silurian, was the first Appalachian mountain building episode and is linked to the collision of eastern Laurentia with volcanic arcs and accreted terranes (Figure 3; Drake et al., 1989; Hatcher et al., 1989). The Taconic was originally defined by mapping of high-grade metamorphic rocks in the New England area. Oceanic terranes were accreted onto the Laurentian margin in the Taconic event, including obducted ophiolites (Whitehead et al., 1996). These ophiolites yield U-Pb zircon and $^{40}Ar/^{39}Ar$ hornblende ages of 479 ± 3 Ma and 477 ± 5 Ma respectively (Whitehead et al., 1995; 1996). The onset of the Taconic orogeny has been constrained by multiple geochronologic techniques to be in the range of 480 Ma (Ordovician) to 440 Ma (Silurian). Ages for widespread Taconic metamorphic rocks in the northern Appalachians are as old as ca. 465 Ma (Laird et al., 1984; Sutter et al., 1985; Whitehead et al., 1996). Graptolite fossils and $^{40}Ar/^{39}Ar$ ages for Laurentian strata of New England indicate Barrovian metamorphism of ca. 455-445 Ma (Hames et al., 1991), leading to the suggestion that pre 455 Ma Taconic ages in New England record events that occurred prior to terrane emplacement (Ratcliffe et al, 1998). Taconic metamorphism in the southern and central Appalachians ranges from 510 Ma to 460 Ma (Drake et al., 1986). Taconic tectonism in the southern Appalachians during the Early to Middle Ordovician is associated with collision of arc systems with Laurentia and outboard southern Appalachian terranes (e.g. Hillabee-Dahlonega arc; McClellan et al., 2007). In the southern Appalachians, Taconic plutons within the Eastern Blue Ridge have U-Pb ID-TIMS ages of 457.6 ± 1 Ma and 455.7 ± 2 Ma (Figure 3; Miller et al., 2006), and monazite inclusions within prograde garnet yield similar ages (Corrie and Kohn, 2008).

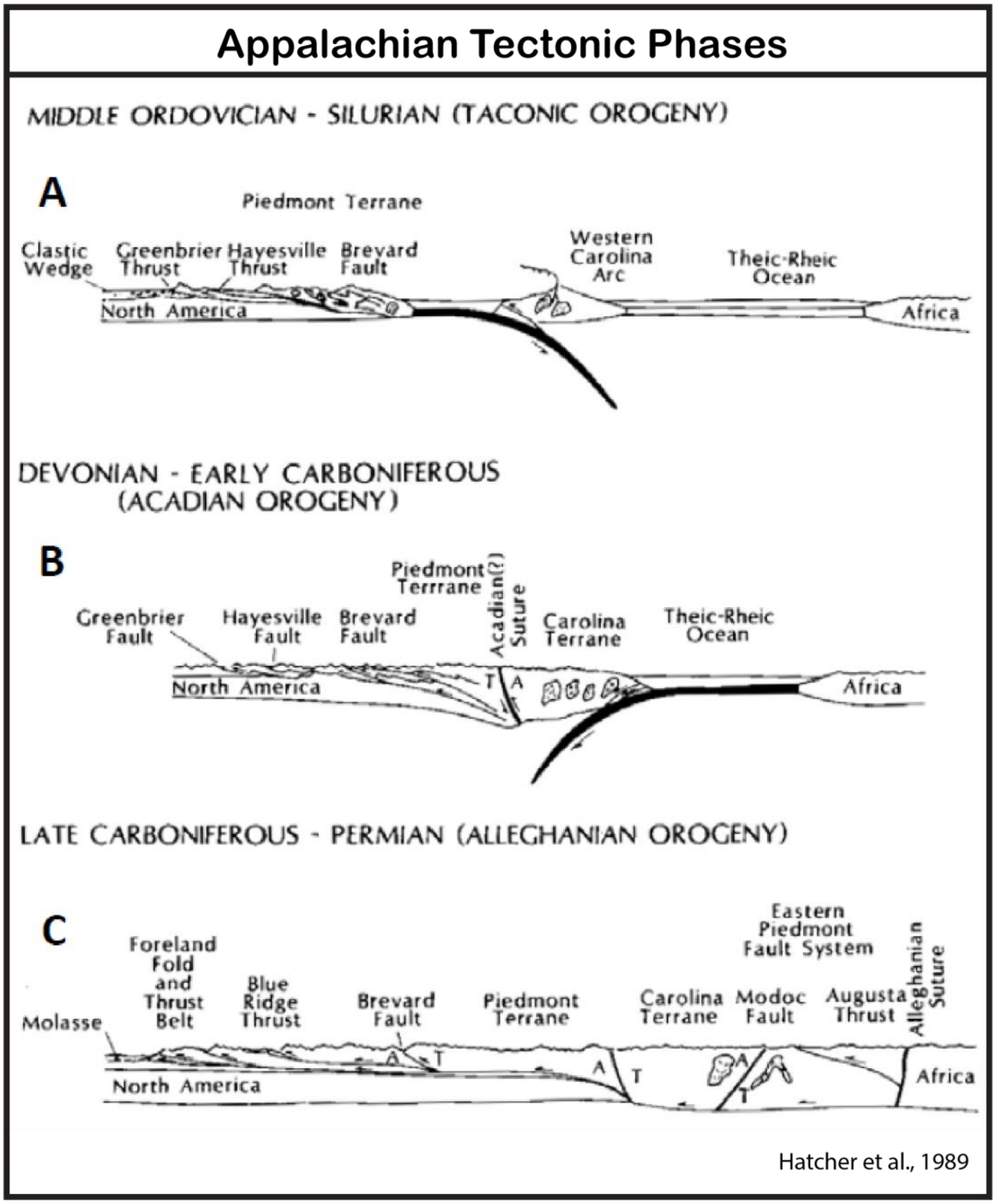


Figure 3 (A, B, and C): Tectonic models of the multiple Appalachian orogenic phases from Hatcher et al. (1989; A-C). A-C shows Taconic, Acadian, Alleghanian orogenies and terrane arrangement from the Middle Ordovician to Permian.

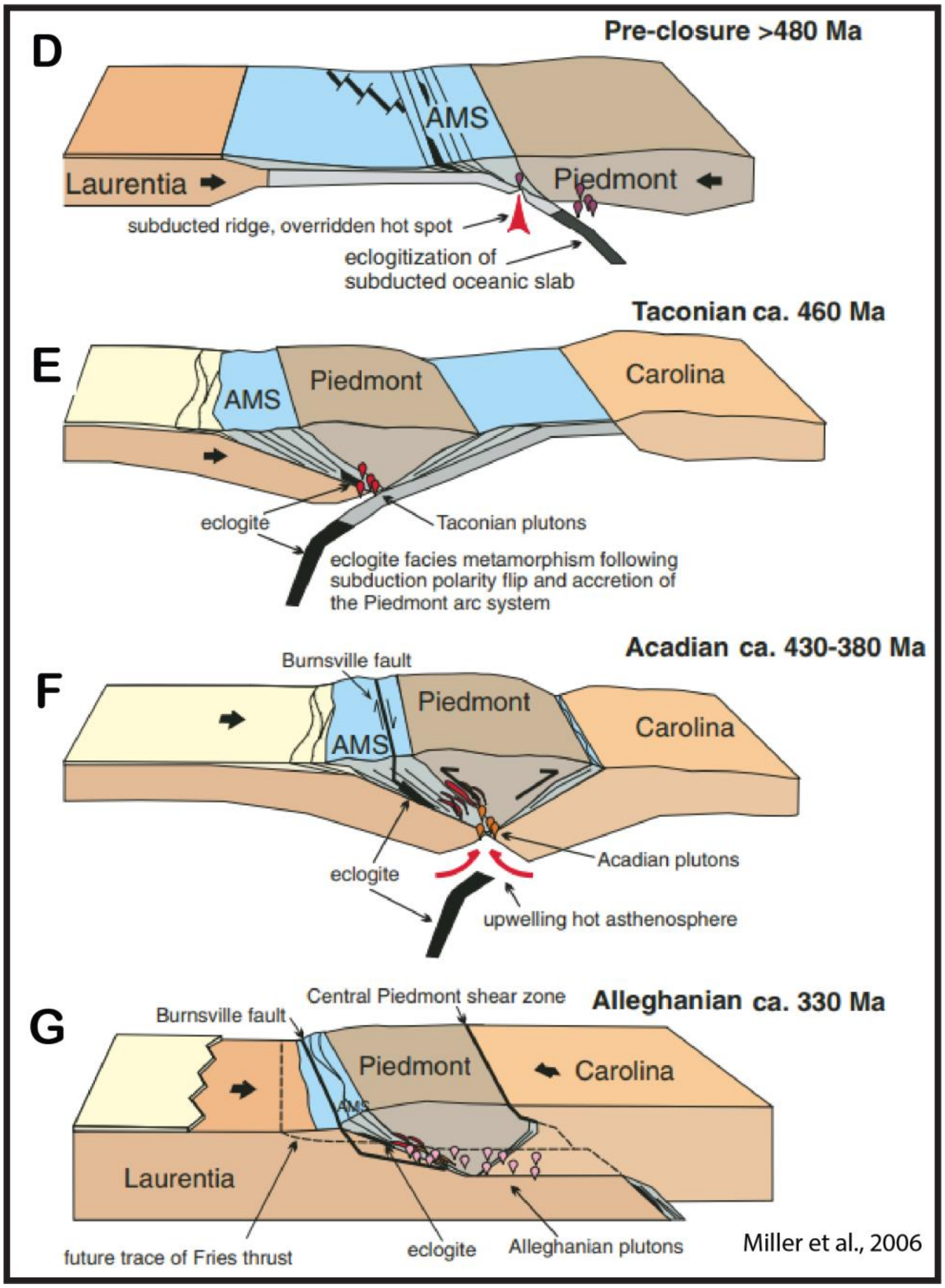


Figure 3 (D, E, F, and G): Tectonic models of the multiple Appalachian orogenic phases from Miller et al. (2006; D-G). D-G represents tectonic models of the Appalachian tectophases from pre-Taconic through Alleghanian, which illustrates collisional tectonics and the resulting plutonism. Miller et al., (2006) focuses on eclogite facies and pluton distribution during collisional events. AMS – Ashe Metamorphic Suite.

Detrital minerals that yield geochronologic ages prior to 480 Ma could be suggested as outboard pre-collisional arc complex remnants or pre-Taconic peri-Gondwanan realm terrane sources.

Taconic Clastic Wedge

In the Ordovician to Silurian, Taconian tectonic loading caused significant flexural subsidence in the Appalachian foreland and provided accommodation space for the erosion of uplifted and unroofed source rock to shed sediment into the Northern Appalachian foreland basin. Southern Appalachian uplifted source rock contributed eroded sediment to multiple Ordovician-Silurian clastic wedges with multiple depocenters between the recently uplifted mountains and the interior forebulge (Diecchio, 1993). Multiple interpretations exist for Ordovician foreland sediment accumulation, including that the entire Appalachian Basin was a Taconian foredeep basin (Quinlan and Beaumont, 1984; Beaumont et al., 1988; Ettensohn, 1991), or that a series of foredeeps existed along the continental margin (Diecchio, 1993).

The Taconic clastic wedge complexes were shaped by the Blount and Queenston deltaic system. The Blount deltaic system was the earliest Taconic delta complex located in the Virginia Promontory region. The Blount delta deposited sands from recycled sedimentary and low-grade metamorphic sources into much of the Central and Southern Appalachian Basin sections (Mack et al, 1983). The Queenston delta complex was a larger delta system that extended nearly the length of the Appalachians and prograded towards the craton interior reaching the Michigan Basin (Kay and Colbert, 1965; Colton, 1970; Sanford, 1993; Ettensohn, 2004). The foreland depocenter associated with the Queenston delta was around the New York Promontory and received a significant sediment supply in the Late Ordovician and Early Silurian sourced from the recent Taconic uplift (Faill, 1997). The Salinic tectophase also contributed to the Silurian clastic wedge in the Northern Appalachians via the Bloomsburg delta (Ettensohn and Brett, 2002).

Acadian Orogeny

The Silurian to Devonian Acadian orogeny was associated with arc terrane collision between the eastern Laurentian margin and various exotic terranes and microcontinents outboard of the supercontinent Gondwana. Acadian deformation is believed to be related to northwestward convergence of the Avalon and Carolina superterranes with the eastern edge of Laurentia and recently accreted Taconian terranes, subsequently closing the Rheic remnant ocean and subducting the Taconian terranes (Hatcher et al., 2007; Merschat and Hatcher, 2007; Ettensohn, 2011). The Acadian orogeny in the northern Appalachians refers to collision of the Avalon and Meguma terranes with peak deformation becoming progressively younger northward (Donohoe and Pajari, 1973; Robinson et al., 1998; Murphy and Keppie, 2005). The docking of the Carolina superterrane began in the Early Devonian as a transpressive, zippering collision throughout the Devonian moving from the New York Promontory to the southern Appalachians (Figure 3; Hatcher et al., 1989; Hatcher et al., 2007). The multiple terrane collisions and peak deformation periods suggest multiple events along the vast Laurentian margin. The Acadian event has yielded radiometric ages spanning 420-350 Ma, leading some to suggest a younger and distinct Neoacadian component (Thomas et al., 2017).

The Neoacadian has been associated with the younger Late Devonian to Mississippian deformation recognized in the Inner Piedmont of the Southern and South-Central Appalachians (Mershcat et al., 2005). The Acadian-Neoacadian produced high grade metamorphism of Inner Piedmont terranes throughout the Southern Appalachians (Merschat et al., 2012). The Southern Appalachian Acadian-Neoacadian dates are linked to Piedmont deformation and plutonism within the eastern Blue Ridge at ca. 377 Ma (Figure 3; Miller et al., 2006) and ca. 362 Ma (Sinha et al., 2012) as well as peak metamorphic ages of ca. 400 Ma, 380 Ma, and 360 Ma (Hatcher et al., 2007). The two distinctive peak ages associated with the Acadian event provide evidence for multiple tectonic events within the Acadian, those being the traditional Early Devonian Acadian event (405-400 Ma) and a younger Late Devonian Neoacadian event (380-360 Ma). Neoacadian events have also been recognized in the present-day Nova Scotian region of Canada, producing deformation and low-grade metamorphism at ca. 365 Ma to 375 Ma (White et al., 2007; White, 2010).

Acadian Clastic Wedges

Acadian-Neoacadian orogenesis resulted in a thick accumulation of clastic sediment that was deposited into the Northern Appalachian foreland. Multiple major delta complexes were formed from the Northern Appalachians as represented today in the New York and Virginia promontories. Acadian synorogenic deposition in the South-Central Appalachians is represented by the Catskill clastic wedge and the Late Devonian to Mississippian Price-Pocono clastic wedge (Osberg et al., 1989; Ettensohn, 2004; Park et al., 2010). The Mississippian clastic wedge provides an extensive sequence of lithologies from deltaics to marginal marine lithofacies in the Pennington and Mauch Chunk groups (Ettensohn, 2004).

Organization of the Acadian wedge evolved from the Early Devonian through the late Mississippian and perhaps into the early Pennsylvanian (Faill, 1985, 1997; Ettensohn, 1985, 2004). The earliest Acadian clastic wedges are thought to be excised in the Maritime region due to succeeding tectonic events. The earliest well-preserved wedge is associated with the Middle Devonian collision in the New York promontory region. The terrane collision closed progressively in a zipper-like fashion southward towards the Virginia promontory and gave rise to the Catskill deltaic complex. The Pennington-Mauch Chunk and Allegheny clastic wedges were constructed by deposition from the Catskill, Bedford-Berea, Borden, Pocono, and Allegheny deltas (Wanless et al., 1970; Ettensohn, 2004). The Catskill delta was principally focused in the regions proximal to the New York and Virginia promontories, but also spread sediment across the Cincinnati Arch into the Illinois and Michigan basins (Ettensohn et al., 1988; Matthews, 1993; Ettensohn 2004). A following deltaic complex, the Bedford-Berea delta, was likely formed by the reworking of the Catskill delta during lowstand conditions (Pashin and Ettensohn, 1995).

The last Acadian-Neoacadian tectonic event in the Mississippian formed two clastic wedges with deposition that extended into the Pennsylvanian Period. The first clastic wedge is comprised of the Price-Pocono and Borden deltaic systems. The Price-Pocono was a more proximal deltaic complex, while the Borden is a distal subaqueous delta system that extended well past the Cincinnati Arch and into the Illinois Basin (Swann et al., 1965; Lineback, 1966; Ettensohn, 2004). The Mississippian to Early Pennsylvanian clastic wedge, known as the Pennington-Lee clastic wedge, extends through much of the Central and Southern Appalachians and contains a variety of terrestrial to marginal marine facies. The sediment of the Pennington-

Lee has been interpreted to be proximal and sourced from nearby southeastern sources (Thomas and Schenk, 1988).

Alleghanian Orogeny

The concluding Appalachian tectonic event, the Alleghanian orogeny, was heralded by the closure of the Rheic ocean and the docking of Gondwana onto the Laurentian margin, producing the supercontinent of Pangea. Gondwana collided with the outer seaboard edge of Laurentia causing Gondwana to be thrust on top of the Laurentia, thus completing the full Wilson Cycle from Proterozoic Rodinia to Pangaea. The Alleghanian compressional phase is attributed to a zipper-like, transpressional and oblique convergence from the Maritime region in Canada that youngs southward to the central and Southern Appalachian region (Ettensohn, 2008). Timing of collision and deformation varies from region to region due to the clockwise rotational convergence of Gondwana (Ziegler, 1988; Hatcher, 2005; Ettensohn, 2008). In the Northern Appalachian region, indications of docking as early as Late Devonian time have been reported (Ziegler, 1988). In the New York promontory region, primary docking of the Reguibat promontory (Africa) occurred at ca. 315 Ma (Faill, 1997, Hatcher, 2005). The diachronous deformation and metamorphism in the Central and Southern Appalachians occurred from 330 Ma to 265 Ma based on Alleghanian plutons and cooling ages (Dallmeyer et al., 1986). Uplift and subsequent erosion began in the Late Mississippian at around 325-320 Ma, resulting in complex sedimentation into the Alleghany foreland.

Allegheny Clastic Wedge

The accumulations of siliciclastic synorogenic sediment in the Appalachian foreland due to the uplift and unroofing associated with the Alleghanian orogen are exceptionally vast: the Allegheny clastic wedge extends more than 1,300 km throughout the eastern United States, from the Northern Appalachian Basin to the Black Warrior Basin in Alabama and Mississippi (Ettensohn, 2004). The sedimentary record attributed to the Alleghanian orogen comprises more terrestrial and marginal-marine, molasse-like sediments, in comparison to the deep-water marine shales and flysch-like sediments associated with the earlier Paleozoic tectonic events (Ettensohn, 2008; and references therein). The clastic wedge assembly largely reflects cratonward-prograding systems sourced from proximal regional uplift linked to collisional tectophases. The exception being the Alleghanian orogeny and associated clastic wedge that deals with rotational collision and relatively soft docking between Laurentia and Gondwana. The Allegheny clastic wedge is composed of cyclic facies from marginal marine to terrestrial sediment and lacks deep-water marine type facies. A transition from marine to non-marine deposition in the Alleghanian foreland occurred in the late Mississippian to early Pennsylvanian, as recorded by an abundance of coal layers within the traditional marine to non-marine cycles. These cyclical changes referred to regionally as cyclothems - dominate the Alleghenian clastic wedges and are linked to eustatic sea-level fluctuation and tectonic processes that occurred throughout the Carboniferous (Chesnut, 1993; Pashin, 1994). Pennsylvanian cyclothems within the Allegheny strata characterize the numerous transgressive and regressive cycles that took place due to Alleghanian tectonic activity and global eustatic events (Heckel, 1995).

Formation of the Appalachian-Ouachita Foreland

The Appalachian-Ouachita foreland is a wide-spread complex basin system composed of thick accumulations of Paleozoic strata in numerous depozones in areas of flexural or subduction subsidence, which developed in response to various geodynamic processes. The Appalachian-Ouachita foreland shows subsidence from slab-pull in the peripheral system (pro-foreland basin, Arkoma Basin) and regional viscous coupling from the overriding plate in the retroarc system (Appalachian Basin; DeCelles and Giles, 1996). The vast foreland was constructed in direct response to Appalachian-Ouachita mountain building episodes in an elongated region that today ranges from Maritime Canada to Alabama and west to Oklahoma. The foreland evolved with each Paleozoic orogenic event, rearranging the structure of the overall system. Earlier foredeep thickening, with the thickest sediment accumulation adjacent to the immediate thrust belt (Jordan, 1995; DeCelles and Giles, 1996), was followed by zippering tectonics and displacement of Northern Appalachian to Southern Appalachian thrust sources. The Appalachian-Ouachita foreland (Figure 4; Thomas, 2011) is composed of the Northern Appalachian Basin (PA), Central Appalachian Basin (WV), Southern Appalachian Black Warrior Basin (AL), and Ouachita-Arkoma Basins (AR, OK). The Northern and Central Appalachian Basins formed as a retro-foreland basin (Allen et al., 1986) in response to the Appalachian folding and thrusting. The Ouachita-Arkoma Basins formed as a remnant ocean basin (Ouachita) and evolved into a classic peripheral foreland basin (Arkoma) connected to the Ouachita fold and thrust belt (Arbenz, 1989; Ingersoll et al., 2003). Subsidence of the Black Warrior Basin has been attributed to both the Ouachita Orogeny (Thomas, 1976; 1993) and the Appalachian Orogeny (Pashin, 2004). The reactivation of basin subsidence of the Michigan and

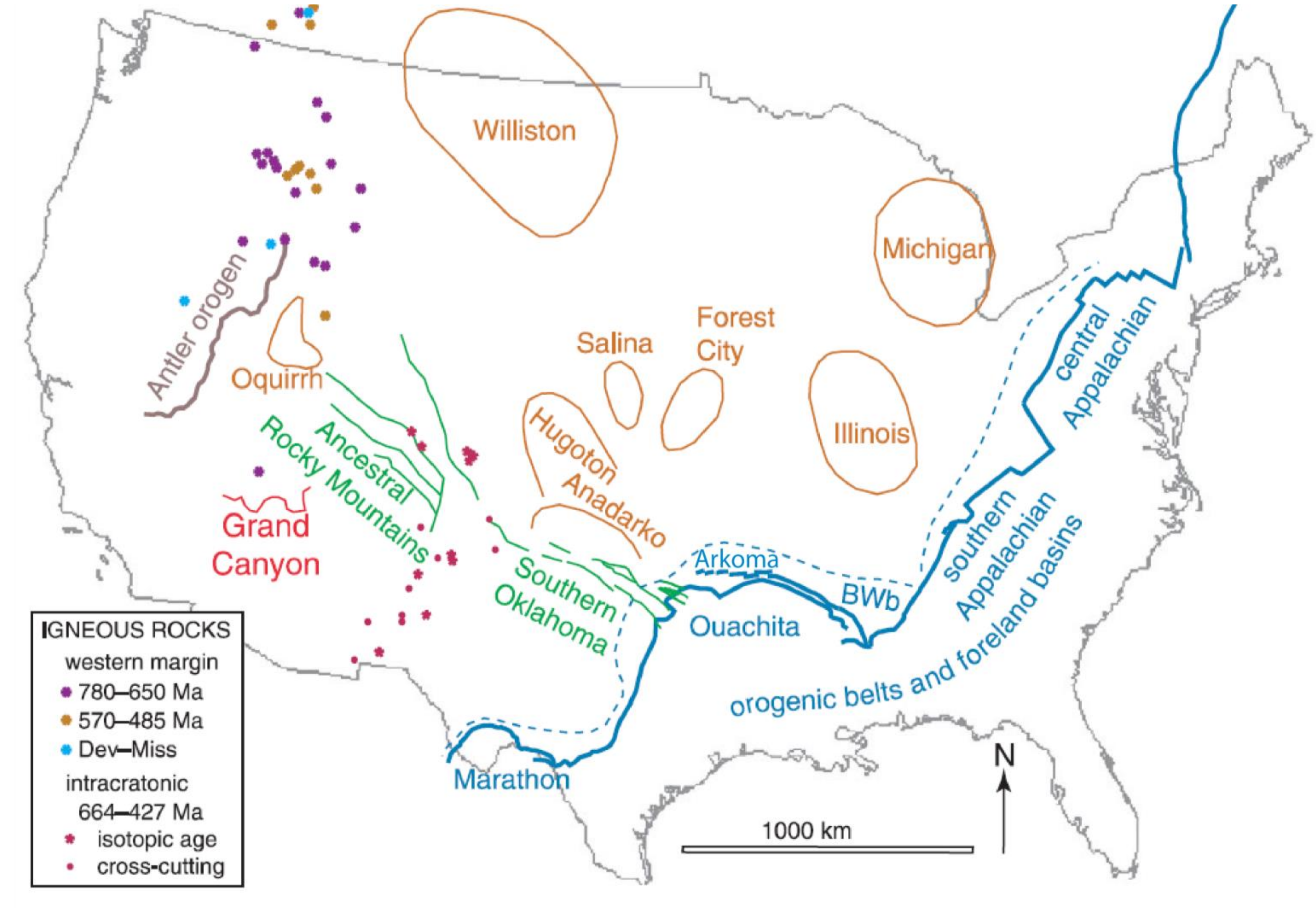


Figure 4: Paleozoic structure map from Thomas (2011) showing the greater Appalachian-Ouachita foreland system and the locations of structural basins distributed throughout the present-day United States. The Intra-cratonic basins are colored orange and the Appalachian-Ouachita structural basins are colored blue. BWB – Black Warrior Basin

Illinois intra-cratonic basins has also been linked to the Appalachian-Ouachita orogenies (Howell and van der Pluijm, 1990). The vast Appalachian-Ouachita foreland system chronicles not only the evolution of the Laurentian continental margin, but a full Wilson Cycle that created the supercontinent of Pangaea.

Black Warrior Basin

The Paleozoic Black Warrior Basin is a foreland basin located at the southern extent of the Appalachians in the syntaxis between the Appalachian and Ouachita thrust belts (in modern day Alabama and Mississippi). The Black Warrior Basin was a passive margin throughout much of its history, slowly accumulating shallow marine facies from the Cambrian to Early Mississippian. The Carboniferous section of the foreland basin underwent flexural subsidence in the Mississippian related to the tectonic loading of the Ouachita orogeny and subsequently received clastic wedge deposition of shallow marine to deltaic facies as the basin evolved (Thomas, 1988). Thomas (1974, 1977, 1988) suggested the clastic wedge thinned northeastward from the Ouachita salient represented by Mississippian syntectonic deposition. Hines (1988) and Thomas (1988) claimed the southwestern portion of the Black Warrior Basin underwent greater subsidence rates, in the range of 2.8 to 3.1 cm/ka in the Mississippian and 28.9 to 30.4 cm/ka during the Pennsylvanian and filled with sediment sourced from southwest orogenic terranes. Pashin (2004) proposed the Black Warrior Basin underwent subsidence related to the Alleghanian orogeny in the early Pennsylvanian with increasing subsidence to the southeast. Alleghanian tectonic activity caused folding and faulting of the basin that sectionalized the basin into the Black Warrior Basin, the Cahaba synclinorium, and the Coosa synclinorium. The Black Warrior was a major sediment depozone in the Pennsylvanian, achieving rapid sedimentation amounting to around 2.5 km of deposited sediment (Pashin, 2004; Figure 5).

The carbonate-platform facies that dominated the early history of the Black Warrior Basin was rapidly succeeded by a Mississippian cratonward-prograding clastic wedge in the southwestern portion of the basin, with shallow marine to deltaic facies connected to the Parkwood delta system (Pashin, 1993; Moore, 2012). The northeastern section continued to be dominated by oolitic and skeletal calcarenites in the Bangor Limestone, while the southwestern portion of the basin received siliciclastic sediments of the Floyd Shale and Parkwood Formation (Pashin and Gastaldo, 2009). The Parkwood Formation is a mixed carbonate-siliciclastic system that commonly intertongues the Bangor limestone strata. The upper Parkwood is predominantly siliciclastic sandstones with compositions of quartzarenite to litharenite (Mack et al., 1981; Pashin and Gastaldo, 2009). The upper Parkwood Formation encompasses the Mississippian-Pennsylvanian boundary, but the exact horizon has not been identified in the Black Warrior Basin strata.

The Pennsylvanian Pottsville Formation directly overlies the Parkwood Formation in the Alabama section of the Black Warrior Basin, but becomes gradational to the southwestern section (Thomas, 1974; Pashin, 1993; Pashin and Gastaldo, 2009). The Pottsville represents the rapid sediment dump onset by the Alleghanian orogeny and contains of cyclic marine to terrestrial facies capped by a heterogenous coal zone (Pennsylvanian cyclothem).

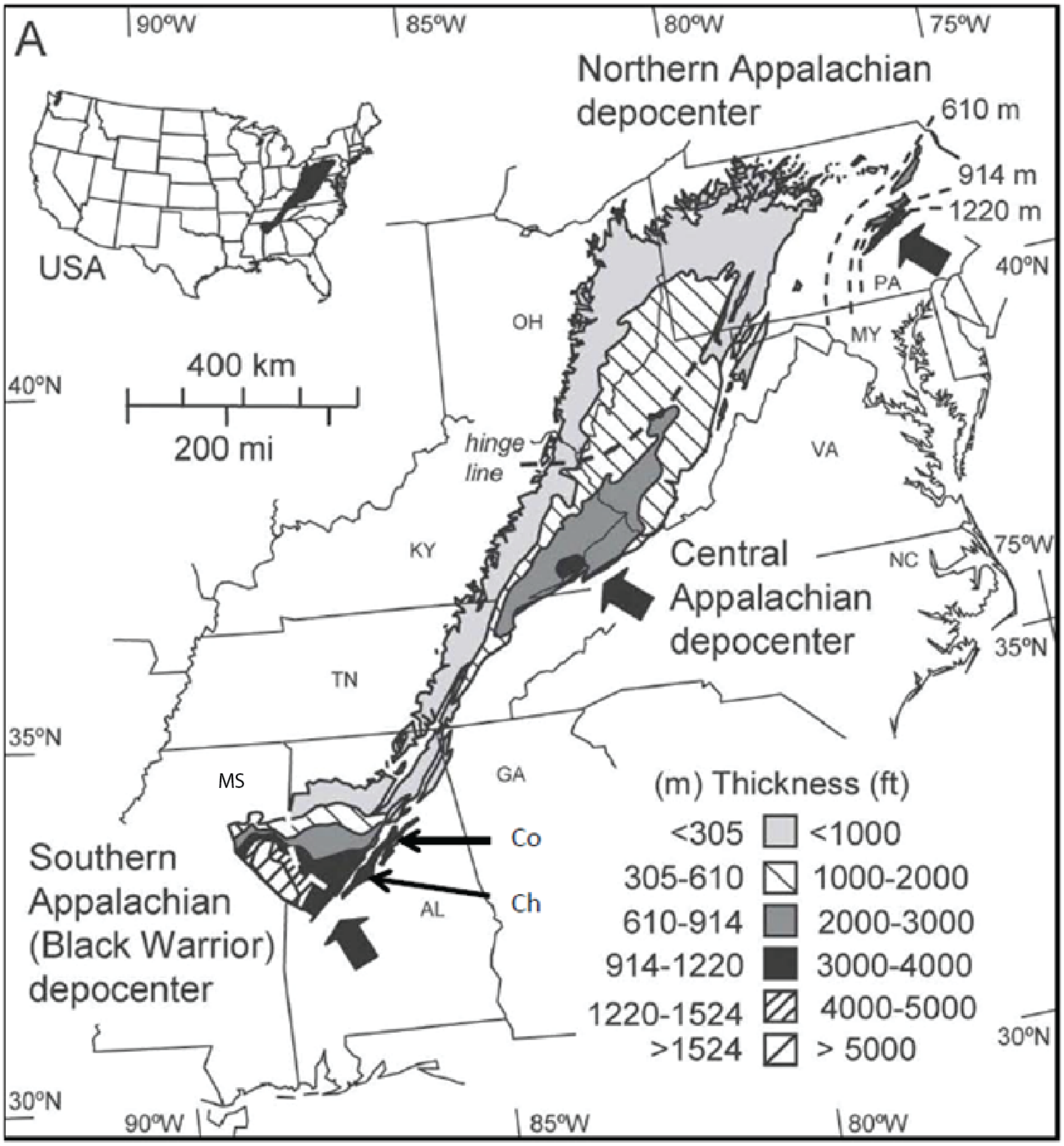


Figure 5: Appalachian and Black Warrior Basin Isopach Map from Greb et al. (2008) with modification by Moore (2012). The Northern, Central, and Southern Appalachian Depocenters are indicated along with their associated sediment thicknesses. The Black Warrior Basin represents the southern extent of the Appalachian system and is the region of maximum sediment accumulation and subsidence. The Coosa (Co) and Cahaba (Ch) synclinoria are also represented within the Greater Black Warrior Basin.

Pottsville sandstones are often immature or rich in lithic fragments thought to be proximally sourced from nearby uplift, whereas the mature quartzarenites are more distally sourced from northern uplifts. Pottsville deposition extended from the early Pennsylvanian to the middle Pennsylvanian, ca. 308 Ma based on an ash layer dated in the youngest part of the upper Pottsville stratigraphy in Mississippi (Uddin et al., 2016).

Ouachita Basin and Stratigraphy

The Ouachita Basin (or Ouachita trough), is a Paleozoic deep-water remnant ocean basin (stratigraphic column represented in Figure 6) that formed from the rifting and breaking up of Rodinia (Morris, 1989; Miall, 2000; 2008). The Ouachita Basin was located off the southern Laurentian margin in the Early Paleozoic and was constrained by an approaching arc-system to the south and the encroaching orogenic front to the east (Miall and Blakely, 2008; Shaulis et al., 2012). The basin was relatively sediment starved in much of the early Paleozoic, receiving deposition of deep-water siliciclastics, novaculites, and sparse carbonates during the Cambrian to Carboniferous (Morris, 1974; Sutherland, 1988; Lowe 1989; Shaulis et al., 2012). The Carboniferous section of the Ouachita Basin underwent rapid deposition in the Mississippian contemporaneously with the transition from mixed carbonate siliciclastic to dominant clastic deposition that is seen throughout the greater Appalachian-Ouachita foreland system (Thomas, 1985). The Mississippian Stanley Group is comprised of mixed shales and sandstones from deep-marine fan deposits following a traditional turbidite sequence along with sporadic tuffaceous material from an encroaching arc terrane (Morris, 1989; Shaulis et al., 2012). Regional paleocurrent data indicates a northwesterly to westerly flow of the turbidity currents (Morris, 1974). Overlying the Stanley Group is the Pennsylvanian Jackfork Group, an Early

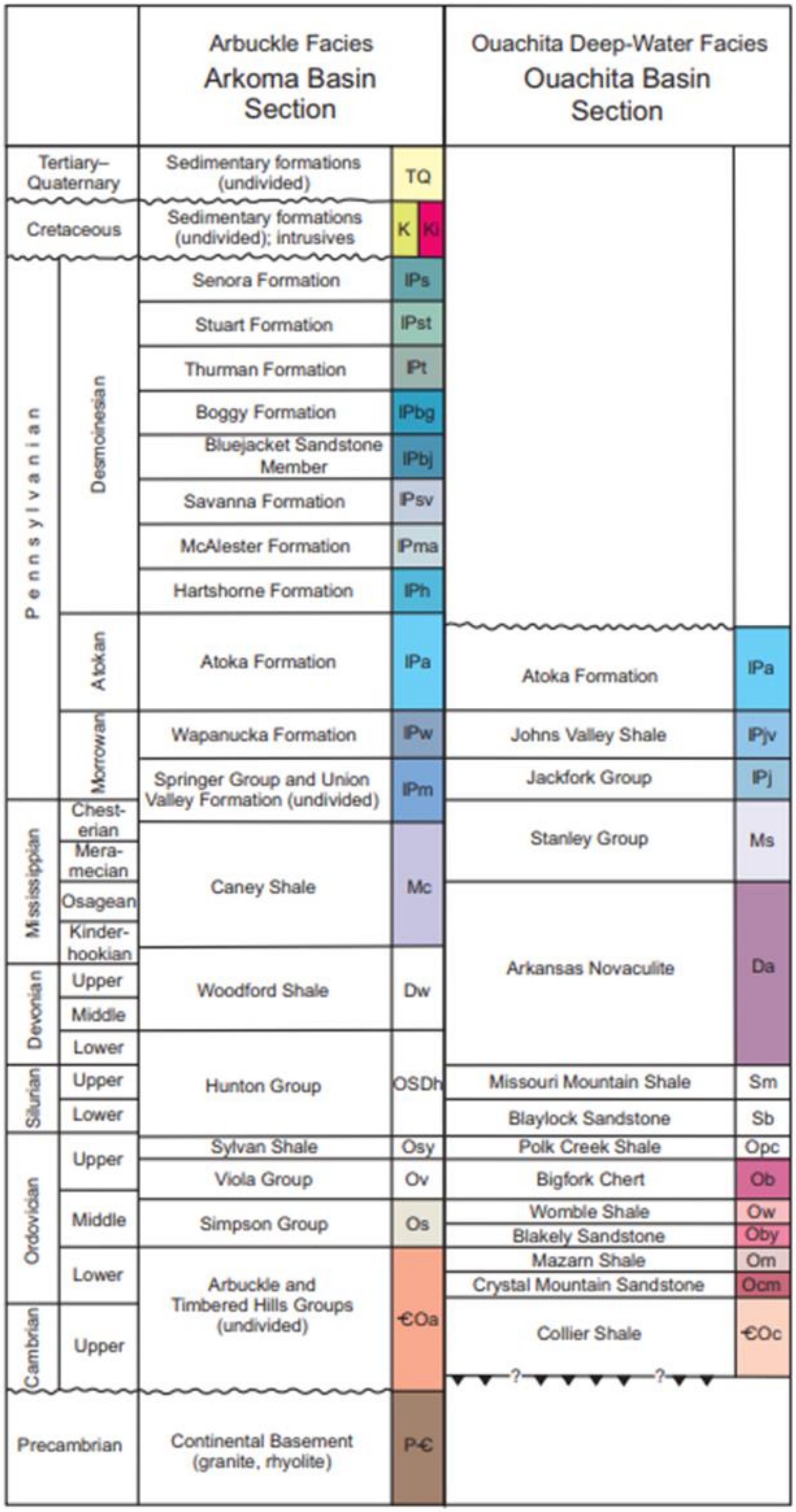


Figure 6: Stratigraphic column of the Ouachita deep water basin and the Arkoma foreland basin modified from Arbenz (2008). Krebs Group of the Arkoma Basin is represented by Hartshorne – Boggy Formations in the middle Pennsylvanian.

Pennsylvanian (Morrowan) sequence of siliceous shales and quartz-rich sandstones marked by marine shales in the lower Jackfork and grades into channel sand deposits in the upper Jackfork Group (Morris, 1974; Sutherland, 1979; Pauli, 1994). The youngest strata represented in the Ouachita Basin, the Atoka Formation, records deposition of the massive influx of syntectonic marginal marine to fluvio-deltaic sands observed throughout the Ouachita region.

The Ouachita Basin section of the Ouachita foreland is embodied by uplifted Paleozoic deep-water sedimentary facies in the Ouachita central and frontal range. The Ouachita frontal range is marked by the Choctaw and Ross Creek faults in the north, whereas the central Ouachitas are delineated by the Windingstair Fault to the south and Gulf Coast Plain in the west.

Arkoma Basin and Stratigraphy

The Arkoma peripheral foreland basin records the closing of the Ouachita remnant ocean basin and development of the Arkoma foreland basin in response to the continent-continent collision between Gondwana and Laurentia. The preserved sections of the Arkoma Basin are located in southeastern Oklahoma and central Arkansas. The foreland basin extent is separated from the Ouachita Basin and central uplift regions by the Choctaw fault in the south, the Arbuckle Mountains to the southwest, and the Ozark uplift to the north (Figure, 2). The Arkoma Basin was a stable shelf along a passive margin composed of irregular carbonate and siliciclastic sediments sourced from the craton to the north (Sutherland, 1988). The foreland underwent subsidence caused by tectonic loading from the docking of Gondwana. Graham et al. (1975) and Thomas (1984) have suggested sequential east to west closure of the Ouachita remnant ocean basin as evidenced by upward gradation of shallow-marine and deltaic facies formed in a collision orogen that intersected the continental margin obliquely. This model proposed by Thomas (1984) also links sediment routing from the Black Warrior region northwestward to the Ouachita region, however, Arbenz (1984) and Link and Roberts (1986) found the closure of the Ouachita Basin was due to northwestward-advancing thrust sheets that resulted in the flexural subsidence of the Arkoma peripheral foreland basin beginning in the Desmoinesian (Sutherland, 1988). Continued downwarping of the Arkoma foreland extended through the Middle Pennsylvanian followed by subsequent basin fill of shallow-marine, deltaic, and fluvial sediments (Houseknecht, 1986; Sutherland, 1988). Sediment derivation of the Arkoma foreland sediment has been linked to both the Ouachita fold belt and the craton to the north. Regional paleocurrent directions have been reported to have flowed from the northeast, southeast, and possibly east (Houseknecht and Kacena, 1983). Oklahoman paleocurrent data from Briggs and Cline (1967) suggest only directions from the north or northeast, none from the south. Thus, the overall Paleozoic depositional history regarding sediment provenance for the Ouachita region is highly variable and reflects the complicated tectonic history of the southern Laurentian margin.

Arkoma Basin Stratigraphy

The Arkoma Basin Cambrian to Mississippian stratigraphy is represented by a mixed carbonate siliciclastic succession. The passive margin shelf deposition of the Arkoma Basin is represented by an organic-rich Devonian to Mississippian marine shale, the Woodford Shale. The Woodford Shale is predominantly an organic-rich mudstone with upwelling chert facies found throughout the formation (Kvale and Bynum, 2014). Overlaying the Woodford Shale is the Caney Shale of the Mississippian-Pennsylvanian section of the Arkoma, characterized by carbonate and clastic facies that transition into coarser and more extensive clastic sediments in the Pennsylvanian (Thomas, 1985). The Mississippian section thickens southward and is composed of shallow-marine mudstones, sandstones, and limestones (Glick, 1979; Haley, 1982; Thomas, 1985). The lower Pennsylvanian strata within the Arkoma Basin are similar to that of the Mississippian with the exception of the incursion of the Atoka Formation in the late early Pennsylvanian. The Atoka Formation is subdivided into the lower, middle, and upper intervals based on depositional history and syndepostional faults causing intraformational thickening (Buchanan and Johnson, 1968; Zachry, 1983; Sutherland, 1988). The lower Atoka is best represented by well sorted quartz-rich sandstones, the middle Atoka by quartz-arenites to litharenites, and the upper Atoka by basin fill deltaic facies composing of litharenites, quartz-arenites, and shales (Zachry, 1983; Houseknecht, 1986; Sutherland, 1988). The Desmoinesian Krebs Group consisting of the Hartshorne, McAlester, Savanna, and Boggy Formations deposited in a tidally influenced fluvial-deltaic complex that spanned into the late Early Desmoinesian (Sutherland, 1988). Middle Desmoinesian through end of Pennsylvanian deposition marked a change in deposition with sediment including chert-pebble conglomerates sourced from the Ouachita fold thrust belt (Sutherland, 1988). The Ouachita Basin encompasses an off-shelf slope, rise, abyssal plain and fan complex from the Cambrian to the Pennsylvanian, whereas the Arkoma reflects a stable shelf environment grading into shallow-marine to fluvio-deltaics in the Pennsylvanian (Sutherland, 1988; Gleason et al., 2002; Figure 6).

Black Warrior Basin to Ouachita-Arkoma Stratigraphic Comparison

The Ouachita and Arkoma Basins have been compared to the Black Warrior Basin due to the simultaneous flexural subsidence related to the Alleghany and Ouachita orogenies (Figure 7; H. Johnson, dissertation in progress). The Mississippian-Pennsylvanian successions in these foreland basins are composed of mixed carbonate and clastic sediment in the Mississippian followed by a significant increase in sedimentation rate during the Pennsylvanian. The Ouachita salient clastic wedge comprises a thick deep-water turbidite sequence grading from mudstone in the lower portion to sandstones in the upper portion (Cline, 1970; Morris, 1974; Thomas, 2004). The depositional setting of the Black Warrior Basin is much different than the Ouachita salient during the time of the Ouachita turbidite deposition. Upon closure of the remnant ocean basin, an upward gradation of shallow-marine and deltaics is observed in the Ouachitas, and Thomas (1984) attributes this to the collision intersecting the continental margin obliquely. Thomas (1984) has also suggested west-ward flow of sediment from the Black Warrior region into the Ouachita trough and continuing into the Ouachita foreland. The Ouachita-Arkoma Basin represents a larger accumulation of Paleozoic strata than the Black Warrior Basin, but the period of rapid sedimentation associated with the Appalachian-Ouachita tectophases is evident in both regions.

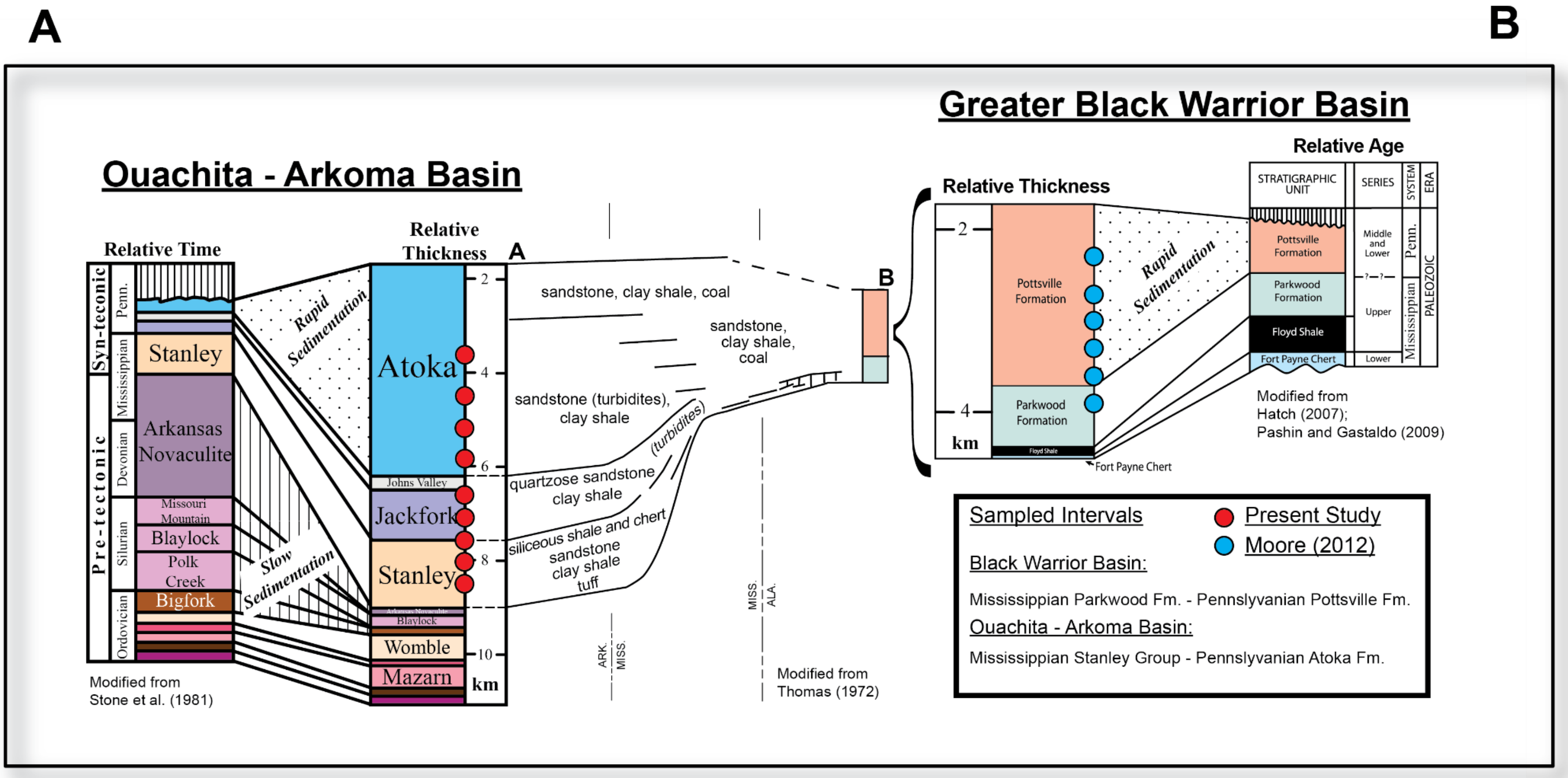


Figure 7: Ouachita-Arkoma (A) to Black Warrior Basin (B) stratigraphic correlation diagram modified from H. Johnson (Dissertation in progress). The two stratigraphic columns for each region represent relative thickness (km of sediment deposited) and relative depositional age (age dating). The correlation records the transition from pre-tectonic slow sedimentation to the rapid influx of syn-tectonic sediment attributed to the Alleghanian-Ouachita orogenesis. Sediment thickening across Ark/Miss boundary indicates rapid deepening of Ouachita Basin. Bars at top of columns marks end of Pennsylvanian basin deposition. Red circles represent the present studies sampled intervals for geochronology analysis and blue circles represent sampled intervals from Moore (2012).

Cratonic Interior Basins

The Michigan and Illinois Basins are intra-cratonic basins that were strongly influenced by Appalachian-Ouachita orogenesis (Figure 4). Both basins were both formed on the interior of the craton and preserve Neoproterozoic to Pennsylvanian strata. These basin systems formed due to crustal subsidence associated with combinations of thermal contraction, lithospheric stretching, or mechanical weakening of underlying crust due to orogenic events (Howell and van der Pluijm, 1990). The Michigan and Illinois Basins comprise mixed carbonate siliciclastic strata deposited in the Cambrian to Mississippian, with the greater subsidence and dominant clastic deposition as the Alleghanian and Ouachita orogenies ensued.

The subsidence and depositional history of the Michigan Basin is documented by a fairly discontinuous stratigraphic record consisting of mixed siliciclastic, carbonate, and evaporite deposition from the Cambrian to the Early Mississippian (Boothroyd, 2012). The early subsidence history, represented by the pre-Carboniferous strata, is most likely attributed to subsidence during thermal contraction (Howell and van der Pluijm, 1990). The Carboniferous sedimentary record is dominated by clastic fluvio-deltaic sediments. The transition to marginal marine and deltaic sequences in the Carboniferous is attributed to mountain building events occurring in the Appalachian and Ouachita regions. Sediment dispersal systems of the craton interior are complicated due to complex arch systems, but flow directions from paleocurrent data of sandstone cross-beds into the Michigan and Illinois Basins are generally considered to be from the east northeast in the Mississippian and northeast to the southwest in the Pennsylvanian (Siever and Potter, 1956; Potter and Pryor, 1961; Shideler, 1969; Ettensohn, 2004; Boothroyd, 2012). Late Paleozoic deposition of the Michigan Basin is controlled by exhumation, erosion, and transport of source terranes located in the Appalachian region with minor input of recycled sediment from interior basins.

Early Illinois Basin subsidence is suggested to be related to failed rifting during the breakup of a supercontinent from the Late Neoproterozoic to the Cambrian (Kolata et al., 1990). Continued Paleozoic subsidence of the intra-cratonic basin is related to Appalachian-Ouachita tectonic episodes reactivating the failed rift system causing further subsidence. Much like the Michigan Basin, the Illinois Basin underwent deposition of mixed siliciclastic and carbonates prior to the Carboniferous transition. Deltaic clastics periodically reached the Illinois Basin from earlier tectonic events, such as the Devonian Acadian event, but the dominant clastic input occurred in the Pennsylvanian concurrent with Alleghanian orogenesis and eustatic sea level rise (Hatcher, 1972, 2002; Kissock et al., 2017). The source of sediment in the late Early Pennsylvanian and Middle Pennsylvanian represents a growing Appalachian component that becomes the primary source as proximal foreland basins fill and sediment dispersal systems distribute sediment to the craton interior (Tankard, 1986, Dickinson and Gehrels, 2003; Thomas et al., 2004; Kissock et al., 2017).

Chapter II: Objectives and Strategy of Present Study

Overarching Objectives

The overarching objective of this study is to provide data bearing on the complex source-to-sink geology of the Laurentian continent during the construction of Pangaea and possible paleodrainage networks from initial source terranes to the ultimate depositional systems. The first objective is to assess feasible sources of sediment deposited into the Ouachita foreland using detrital geochronology and sandstone compositional analysis. The second objective is to investigate Ouachita basin evolution from oceanic remnant basin (Ouachita Basin) to foreland basin (Arkoma Basin) through the detrital geochronologic signature. A third objective is to analyze the characteristics of the greater Appalachian-Ouachita foreland system in order to contribute to the paleogeographic reconstruction of the Laurentian continent throughout the Carboniferous. An analysis of the entire Appalachian-Ouachita foreland system is fundamental to understanding the sediment routing systems that controlled basin deposition.

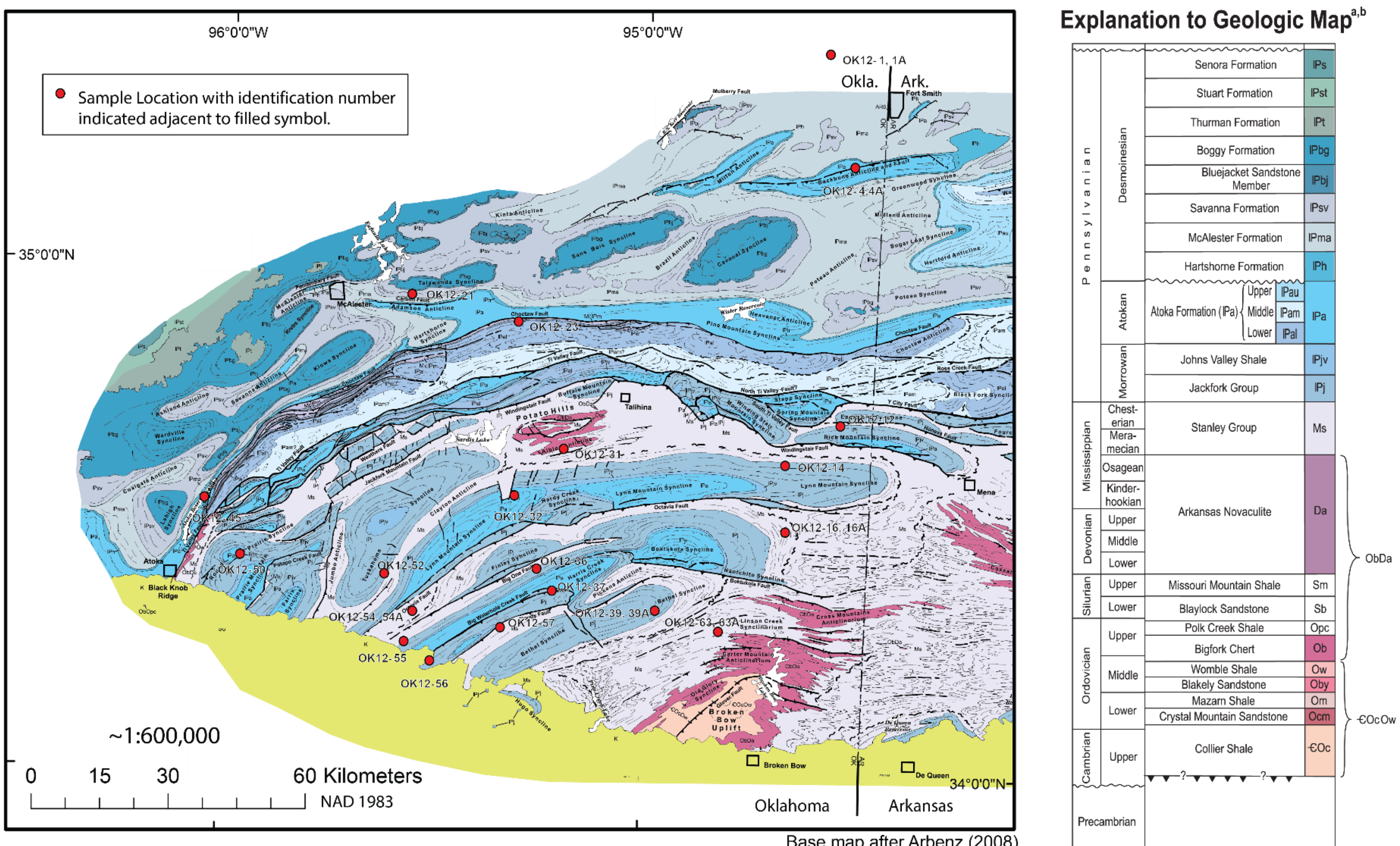
Source-to-Sink Geology

'Source-to-sink' geology refers to a process of combining data from various geologic disciplines to determine how detrital sediment reflect their sources as a result of complex geologic processes and the way these processes fractionate or bias sediment composition. The ability to apply sedimentology, stratigraphy, and geomorphology to metamorphic or igneous source areas in order to reconstruct the past is instrumental in understanding the history of the Earth. Investigation of ancient surface processes by linking sediment deposition via sediment routing systems to source terranes is an increasingly robust research approach. An effective way to explore source-to-sink relations is through coupled geochronologic techniques and compositional analysis. The present study will utilize these techniques in order to investigate the development of the greater Appalachian-Ouachita foreland during the assembly of Pangaea.

Ouachita-Arkoma Sampling

For the present study, sections of the Ouachita deep-water basin and the Arkoma foreland basin were sampled in order to investigate sediment provenance, basin evolution, and depositional history of the Ouachita region. More than 30 samples of very fine to coarse grained Carboniferous sandstones were processed for this study in coordination with ongoing PhD. research of H. Johnson at TAMU (Johnson et al., 2016). Sampling focused on the Mississippian-Pennsylvanian clastic sedimentary strata from the Mississippian Stanley Group to the Pennsylvanian Krebs Group (Figure 8). The sampling strategy was chosen in order to best represent the evolution of the Ouachita region from remnant ocean basin to foreland basin and aide in the investigation of sediment dispersal and source derivation throughout the history of the region. A second goal of the sampling strategy was to provide a basis for assessing shifts in sediment sources at the Mississippian-Pennsylvanian boundary.

Geologic Setting and Generalized Stratigraphy of Southeastern Oklahoma



Base map after Arbenz (2008)

[a]Modified from Haley and others (1976), Stone and others (1986), Johnson (1988), Suneson and others (1990), and Suneson and others (1994).
[b]Where data are lacking (and/or because of space constraints), formations are combined and the oldest and youngest are shown.

Adapted from Arbenz (2008)

Figure 8: Geologic Map of the Ouachita-Arkoma region modified from Arbenz (2008) and references therein. The red circles indicate the sampled locations of the present study from both the Ouachita deep-water section and the Arkoma Basin section. Sample locations listed in Appendix 1.

Detrital Geochronology

Detrital geochronology has become a principal tool in source-to-sink geology and basin analysis. Detrital mineral grains are dated using various techniques in order to investigate possible links between an aliquot of sediment ages and source areas or provinces. Two common techniques are U-Pb dating of zircons and $^{40}Ar/^{39}Ar$ dating of muscovite. Each technique yields different signatures based on the mineral grain. The U-Pb detrital zircon signature characteristically records older crystallization events due to zircon forming at higher temperatures and being a refractory mineral. The $^{40}Ar/^{39}Ar$ detrital muscovite signature typically represents the youngest tectonic events of sources due to the lower closure temperature (400-300 °C) and micas commonly recrystallize during deformation or metamorphic events. Thus, the zircon record generally records higher temperature orogenic events and craton evolution, whereas the muscovite age is biased to more recent tectonic events. In this study, detrital geochronology is used to investigate the links between sediment and possible source terranes through first cycle detrital muscovite crystal ages.

Sandstone Compositional Analysis

Petrographic sediment composition techniques have long been used in provenance studies to determine sediment source based on sandstone composition and grain characteristics. Sandstone compositions directly reflects source terranes based on weathering susceptibility and climatic impact on mineral makeup, whereas sediment grain characteristics archive grain size and boundaries related to source rock and transport history. Point counting techniques allow for types of source terranes to be identified based on quartz, feldspar, and lithic fragment content. Quartz dominated sands with no lithic component are more characteristic of cratonic sources and sandstones with a high lithic component and no feldspar are characteristic of recycled orogenic sources (Dickinson, 1985). Grain characteristics, such as roundness and sorting, yields information on transport history and overall sandstone maturity. Both of these techniques are applied to the Carboniferous Ouachita sandstones using petrographic analysis and microprobe analysis in order to investigate the likely sediment sources and the sediment transport history.

Chapter III: Previous Work

Appalachian-Ouachita Sediment Provenance

The Appalachian-Ouachita foreland system has been the subject of numerous provenance studies that typically focus on sediment dispersal associated with the tectonic mountain building of the Appalachians. Early studies investigated stratigraphy and depositional characteristics of the multiple clastic wedges found within the Appalachian foreland basin (Meckel, 1970; Patchen et al., 1985; Ettensohn, 1985, 1987). The early sediment provenance studies utilized paleocurrent directions, sandstone compositions, and petrographic descriptions to determine source direction and possible links to Appalachian sources (Siever and Potter, 1956; Briggs and Cline, 1967; Graham et al., 1975, 1976; Dickinson and Suczek, 1979). Regional facies mapping throughout the Appalachian-Ouachita foreland (Archer and Greb, 1995) also contributed to the ongoing investigation of sediment dispersal on the Laurentian continent. The focus of provenance studies shifted with the growing interest in detrital geochronology (e.g., Gray and Zeitler, 1997). The detrital geochronology role in provenance studies in modern studies is almost a necessity, as nearly every provenance study is now centered around some type of detrital geochronologic age data. Recent sediment drainage models have used all of these tools to construct and propose drainage patterns throughout the greater Appalachian-Ouachita foreland (Gehrels et al., 2011, Uddin et al., 2016, Xie et al., 2016, Kissock et al., 2017; Xie et al., 2018).

Sandstone Compositional Analysis

Modal and compositional analysis of sandstones have long been used to present possible source areas and transport history in the Appalachian-Ouachita region (Siever and Potter, 1956; Dickinson and Suczek, 1979; Dickinson, 1985; Uddin et al., 2016; Xie et al., 2018). Dickinson (1985) found the importance of modal mineralogy as expressed through point counting plots that represent total quartz, feldspar, and lithic content. In the Ouachita and Black Warrior regions, Graham et al. (1976) used provenance petrology to compare the recycled orogenic sediment of the Appalachian-Ouachita to the Himalayan-Bengal system. Graham et al. (1976) attributed the compositions they documented to collisional orogenic sources via a longitudinal drainage of orogenic highlands.

The majority of sandstone compositional analyses throughout the Appalachian-Ouachita foreland show that sandstone compositions can be associated with either recycled orogenic or craton interior sources with low feldspar contents (Siever and Potter, 1956; Siever, 1957; Becker et al., 2005; Boothroyd, 2012; Moore, 2012; Uddin et al., 2016; Xie et al., 2018). Black Warrior basin sandstones (Moore, 2012; Uddin et al., 2016) tend to be less mature both compositionally and texturally than the sandstones of the Ouachita region (Graham et al., 1975). Craton interior compositions from the Illinois and Michigan Basins typically have more than 85% quartz and can be associated with cratonic sources (Siever and Potter, 1956; Siever, 1957; Boothroyd, 2012). Central and northern portions of the Appalachian Basin sandstones are characteristically more immature than the Ouachita sandstones, which can be correlated with recycled orogenic sources and are comparable to the Black Warrior Basin sandstones (Siever, 1957; Sheehan, 2002; Becker et al., 2005; Reed et al., 2005).

Early Sediment Transport Models

Gleason et al. (1994) combined regional facies relations and petrographic studies with Nd isotopic data to infer the Ouachita Paleozoic turbidites were derived from Appalachian sources. The sediment dispersal models began with Ordovician to Silurian tectonic uplift in the Appalachians and showed the progression of sediment transport from the Appalachians through the Black Warrior region and westward into the Ouachitas in the Pennsylvanian. Gleason et al. (1994) concludes that a dominant Appalachian provenance for much of the Paleozoic Ouachita sediment and a continental-scale dispersal system from the Appalachians overwhelmed all other potential sources.

Archer and Greb (1995) proposed an Appalachian Basin drainage model based on regional facies mapping of Morrowan conglomerate sandstones throughout the Central Appalachian, Illinois Basin, and Hugoton Embayment. Paleogeographic reconstructions were used to estimate paleodrainages for each basin and used to determine that these drainage areas were comparable to Amazon-scale drainage areas. The paleogeographic reconstruction and fluvial system model propose two continental (Amazon-scale) drainage networks separated by a topographic high (Cincinnati Arch). The fluvial systems as proposed require sediment transport starting in far north (present-day Canada) sources that traverse the Laurentian continent. The interior fluvial system intersects the Michigan and Illinois Basins and deposits into the Ouachita region, whereas the eastern fluvial system spans the length of the adjacent Appalachian Mountains and deposits into the Black Warrior region. These transport models stem from an enormous amount of provenance interpretation and are still under investigation today.

Detrital Zircon Geochronology

U-Pb detrital zircon geochronology has become a major provenance investigation tool and resulted in numerous studies concentrating on Appalachian-Ouachita Paleozoic strata across the entire foreland and cratonic interior (Figure 9; Gray and Zeitler, 1997; Eriksson et al., 2004; Thomas et al., 2004; Becker et al., 2005; Park et al., 2010; Boothroyd, 2012; Shaulis et al., 2012; Xie et al., 2016; Kissock et al., 2017; Thomas et al., 2017; Xie et al., 2018). The detrital zircon studies have sampled clastic wedge material associated with all three/four tectophases of the Appalachian orogenesis (Park et al., 2010), but most studies have focused on the early to middle Pennsylvanian (Morrowan to Desmoinesian) strata (Figure 9).

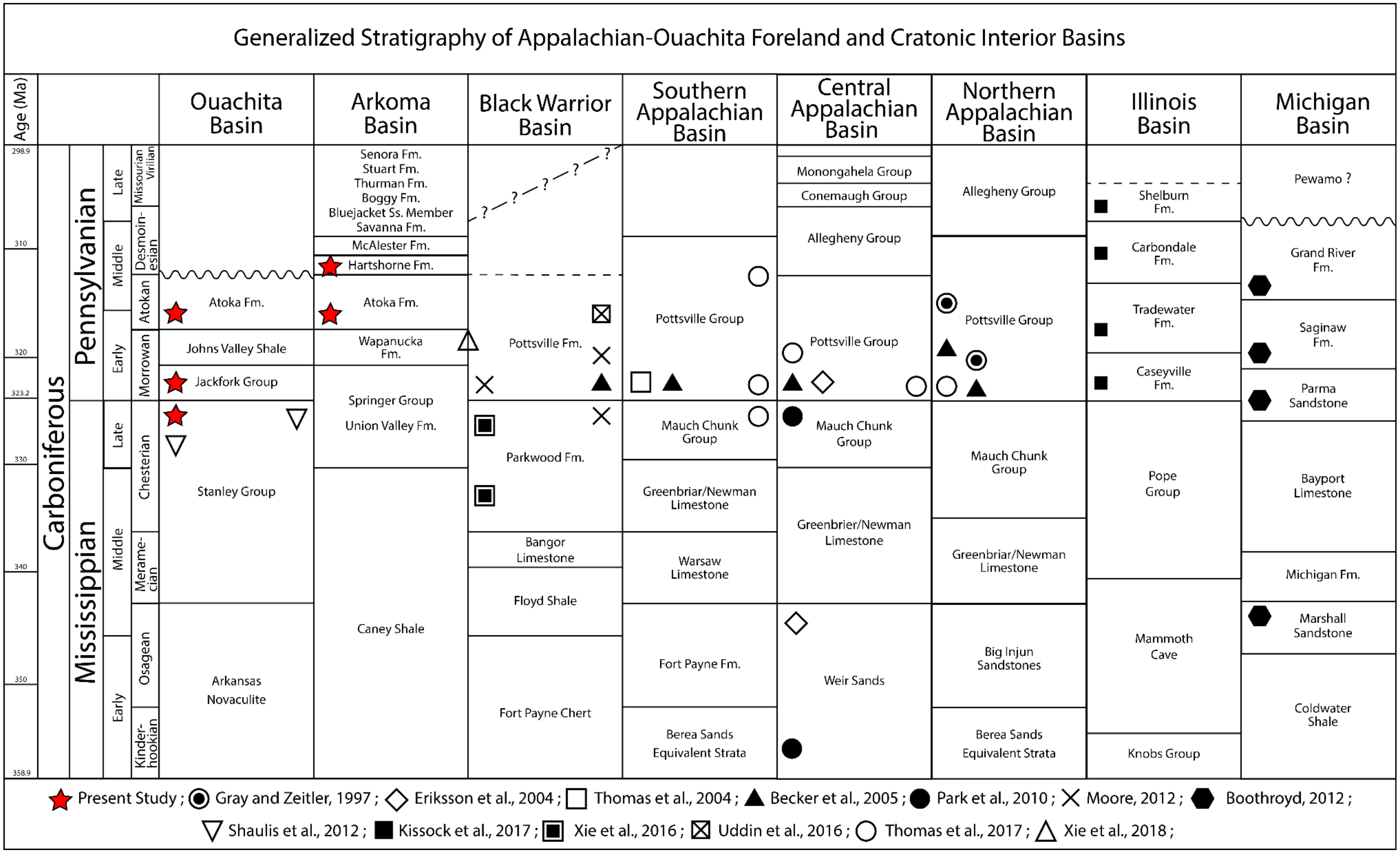


Figure 9: Generalized stratigraphy of Appalachian-Ouachita foreland and craton interior showing the focus of geochronologic and provenance studies throughout the Appalachian-Ouachita foreland and associated basins. Heavy focus of sampling in these studies is located along the Mississippian-Pennsylvanian boundary and Morrowan strata in general. The present study's sampled stratigraphy is indicated by the red star in the Ouachita and Arkoma Basins.

Becker et al. (2005) sampled lower Pennsylvanian sandstones along the Appalachian orogen from Pennsylvania to Alabama for detrital zircon dating. The detrital signature reflected a dominant Laurentian crust-forming event with minor ages clusters of Pan-African and Trans-Amazonian aged zircons. Becker et al. (2005) ultimately concluded that the Alleghenian clastic wedge sediment was derived from Laurentian sources.

Park et al. (2010) also used detrital zircons from the Central and Southern Appalachian foreland to examine Taconic, Acadian, and Alleghenian clastic wedges. Park et al. (2010) found a variety of different signatures for each clastic wedge. Each clastic wedge contained a prominent Grenville component. The Taconic clastic wedge contained a mostly Grenville signature with minor early Mesoproterozoic (1400 Ma) and Ordovician peaks. The Acadian clastic wedge provided an interesting Neoproterozoic component (550-700 Ma) and an older 1900-2250 Ma mode interpreted to be Trans-Amazonian. The Alleghenian clastic wedge displays a Grenville population along with an Archean component. Park et al. (2010) concluded that the Acadian and Alleghanian tectophases exhumed preexisting hinterlands and produced new sediment dispersal patterns from various sources. Lastly, Park et al. (2010) concluded the younging-upward progression of Grenville aged provinces is indicative of a “reverse unroofing sequence” suggesting multiple cycles of zircon grain recycling.

Thomas et al. (2017) summarized detrital zircon records from the Appalachian foreland system and added seven new samples to better illustrate provenance and source areas for the Appalachian foreland (Figure 10). The new samples extend the study of zircon age distribution to upper Mississippian and lower Pennsylvanian strata. The ultimate conclusions from this study is that of a complex and composite source terrane(s), dominated by Laurentian crustal sources but with significant components of Pan-African/Braziliano and Iapetan synrift igneous rocks that provided zircons to the Appalachian foreland. However, Paleozoic, Appalachian zircons are scarce among the results compiled by Thomas et al. (2017) and Alleghanian zircons are conspicuously absent (Figure 10). It has been suggested that a lack of zirconium mobility during Paleozoic metamorphism and intrusion limited production of zircons on the foreland side of the Appalachians (Moecher and Samson, 2006).

Xie et al. (2016) analyzed zircons from Mississippian Black Warrior Basin strata and found four distinctive modes attributed to Paleozoic, Grenville, Granite-Rhyolite, and Yavapai-Mazatzal provinces. Xie et al. (2016) interpreted that the distribution of ages from the Black Warrior Basin are dominated by Laurentian cratonic sources, with sediment transported from the north via major axial drainage to the Black Warrior basin. Xie et al. (2016) used the zircon age interpretations to propose a sediment pathway model suggesting two systems that merge together and deposit sediment in the Black Warrior Basin, one from the midcontinent and one from the northern Appalachians.

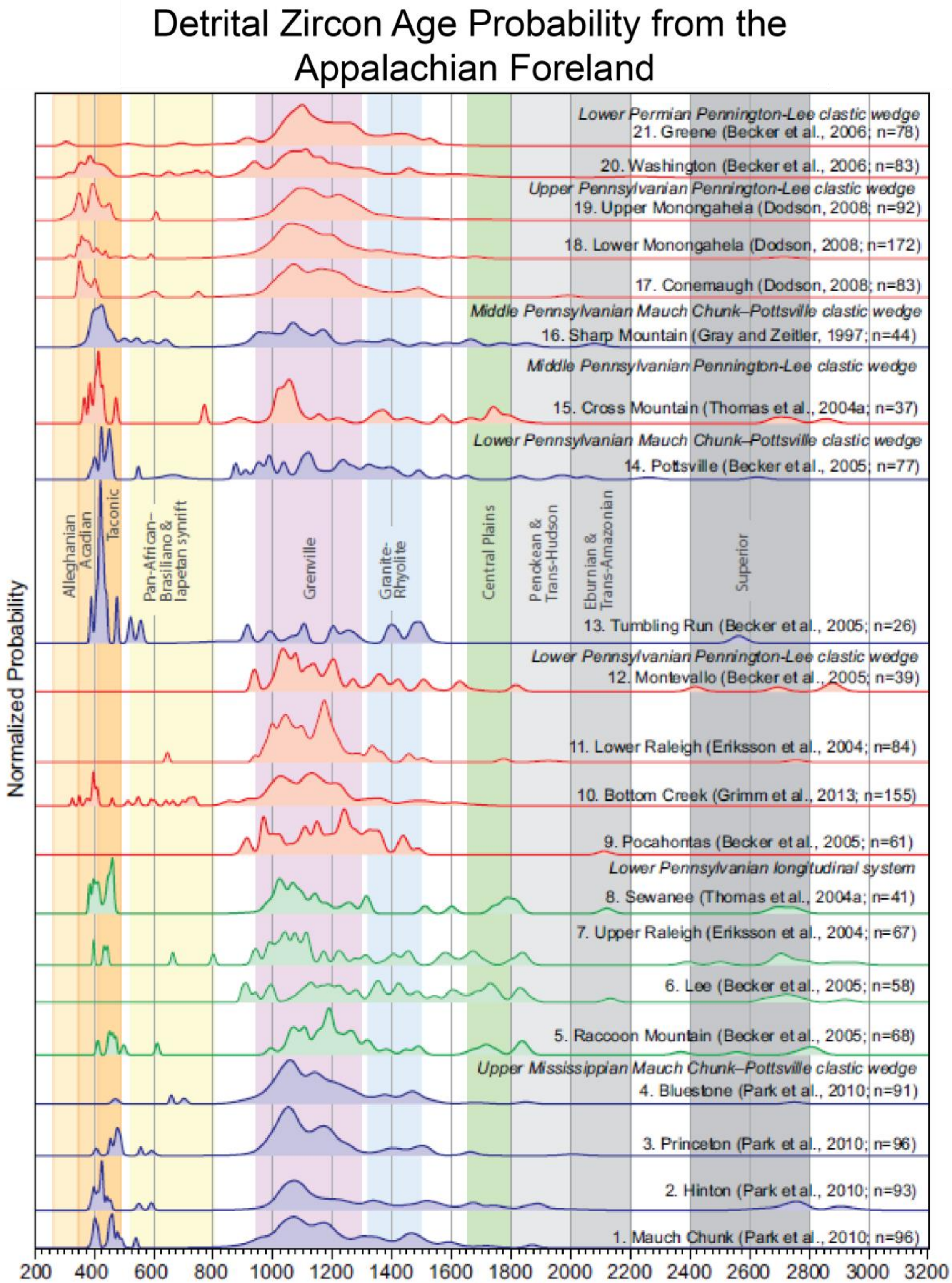


Figure 10: Normalized age probability plots of detrital zircons from Appalachian foreland sandstones from Thomas et al. (2017). The vertical color bars represent likely Provinces attributed to detrital sediment throughout the North American Craton.

Gehrels et al. (2011) sampled Paleozoic strata from the Grand Canyon beginning in the Cambrian and spanning through the Permian in order to constrain the Paleozoic transport history from the eastern Laurentian margin to the Grand Canyon. The large dataset was compared to existing Mississippian to Permian zircon data from the Laurentian continent. The result was large scale sediment transport models of Cambrian to Early Permian with regional pathways flowing from the Appalachian uplift towards the western portion of the Laurentian continent (partially represented in Figure 11). Gehrels et al. (2011) concluded that the provenance of Paleozoic sandstones varied significantly throughout the Paleozoic and that the upper section of the Grand Canyon strata is derived from distal sources including the Appalachian orogen.

Xie et al. (2018) investigated Early Pennsylvanian sediment dispersal through detrital zircon geochronology and sandstone compositions of Morrowan sands from northern Arkansas. The detrital zircon record showed all major North American Craton basement sources: Grenville, Yavapai-Mazatzal, Midcontinent Granite-Rhyolite, and Superior. The sources of these recycled sediments are interpreted to be from the Appalachian orogenic belt and foreland system. The proposed sediment dispersal system is that of Laurentian derived sediment transported southward toward the Ouachita foreland (Figure 11; Xie et al., 2018). The Xie et al. (2018) model suggests a sediment dispersal path that bypasses the Michigan Basin and continues southwestward through the Illinois Basin.

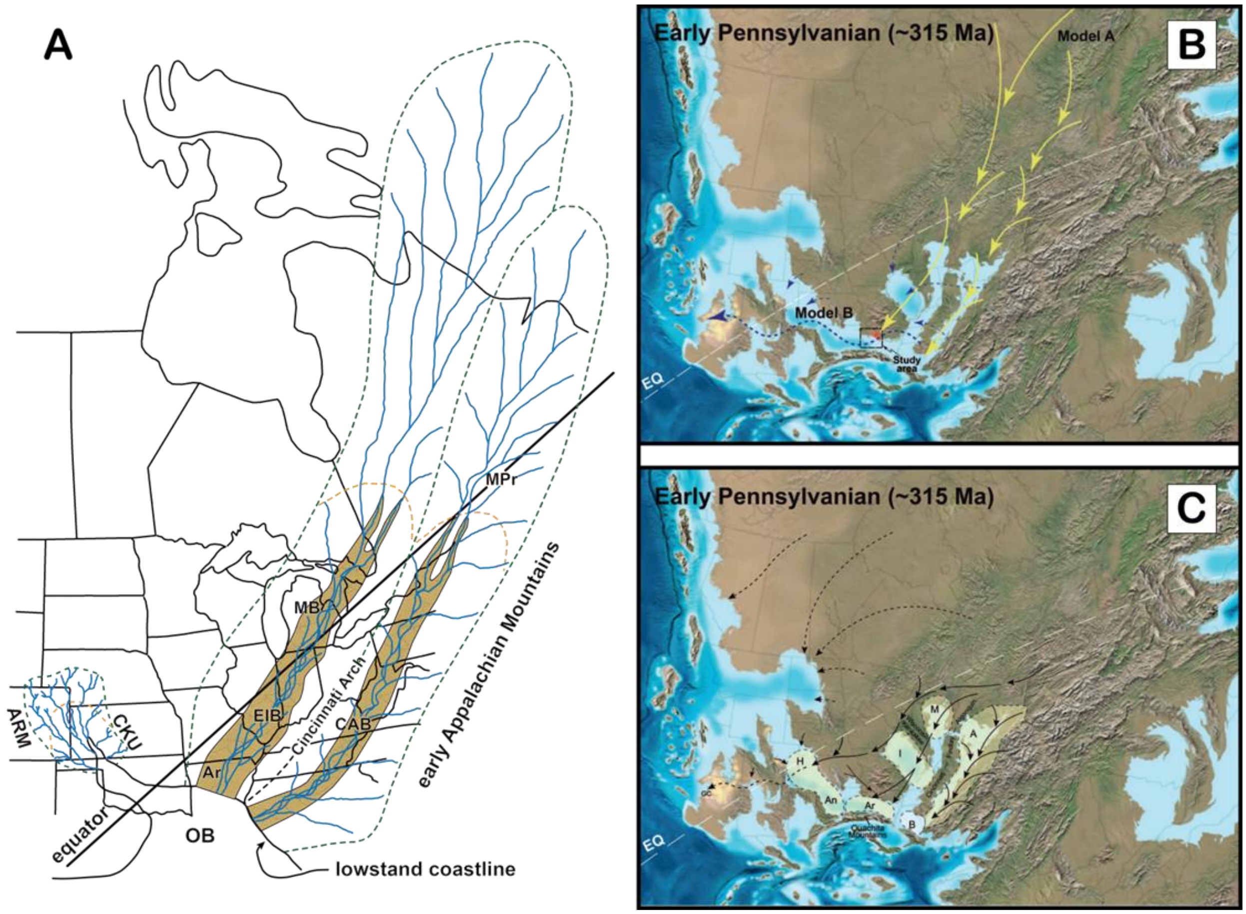


Figure 11: Recent sediment drainage models from Archer and Greb (1995), Gehrels et al. (2011,) and Xie et al. (2018). The drainage models represent Early Pennsylvanian sediment dispersal pathways from Appalachian sources. A). The Archer and Greb (1995) model (left) displays two Amazon-scale longitudinal drainage systems stemming from distal Northern Appalachian sources. B). The Gehrels et al. (2011) model is represented by the blue lines in the top paleogeographic model and proposes a transverse system supplying sediment westward to the Grand Canyon. C). The bottom paleogeographic map is the Xie et al. (2018) model building upon the longitudinal drainage model sourced from the Northern Appalachians.

Detrital Muscovite Geochronology

Detrital muscovite $^{40}Ar/^{39}Ar$ ages have been used in the greater Black Warrior Basin to characterize the sediment provenance and infer detrital history. In the Pennsylvanian Pottsville Formation of the Cahaba synclinorium (Peavy, 2008; Uddin et al., 2016), sandstones provided muscovite with ages corresponding to all three major Appalachian tectonic events. The conclusion from these studies is that the greater Black Warrior Basin in the early Pennsylvanian received sediment sourced from dispersal systems that originated in the Southern Appalachians.

Moore (2012) used a similar approach in order to investigate detritus that was input into the Black Warrior Basin during the Carboniferous. Detrital muscovite from drill core and outcrop samples yielded a younging-upward progression with an initial Taconic signature in quartz arenites lower in the section followed by a gradual transition to Acadian and eventual Alleghanian signature higher up in the section (Figure 12). The detrital muscovite recorded all three major Appalachian orogenic events dominated by Alleghanian signature in the upper Pottsville stratigraphy. One Mississippian Parkwood sample was analyzed, which also recorded all three orogenic events, from which Moore (2012) concluded that perhaps the Mississippian and Pennsylvanian strata of the Black Warrior Basin are not vastly different. Moore (2012) also investigated facies and sandstone maturity finding a lithicarenite sample showing a markedly different age signature than the quartz-arenites immediately under and overlying this sample. Moore (2012) concluded that sea level plays an important role on deposition proximal versus distal sources and perhaps grain ages from different sources.

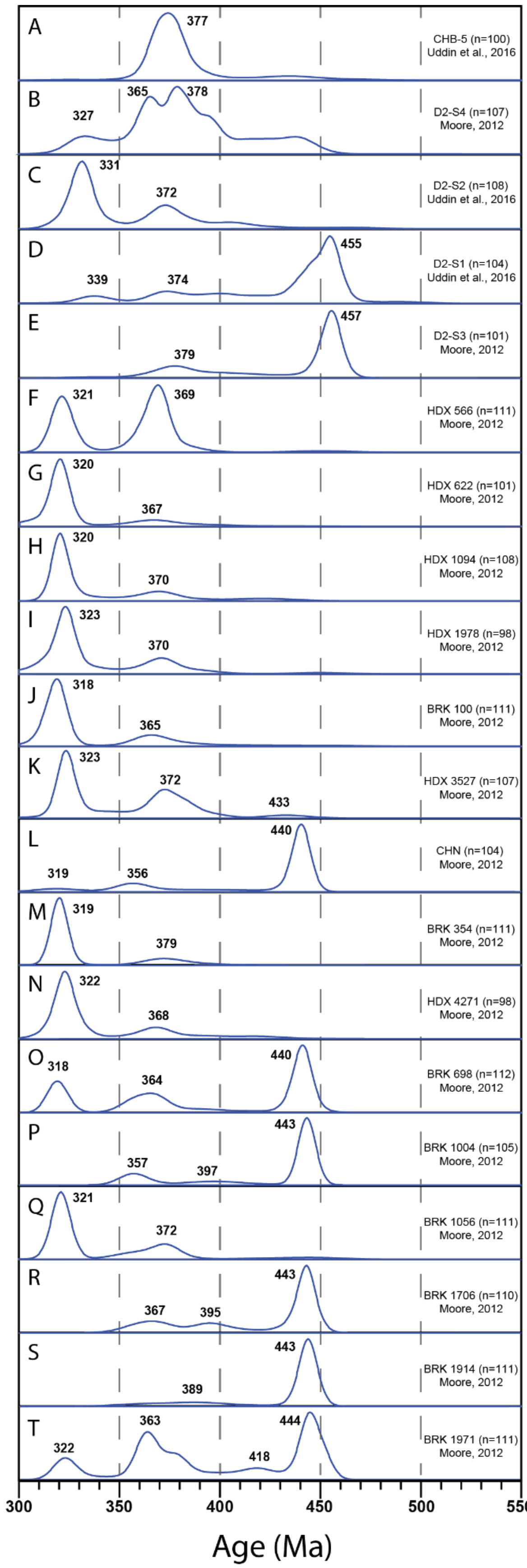


Figure 12: Stacked density plot of Black Warrior Basin detrital muscovite $^{40}Ar/^{39}Ar$ age dates from Peavy (2008), Moore (2012), and Uddin et al. (2012), and Uddin et al. (2016). The stacked detrital age plots best display the detrital signature and the evolution of detrital age with respect to stratigraphic position. Plots (A, C, and D) are samples from work done by Peavy (2008) and represented in Uddin et al. (2016). Plots (F – I, K and N) are from the Hendrix core in Moore (2012). Plots (J, M, and O – T) are from the Brooks core in Moore (2012). Plots (B and L) are outcrop samples from Moore (2012).

Chapter IV: Analytical Methods

Detrital Geochronology Sample Preparation

Sample selection for initial detrital geochronology analysis focused primarily on upper Mississippian and lower Pennsylvanian strata. Secondary sampling focused on basin evolution and transition from the Ouachita deep-water section to the peripheral Arkoma foreland basin section. Approximately twenty very fine to medium grained sandstones were selected for detrital geochronology analysis. Fourteen of the sandstones were designated for detrital muscovite $^{40}Ar/^{39}Ar$ analysis and six for detrital zircon U/Pb analysis (work represented in the ongoing dissertation research of H. Johnson, and represented by Johnson et al., 2016), with two of those sandstones analyzed using both techniques. Thin section samples correspond to eleven of the fourteen detrital muscovite samples. The collective sampling spans from late Mississippian through middle Pennsylvanian strata. Standard disaggregation techniques of bulk outcrop sampling (~20 kg) were performed using jawcrusher, pulverizer, and heavy/light separation on Wilfley table, followed by hand picking.

Muscovite Separation

Muscovite grain separation was performed on Wilfley table light separates that included quartz, feldspar, and micas. The light separates were processed through mesh sieves of sizes #40 (420 microns), #60 (250 microns), and #80 (177 microns). The majority of grains were of the

250-177 µm size fraction, and this size range was utilized for this study. Sieved material was then placed on filter paper and processed using paper shaking to eliminate quartz and feldspar grains. Approximately 200 muscovite grains were then randomly selected for each sample and picked under a binocular microscope for irradiation.

$^{40}Ar/^{39}Ar$ Dating Method

Sample Irradiation for $^{40}Ar/^{39}Ar$ Dating

The K/Ar dating technique is based upon the natural occurrence of the radioactive isotope potassium (^{40}K), which undergoes dual decay to ^{40}Ca and ^{40}Ar and has a half-life of 1.25 billion years. In order to utilize the $^{40}Ar/^{39}Ar$ method, some ^{39}K is converted into ^{39}Ar in a nuclear reactor by fast neutron bombardment (Merrihue and Turner, 1966; Dalrymple et al., 1981; McDougal and Harrison, 1989).

Muscovite grains for each sample were wrapped in aluminum foil, which were then placed in aluminum disks of a fixed geometry. Monitor minerals (GA-1550 Biotite and Fish Canyon Sanidine) were arranged to evaluate radial and vertical gradients in neutron flux and production of ^{39}Ar. Samples were irradiated in the United States Geological Survey TRIGA Reactor (GSTR) for 80 hours. Flux monitors included in the irradiation package and used to calculate the J value were Fish Canyon Sanidine (28.02 Ma assigned age; Renne et al., 1998) and GA-1550 Biotite (98.79 Ma assigned age; Renne et al., 1998).

Detrital Muscovite Analysis and Age Calculation

Individual detrital grains were analyzed by single crystal laser fusion analysis using a Synrad Firestar CO_2 laser. Argon isotopes were then measured with computer automated analyses on the GLM-110 mass spectrometer in the Auburn Noble Isotope Mass Analysis Lab (ANIMAL) at Auburn University.

Vermeesch (2004) showed that ≈117 individual grains are needed in order to achieve 95% certainty for detection of any age component composing of 5% or more of a population within a detrital sample. Thus, many detrital mineral studies strive to have a sample size greater than 100 analyses. The laser sampling system in the ANIMAL lab hosts a sample planchette that can conveniently accommodate 112 individual mineral grains per loading cycle, and this was utilized for the present study.

Ages were determined using the following relationship from (Merrihue and Turner, 1966), where t is the age of the sample, λ is the decay constant, and J is the variable determined from the production of ^{39}Ar and its relationship to ^{40}Ar based on the known monitors from the irradiation package:

$$t = \frac{1}{\lambda} \ln \left(\frac{40Ar}{39Ar} J + 1\right)$$

Sandstone Compositional Analysis

Eleven very fine to medium grained Carboniferous sandstones corresponding to the same bed as the detrital muscovite samples were selected for compositional analysis, modal mineralogy, and textural observations. These sandstones comprise two upper Mississippian Stanley Group (Chesterian) samples, two lower Pennsylvanian Jackfork Group (Morrowan) samples, six Pennsylvanian Atoka Fm. (Atokan) samples, and one middle Pennsylvanian Krebs Group (Desmoinesian) sample. Thin sections for petrographic analysis were made by Wagner Petrographic, following standard protocol for uncovered and unpolished 24x46 mm thin sections.

Sandstone composition was determined utilizing the Gazzi-Dickinson point counting method, which requires that at least 300 framework grains are identified per sample in order to represent the composition as a whole (Dickinson, 1970; Ingersoll et al., 1984). For the present study, a minimum of 600 framework grains, or points, were identified using a grid system to calculate accurate increments between points and in order to best represent the entire sample. Thin sections were placed on a petrographic stage with incremental movement capabilities. Framework grains were categorized based on composition: Monocrystalline quartz (Qm), polycrystalline quartz (Qp), tectonic quartz (Qtc; metamorphically altered quartz or polycrystalline quartz grains), potassium feldspar (Fk), plagioclase feldspar (Fp), volcanic lithic (Lv), metamorphic lithic (Lm), sedimentary lithic (Ls), muscovite, biotite, carbonate, chert, zircon, garnet, and opaques. Modal data were constructed and normalized for plotting purposes (Table 2, Figure 16) following Dickinson and Suczek (1979) and Dickinson (1985) using Qt-F-L and Qm-F-Lt diagrams, where Qt = (Qm + Qp + Qtc); F = (Fk + Fp); L = (Lv + Lm + Ls); Lt =

(Qp + Lv + Lm + Ls). Modal analysis was constructed using software from Zahid and Barbeau (2011).

Textural observations were composed to aide in further understanding of sandstone composition and comprehensive characteristics of each sample. The observations included grain size, sorting, and roundness, as well as cement type, clay content and unique textural characteristics.

Microprobe Analysis

Thin sections were also utilized for microprobe analysis in order to determine chemical composition of lithic fragments and evaluate the overall mineral composition of samples. Microprobe analysis was performed at Auburn University in the Electron Microprobe Analysis Lab (EMPA) using a JEOL JXA-8600 electron microprobe. Lithic fragments were analyzed by stage and beam rasters to show aluminum (Al), iron (Fe), potassium (K), and sodium (Na) content. Backscattered electron imaging was performed in order to view contrasting atomic number of elements within lithic fragments. Larger scale high-resolution compositional maps were constructed in order to represent sandstone composition and volume percentages of lithic fragments within the sandstone samples. The large scale representative compositional maps were optimized to show aluminum, iron, potassium, and sodium content.

Chapter V: Data and Results

Sandstone Compositional Analysis

Sandstone textures and characteristics vary from sample to sample with no distinct trend in maturity from the uppermost Mississippian to the middle Pennsylvanian sample. Samples range from mature litharenites to slightly immature or immature lithic arenites with considerable clay content and excess cementation providing no grain contacts (OK12-31; Figure 13). Pennsylvanian Jackfork samples show very similar compositions and textural characteristics with moderately sorted, sub-rounded grains, and are dominated by silica cement. Also, the Jackfork sands show a considerable amount of monocrystalline quartz and secondary lithic fragments with scattered zircon and muscovite grains (Figure 14). Pennsylvanian Atoka samples become more consistent higher in the section with slightly rounded grains, silica cement, and smaller grain size. However, a few outliers exist in the Atoka samples, for example, OK12-45 provides more immature characteristics of sub-angular grains and jagged grain boundaries with clay overgrowth (Figure 15). Each sample presents a unique story and insight into the maturity of the sandstone, the textural characteristics and petrographic observations demonstrate that the cumulative sampling for this study focusses on slightly immature to slightly mature litharenite sandstones.

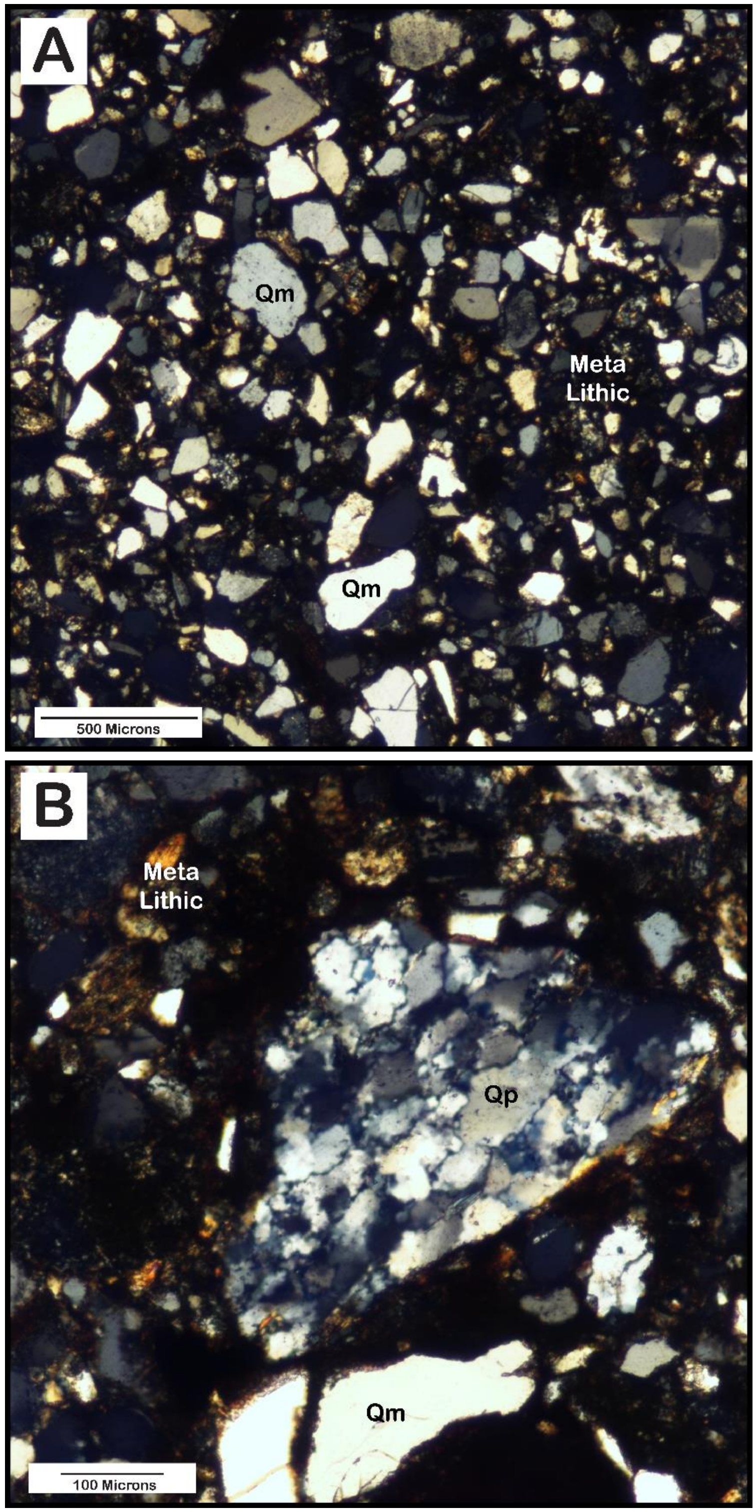


Figure 13: Photomicrograph in cross polarized illumination of Mississippian Stanley sample OK12-31 showing in the top image (A) an abundance of matrix/psuedomatrix along with monocrystalline quartz (Qm) and lithic components. The bottom image (B) shows polycrystalline quartz (Qp), matrix, and lithic components.

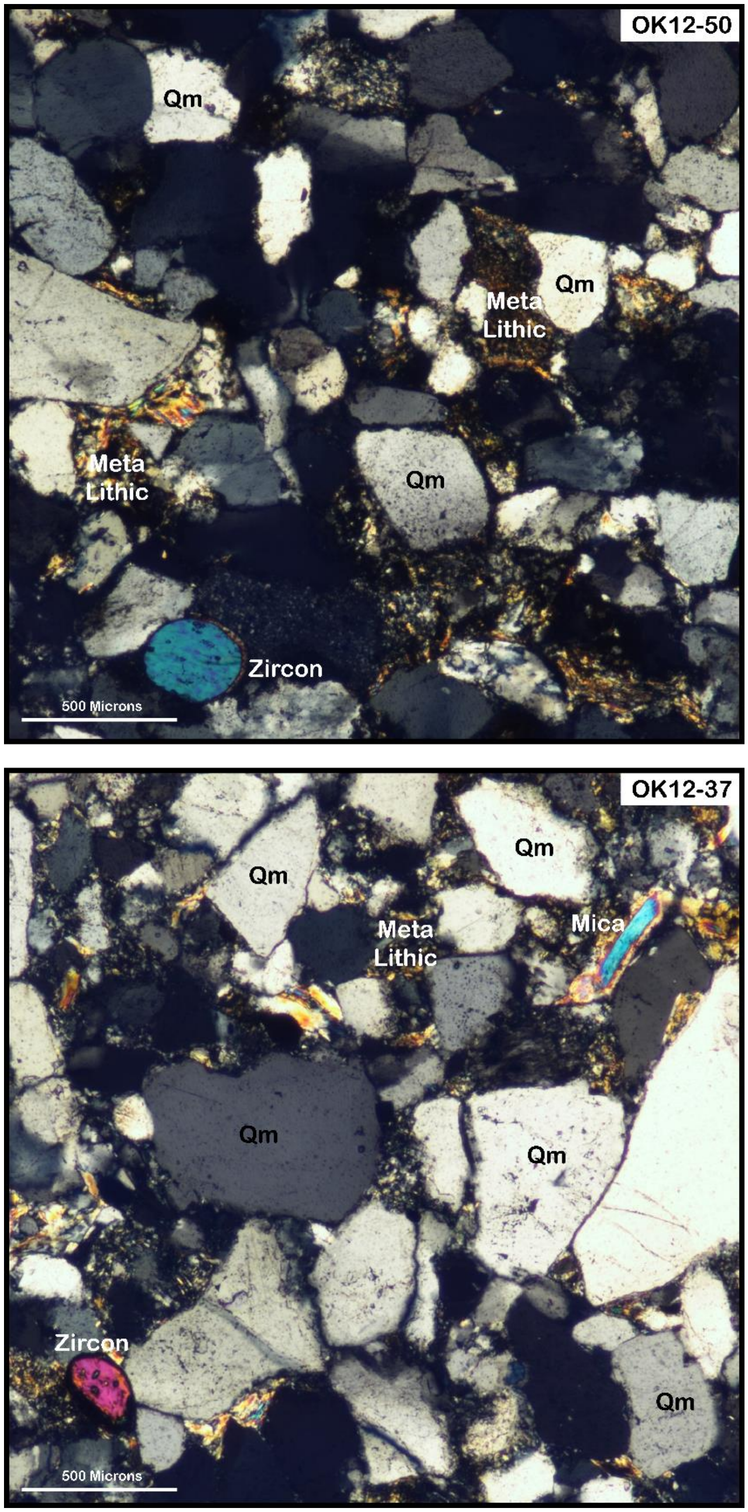


Figure 14: Photomicrograph of Pennsylvanian Jackfork samples OK12-50 and OK12-37. The samples show quartz dominated sandstones with minor metamorphic lithic components and presence of mica and zircons.

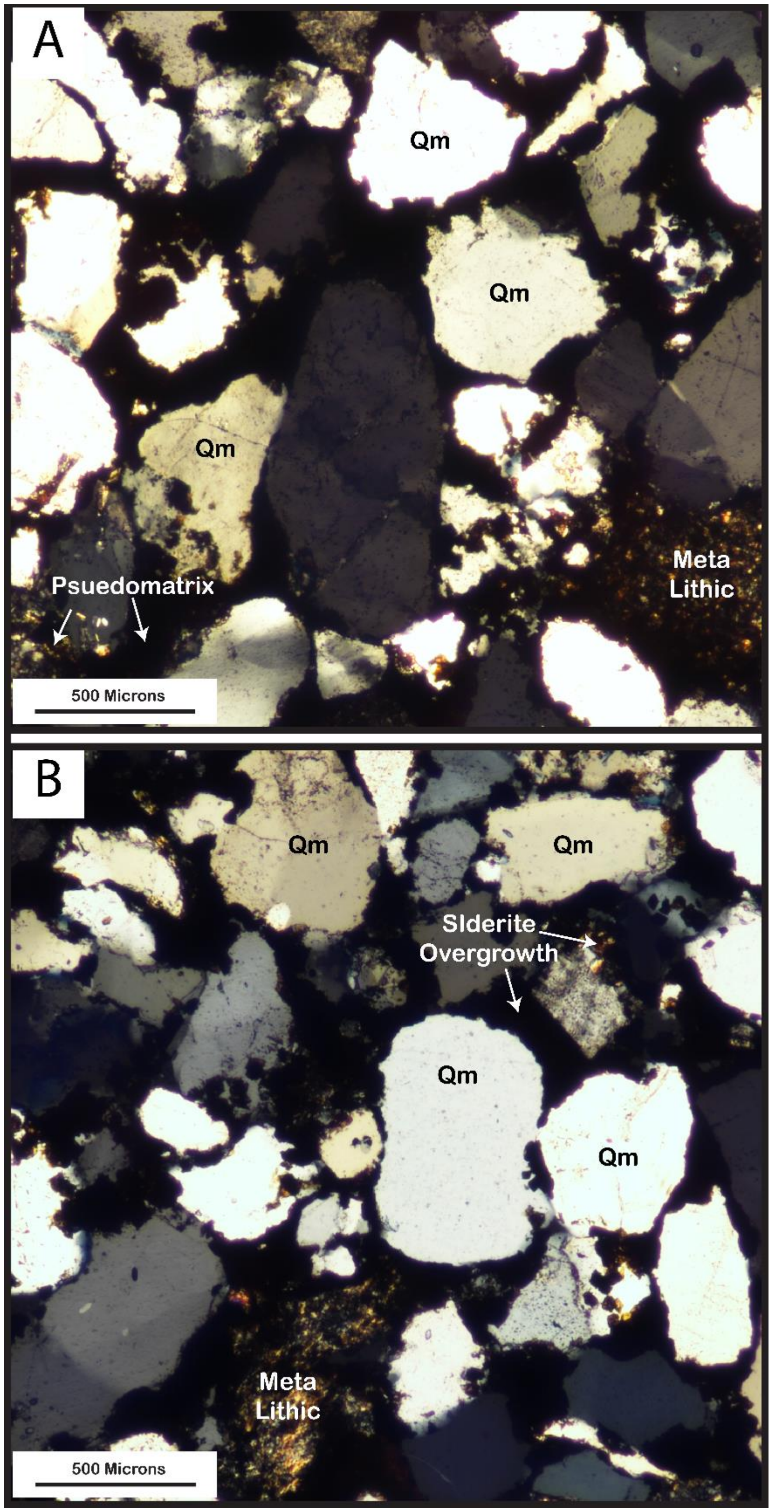


Figure 15: Photomicrograph of Pennsylvanian Atoka Formation sample OK12-45. The photomicrograph shows jagged grain boundaries with clay and siderite overgrowth and a significant psuedomatrix component.

Textural characteristics were observed for each of the Carboniferous sandstones in order to assess the overall maturity of the sandstone based on clay content, degree of sorting, degree of rounding, cement type, grain size, and grain boundary conditions (Table 1). Table 1 shows the summarized observations that were made for each thin section sample.

The Mississippian Stanley Group sandstones range from moderately sorted to poorly sorted and have the most clay percentage out of all the Ouachita-Arkoma samples. Grain sorting varies from well-rounded to sub-angular and range from 0.06 – 1 mm in size. Grain boundaries are represented by tangential boundaries and significant clay rim precipitants. Cementation is predominantly silica cement with minor iron-oxide cement.

Pennsylvanian Jackfork Group sandstones range from sub-rounded to sub-angular and have a low clay percentage. Jackfork samples are moderately to poorly sorted and grain sizes are between 0.08 – 0.6 mm. Multiple grain contacts are observed but represented mostly by line and sutured contacts. Silica cement makes up most of cementation with minor iron-oxide cement.

The Atoka Formation and Krebs Group sandstones range from sub-rounded to sub-angular and are low in clay percentage with the exception of the OK12-32 sample. Lower Atoka samples are poorly sorted, whereas upper Atoka and Krebs samples are moderate to well sorted. Grain sizes range from 0.05 – 1 mm and display a variety of grain boundaries. Silica cement dominates all samples but lower Atoka samples have minor iron-oxide cement.

	Sample	Clay %	Sorting	Rounding	Cement	Grain Size	Grain Boundaries
Pennslyvanian	**OK12-21 Krebs**	5-7%	Well sorted to moderately sorted	Sub-rounded	Silica	0.08 - 0.5 mm	Point + Line Contacts + Sutured Grains
	OK12-1 Atoka	5-10%	Moderately sorted	Sub-rounded to Sub-angular	Silica	0.05 - 0.3 mm	Tangential + Line + Sutured Grain Boundaries
	OK12-4 Atoka	5%	Moderately to well sorted	Sub-rounded to Sub-angular	Silica	0.05 - 0.6 mm	Concavo-Convex + Line Boundaries
	OK12-23 Atoka	2-5%	Moderately to well sorted	Sub-rounded	Silica	0.1 - 0.5 mm	Sutured Grain Boundaries + Qtz Overgrowth
	OK12-45 Atoka	10%	Moderately sorted	Sub-angular	Silica + Iron-Oxide	0.2 -0.7 mm	Sutured Grain Boundaries + Clay Overgrowth + Siderite
	OK12-32 Atoka	10-15%	Poorly sorted	Sub-rounded to Sub-angular	Silica + Iron-Oxide	0.1 - 0.8 mm	Point + Line Grain Contacts + Minor Clay Rim Precip.
	OK12-55 Atoka	5-10%	Poorly sorted	Sub-rounded	Silica + Iron-Oxide	0.08 - 1 mm	Concavo-Convex + Line Boundaries + Qtz Overgrowth
	OK12-50 Jackfork	5-10%	Moderately sorted	Sub-rounded to Sub-angular	Silica + Iron-Oxide	0.2 - 0.6 mm	Line + Sutured Boundaries + Point Contacts
	OK12-37 Jackfork	10%	Moderately to poorly sorted	Sub-rounded	Silica	0.1 - 0.6 mm	Line + Sutured + Concavo-Convex Grain Boundaries
Miss.	**OK12-31 Stanley**	20-25%	Poorly sorted	Sub-rounded to Sub-angular	Silica + Iron-Oxide	0.06 - 0.8 mm	Tangential Boundaries + Clay Rim Precip.
	OK12-63 Stanley	5-10%	Moderately sorted	Well rounded	Silica	0.3 - 1 mm	Point + Concavo-Convex + Qtz Overgrowth

Table 1: Textural characteristics and observations of Ouachita Carboniferous sandstones. Overall, textural characteristics and observations evaluate the maturity of the sandstones. Samples were highly variable in textural maturity but fell within the slightly mature to slightly immature range for common orogenic recycled sandstones.

Compositional analysis of the Carboniferous sandstones are represented in Table 2. The samples are arranged by stratigraphic group/formation based on depositional ages, ranging from the late Mississippian Stanley Group to the middle Pennsylvanian Krebs Group. The table shows the initial raw point counting data relative to each grain that was counted and then normalized compositions of Q_t-F-L and Q_m-F-Lt for construction of ternary diagrams using methods described by Dickinson et al. (1985) and Zahid and Barbeau (2011).

The compositions of all sandstones tend to be fairly consistent but do show minor changes in lithic types. The overall modal compositional average of all the Carboniferous Ouachita samples is $Qt_{70}F_{1}L_{29}$ and $Qm_{65}F_{1}L_{34}$. The Mississippian samples show staggering differences in their quartz and lithic abundances. For example, the OK12-31 sample demonstrates a 25% decrease in quartz composition compared to other Mississippian samples, while including a much larger metamorphic lithic component. The Mississippian Stanley Group average is $Qt_{70}F_{3}L_{27}$ and $Qm_{67}F_{3}L_{30}$. The transition from the Mississippian to the Pennsylvanian strata does not present a change in composition, as the average of the lowermost Pennsylvanian samples has averages of modal composition of $Qt_{70}F_{0}L_{30}$ and $Qm_{68}F_{0}L_{32}$.

Sample #	OK12-63	OK12-31	OK12-37	OK12-50	OK12-1	OK12-4	OK12-23	OK12-32	OK12-45	OK12-55	OK12-21		
Dep. Age	**Miss. Stanley**		**Penn. Jackfork**		**Penn. Atoka**						**Penn Krebs**		
Mono Qtz	418	421	500	432	353	272	841	368	458	521	555		
Poly Qtz	112	38	85	25	282	128	101	103	28	83	34		
Tect Qtz	25	0	2	1	12	1	28	0	0	0	0		
Plag. Feld	26	6	0	0	0	5	6	11	5	0	0		
K Feld	0	0	0	0	0	0	2	4	0	0	0		
Musc	2	7	15	7	11	2	11	4	6	4	9		
Bio	0	0	3	0	0	0	3		4	3	0		
Carb	0	0	0	0	0	0	0	0	0	0	0		
Chert	23	1	1	6	2	16	15	1	0	4	0		
Ign LF	0	0	0	0	0	0	0	0	0	0	0		
Meta LF	14	216	91	166	103	82	70	121	224	78	52		
Sed LF	71	121	141	40	144	106	191	204	121	73	202		
Zircon	3	0	2	1	0	2	3	0	0	1	0		
Garnet	1	0	1	0	0	0	0	0	0	0	0		
Opaque	0	0	1	0	0	22	0	9	0	0	0		
Total	695	810	842	678	907	636	1271	825	846	767	852		
QFL												Ave.	StDev
Qt%	83%	57%	72%	69%	72%	68%	78%	58%	58%	80%	70%	70%	9%
F%	4%	1%	0%	0%	0%	1%	1%	2%	1%	0%	0%	1%	1%
Lt%	13%	42%	28%	31%	28%	32%	21%	40%	41%	20%	30%	30%	9%
Qm%	79%	55%	68%	68%	59%	58%	76%	52%	57%	78%	69%	65%	10%
F%	5%	1%	0%	0%	0%	1%	1%	2%	1%	0%	0%	1%	1%
Lt%	16%	44%	32%	32%	41%	40%	24%	46%	43%	22%	31%	34%	10%

Table 2: Modal mineralogy point counting data of Ouachita Carboniferous sandstones. Abbreviations are as follows: Mono – Monocrystalline, Poly – Polycrystalline, Tect – Tectonic, Plag – Plagioclase, Feld, F – Feldspar, K – Potassium, Musc – Muscovite, Bio – Biotite, Carb – Carbonate, Ign – Igneous, Meta – Metamorphic, Sed – Sedimentary, Qtz – Quartz, Qt – Total Quartz, Lt – Total Lithics, Qm – Monocrystalline Quartz, Ave – Average, StDev – Standard Deviation.

The Pennsylvanian Jackfork samples provide roughly the same modal mineralogy with similar minor changes of lithic type. Feldspar is notably absent within the point counting data for the Pennsylvanian Jackfork samples. The Pennsylvanian Atoka Formation samples have an average modal composition of $Qt_{69}F_{1}L_{30}$ and $Qm_{63}F_{1}L_{36}$. The Atoka samples vary from 58% to 80% but follow a trend of a 70% average of quartz throughout all the Carboniferous samples. The sample from the Middle Pennsylvanian Krebs Group, of the youngest depositional age in this study, has similar modal compositions of $Qt_{70}F_{0}L_{30}$ and $Qm_{69}F_{0}L_{31}$. The Carboniferous sandstones consistently contain less than 4% feldspar and more than 57% quartz.

The sandstone compositional data are shown in the ternary plots of Figure 16. The top two ternary plots (Figure 16a, 16b) present the normalized Qt-F-L and Qm-F-Lt compositions as they relate to provenance and the bottom (Figure 16c) ternary plot from (Folk, 1980) shows the data with respect to sandstone compositional fields. The Qt-F-L data are all within the recycled orogenic field along the Qt-L binary line with little to no feldspar indicated by the point counting data. The Qm-F-L plot shows the same trend along the Qm-L binary line but with two clusters, a recycled orogenic more quartz rich group, and a transitional recycled lithic abundant group. A majority of the present study sandstones are sublitharenites to litharenites based on the ternary plot of Folk (1980; Figure 16c).

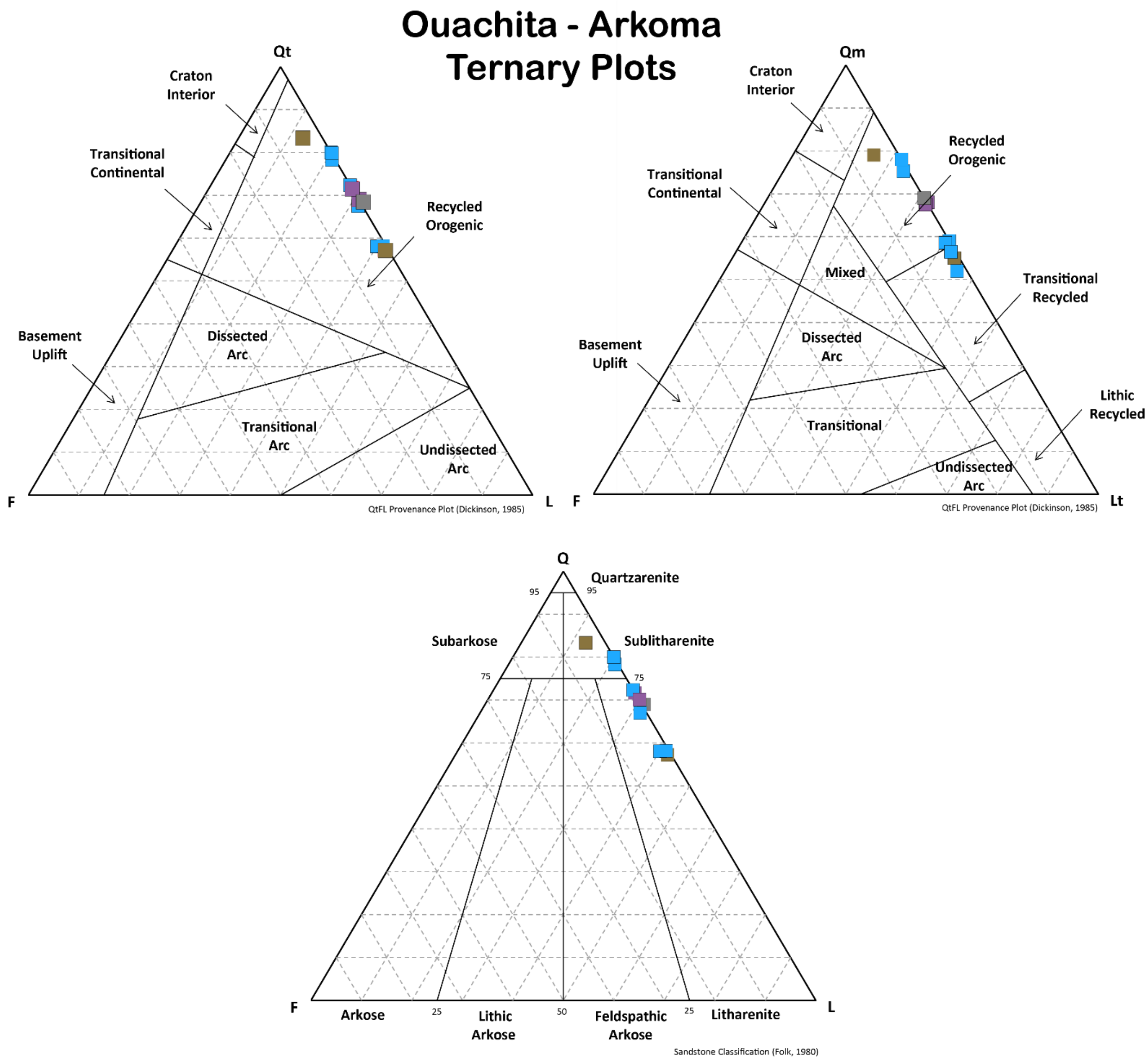


Figure 13: Ouachita-Arkoma QtFL (A), QmFLt (B), and QFL (C) ternary plots. The samples show a recycled orogenic compositional field that splits into two groups along the quartzolithic binary line. The samples are comprised of sublitharenites and litharenite compositions depicted by the QFL diagram after Folk (1980). Tan – Mississippian Stanley Group, Purple – Pennsylvanian Jackfork Group, Blue – Pennsylvanian Atoka Formation, and Grey – Pennsylvanian Krebs Group.

Microprobe Analysis

Representative compositional maps of Pennsylvanian Atoka sandstones were obtained using stage and beam rasters along with back scattered electron imaging. Elemental maps were made with WDS detectors, for aluminum, iron, potassium, and sodium. The high-resolution compositional maps (Figures 17, 18, 19, and 20) show the abundance of lithic fragments, matrix and pseudo-maxtrix, along with the mineral and cement compositions that make up these Carboniferous Atoka sandstones.

The OK12-23 sample represented in Figure 17, is a quartz dominated sandstone with minor amounts of clay content and lithic fragments. The compositional map shows a minor component of aluminum and potassium constituents and a depletion in iron and sodium rich minerals. A lack of sodium rich minerals signifies the low albitic plagioclase feldspar content of this sandstone, and the absence of iron rich components are taken to indicate little Fe-rich clay or hematitic cement. Higher contents of aluminum and potassium are compatible with metamorphic source areas contributing micas and metamorphic lithics into the sandstone. The greater potassium content is attributed to mica-rich fragments that make up a secondary component of the total composition. Overall, the OK12-23 sample displays a silica dominated sandstone with minor metamorphic lithic fragments and minor clays.

The OK12-32 sample represented in Figure 18, is a quartz-rich sandstone with a significant sedimentary and metamorphic lithic fragment component. The compositional map shows a wealth of aluminum, potassium, iron, and sodium content. The existence of higher sodium and iron content represents an increase in clay content from the OK12-23 sample.

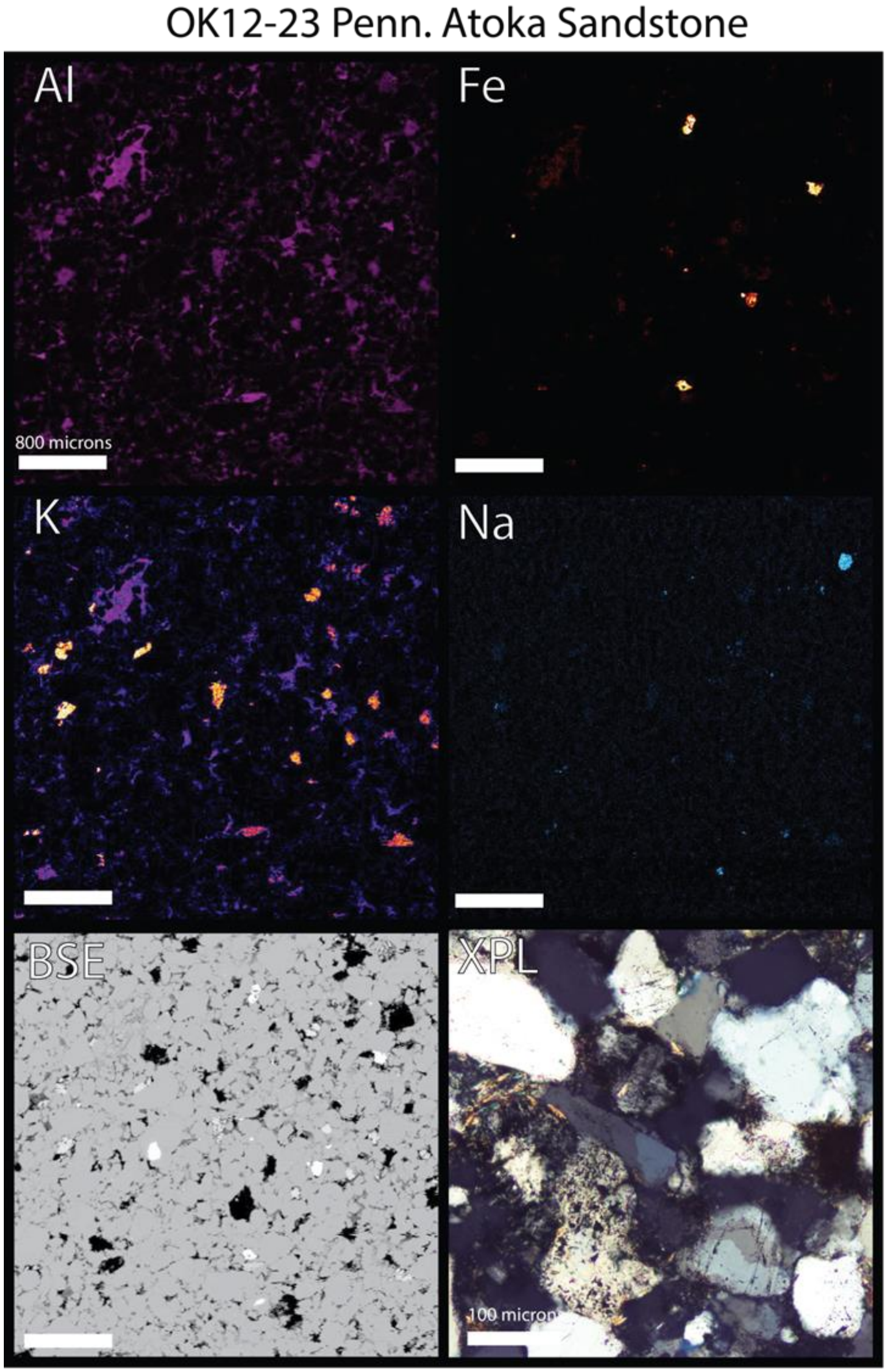


Figure 14: High resolution compositional map of Pennsylvanian Atoka sandstone (OK12-23). Compositional maps analyzed for Al -Aluminum, Fe – Iron, K – Potassium, Na – Sodium, and BSE – Back Scattered Electron images. XPL – is a representative thin section image in cross polars showing monocrystalline quartz and metamorphic lithic fragments.

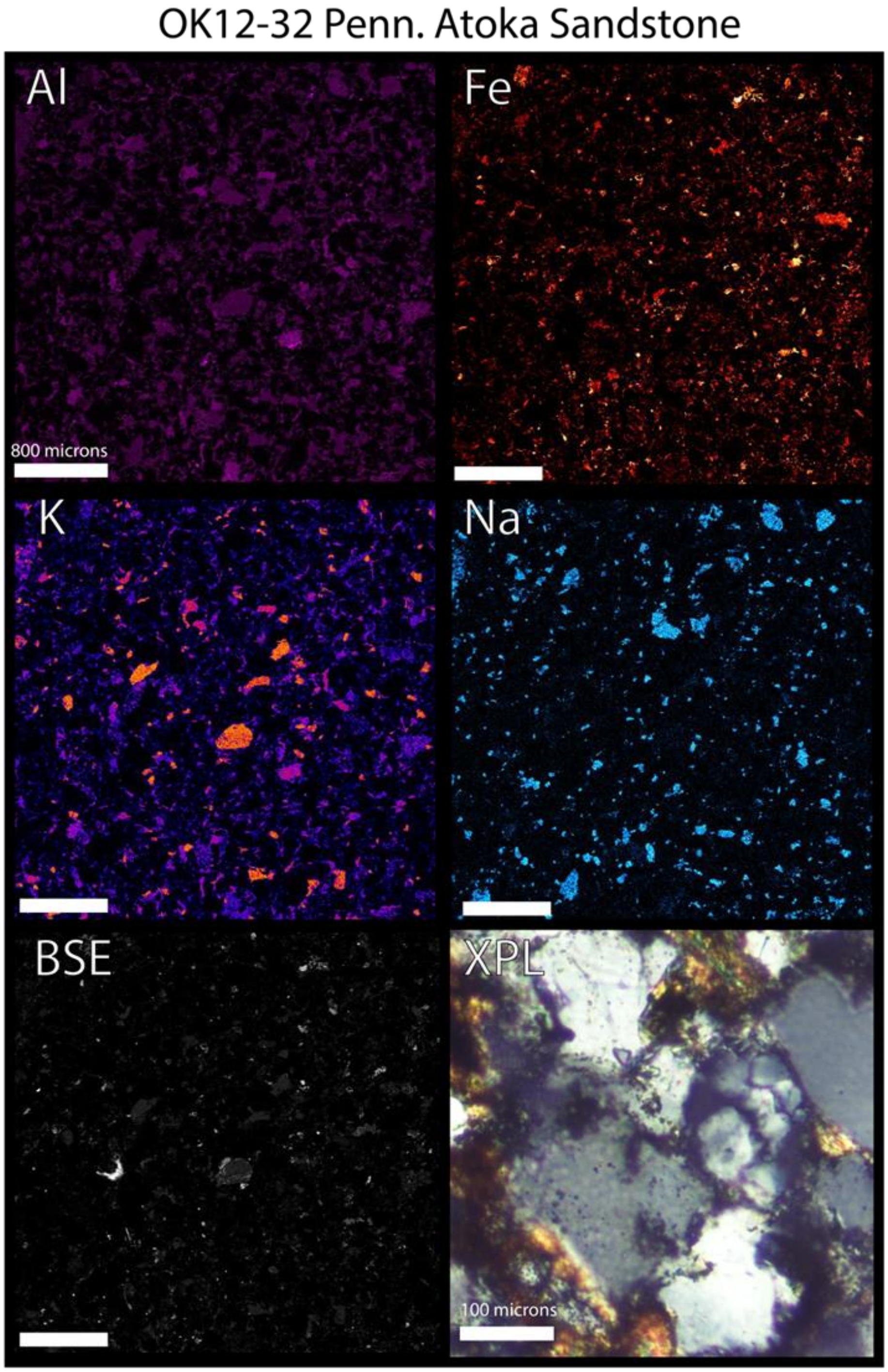


Figure 18: High resolution compositional map of Pennsylvanian Atoka sandstone (OK12-32). Compositional maps analyzed for Al -Aluminum, Fe – Iron, K – Potassium, Na – Sodium, and BSE – Back Scattered Electron images. XPL – is a representative thin section image in cross polars showing monocrystalline quartz and metamorphic lithic fragments.

The abundance of potassium rich fragments and clay content suggests an illite clay composition within the OK12-32 sample. The sodium content can also be attributed to the clay component as smectite clay, possible sodium montmorillonite, and low feldspar contents. The aluminum and potassium contents are characteristic of the metamorphic lithic fragments and mica compositions that exist in the sandstone. Overall, the OK12-32 sandstone is primarily composed of quartz and lithic fragments but shows a substantial mixed clay component.

The OK12-1 Atoka sample represented in Figure 19, is a finer grained quartz-rich sandstone with an abundance of aluminum, potassium, iron, and sodium minerals and lithic fragments. The lithic fragments are micaceous and have higher concentrations of potassium and aluminum on the compositional maps. Illite and smectite clays fill preexisting pore spaces. The iron-oxides appear concentrated in matrix and are attributed to diagenetic siderite formed from alteration of metamorphic lithic fragments. The OK12-1 sample is a quartz dominated sandstone with a considerable lithic fragment component that contributed to the existence of diagenetic siderite and clay-rich components.

The OK12-4 Atoka sample represented in Figure 20, is another fine-grained sandstone with an abundance of aluminum, potassium, iron, and sodium. The compositional map displays a significant iron component that indicates potential iron-oxide cementation and the existence of diagenetic siderite. The increase in iron composition suggests early diagenesis forming larger siderite grains from the iron precipitation of existing iron-rich lithic fragments. The significant siderite composition is characteristic of deeper water deposition of the sandstone (Morris et al., 1979).

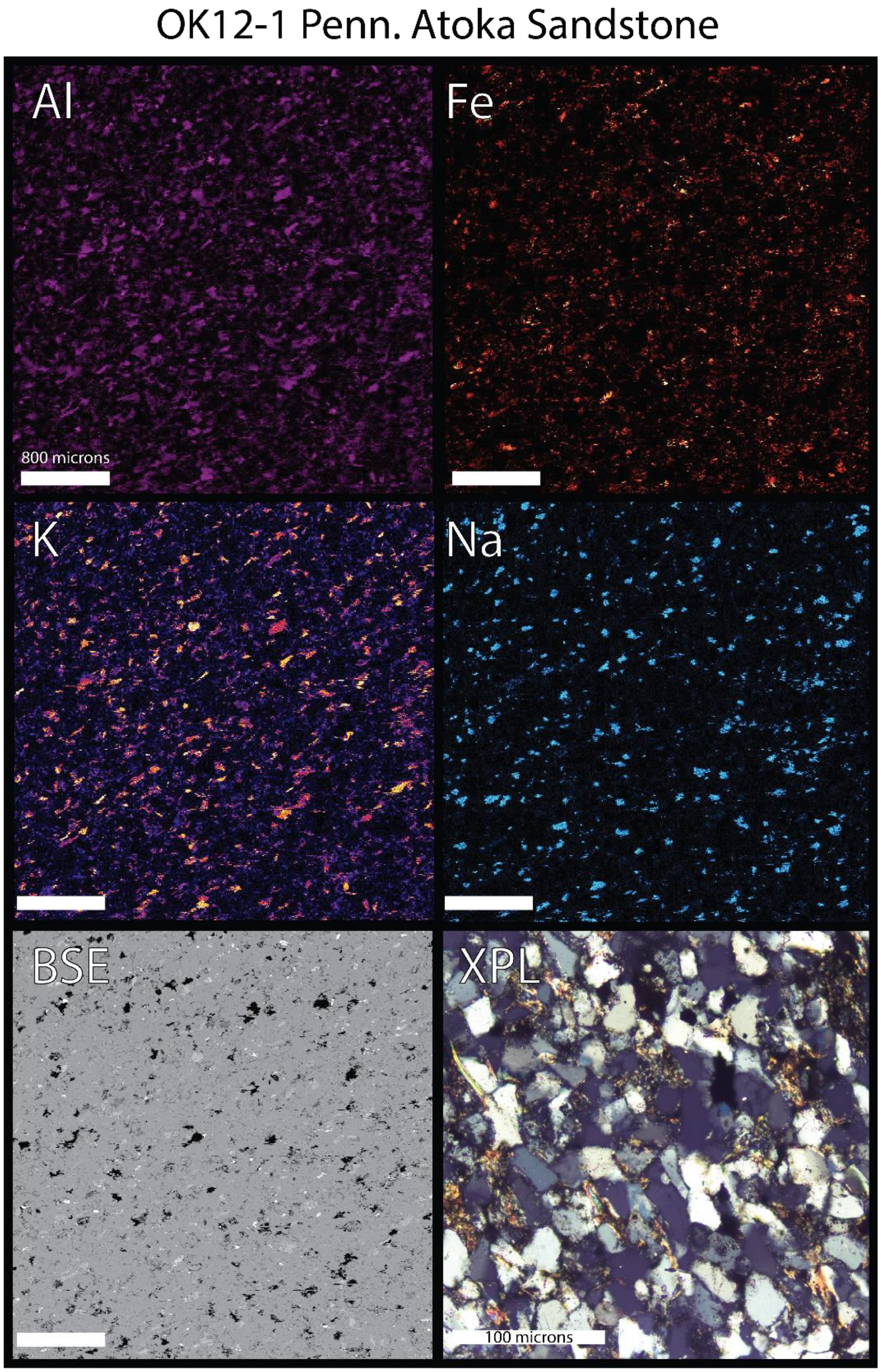


Figure 19: High resolution compositional map of Pennsylvanian Atoka sandstone (OK12-1). Compositional maps analyzed for Al -Aluminum, Fe – Iron, K – Potassium, Na – Sodium, and BSE – Back Scattered Electron images. XPL – is a representative thin section image in cross polars showing monocrystalline quartz and metamorphic lithic fragments.

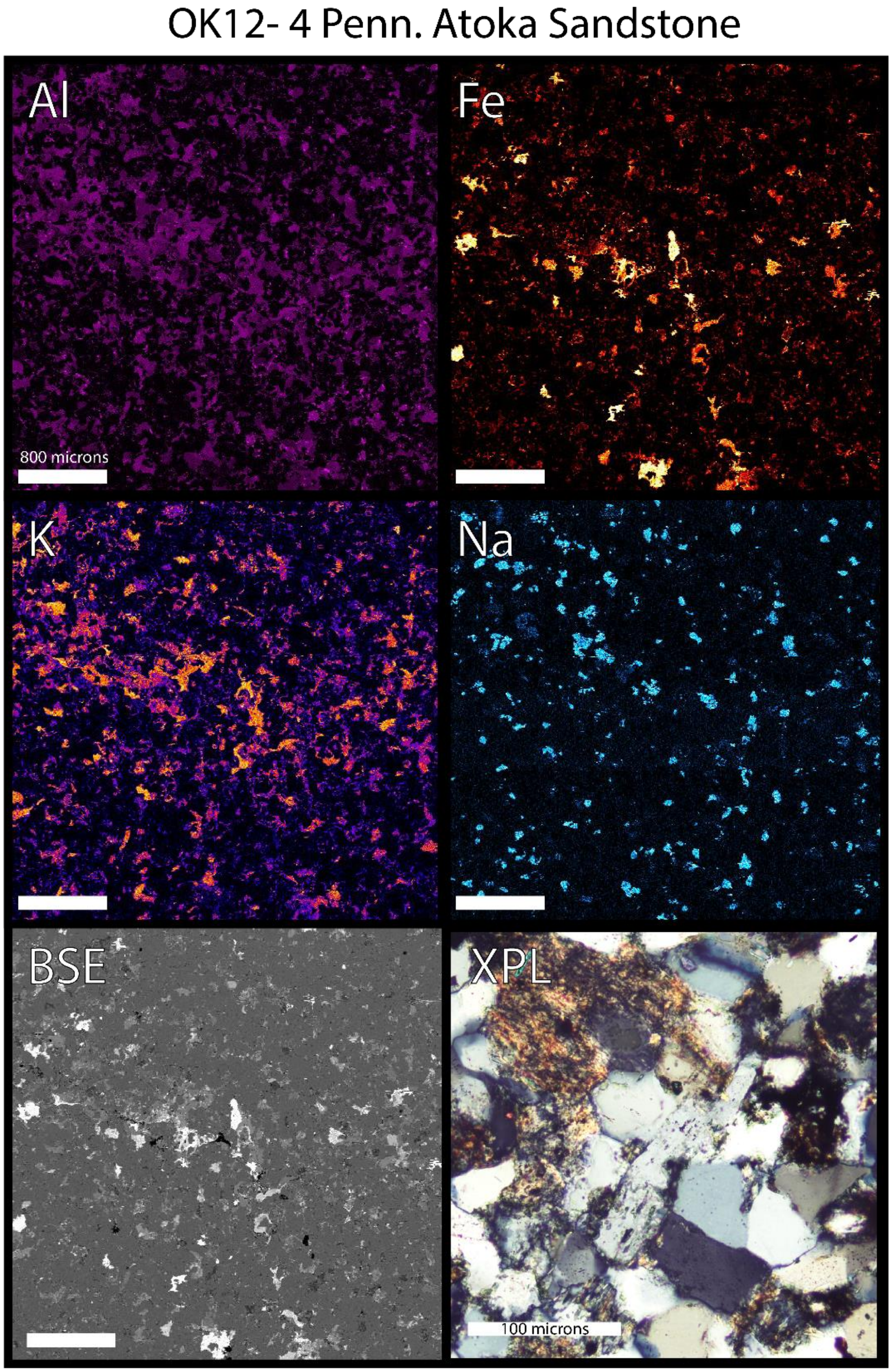


Figure 20: High resolution compositional map of Pennsylvanian Atoka sandstone (OK12-4). Compositional maps analyzed for Al -Aluminum, Fe – Iron, K – Potassium, Na – Sodium, and BSE – Back Scattered Electron images. XPL – is a representative thin section image in cross polars showing monocrystalline quartz and metamorphic lithic fragments.

The sample also shows a considerable amount of micaceous rich lithic fragments and recycled silica rich sedimentary lithics. Overall, the OK12-4 sample is a quartz dominated sand with micaceous lithics and a noticeable siderite component.

High resolution compositional maps were used on a finer scale to examine the chemical composition of the lithic fragments in order to determine lithic type and possible source rock metamorphic grade based on composition. The Pennsylvanian Atoka sample OK12-1 (Figure 19) was further examined by analyzing the lithic fragments represented by Figure 21. The compositional maps of the OK12-1 lithic fragment show a high aluminum and potassium content and lesser iron and sodium contents. The lithic fragment is micaceous and appears to be a low grade metamorphic lithic fragment. The BSE image exhibits thin slivers of high contrast inclusions rich in Fe (and perhaps also Ti). These slivers are composed of titanium-oxide and iron titanium-oxide that exhibit a flowing pattern within the metamorphic lithic.

Overall, the microprobe analysis of the Carboniferous sandstones aid and contribute to the modal mineralogy and petrology work by providing a finer scale look into compositions that cannot be achieved through petrographic point counting. For example, the WDS maps of Atoka sandstone OK12-1 indicate a significant proportion of albitic plagioclase crystals, that were not detected by point counting. The albitic composition can be linked to source terranes as potash feldspars are not removed by chemical weathering (Middleton, 1972). The WDS maps also highlight a correspondence between samples rich in Al and Na, indicating a link to a more significant plagioclase composition that is not represented in the point counting data. The finer composition evaluation using the microprobe allows for a more meticulous assessment of clay content, clay composition, and textural and metalogical details of lithic fragments.

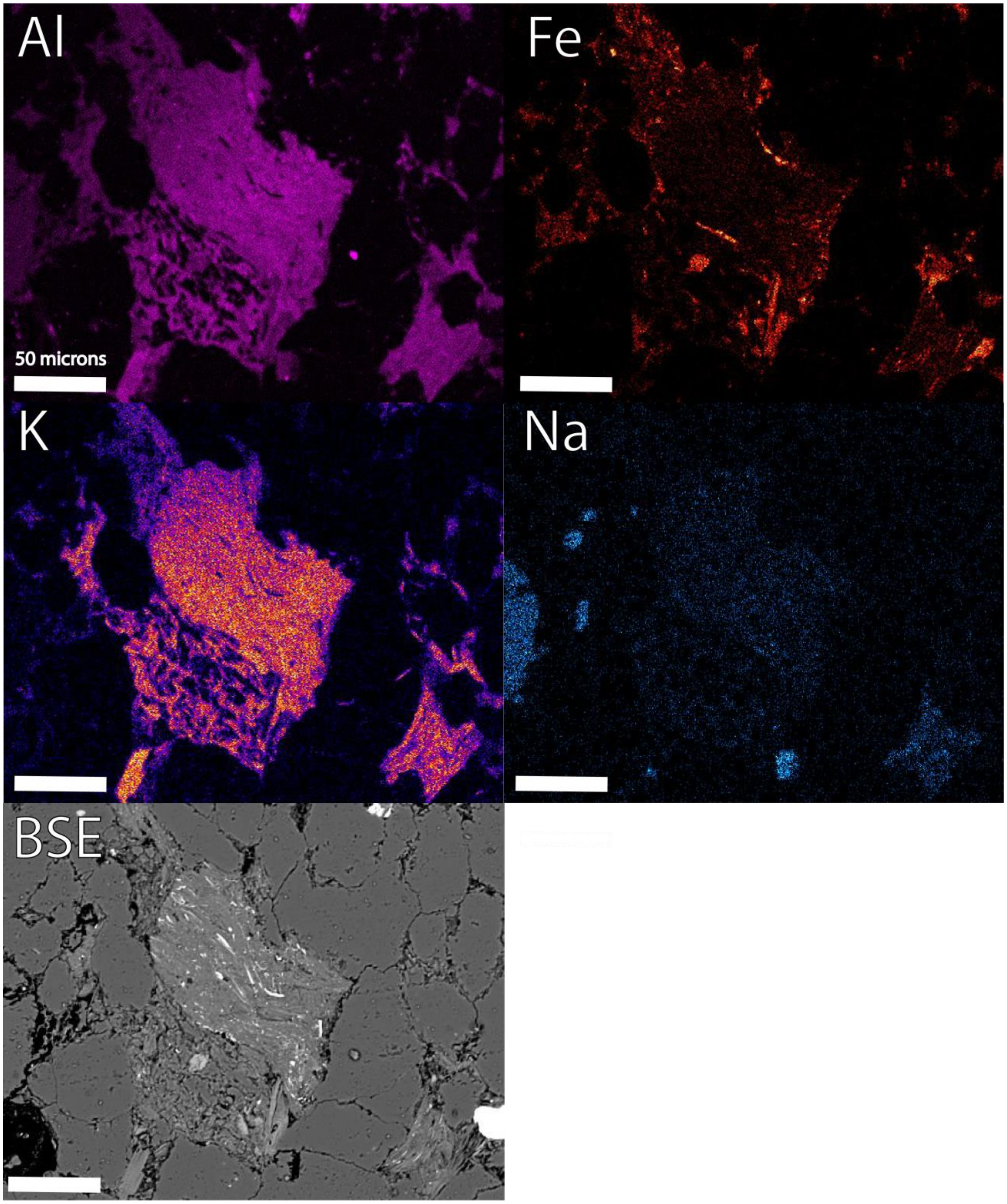


Figure 21: High resolution compositional map of a lithic fragment within the Pennsylvanian Atoka OK12-1 sample. Compositional maps analyzed for Al -Aluminum, Fe – Iron, K – Potassium, Na – Sodium, and BSE – Back Scattered Electron images. Thin crystals with high brightness in the BSE image and high Fe, are interpreted to be ilmenite.

Detrital Muscovite Analysis

$^{40}Ar/^{39}Ar$ detrital muscovite geochronology was performed on fourteen Carboniferous sandstones from the deep-water Ouachita Basin section and the Arkoma foreland basin (as represented by the map and stratigraphy of Figures 8 and 9, respectively). The fourteen sandstone samples consist of three Mississippian Stanley Group samples, four Pennsylvanian Jackfork Group samples, six Pennsylvanian Atoka Formation samples, and one Pennsylvanian Krebs Group sample. Two of these samples were analyzed using both detrital muscovite and detrital zircon geochronology techniques (Johnson et al., 2016; Thompson et al., 2017; Thompson et al., 2018; and ongoing dissertation research of H. Johnson), one from the Mississippian Stanley Group (OK12-54) and one from the Pennsylvanian Jackfork Group (OK12-39). These samples are represented in the present research by 1,515 new detrital muscovite grain ages: for the Mississippian Stanley Group n = 327, Pennsylvanian Jackfork Group n = 426, Pennsylvanian Atoka Formation n = 650, and Pennsylvanian Krebs Group n = 112.

Mississippian Stanley Group

The Mississippian Stanley Group samples are displayed in Figure 22 by probability density plots. The Mississippian Stanley Group is represented by three (N=3) sandstone samples labeled as OK12-54, OK12-31, and OK12-63. These Mississippian sandstones contain a significant amount of muscovite grain ages in the 540 Ma to 465 Ma range. The OK12-54 sample provides the oldest ages with 40% of grains older than 465 Ma. The OK12-54 sample presents three modes at ca. 440 Ma, 465 Ma, and 487 Ma. The OK12-63 sample shows the youngest ages of the Mississippian suite with two dominant modes of 385 Ma and 372 Ma.

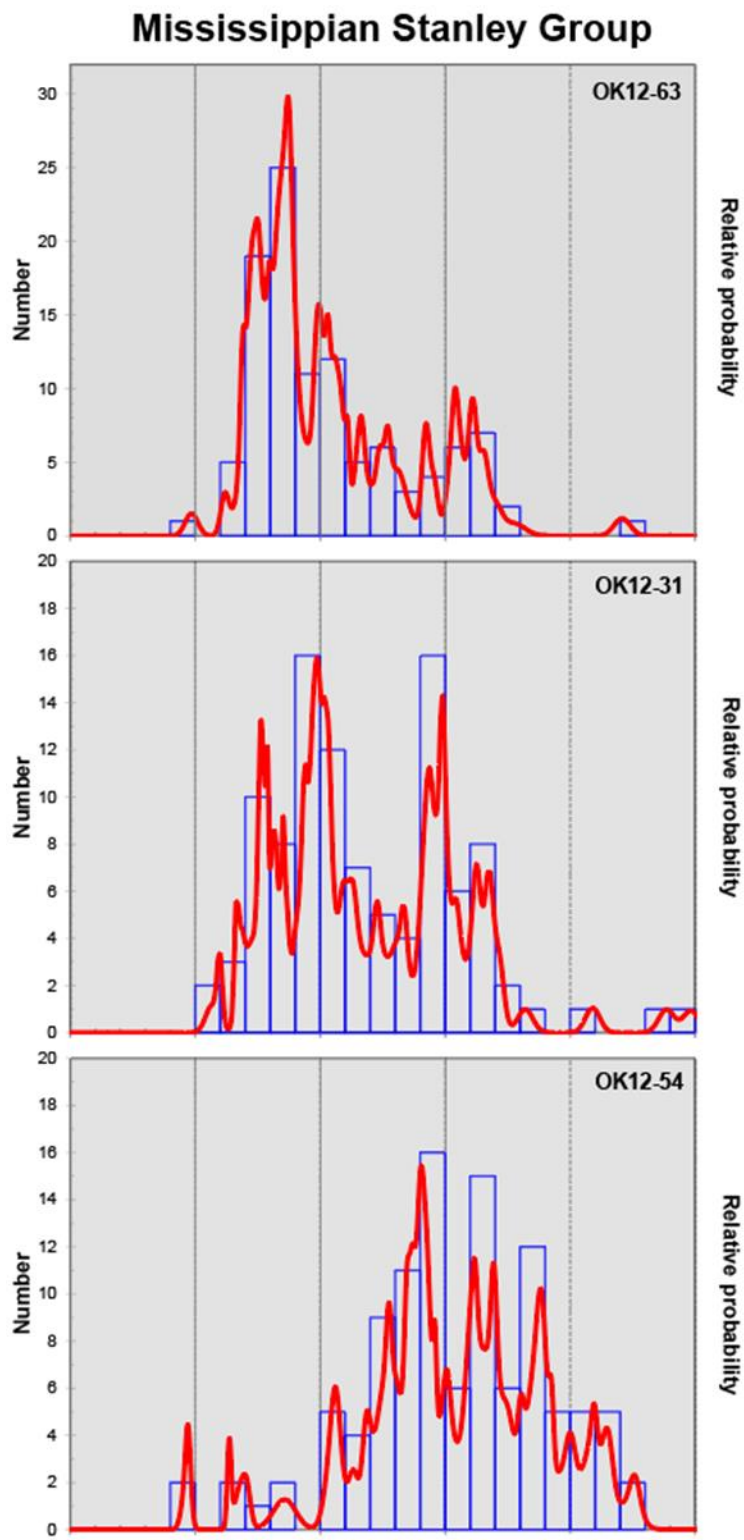


Figure 22: Probability Density Plot of Mississippian Stanley detrital muscovite samples.

A lesser Devonian mode is observed at ca. 400 Ma in sample OK12-63, though such ages are more abundant in OK12-31. The most abundant age range for the OK12-63 sample is from 465 Ma to 435 Ma followed by the 420 Ma to 380 Ma range. The OK12-31 sample delivers a wide range of muscovite ages with 2 % of the sample being Paleoproterozoic in age and 14% of the ages are Early to Middle Devonian time range. The OK12-31 sample is split up into two broad ranges with modes at ca. 446 Ma, 399 Ma, and 378 Ma. 40% of the ages for OK12-31 are in the 420 Ma to 380 Ma Devonian age range. The largest Mississippian cluster is found from 420 Ma to 380 Ma at ca. 33% of all detrital grain ages. Two sub-ordinate population zones are found between 465 Ma to 435 Ma and 380 Ma to 340 Ma. Roughly 3% of all Mississippian grains are Neoproterozoic in age.

Pennsylvanian Jackfork Group

The Pennsylvanian Jackfork Group samples are displayed in Figure 23 by probability density plots. The Pennsylvanian Jackfork Group is represented by four (N=4) sandstone samples labeled as OK12-37, OK12-39, OK12-56, and OK12-50. The OK12-50 sample contains a prominent age peak at ca. 452 Ma and two subordinate peaks of 397 Ma and 364 Ma. Much like the OK12-50 sample, the OK12-56 sample is dominated by a 453 Ma mode and two secondary modes at 400 Ma and 377 Ma respectively. The OK12-56 sample contains a noticeable 5% of grains in the younger 340 Ma to 300 Ma age range. The 340 Ma to 300 Ma range only comprises 1% of all Ouachita detrital muscovite and a substantial amount of those grain ages (ca. 5) are found in the OK12-56 sample. The OK12-37 sample has three relatively even peaks at 451 Ma, 400 Ma, and 377 Ma. The age range from 420 Ma to 380 Ma contains 41% of the detrital muscovite ages in the OK12-37 sample. The OK12-39 sample expresses the

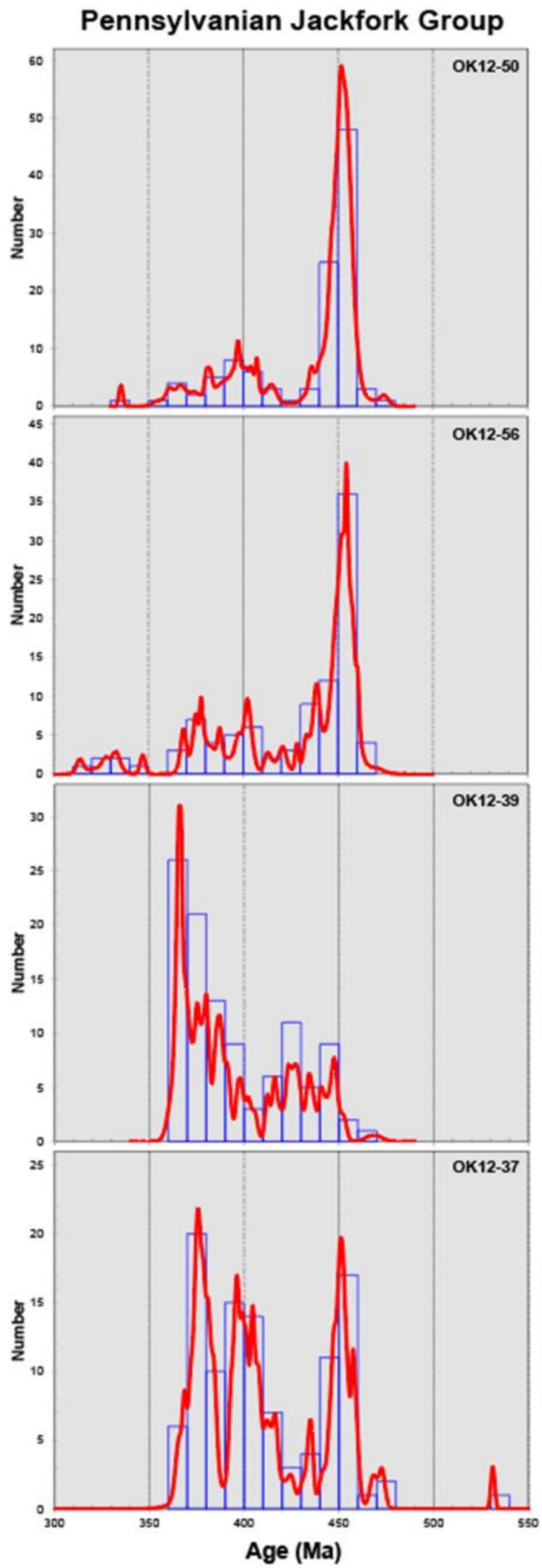


Figure 23: Probability Density Plot of Pennsylvanian Jackfork Group detrital muscovite samples.

youngest peak of the Jackfork samples with 44% of its grain ages falling in the 380 Ma to 340 Ma age range. The prominent age peak for this sample is at ca. 367 Ma trailed by secondary peaks at 425 Ma and 444 Ma. The Pennsylvanian Jackfork muscovite ages have less range than observed for the Mississippian Stanley samples, with only two grains older than 500 Ma and no grains older than 730 Ma. The greatest age cluster is from 465 Ma to 435 Ma and composes ca. 42% of the Jackfork grains. Two secondary age ranges are found to be 420 Ma to 380 Ma and 380 Ma to 340 Ma. The dominant age range is largely influenced by the OK12-50 and OK12-56 samples, which show 60% and 69% of their overall muscovite grain ages to be within the 465 Ma to 435 Ma age range.

Pennsylvanian Atoka Formation

The Pennsylvanian Atoka Formation detrital ages are represented in Figure 24 by probability density plots. Atoka Formation samples are represented by six (N=6) sandstone samples labeled as OK12-55, OK12-32, OK12-45, OK12-23, OK12-4, and OK12-1. The OK12-55 sample shows a dominant ca. 451 Ma mode with secondary modes at ca. 405 Ma and ca. 382 Ma. This sample also displays 3% of its total grains as Neoproterozoic in age. The OK12-32 sample is dominated by ages within the range of 465 Ma to 435 Ma, which makes up over 70% of the samples total grain ages. Minor peaks at ca. 404 Ma and ca. 365 Ma are also observed. The OK12-45 sample follows suit with a primary peak age at ca. 453 Ma due to 67% of its grain ages being within the 465 Ma to 435 Ma range. The OK12-23 sample displays two modes at ca. 449 Ma and ca. 397 Ma along with a minor Silurian (435 Ma to 420 Ma) cluster of seven grains. The OK12-4 and OK12-1 samples are similar with prominent ages falling in the 420 Ma to 380 Ma age range and a secondary cluster in the 380 Ma to 340 Ma age range.

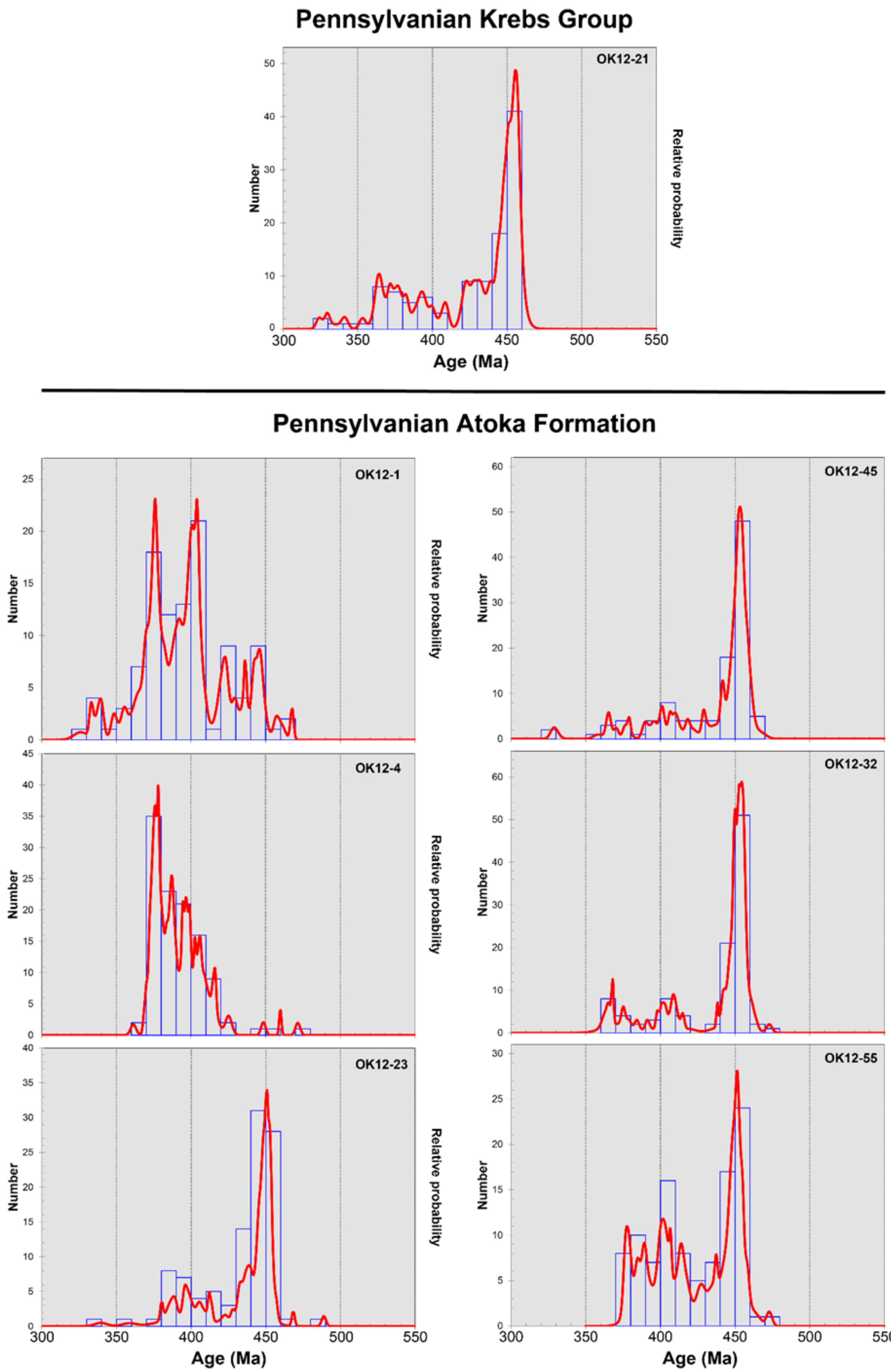


Figure 24: Probability Density Plots of Pennsylvanian Atoka Formation and Pennsylvanian Krebs Group detrital muscovite samples. Lower most Atoka samples on right side of figure.

The OK12-1 sample has two dominant peaks at ca. 400 Ma and ca. 375 Ma with secondary modes of ca. 424 Ma and ca. 444 Ma. The OK12-4 sample highlights two dominant peaks at ca. 397 Ma and ca. 377 Ma. The overall Pennsylvanian Atoka signature is characteristic of the 465 Ma to 435 Ma age range with samples OK12-1 and OK12-4 being the exception. These two samples show a dominant age range of 420 Ma to 380 Ma. The prominent Atokan age mode for all samples is ca. 444 Ma to 454 Ma with subordinate modes observed at ca. 400 Ma and 375 Ma.

Pennsylvanian Krebs Group

The Pennsylvanian Krebs Group sample is represented by one (N=1) sandstone sample labeled as OK12-21 (Figure 24). The Pennsylvanian Krebs Group detrital muscovite signature is dominated by the 465 Ma to 435 Ma age range, which comprises 57% of all the samples detrital ages. Three modes are observed, the primary ca. 454 Ma mode and two secondary modes at ca. 430 Ma and 371 Ma respectively.

Collectively the detrital muscovite grain ages for the Ouachita-Arkoma samples show a dominant Late Ordovician mode followed by two consistent subordinate Devonian modes. Also, grains younger than ca. 340 Ma are rare (only 5) were detected in the detrital muscovite data from the Ouachita region. Lastly, a slight age shift is observed over the Mississippian-Pennsylvanian boundary that records a slightly older and more distributed age range for the Mississippian samples, whereas the Pennsylvanian Jackfork and Atoka samples show a dominant ca. 450 Ma mode followed by two lesser Devonian aged modes and few grains older than ca. 465 Ma.

Chapter VI: Discussion

Sandstone Compositional Analysis Based on Petrography and Microprobe Analysis

The turbidite sequences of the Mississippian Stanley are composed of quartz and lithic fragments deposited in submarine fans, abyssal plains, and slumped margins within a remnant ocean basin. The modal compositions are consistent with sandstones composed of sediment shed from a closing suture belt and transported by longitudinal drainage adjacent to developing orogenic highlands (Graham et al., 1976). The OK12-31 sample provides a significant amount of psuedomatrix (deformed lithic fragments) between grains and distinguished by rigid grain boundaries (Figure 13). The abundance of psuedomatrix corresponds to the abundance of lithic fragments in the sample. The OK12-63 sample is quartz dominated with a significant chert component, which is also characteristic of recycled orogenic sediment deposited in a deep marine fan complex.

The Pennsylvanian Jackfork samples are the most texturally and compositionally mature sandstones of this study and contain roughly 70% monocrystalline quartz composition (Figure 14). The minor sedimentary and metasedimentary lithics of the Jackfork samples are predominantly polycrystalline mica, tectonites (grains containing deformed quartz and mica), and metamorphic rock fragments including phyllite. The quartzolithic composition and lithic types are characteristic of recycled orogenic provinces and marginal marine deposition

(Dickinson, 1985). Individual grains are typically sub-rounded with line, sutured, and concavo-convex grain boundaries. The overall textural maturity suggests the Jackfork sediment was transported from orogenic highlands to remnant ocean basin via longitudinal dispersal systems running lengthwise perpendicular to the emerging Appalachian orogenic front.

The Pennsylvanian Atoka Formation samples and the Krebs Group sample are made up of quartzolithic composition characterized by quartz-mica tectonites, polycrystalline mica, and an abundance of phyllite fragments. The northern Arkoma Basin samples (OK12-1, OK12-4) have an increased content of polycrystalline quartz. The composition consistency can be attributed to a rapid sediment influx of sediment transported during the early to middle Pennsylvanian from extensive erosional events in the Appalachians. However, the textural maturity varies greatly throughout the Atoka samples. The sands range from poorly to well sorted and sub-angular to sub-rounded. The OK12-45 sample shows rigid grain boundaries with abundant psuedomatrix and clay mineral overgrowth (siderite) surrounding the monocrystalline quartz boundaries (Figure 15).

Compositional maps of the Atoka sandstones (Figure 17, 18, 19 and 20) show they have a high aluminum and potassium content. The high aluminum and potassium compositions are attributed to an abundance of metamorphic lithics found in the samples and suggest a recycled orogenic source with a significant low-grade metamorphic component. The high iron content of most Atokan samples is associated with the samples’ clay matrix and psuedomatrix components. The psuedomatrix components and higher iron content samples are rich in metamorphic lithic fragments that have deformed and precipitated-out iron making up the psuedomatrix along grain boundaries. High-resolution compositional maps of a lithic fragment in the Atoka sample OK12-1 are high in aluminum and potassium components. The high aluminum and potassium totals suggest lithic fragments are from low grade metamorphic sources. Presence of sodium and iron in the compositional maps signifies the chemical weathering products of sodic plagioclase grains based on regional paleoclimate and paleoweathering conditions (Fedo et al., 1997). The evidence of sodium in the Ouachita sandstone composition indicates the plagioclase-rich nature of the initial source terranes. Varying global glacial cycles influence the perseveration of minerals susceptible to chemical weathering. However, the indication of chemically weathered feldspar grains in the Ouachita-Arkoma data suggest a period of fairly warm climate causing an increase in weathering for the early to middle Pennsylvanian sandstones (Fedo et al., 1997). During the time of sediment delivery and deposition, the warm climatic conditions are attributed to the proximity of the basin and dispersal systems to the equator.

Modal analysis of the Carboniferous sandstones from the Ouachita-Arkoma Basins yield an average modal composition of $Qt_{70}F_{1}L_{29}$ and $Qm_{67}F_{3}L_{30}$, characteristic of recycled orogenic sediment sources as defined by Dickinson and Suczek (1979). The compositional fields represented in the Ouachita-Arkoma samples are largely quartz dominated with significant metamorphic and sedimentary lithic components interpreted to be sourced from orogenic terranes along a continent-continent suture belt with low feldspar and volcanic lithic components. Sandstone samples from the Ouachita-Arkoma region are comprised of litharenites and sublitharenites with varying compositional and textural maturities. The majority of the samples are relatively mature and composed of quartz and lithic fragments as are typically associated with sand sediment delivered from a fold and thrust system. The lithic fragments are mostly metamorphic and sedimentary in origin consisting of polycrystalline mica, quartz-mica tectonite, chert, metaquartzite, argillite-shale, and phyllite fragments. The lithic fragment types coincide with the overall composition to suggest the sandstones represent deposition of material sourced from uplifted sedimentary and metasedimentary terranes along a orogenic belt. The textural maturity characteristics are highly variable, ranging in grain roundness from sub-angular to sub-rounded and in sorting from poorly to well-sorted. The overall textural maturity in the context of grain boundaries and roundness is slightly immature. Large amounts of matrix and pseudomatrix are present in some samples, which is expected in fine-grained samples from the Ouachita turbidite deposition. The textural observations are characteristic of recycled orogenic detritus comprising quartzolithic sediment result in quartz overgrowths and the abundance of pseudomatrix from deformation of metamorphic lithic fragments. Climatic conditions based on textural characteristics and composition suggests a stage of warm paleoclimate and increase in chemical weathering due to proximity to the equator. The variance in textural maturity could be evident of closure of the remnant ocean basin and the transition to more distal source terranes supplying sediment into the foreland basin (Graham et al., 1976).

Ouachita-Arkoma to Appalachian Foreland Comparison

The comparison between the Appalachian Basin and the Ouachita basins with regards to sediment provenance is largely based upon sandstone composition analysis. The Appalachian Basin sediment is sourced from adjacent orogenic terranes associated with Taconic, Acadian, Neoacadian, and Alleghanian terranes (Park et al., 2010). The nearby uplift and associated fluvial dispersal systems provided deltaic deposition directly into the Appalachian foreland, which preserved extensive sedimentary packages shed from exposed Appalachian source terranes that can be used to explore fore linkages with sediment sources of the Ouachita foreland. The sandstone compositions of the Appalachian Basin (Siever, 1957; Sheehan, 2002; Becker et al., 2005; Reed et al., 2005) illustrates a strikingly similar composition to that of the Ouachita-Arkoma region (Figure 25). The lithic fragment types of the Ouachita-Arkoma region are linked to low-grade metasedimentary and sedimentary fragments that are observed in the Appalachian foreland and said to be “indistinguishable” between the two regions (Graham et al., 1976).

The Black Warrior Basin to Ouachita-Arkoma Basin is perhaps a more fitting comparison as both regions underwent rapid flexural deepening due to the Ouachita orogenic uplift directly adjacent to both basins. The Ouachita deep-water basin offers a different sedimentologic setting than the Black Warrior as the remnant ocean basin closed in response to the collisional orogen, but similar shallow marine and deltaic facies are observed in the Pennsylvanian section of the Ouachita basin and the peripheral Arkoma basin. Existing comparisons of these two regions is by sandstone compositional analysis (Figure 25; Graham et al., 1976; Mack et al., 1983; Becker et al., 2005; Peavy, 2008; Moore, 2012; Uddin et al., 2016) and detrital muscovite geochronology (Figures 26 and 27; Peavy, 2008; Moore, 2012; Uddin et al., 2016).

The modal analyses and textural maturity of sandstones in the Black Warrior and Ouachita-Arkoma Basins are remarkably similar (Figure 25). The sandstone compositions from these two regions are predominantly composed of monocrystalline quartz, sedimentary and metamorphic lithic fragments. The overall maturity shows some differences in feldspar content and lithic types but are mostly characterized as mature litharenites to sublitharenites that fall within the recycled orogenic source composition field (Figure 25). The differences in lithic fragments is predictable as the Ouachita-Arkoma samples display a larger sedimentary lithic component associated with deposition of deep-water fans and abyssal plains in a remnant ocean basin (Ingersoll and Suczek, 1979). The sandstone compositions, lithic types, and textural characteristics suggest longitudinal fluvial systems transporting sediment adjacent to the Appalachian Mountains both in the immediate foreland and towards the craton interior along uplifted arch systems associated with collisional fore-bulge. The mature sandstone compositions indicate sediment travelling from distal sources, while less mature sands found throughout the regions are sourced from more proximal terranes.

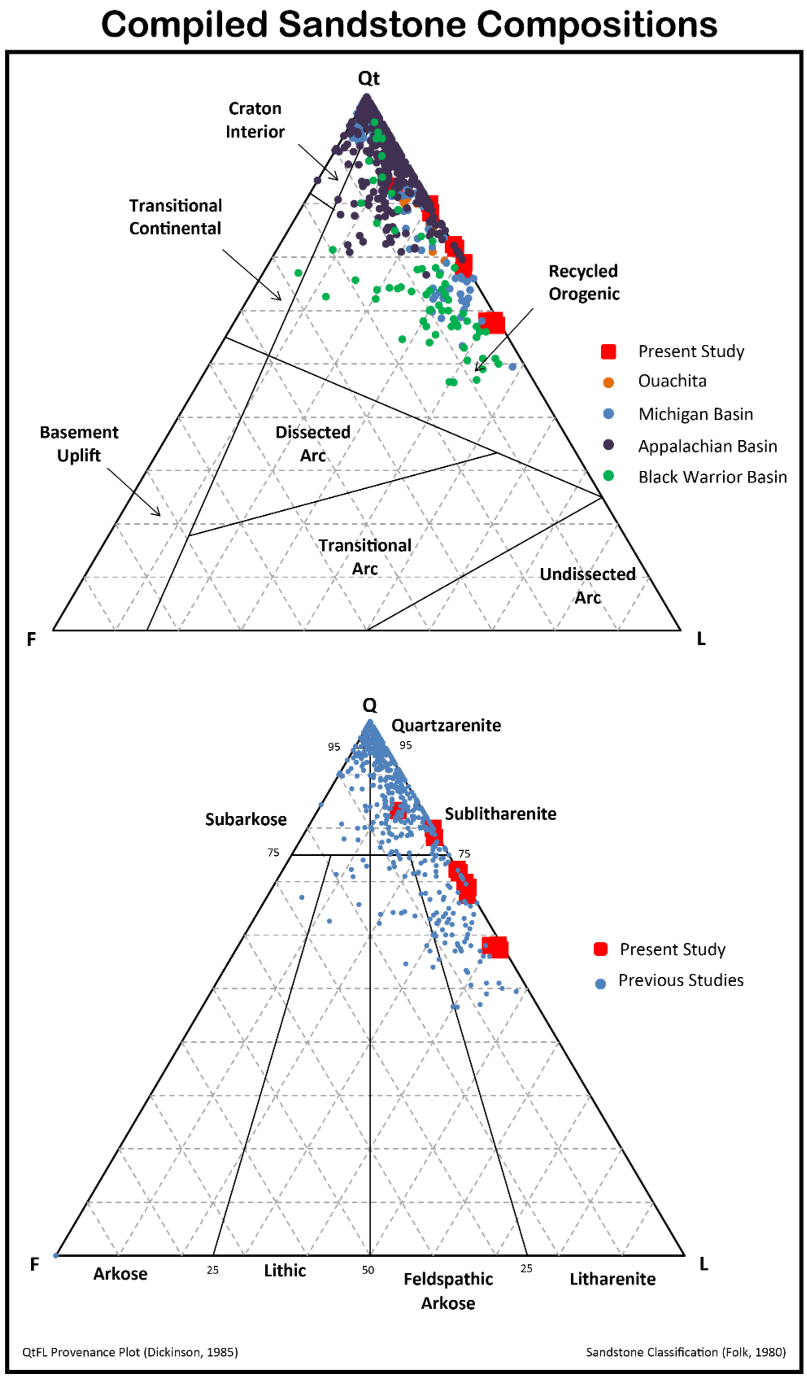


Figure 25: Composite sandstone composition QtFL and QFL plots from all Appalachian-Ouachita related basins including cratonic interior basins from previous studies (Siever and Potter, 1956; Graham et al., 1975; Sheehan 2002; Becker et al., 2005; Reed et al., 2005; Moore, 2012; Boothroyd, 2012; Uddin et al., 2016; Xie et al., 2018) along with new data of the present study.

Detrital Muscovite Age Interpretation

The detrital geochronologic data allows for interpretation of the detrital age and the link to various geologic provinces in order to determine the sediment sources. The numerous geochronologic provinces associated with the Appalachians include both basement provinces and Paleozoic metamorphic terranes. The detrital muscovite record is more receptive to younger tectonic events than U/Pb detrital zircon ages evident by the 98% distribution of Paleozoic muscovite in this study (Figure: 26; Table 3). The provinces that are considered in this study for Paleozoic grains are the Alleghanian, Neoacadian, Acadian, Taconic, Pre-Taconic, and Pan-African (Cambrian) provinces (Table 3). Older provinces for the Neoproterozoic, Mesoproterozoic, and Paleoproterozoic grains are also investigated with links to the Yavapai-Mazatzal (Laramide orogeny and Ancestral Rocky Mountains) and the Shield Province (Trans-Hudson, Wyoming, and Superior orogenies).

The Paleozoic Appalachian tectonic provinces investigated in this study are the Alleghanian, Neoacadian, Acadian, and Taconic. The Alleghanian province for this investigation spans from 340 Ma through depositional age of the Pennsylvanian sandstones located in the Ouachita-Arkoma foreland. The Neoacadian province, the younger Devonian collisional events of the Acadian tectophase, extends from 380 Ma to 340 Ma (Hatcher and Merschat, 2006; Merschat and Hatcher, 2007; Hatcher, 2010). The Acadian province corresponding to ages from 420 Ma to 380 Ma related to collision of Avalon and Carolina terranes. The Taconic province and the first Appalachian event consists of grain ages ranging from 465 Ma to 435 Ma.

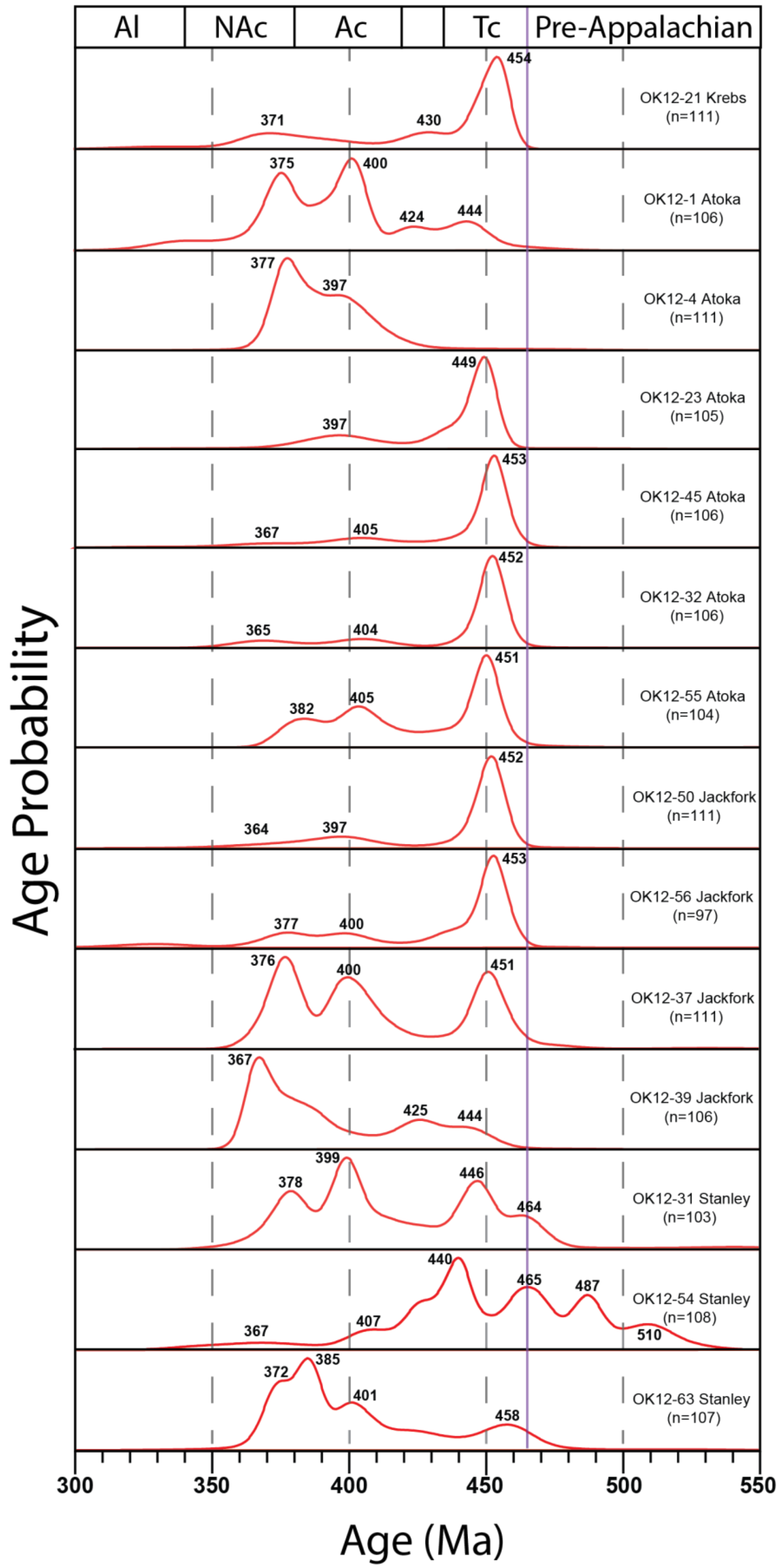


Figure 26: Stacked probability plots of Ouachita-Arkoma detrital muscovite in relative stratigraphic order from all Carboniferous sandstones with peak ages labeled. Purple line marks the border of Appalachian and Pre-Appalachian events. Tc – Taconic, Ac – Acadian, NAc – Neoacadian, and Al – Alleghanian.

Sample Stratigraphy	Sample Number	Number of Grains (n)	Alleghenian (300-340 Ma)	Neo-Acadian (340-380 Ma)	Acadian (380-420 Ma)	Taconic (435-465 Ma)	Pre-Taconic (465-490 Ma)	Cambrian (490-540 Ma)	Paleozoic (300-540 Ma)	Neoproterozoic (540-1000 Ma)	Mesoproterozoic (1000-1600 Ma)	Paleoproterozoic (1600-2500 Ma)
Penn. Krebs Group	**OK12-21**	**n=112**	3%	15%	13%	57%	0%	0%	**99%**	0%	0%	1%
Penn. Atoka Formation	**OK12-1**	**n = 108**	5%	27%	44%	13%	1%	0%	**98%**	0%	0%	2%
	OK12-4	**n = 112**	0%	33%	62%	2%	1%	0%	**99%**	1%	0%	0%
	OK12-23	**n=107**	1%	2%	22%	64%	2%	0%	**98%**	1%	0%	1%
	OK12-45	**n = 109**	2%	7%	16%	67%	1%	0%	**97%**	3%	0%	0%
	OK12-32	**n = 107**	0%	11%	16%	71%	1%	0%	**99%**	0%	0%	1%
	OK12-55	**n = 107**	0%	7%	38%	43%	1%	0%	**97%**	3%	0%	0%
Penn. Jackfork Group	**OK12-50**	**n = 111**	1%	6%	20%	69%	2%	0%	**100%**	0%	0%	0%
	OK12-56	**n = 97**	5%	11%	18%	60%	1%	0%	**100%**	0%	0%	0%
	OK12-37	**n =112**	0%	23%	41%	26%	3%	1%	**99%**	1%	0%	0%
	OK12-39*	**n = 106**	0%	44%	29%	13%	1%	0%	**100%**	0%	0%	0%
Miss. Stanley Group	**OK12-31**	**n = 107**	0%	14%	40%	24%	7%	2%	**95%**	3%	0%	2%
	OK12-54*	**n = 110**	0%	5%	10%	34%	23%	15%	**98%**	2%	0%	0%
	OK12-63	**n = 110**	0%	23%	48%	15%	4%	1%	**97%**	3%	0%	0%
	Total	**n = 1515**	**1%**	**16%**	**30%**	**40%**	**3%**	**1%**	**98%**	**1%**	**0%**	**0%**

*Table 3: Statistical analysis of all Ouachita Carboniferous detrital muscovite samples. Data is separated into age ranges and possible geologic provinces associated with the North American Craton and Pan-Africa. *signifies samples that were analyzed utilizing both detrital muscovite and detrital zircon geochronologic techniques.*

A proportion of ages (ca. 5% overall) predate terrane emplacement and metamorphism of Laurentia during Appalachian orogenesis. The Middle Ordovician through Cambrian detrital muscovite ages (Figures 22, 23, 24, and 25; Table 3) are considered to be related to Pre-Taconic events and the Pan-African province. The pre-Taconic associated grains are interpreted to be within the range of 490 Ma to 465 Ma. These early Taconic and pre-Taconic ages are thought to be attributed to tectonic activity that happened outboard of the Laurentian margin or from early exotic terrane/microcontinent collision (Sinha et al., 2012 and references therein). The Pan-African province is connected to Gondwanan realm sources from either accreted terranes or Iapetan rifting and magmatism on the Laurentian margin.

Mississippian Stanley Group

The Mississippian detrital geochronologic record for the Ouachita-Arkoma region presents a relatively scattered age distribution of detrital grains. The leading age components are consistent with the Appalachian tectonic events, but a noticeable secondary component exists yielding a slightly older age cluster (Figure 26). The Taconic and both Acadian events comprise around 70% of the overall Mississippian grain ages but a substantial 21% of grains fall in the peri-Gondwanan realm provinces. The samples from the Stanley Group tend to fluctuate a great deal and are perhaps not best represented by composite analysis. The turbidites of the upper Mississippian Stanley Group offer varying sedimentary sources attributed to deep-water turbidity currents and the progressing flysch depositional sequence. The central basin samples (OK12-63 and OK12-31) provide a dominant Acadian peak with secondary Neoacadian and Taconic peaks, signifying the primary Laurentian derived source from most likely Central to Northern Appalachian terranes that underwent uplift and extensive erosion in the Devonian and Early Mississippian. The OK12-54 sample provides the strongest Pan-African and Pre-Taconic component, both as secondary peaks to the Taconic mode which comprises 34% of the sample. Initial interpretation of pre-Taconic and Pan-African ages suggest linkage to Southern Appalachian outboard collision and possible linkage to the Uchee terrane (McClellan et al., 2007; Steltenpohl et al., 2008). The existence of the Pan-African component along with pre-Taconic and Taconic signatures could also suggest a northern source explained by the leading contribution of traditional Northern Appalachian Taconic ages mixed with grain ages linked to outboard collision of exotic terranes that are seen in the Central and Northern Appalachians (Dorsch et al., 1994; Hibbard, 2000). An alternate interpretation of the more traditional Pan-African orogeny ages indicates the sediment drainage pathways intersected Peri-Gondwanan related terranes and contributed sediment to the overall drainage network. A minor input of Silurian aged detritus is noticed in the Mississippian record connecting a possible Salinic orogenic source to the Ouachita detritus. The Salinic aged grains (435 Ma to 420 Ma) is characteristic of a smaller collision event that is noticed in the Northern and Maritime Appalachians, which could add to the suggestion of Northern Appalachian source terranes (van Staal et al., 1998; Ettensohn and Brett, 2002).

Pennsylvanian Jackfork Group

The lower Pennsylvanian Jackfork Group detrital record is represented by three Appalachian modes, Taconic (ca. 450 Ma), Acadian (ca. 400 Ma), and Neoacadian (ca. 370 Ma). The Taconic province was the leading contributor of sediment during the deposition of the Jackfork sands comprising of 42% of the dated detrital grains. The western Ouachita samples show a prominent Taconic peak making up nearly 65% of those samples. The overwhelming amount of

Taconic grains and textural and compositional maturity (Figure 14; Table 1) in these samples suggest a principal drainage sourced directly from unroofed Taconic terranes in the Northern Appalachians. Early Pennsylvanian deposition in the Ouachita region could also be interpreted to be sourced from metasedimentary rocks located in the eastern Blue Ridge of the Southern Appalachians (Steltenpohl et al., 2008). The two centralized samples from the basin display a slightly different distribution with the two dominant modes being Acadian and Neoacadian. The OK12-37 sample represents the most evenly distributed sample showing three modes with equal amplitudes (Figure 26). The three modes are typical of source terranes that would be located in the Central and Southern Appalachians due to the strong presence of both Acadian events. The OK12-39 sample shows a similar binary Devonian peak signature credited to the multiple Acadian events but also display a lesser Taconic input. The OK12-39 signature represents another lower Pennsylvanian sample likely sourced from the Central or Southern Appalachians due to the hefty Devonian constituent. The absence of Peri-Gondwanan realm detritus in the Pennsylvanian Jackfork samples advocates for an apparent cut-off of Pan-African terranes in the source region.

Pennsylvanian Atoka Formation

The Pennsylvanian Atoka detrital geochronology samples provide context of the transition from deep-water oceanic basin to peripheral foreland basin and the impacts this had on sediment dispersal. However, the Atoka Formation samples continued on with the Appalachian trend by displaying a dominant Taconic mode at ca. 450 Ma followed by subordinate Acadian and Neoacadian modes at ca. 405 Ma and ca. 370 Ma respectively. The Early Pennsylvanian litharenites and sublitharenites exhibit a tight high-amplitude peak of ages ranging 449 Ma to

452 Ma suggesting similar principal source terranes supplying sediment into the Ouachita foreland during the late early to middle Pennsylvanian. The farthest north samples (OK12-1, OK12-4) in the Arkoma foreland basin present a slightly different signature with a shift to prolific Acadian and Neoacadian modes. The shift from Taconic to Acadian signature perhaps provides some context of basin evolution as further into the foreland an adjustment of source is evident. The distribution of ages from Taconic to Neoacadian suggests multiple source terranes supplied sediment into the Arkoma Basin. The initial dominance of Taconic sourced sediment is indicative of the rapid influx of sediment during the early to middle Pennsylvanian that is observed throughout the greater Appalachian-Ouachita foreland (Briggs and Roeder, 1975). The tremendous influx of sediment is attributed to extensive erosional events coinciding with regional uplift and exposure that results in the primarily unimodal detrital signature from similar source terranes.

Pennsylvanian Krebs Group

The Middle Pennsylvanian Krebs Group detrital muscovite ages represents a shift back to the dominant ca. 450 Ma mode. The Taconic province makes up 57% of the Krebs Group detrital ages and provides evidence of the continuous Taconic sourced input of detritus into the Ouachita-Arkoma region. The Krebs Group sample shows minor populations of Acadian and Neoacadian grains, characteristic of multiple source terranes contributing sediment into the foreland. A small cluster of Silurian age grains in both the Krebs Group and the Atoka Formation is observed and can be attributed to either sediment being sourced from the Northern Appalachian region where collision along the Laurentian margin resulted in the Salinic orogeny (van Staal et al., 1998) or sediment sourced from pre-Taconic sources in the Southern

Appalachians (McClellan et al., 2007; Steltenpohl et al., 2008). The Atoka and Krebs samples also display a few Paleoproterozoic grains that are inferred to be related to the Yavapai-Mazatzal province and more specifically from the Ancestral Rocky Mountain uplift (Bennett and DePaolo, 1987; Karlstrom and Bowring, 1988; Hodges et al., 1994; Karlstrom et al., 2016). A minor input of sediment into the Ouachita region is perhaps from western Laurentian sources carried by interior fluvial systems that connect to the large-scale systems head-watered in the Northern and Central Appalachians.

Ouachita-Arkoma to Black Warrior Basin Detrital Age Comparison

The Ouachita-Arkoma age distribution shows a dominant Taconic mode throughout the Mississippian and Pennsylvanian strata. The three modes observed in the Ouachita-Arkoma samples ca. 450 Ma, 400 Ma, and 370 Ma are characteristic of the Ordovician – Devonian Appalachian tectonic events but lacks the concluding Alleghanian Appalachian tectonic event. As shown by Moore (2012) the individual detrital age distribution from the Black Warrior Basin presents a younging-progression throughout the strata from Taconic to Alleghanian modes (Figure 27). The Black Warrior Basin also displays evidence for all major Appalachian tectonic events with three distinct modes at ca. 445 Ma, ca. 370 Ma, and ca. 320 Ma.

The Ouachita-Arkoma detrital age distribution yields a much older signature, especially in the Mississippian samples, that is not seen in any of the Black Warrior Basin samples (Figure 27). The Ouachita samples provide a noticeable Pan-African and Pre-Taconic component that likely corresponds to peri-Gondwanan realm terranes (Hibbard et al., 2003; Reynolds et al., 2009). Southern Appalachian interpretation for these older grains would suggest fluvial systems

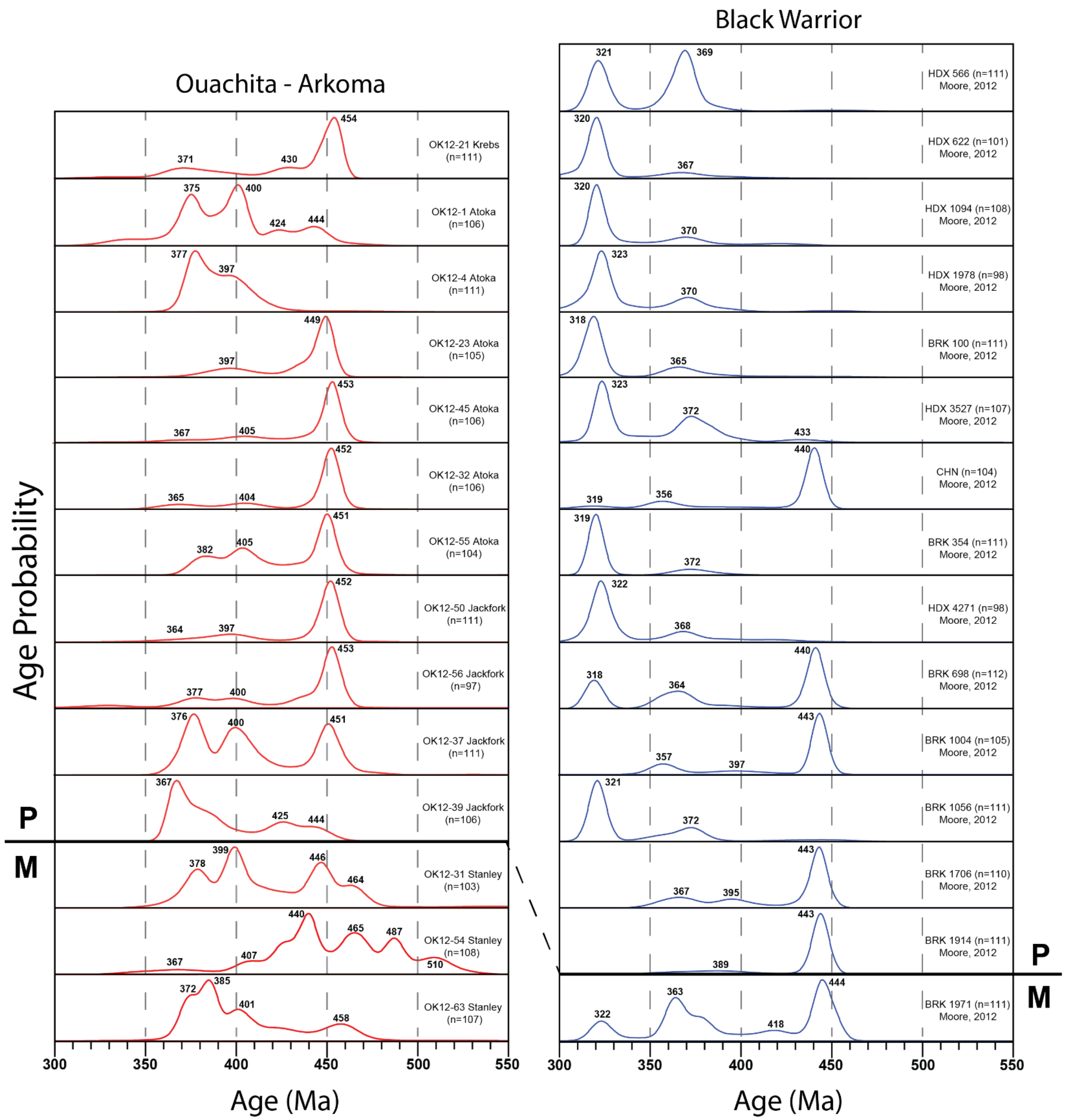


Figure 27: Stacked density plots comparing Black Warrior Basin detrital muscovite (Moore, 2012) to Ouachita-Arkoma detrital muscovite. The Black Warrior Basin detrital signature represents the Taconic, Neoacadian, and Alleghanian events. The Ouachita-Arkoma signature represents the Taconic, Acadian, and Neoacadian events. M/P indicates the boundary in Mississippian and Pennsylvanian strata. The Black Warrior samples represent Mississippian. Parkwood below the boundary and Pennsylvanian. Pottsville above the boundary.

traversing Gondwanan terranes that are located in the extreme Southern Appalachians (e.g. Suwanee terrane). Earlier in this study, the older grain ages are proposed to be associated with intersection and fluvial incision of accreted peri-Gondwanan terranes in the source area. In order for this interpretation to be accurate it would imply that the same fluvial systems supplying sediment to the Ouachita region would not have supplied sediment to the Black Warrior Basin due to the lack of grains older than 485 Ma.

The presence of two Devonian peaks in the Ouachita detrital record presents evidence for multiple source terranes that underwent Acadian deformation at two distinctively different times. The two Devonian peaks are connected to the Acadian and Neoacadian, respectively, but suggest that sources of detritus for the Arkoma shelf is derived from two considerably different Appalachian regions. The Black Warrior Basin Acadian signature is more typical of southern Acadian (Neoacadian) and lacks the traditional New England Acadian deformation ages of ca. 400 Ma (Harrison et al., 1989; Hames et al., 1991; Whitehead et al., 1996). The two Acadian mode signature that are observed in the Ouachita samples advocates for more distal sediment source from the Central Appalachians, Northern Appalachians, Southern Appalachians or possibly a combination of these areas. The Ouachita two Acadian mode could also be linked to low grade metamorphism in the distal Northern Appalachian region of present-day Nova Scotia, based on regional metamorphism dated to indicate a Neoacadian deformation aged event at around 375 to 365 Ma (White et al., 2007; White, 2010) but these ages are also common in much of the Southern Appalachians. The Black Warrior Basin single Neoacadian peak indicates sediment supply from more localized proximal sources of the Southern Appalachians or perhaps presents a constraint on sediment dispersal from source areas containing the older Acadian deformation event (Merschat et al., 2012).

The absence of an Alleghanian component in the Ouachita samples is striking due to the dominance of Alleghanian aged sediment higher in the Black Warrior section. Previous suggestions of east to west flow (Gleason et al., 1994; Gehrels et al., 2011) from the Black Warrior Basin would suggest the input of the Alleghanian component detected in the Black Warrior Basin to be detected in the younger Ouachita-Arkoma strata. Pennsylvanian Pottsville unroofing in the Black Warrior Basin is believed to have occurred around 310 Ma (Thibodeaux, 2015) and if the east-to-west flow was in existence, the Atokan and Desmoinesian strata of the Arkoma would logically contain Alleghanian aged detritus. The lack of Alleghanian grains in the Ouachita samples advocates for an apparent cutoff between the two forelands, perhaps in connection with uplift in either the Ozark Plateau or Nashville Dome.

The composite probability plots (Figure 28) display the similarities and differences between the two regions. The evidence for multiple source terranes within the North, Central, and Southern Appalachians providing sediment into the greater Appalachian-Ouachita region is manifested by the detrital age distributions from these two regions. The most noticeable difference being the lack of an Alleghanian mode in the Ouachita-Arkoma data and prominent Alleghanian peaks in the Black Warrior Basin data from both the Mississippian and Pennsylvanian samples (Figure 28). Another notable takeaway from the comparison (Figure 28) is the 400 Ma peak in the Ouachita-Arkoma samples and a rather suppressed 400 Ma age signature in the Black Warrior Basin samples. However, both regions produce the younger Acadian (Neoacadian) signature. The comparison of detrital ages from the two regions in

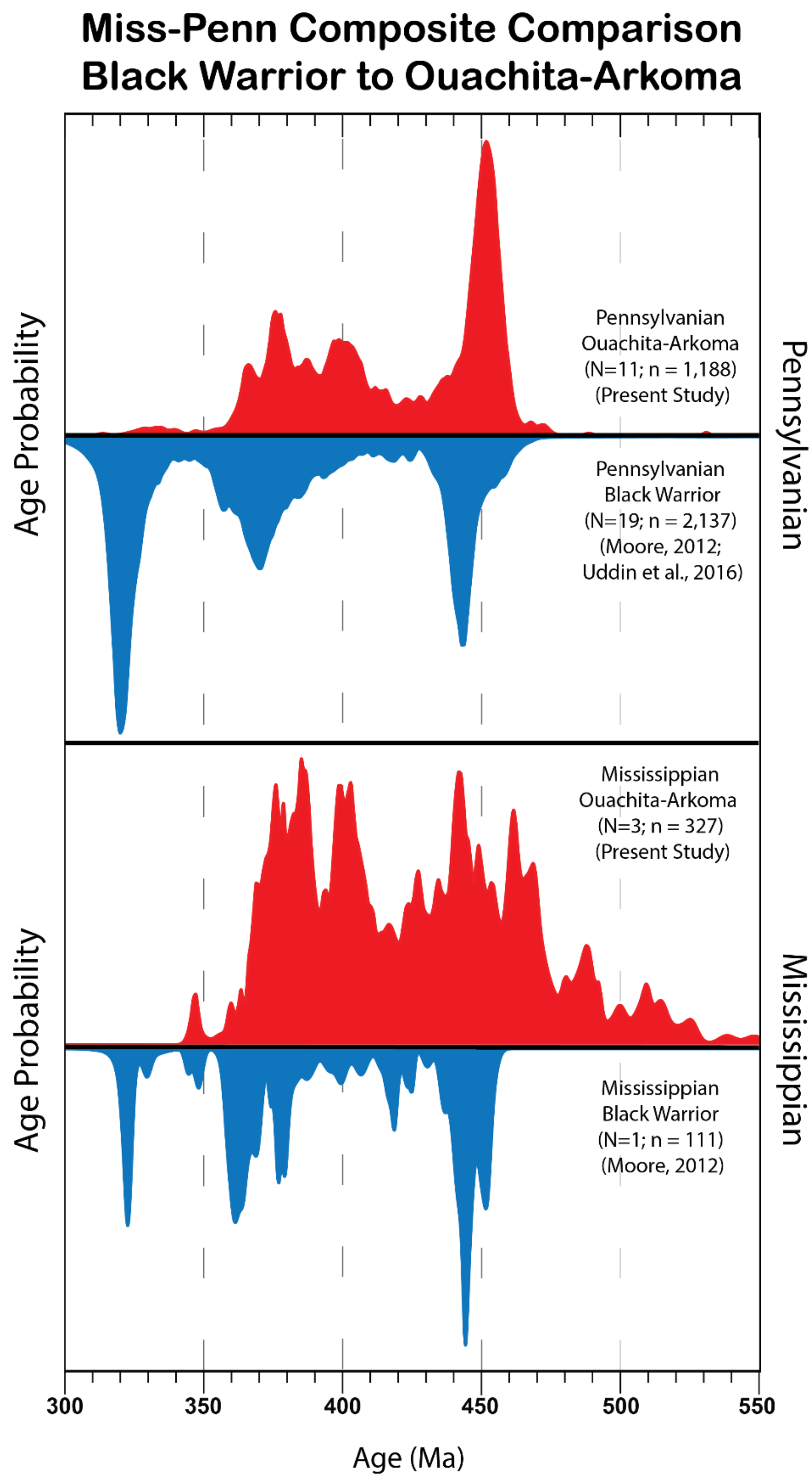


Figure 28: Cumulative probability density plots of detrital mica from both the Ouachita-Arkoma Basins (Red) and Black Warrior Basins (Blue: Moore 2012; Uddin et al., 2016). The bottom plot shows detrital age probability distribution of the Mississippian sandstones from both regions. The top plot displays the Pennsylvanian probability distribution from both regions.

Figure 28 highlights an apparent delay in the Black Warrior Basin signature, where similar Taconic and Acadian peaks are slightly younger than peaks represented in the Ouachita data.

Sediment Dispersal Pathways

Paleodrainage and sediment routing systems of the late Mississippian and Pennsylvanian Laurentian continent have been reconstructed based on regional facies mapping, compositional analysis, and detrital geochronology. Focus has centered on the role that northeast-southwest longitudinal fluvial systems versus transverse westward systems play on sediment dispersal and eventual deposition into the southern Appalachian-Ouachita foreland. Longitudinal systems have been proposed by Archer and Greb (1995) and Xie et al. (2016, 2018), whereas transverse systems were suggested by Gehrels et al. (2011) to supply sediment to the Grand Canyon region. The present study concludes that Mississippian-Pennsylvanian dispersal systems are highly complex and provide sediment contribution to the foreland from both transverse and longitudinal fluvial systems. The complex dispersal pathways during the assembly of Pangaea was primarily influenced by tectonic episodes that caused intricate structural uplift of the Laurentian margin and the continental interior. Complicated arch and fore-bulge arrangements routed Appalachian sourced sediment in various axial and transverse directions into the multiple foreland basins associated with the Appalachian-Ouachita orogenesis.

The Gehrels et al. (2011) model suggests westward flow and drainage directed from the Southern Appalachian region at ca. 320 Ma subsequently provided similar sourced sediment into the Black Warrior and Ouachita-Arkoma Basins. With the Gehrels et al. (2011) model, the sediment traversing the Black Warrior Basin would combine with unroofed Black Warrior sediment (ca. 310 Ma) contributing Alleghanian aged sediment into the Ouachita-Arkoma region. The work of Moore (2012) shows a dominance of Alleghanian muscovite in stratigraphically higher sandstones, presumably derived from erosion of the Blue Ridge and Piedmont of the Southern Appalachians by transverse drainages. The present study illustrates an apparent cutoff of sediment from the Black Warrior to Ouachita region in the early to middle Pennsylvanian. However, the two Acadian peaks observed in the Ouachita data suggests that multiple sources including Southern, Central, and Northern Appalachians contributed sediment to the Ouachita-Arkoma region from westward drainage. The Neoacadian signal that is present in the data is interpreted to be associated with the docking of the Carolina terrane in the South-Central Appalachians (Hatcher, 2005). This interpretation suggests a westward fluvial system that bypasses the Black Warrior Basin and adjoins the continental-scale longitudinal system originated in the Northern Appalachians to deposit sediment into the Ouachita foreland.

The Xie et al. (2018) and Archer and Greb (1995) models propose multiple continental-scale river systems separated by a chain of structural highs separating the eastern fluvial system from the interior systems. The eastern system parallels the Appalachian uplift and terminates into the Black Warrior Basin. The interior longitudinal system originates in the Northern Appalachians and intersects the cratonic Michigan and Illinois Basins before depositing into the Ouachita region. The data from the present study are generally compatible with the dominant longitudinal systems (Archer and Greb, 1995) deriving sediment from the Northern Appalachians as proposed by Xie et al. (2018) with implications of Southern Appalachian sourced sediment. The exception to these models is the signature of South-Central Appalachian sources observed in the first cycle constituents of the Ouachita-Arkoma Basins. The dominant

Northern Appalachian longitudinal system is displayed by the overwhelming prominence of Taconic signature and absence of Alleghanian grains in the detrital muscovite data, but the secondary Acadian and Neoacadian peaks are linked to source terranes in the Central Appalachians. The Acadian components are interpreted to record a transverse system that provided east-to-west flow of sediment from the orogenic front to the east eventually adjoining the continental-scale longitudinal system. The pirating of the transverse system by the large-scale longitudinal system allows for a dominant Northern Appalachian signature (Taconic and Acadian) followed by subordinate Acadian/Neoacadian signatures from the transverse system. An alternative hypothesis is that Mississippian clastic wedge strata from the Illinois Basin, previously deposited from distal deltaic pulses into back-arc systems, occurred during Acadian deltaic time and has undergone reworking and fluvial incision resulting in Carboniferous deposition into the Ouachita region.

The overall reconstruction of the Carboniferous drainage networks is that of intricate arch and dome arrangement associated with the mountain building events of the Appalachians and Ouachitas followed by fluctuations in global sea-level, to control sediment supply from varying proximal and distal sources. The present study's data and interpretation largely parallel the longitudinal Northern Appalachian sources proposed by Archer and Greb (1995) and Xie et al. (2018) with the contribution of secondary sources providing minor sediment into the Ouachita foreland. The arch arrangement of the Cincinnati, Findlay, Algonquin, Wisconsin, and Kankakee arches along with Nashville and Ozark Dome locations provides substantial control on the Laurentian dispersal patterns. Localized and regional fluvial systems that ultimately contributed sediment to the large-scale drainages in the greater Appalachian-Ouachita foreland are arranged by the various structural highs caused by orogenic uplift. The migration of an Alleghanian forebulge towards the craton interior likely also played a critical role in the sediment source reconstruction and the overall influx of sediment to regions of flexural subsidence.

Chapter VIII: Conclusions

The investigation of Carboniferous sandstones from the Ouachita-Arkoma Basin results in new detrital geochronology and sandstone composition data that provides additional constraints on sediment routing and dispersal patterns for the Laurentian continent during the assembly of Pangaea. The Ouachita-Arkoma detrital age distribution allows for the evaluation of possible links between source terranes and eventual sediment accumulation. These new data for Carboniferous sandstones of the Ouachita-Arkoma region indicate a dominant Laurentian derived source of sediment into the Ouachita region with lesser secondary sources from Pan-African accreted terranes and perhaps a small input of sediment from the western Ancestral Rocky Mountain uplift.

The paleodrainage networks of the Carboniferous Laurentian continent appear to be made up of highly complex regional and continental-scale river systems that dispersed sediment throughout the greater Appalachian-Ouachita foreland. Sediment was transported from Appalachian sources via both longitudinal and transverse fluvial systems. An interior longitudinal system that intersected and recycled sediment from cratonic interior basins is also evident in the Ouachita foreland.

The overwhelming Appalachian tectonic signal is primarily indicated by the high amplitude Taconic peak in the Pennsylvanian mica record of the Ouachita-Arkoma region followed by two subordinate Acadian modes. More precisely, sediment supplied into the Ouachita foreland closely reflects sediment sourced from the Central Appalachians along with the reworking of underlying sediment by fluvial incision within the cratonic interior based on sediment composition. The recycled orogenic compositions of the sandstones for the Appalachian and Black Warrior Basins are comparable, providing strong indication of sediment provenance associated with the Appalachians.

The comparison of the detrital muscovite record from the Black Warrior and Ouachita-Arkoma regions provides the best context for assessment of detrital source and possible links to dispersal systems. The lack of Alleghanian sourced detritus in the Ouachita-Arkoma region is interpreted to result from a cutoff of east-to-west flow from the Black Warrior basin to the Ouachita region throughout the Mississippian and Pennsylvanian. Complex arch arrangement during the Pennsylvanian associated with fore-bulge and migration of Alleghanian fore-bulge caused sediment routing systems between to two forelands to be severed. This resulted in the Black Warrior Basin detrital record of Moore (2012) to display a younging-upward progression into a dominant Alleghanian signature characteristic of the Southern Appalachians, while the Arkoma Basin sediment remained dominated by Taconic sources of the Northern, Central, and Southern Appalachians.

The new detrital muscovite data from the Ouachita-Arkoma Basin displays an Early Devonian and Late Devonian mode interpreted to be connected to multiple Acadian events, the older 400 Ma Acadian and the younger 365 Ma Neoacadian. The Black Warrior Basin detrital muscovite data from Moore (2012) shows a similar Late Devonian mode but lacks the Early Devonian signature. The lack of an older Devonian mode in the Black Warrior Basin suggests different source areas for sediment being deposited into the two regions during the Pennsylvanian. The younger (Neoacadian) Devonian mode in the Black Warrior Basin is most likely linked to proximal sources of the Southern Appalachians. However, absence of a prevalent 400 Ma mode in the Black Warrior suggests the sediment deposited into the Ouachita-Arkoma Basin is likely sourced from a more distal region such as the Central or Northern Appalachians.

Secondary source provenance is evident throughout the Ouachita-Arkoma sedimentary record, especially in the Mississippian strata. The Mississippian Stanley Group has a component of ages that are noticeably older, ca. 500 Ma to 700 Ma (Table 3), which can be attributed to different source terranes contributing sediment into the sediment drainage networks. The Cambrian to Neoproterozoic Pan-African aged sediment could be suggestive of fluvial systems traversing through accreted Peri-Gondwanan realm terranes or intersection of thrusted exotic terranes in the Appalachian source region. The Pan-African aged detritus in these samples is accompanied by a prominent Devonian signature, that is taken to indicate a similar source to that of the Acadian clastic wedge of the Appalachian Basin and sediment shed in association with accretion of the Carolina terrane. The Ouachita-Arkoma age distribution also presents Paleoproterozoic grains (>1,600 Ma; Table 3) that slightly increase in the late early to middle Pennsylvanian samples interpreted to be from Yavapai-Mazatzal or Mid-Continent provinces (Karlstrom and Bowring, 1988; Hodges et al., 1994; Karlstrom et al., 2016). The evolution of the sediment dispersal systems throughout the Pennsylvanian (Gehrels et al., 2011) begins to show a western input into the Ouachita-Arkoma region based on uplift and exposure of the Ancestral Rocky Mountains beginning in the Mississippian.

Overall, the examination of Carboniferous litharenites and sublitharenites from the Ouachita-Arkoma Basins using detrital geochronology and sandstone composition offers critical insight into sediment provenance and the complex routing history of the Laurentian supercontinent. The new detrital mica ages display the complex nature of the Laurentian sediment routing systems. Detection of multiple Acadian events suggest implications for various source terranes in the Northern, Central, and Southern Appalachians that supplied sediment to the Ouachita region. Evidence of an interior longitudinal system bypassing the Black Warrior Basin is observed in the Ouachita detrital data related to the cutoff of Alleghanian sediment between the Black Warrior and Ouachita-Arkoma Basins. Basin evolution of the Ouachita region from remnant ocean basin to peripheral foreland basin records variations of sediment supply from multiple different sources throughout the Carboniferous. Appalachian tectonic activity along with eustatic sea level and climate conditions played pivotal roles in the supply of sediment into the Ouachita-Arkoma region.

References

Allen, P.A., 2008. From landscapes into geological history. Nature 451 (7176), p. 274–276.

Allen, P. A., Homewood, P., and Williams, G. D., 1986, Foreland basins: An introduction, in Allen, P. A., and Homewood, P., eds., Foreland basins: International Association of Sedimentologists Special Publication 8, p. 3–12.

Arbenz, J. K., 1984, A structural cross section through the Ouachita Mountains of western Arkansas, in Stone, C. G., and Haley, B. R., eds., A guidebook to the geology of the Ouachita Mountains, Arkansas: Arkansas Geological Commission Guidebook 84-2, p. 76-81.

Arbenz, J.K., 1989, Ouachita thrust belt and Arkoma basin, in Hatcher, R.D., Jr., Thomas, W.A., and Viele, G.W., eds., The Appalachian–Ouachita orogen in the United States, The Geology of North America: Geological Society of America, v. F-2, p. 621–634.

Arbenz, J.K., 2008, Structural Framework of the Ouachita Mountains, in Suneson, N.H., ed., Stratigraphic and Structural Evolution of the Ouachita Mountains and Arkoma Basin, Southeastern Oklahoma and West-Central Arkansas: Applications to Petroleum Exploration: 2004 Field Symposium (The Arbenz-Misch/Oles Volume), Circular 112A, Oklahoma Geological Survey, Norman, Oklahoma, p. 4-40.

Archer, A.W., and Greb, S.F., 1995, An Amazon-scale drainage system in the early Pennsylvanian of central North America: The Journal of Geology, v. 103, p. 611-628.

Beaumont, C., Quinlan, G.M., and Hamilton, J., 1988, Orogeny and stratigraphy: Numerical models of the Paleozoic in the eastern interior of North America.Tectonics v. 7, p. 389–416.

Becker, T.P., Thomas, W.A., Samson, S.D., and Gehrels, G.E., 2005, Detrital zircon evidence of Laurentian crustal dominance in the lower Pennsylvanian deposits of the Alleghanian clastic wedge in eastern North America: Sedimentary Geology, v. 182, p. 59-86.

Bennett, V.C., and DePaolo, D.J., 1987, Proterozoic crustal history of the western United States as determined by neodymium isotopic mapping: Geological Society of America Bulletin, v. 99, p. 674-685.

Blakey, R.C., 2008, Gondwana paleogeography from assembly to breakup – A 500 m.y. odyssey: Geological Society of America, Special Paper 441, p. 1–28.

Boardman, D. R. I., and Heckel, P. H., 1989, Glacial-eustatic sea-level curve for early Late Pennsylvanian sequence in north-central Texas and biostratigraphic correlation with curve for midcontinent: Geology, v. 17, p. 802-805.

Boothroyd, J., 2012, Carboniferous Provenance Trends from Clastic Strata of the Michigan Basin, MSc. Thesis: Michigan State University, East Lansing, p. 197

Briggs, G., and Cline, L.M., 1967, Paleocurrents and source areas of Late Paleozoic sediments of the Ouachita Mountains, southeastern Oklahoma: Journal of Sedimentary Petrology, v. 37, p. 985-1000.

Briggs, G., and Roeder, D. H., 1975, Sedimentation and plate tectonics, Ouachita Mountains and Arkoma Basin, in Briggs, G., McBride, E. F., and Moiola, R. J., eds., Sedimentology of Paleozoic flysch and associated deposits, Ouachita Mountains Arkoma Basin, Oklahoma: Dallas Geol. Soc., p. 1-22.

Buchanan, R. S., and Johnson, F. K., 1968, Bonanza gas field—A model for Arkoma basin growth faulting, in Cline, L. M., éd., A guidebook to the geology of the western Arkoma basin and Ouachita Mountains, Oklahoma: Oklahoma City Geological Society Guidebook, p. 75-85.

Cawood, P.A., and Nemchin, A.A., 2001, Paleogeographic development of the east Laurentian margin: Constraints from U-Pb dating of detrital zircons in the Newfoundland Appalachians: Geological Society of America Bulletin, v. 113, p. 1234-1246.

Chesnut, D. R., JR., 1993, Eustatic and tectonic control of sedimentation in the Pennsylvanian strata of the central Appalachian basin, U.S.A.: Buenos Aires, Douzie`me Congre`s International de la Stratigraphie et Ge´ologie du Carbonife`re et Permien, Compte Rendu, v. 2, p. 421– 430.

Cline, L. M., 1970, Sedimentary features of late Paleozoic flysch, Ouachita Mountains, Oklahoma, in Lajoie, J., ed., Flysch sedimentology in North America: Geol. Assoc. Canada Spec. Paper 7, p. 85-101.

Colton, G.W., 1970, The Appalachian basin—its depositional sequences and their geologic relationships. In: Fisher, G.W., Pettijohn, F.J., Reed, J.C., Weaver, K.N. (Eds.), Studies of Appalachian geology. Interscience Publishers, New York, p. 5–47.

Corrie, S., and Kohn, M.J., 2008, Trace-element distribution in silicates during prograde metamorphic reactions: Implications for monazite formation: Journal of Metamorphic Geology, v. 26, no. 4, p. 451–464.

Dallmeyer, R. D., Wright, J. E., Secor, D. T. Jr., and Snoke, A. W. 1986, Character of the Alleghany orogeny in the southern Appalachians: Part II. Geochronological constraints on the tectonothermal evolution of the Piedmont in South Carolina. Geol. Soc. Am. Bull. 97: 1329-44.

Dalrymple G. B., Alexander E. C., Lanphere, M. A. and Kraker, G. P., 1981, Irradiation of samples for 40Ar 39Ar dating using the Geological Survey TRIGA Reactor. L/S. Geological Survey. Prof: Paper 1176, p. 55.

Decelles, P.G., 2004, Late Jurassic to Eocene evolution of the Cordilleran thrust belt and foreland basin system, western USA: American Journal of Science, v. 304, p. 105–168.

DeCelles, P. G., and Giles, K. A. 1996, Foreland basin systems. Basin Res. v. 8, p. 105–123

Dickinson, W.R., 1970, Interpreting detrital modes of greywacke and arkose: Journal of Sedimentary Petrology, v. 40, p. 695–707.

Dickinson, W.R., 1985, Interpreting provenance relations from detrital modes of sandstones, in Zuffa, G.G., ed., Provenance of arenites: Boston, D. Reidel, p. 333-361.

Dickinson, W.R., 1988, Provenance and sediment dispersal in relation to paleotectonics and paleogeography of sedimentary basins. In: Kleinspehn, K.L., Paola, C. (Eds.), New Perspectives in Basin Analysis. Springer, New York, p. 3-25.

Dickinson, W.R., and Suczek, C.A., 1979, Plate tectonics and sandstone compositions: American Association of Petroleum Geologists Bulletin, v. 63, p. 2164-2182.

Dickinson, W.R., and Gehrels, G.E., 2003, U-Pb ages of detrital zircons from Permian and Jurassic eolian sandstones of the Colorado Plateau, USA: paleogeographic implications: Sedimentary Geology, v. 163, p. 29–66.

Diecchio, R. J., 1993, Stratigraphic interpretation of the Ordovician of the Appalachian basin and implications for Taconian flexural modeling: Tectonics, v. 12, p. 1410–1419.

Drake, A.A., JR., Sinha, A.K., Laird, J., and Guy, R.E., 1989, The Taconic orogeny, *in* Hatcher, R.D., Jr., Thomas, W.A., and Viele, G.W., eds., The Appalachian–Ouachita orogen in the United States, The Geology of North America: Geological Society of America, v. F-2, p. 101–177.

Donohoe, H. V., and Pajari, G., 1973, The age of Acadian deformation in Maine-New Brunswick: Maritime Sediments, v. 9, p. 78-82.

Dorsch, J., Bambach, R. K., and Driese, S. G., 1994, Basin-rebound origin for the “Tuscarora unconformity” in southwestern Virginia and its bearing on the nature of the Taconic orogeny: American Journal of Science, v. 294, p. 237–255.

Eriksson, K. A.; Campbell, I. H.; Palin, J. M.; Allen, C. M.; and Bock, B. 2004, Evidence for multiple recycling in Neoproterozoic through Pennsylvanian sedimentary rocks of the Central Appalachian Basin. J. Geol. V. 112, p. 261–276.

Ettensohn, F.R., 1985, The Catskill Delta complex and the Acadian Orogeny. In: Woodrow, D.W., Sevon, W.D. (Eds.), The Catskill Delta. Geological Society of America Special Paper 201, p. 39–49.

Ettensohn, F. R. 1987, Rates of relative plate motion during the Acadian Orogeny based on spatial distribution of black shales. Journal of Geology, v. 95, p. 572–582.

Ettensohn, F.R., 1991, Flexural interpretation of relationships between Ordovician tectonism and stratigraphic sequences, central and southern Appalachians, U.S.A. In: Barnes, C.R., Williams, S.H. (Eds.), Advances in Ordovician Geology. Geological Survey of Canada Paper 90-9, p. 213–224.

Ettensohn, F.R., 2004, Modeling the nature and development of major Paleozoic clastic wedges in the Appalachian Basin, USA: Journal of Geodynamics, v. 37, p. 657–681.

Ettensohn, F.R., 2008, Chapter 4: The Appalachian foreland basin in eastern United States. In: Hsu, K.V. (Ed.) Sedimentary Basins of the World. Vol. 5. The Sedimentary Basins of the United States and Canada. Miall, A.B. (Ed.) Elsevier, The Netherlands, p. 105–179.

Ettensohn, F.R., 2011, Flexural and sedimentary responses of the Appalachian Foreland Basin to Neoacadian orogeny, Geological Society of America Abstracts with Programs, Vol. 43, No. 5, p. 366.

Ettensohn, F.R., Miller, M.L., Dillman, S.B., Elam, T.D., Geller, K.L., Swager, D.R., Markowitz, G., Woock, R.D.,Barron, L.S., 1988. Characterization and implications of the Devonian-Mississippian black-shale sequence, eastern and central Kentucky, U.S.A.: Pycnoclines, transgression, regression, and tectonism. In: McMillan, N.J., Embry,A.F., Glass, G.J. (Eds.), Devonian of the world, Proceedings of the Second International Symposium on the Devonian System. Canadian Society of Petroleum Geologists Memoir 14, 2, p .323–345.

Ettensohn, F.R., Brett, C.E., 2002. Stratigraphic evidence from the Appalachian Basin for continuation of the Taconian Orogeny into Early Silurian time. In: Mitchell, C.E., Jacobi, R. (Eds.), Taconic Convergence: Orogen, Foreland Basin, and Craton Physics and Chemistry of the Earth 27, p. 279–288.

Faill, R.T., 1985, The Acadian Orogeny and the Catskill Delta. In: Woodrow, D.W., Sevon, W.D. (Eds.), The Catskill Delta. Geological Sochesciety of America Special Paper 201, p. 15–37.

Faill, R. T. 1997, A geologic history of the north-central Appalachians. 2. The Appalachian basin from the Silurian through the Carboniferous. Am. J. Sci. v. 297, p. 729– 761.

Fedo, C.M., Young, G.M., and Nesbitt, G.M., 1997, Paleoclimatic control on the composition of the Paleoproterozoic Serpent Formation, Huronian Supergroup, Canada: A greenhouse to icehouse transition: Precambrian Research, v. 86, p. 201–223.

Flemings, P. & Jordan, T. E. 1989, A synthetic stratigraphic model of foreland basin development. Journal of Geophysical Research, v. 94, p. 3851–66.

Folk, R.L., 1980. Petrology of Sedimentary Rocks. Hemphill Publ.Co., Austin. p. 182

Gehrels, G.E., Blakey, R., Karlstrom, K.E., Timmons, J.M., Dickinson, B., and Pecha, M., 2011, Detrital zircon U-Pb geochronology of Paleozoic strata in the Grand Canyon, Arizona: Lithosphere, v. 3, p. 183–200.

Gleason, J. D., Patchett, P. J., Dickinson, W. R.; and Ruiz, J. 1994, Nd isotopes link Ouachita turbidites to Appalachian sources. Geology v. 22, p. 347–350.

Gleason, J. D., Finney, S. C., and Gehrels, G. E. 2002, Paleotectonic implications of a Mid- to Late-Ordovician provenance shift, as recorded in sedimentary strata of the Ouachita and southern Appalachian mountains. Journal of Geol. V. 110, p. 291–304.

Glick, E. E. 1979, Arkansas. In Paleotectonic Investigations of the Mississippian System in the United States, US Geol. Surv. Prof Pap. 1010 (Part 1), coord. L. C. Craig, C. W. Connor, p. 125-45.

Graham, S.A., Dickinson, W.R., and Ingersoll, R.V., 1975, Himalayan-Bengal model for flysch dispersal in the Appalachian-Ouachita system: Geological Society of America Bulletin, v.86, p. 273-286.

Graham, S.A., Ingersoll, R.V., and Dickinson, W.R., 1976, Common Provenance for Lithic Grains in Carboniferous Sandstones from Ouachita Mountains and Black Warrior Basin: Journal of Sedimentary Petrology, vol. 46, No. 3, p. 620-632.

Gray, M.B., and Zeitler, P.K., 1997, Comparison of clastic wedge provenance in the Appalachian foreland using U-Pb ages of detrital zircons: Tectonics, v. 16, p. 151–160. GREB, S.F., 1989, Structural controls on the formation of the sub-Absaroka unconformity in the U.S. Eastern Interior basin: Geology, v. 17, p. 889–892.

Haley, B. R. 1982, Geology and energy resources of the Arkoma basin, Oklahoma and Arkansas. Univ. Mo.-Rolla J., v. 3, p. 43-53.

Haley, B.R., Glick, E.E., Bush, W.V., Clardy, R.F., Stone, C.G., Woodward, M.P., and Zachry, D.L., 1976, Geologic map of Arkansas: U.S. Geological Survey and Arkansas Geologic Commission, scale 1:500,000.

Hames, W.E., Tracy, R.J., Ratcliffe, N.M., and Sutter, J.F., 1991, Petrologic, structural and geochronologic characteristics of the Acadian metamorphic overprint on the Taconide zone in part of southwestern New England: American Journal of Science, v. 291, p. 887-913.

Harrison, T.M., Spear, F.S., and Heizier, M.T., 1989, Geochronologic studies in central New England; II: Post-Acadian hinged and differential uplift: Geology, v. 17, p. 185-189.

Hatch, J.R., and Pawlewicz, M.J., 2007, Introduction to the assessment of undiscovered oil and gas resources of the Black Warrior Basin Province of Alabama and Mississippi, in Hatch, J.R., and Pawlewicz, M.J., eds., Geologic assessment of undiscovered oil and gas resources of the Black Warrior Basin Province, Alabama and Mississippi: U.S. Geological Survey Digital Data Series DDS–69–I, Chap. 2, p. 6.

Hatcher, R. D., Jr., 1972, Developmental model for the southern Appalachians: Geological Society of America Bulletin, v. 83, p. 2735-2760. 1978, Tectonics of the western Piedmont and Blue Ridge, southern Appalachians: Review and speculation: American Journal of Science, v. 278, p. 276-304.

Hatcher, R.D., Jr., 2002, The Alleghanian (Appalachian) orogeny, a product of zipper tectonics: Rotational transpressive continent-continent collision and closing of ancient oceans along irregular margins, in Martinez Catalan, J.R., Hatcher, R.D., Jr., Arenas, R., and Garcia , F.D., eds., Variscan-Appalachian Dynamics: The Building of the Late Paleozoic Basement: Geological Society of America Special Paper 394, p. 199–208.

Hatcher, R. D., 2005, Southern and Central Appalachians: London, Elsevier, p. 72–81.

Hatcher, R.D., 2010, The Appalachian orogeny: A brief summary, *in* Tollo, R.P., Bartholomew, M.J., Hibbard, J.P., and Karabinos, P.M., eds., From Rodina to Pangea: The Lithotectonic Record of the Appalachian Region: Geological Society of America, Memoir 206, p. 1-19

Hatcher, R.D., Thomas, W.A., Geiser, P.A., Snoke, A.W., Mosher, S., and Wiltschko, D.V., 1989, Alleghenian orogen: The Geology of North America, v. F-2, The Appalachian–Ouachita Orogen in the United States: The Geological Society of America, p. 233–318.

Hatcher, R. D., Jr., and Merschat, A. J., 2006, The Appalachian Inner Piedmont: An exhumed strike-parallel, tectonically forced orogenic channel, in Law, R. D., Searle, M. P., and Godin, L., editors, Channel flow, ductile extrusion, and exhumation of lower-mid crust in continental collision zones: Geological Society, London, Special Publications, v. 268, p. 517–541.

Hatcher, R., Bream, B., and Merschat, A., 2007, Tectonic map of the southern and central Appalachians: A tale of three orogens and a complete Wilson cycle: The Geological Society of America, Memoir 200, p. 1-38.

Heckel, P.H., 1986, Sea-level curve for Pennsylvanian eustatic marine transgressive-regressive depositional cycles along mid- continent outcrop belt, North America. Geology, v. 14, p. 330-334.

Hibbard, J. P., 2000, Docking Carolina: Mid-Paleozoic accretion in the southern Appalachians Geology, vol. 28, no. 2, p. 127–130.

Hibbard, J., Tracy, R., and Henika, W., 2003, Smith River allochthon: a southern Appalachian periGondwanan terrane emplaced directly on Laurentia?: Geology, v. 31, p. 215–218.

Hibbard, J.P., van Staal, C.R., and Miller, B.V., 2007, Links among Carolinia, Avalonia, and Ganderia in the Appalachian peri-Gondwanan realm, in Sears, J.W., Harms, T.A., and Evenchick, C.A., eds., Whence the Mountains? Inquiries into the Evolution of Orogenic Systems: A Volume in Honor of Raymond A. Price: Geological Society of America Special Paper 433, p. 291–311.

Hines, R. A., Jr., 1988, Carboniferous evolution of the Black Warrior foreland basin, Alabama and Mississippi [Ph.D. thesis]: Tuscaloosa, University of Alabama, 231 p.
Hodges, K.V., Hames, W. E., and Bowring, S.A., 1994, 40Ar/39Ar age gradients in micas from a high temperature–low-pressure metamorphic terrain; evidence for very slow cooling and implications for the interpretation of age spectra: Geology, v. 22, p. 55–58.
Hodges, K.V., Ruhl, K.W., Wobus, C.W., and Pringle, M.S., 2005, 40Ar/39Ar thermochronology of detrital minerals: Reviews in Mineralogy and Geochemistry, v. 58, p. 239–257.
Houseknecht, D.W., 1980, Comparative anatomy of a Pottsville lithic arenite and quartz arenite of the Pocahontas Basin, southern West Virginia: Petrographic, depositional, and stratigraphic implications: Journal of Sedimentary Petrology, v. 50, p. 3-20.
Houseknecht, D. W., and Kacena, J.A., 1983, Tectonic and sedimentary evolution of the Arkoma foreland basin, in Tectonic-sedimentary evolution of the Arkoma basin: SEPM Midcontinent Section, v. 1, p. 3-33.
Houseknecht, D. W., 1986, Evolution from passive margin to foreland basin: The Atoka Formation of the Arkoma basin, south-central U.S.A., in Allen, P. A., and Homewood, P., eds., Foreland basins: International Association of Sedimentologists Special Publication no. 8, p. 327-345.
Howell, P.D., and van der Pluijm, B.A., 1990, Early history of the Michigan basin: Subsidence and Appalachian tectonics. Geology; v. 18 (12), p. 1195–1198.
Ingersoll, R.V., and Suczek, C.A., 1979, Petrology and provenance of Neogene sand from Nicobar and Bengal fans, DSDP sites 211 and 218: Journal of Sedimentary Petrology, v. 49, p. 1217–1228.
Ingersoll, R.V., Bullard, T.F., Ford, R.L., Grimm, J.P., Pickle, J.D., and Sares, S.W., 1984, The effect of grain size on detrital modes: a test of the Gazzi-Dickinson point counting method: Journal of Sedimentary Petrology, v. 54, p. 103–116.
Ingersoll, R.V., Dickinson, W.R., and Graham, S.A., 2003, Remnant-ocean submarine fans: Largest sedimentary systems on Earth, in Isbell, J.L., Miller, M.F., Wolfe, K.L., and Lenaker, P.A., eds., Extreme depositional environments: Mega end members in geologic time: Geological Society of America, Special Paper 370, p. 191- 208.
Johnson, K.S., ed., 1988, Shelf-to-basin geology and resources of Pennsylvanian strata in the Arkoma Basin and frontal Ouachita Mountains of Oklahoma: Oklahoma Geological Survey, Guidebook 25, Norman, Oklahoma, p. 105.
Johnson, H. J., Thompson, J. T., and Miller, B. V., 2016, Basin to Mountains: Carboniferous inversion of the Ouachita Trough, Arkansas and Oklahoma U.S.A.: Geological Society of America, Abstracts with Programs, v. 48
Jordan, T. E., 1995, Retroarc foreland and related basins, in Busby, C. J., and Ingersoll, R. V., eds., Tectonics of sedimentary basins: Cambridge, Massachusetts, Blackwell Science, p. 331–362.
Karlstrom, K. E., and Bowring, S. A., 1988, Early Proterozoic assembly of tectonostratigraphic terranes in southwestern North America. J. Geol. v. 96 p. 561–576.

Karlstrom, K.E., Williams, M.L., Heizler, M.T., Holland, M.E., Grambling, T.A., Amato, J.M., 2016, U-Pb monazite and 40Ar/39Ar data supporting polyphase tectonism in the Manzano Mountains: a record of both the Mazatzal (1.66-1.60 Ga) and Picuris (1.45 Ga) orogenies. In: Frey, B. A., Karlstrom, K.E., Lucas, S.G., Williams, S., Zeigler, K., McLemore, V., Ulmer-Schole, D.S. (Eds), The Geology of the Belen Area, Guidebook, 67th Field Conference. New Mexico Geological Society, p. 177-184.

Kay, M., and Colbert, E.H., 1965, Stratigraphy and Life History. John Wiley & Sons Inc, New York.

Keller, G. R., 2012, An Overview of the Structure and Evolution of the Ouachita Orogenic Belt from Mississippi to Mexico. Search and Discovery Article #30234, Tulsa Geological Society.

Kissock, J.K., Finzel, E.S., Malone, D.H., and Craddock, J.P., 2017, Lower–Middle Pennsylvanian strata in the North American midcontinent record the interplay between erosional unroofing of the Appalachians and eustatic sea-level rise: Geosphere, v. 14, p. 141–161.

Kolata, D.R., Nelson, W.J., and Eidel, J.J., 1990, Tectonic history of the Illinois Basin: an overview: U.S. Geological Survey, Circular 1043, p. 16.

Kvale, E.P. and Bynum, J., 2014, Regional upwelling during Late Devonian Woodford deposition in Oklahoma and its influence on hydrocarbon production and well completion: AAPG Search and Discovery Article #80410, p. 34.

Laird, J., Lanphere, M. A., and Albee, A. L., 1984, Distribution of Ordovician and Devonian metamorphism in mafic and pelitic schists from northern Vermont: American Journal of Science, v. 284, p. 376– 413.

Lineback, J.A., 1966, Deep-water sediments adjacent to the Borden Siltstone (Mississippian) Delta in southern Illinois. Illinois State Geological Survey Circular 401.

Link, M. H., and Roberts, M. T., 1986, Pennsylvanian paleogeography for the Ozarks, Arkoma and Ouachita basins in east-central Arkansas, in Stone, C. G., and Haley, B. D., eds., Sedimentary and igneous rocks of the Ouachita Mountains of Arkansas, Pt. 2: Arkansas Geological Commission Guidebook 86-3, p. 37-60.

Lowe, D.R., 1989, Stratigraphy, sedimentology, and depositional setting of preorogenic rocks of the Ouachita Mountains, Arkansas and Oklahoma, in Hatcher, R.D., Jr., Thomas, W.A., and Viele, G.W., eds., The Appalachian–Ouachita orogen in the United States, The Geology of North America: Geological Society of America, v. F-2, p. 575–590.

Mack, G.H., Thomas, W.A., and Horsey, C.A., 1983, Composition of Carboniferous sandstone and tectonic framework of southern Appalachian-Ouachita Orogen: Journal of Sedimentary Petrology, vol. 53, p. 931-946.

Matthews, R.D., 1993, Review and revision of the Upper Devonian stratigraphy in the Michigan Basin. In: Roen, J.B., Kepferle, R.C. (Eds.), Petroleum geology of the Devonian and Mississippian black shale of eastern North America. U. S. Geological Survey Bulletin 1909, p. D1–D37.

McClellan, E.A., Steltenpohl, M.G., Thomas, C., and Miller, C., 2007, Isotopic age constraints and metamorphic history of the Talladega belt: New evidence for timing of arc magmatism and terrane emplacement along the southern Laurentian margin: Journal of Geology, v. 115, p. 541–561.

McDougal, I., and Harrison, M., 1999, Geochronology and Thermochronology by the 40Ar/39Ar method: Oxford University Press, New York, p. 271.

Meckel, L.D., 1970, Paleozoic alluvial deposition in the central Appalachians, in Fisher, G., Pettijohn, F.J., Reed, J.C., Jr., and Weaver, K.N., eds., Studies of Appalachian Geology: Central and Southern: New York, Interscience Publishers, p. 49–67.

Merrihue, C., and Turner, G., 1966, Potassium-Argon Dating by Activation with Fast Neutrons, J. Geophys. Res., 71(11), p. 2852-2857.

Merschat, A., Hatcher, R., and Davis, T., 2005, The northern Inner Piedmont, southern Appalachians, USA: Kinematics of transpression and SW-directed mid crustal fl ow: Journal of Structural Geology, v. 27, p. 1252–1281.

Merschat, A. J., and R. D. Hatcher Jr., 2007, The Cat Square terrane: Possible Siluro–Devonian remnant ocean basin in the Inner Piedmont, southern Appalachians, U.S.A., in R. D. Hatcher Jr., M. P. Carlson, J. H. McBride, and J. R. Martı´nez Catala´n, eds., 4-D framework of the continental crust: Geological Society of America Memoir 200, p. 553–565.

Merschat, A. J., Hatcher, R. D., Jr., Byars, H. E., and Gilliam, W. G., 2012, The Neoacadian orogenic core of the southern Appalachians: A Geo-traverse through the migmatitic Inner Piedmont from the Brushy Mountains to Lincolnton, North Carolina: Boulder, Colorado, Geological Society of America Annual Meeting Field Trip Guidebook, v. 29, p. 171–217.

Miall, A.D., 2000, Principles of Sedimentary Basin Analysis. 3rd ed. SpringerVerlang, Berlin.

Miall, A.D., 2008, The Southern Midcontinent, Permian Basin, and Ouachitas, in Miall, A.D., ed., The Sedimentary Basins of the United States and Canada, Sedimentary Basins of the World, v. 5: Elsevier, p. 297-327.

Miall, A.D., and Blakey, R.C., 2008, The Phanerozoic tectonic and sedimentary evolution of North America, in Miall, A.D., ed., Sedimentary Basins of United States and Canada: Amsterdam, Netherlands, Elsevier, p. 1–29.

Middleton, G.V., 1972, Albite of secondary origin in Charny Sandstones, Quebec, Journal of Sedimentary Petrology, V. 42, p. 341-349.

Miller, B. V., Fetter, A. H., and Steward, K. G., 2006, Plutonism in three orogenic pulses, Eastern Blue Ridge Province, southern Appalachians: GSA Bulletin, vol. 118, no. ½, p. 171-184.

Moecher, D.P., and Samson, S.D., 2006, Differential zircon fertility of source terranes and natural bias in the detrital zircon record: Implications for sedimentary provenance analysis: Earth and Planetary Science Letters, v. 247, p. 252–266.

Moore, M.F., 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 [MS Thesis]: Auburn University, Alabama, 142 p.

Morris, R.C., 1974, Carboniferous rocks of the Ouachita mountains, Arkansas: A study of facies patterns along the unstable slope and axis of a flysch trough: Geological Society of America, Special Paper 148, p. 241-279.

Morris, R.C., 1989, Stratigraphy and sedimentary history of post-Arkansas Novaculite Carboniferous rocks of the Ouachita Mountains, in Hatcher, R.D., Jr., Thomas, W.A., and Viele, G.W., eds., The Appalachian–Ouachita orogen in the United States, The Geology of North America, v. F-2: Geological Society of America, p. 591–602.

Murphy, J. B., and Keppie, J. D., 2005, The Acadian orogeny in the northern Appalachians. International Geology Review, v. 47, p. 663–687.

Osberg, P.H., Tull, J.F., Robinson, P., Hon, R., and Butler, J.R., 1989, The Acadian orogeny, *in* Hatcher, R.D., Jr., Thomas, W.A., and Viele, G.W., eds., The Appalachian–Ouachita orogen in the United States, The Geology of North America: Geological Society of America, v. F-2, p. 179–232.

Park, H., Barbeau, D.L., JR., Rickenbaker, A., Bachmann-Krug, D., and Gehrels, G., 2010, Application of foreland basin detrital-zircon geochronology to the reconstruction of the Southern and Central Appalachian Orogen: Journal of Geology, v. 118, p. 23-44.

Pashin, J.C., 1993, Tectonics, paleoceanography, and paleoclimate of the Kaskaskia Sequence in the Black Warrior basin of Alabama. Guidebook for the 30th An-nual Field Trip. Alabama Geological Society, p. 1–28.

Pashin, J.C., 1994, Flexurally influenced eustatic cycles in the Pottsville Formation (Lower Pennsylvanian), Black Warrior basin, Alabama. In: Dennison, J.M., Ettensohn, F.R. (Eds.), Tectonic and Eustatic Controls on Sedimentary Cycles. Concepts in Sedimentology and Paleontology, vol. 4. Society of Economic Paleontologists and Mineralogists, p. 89–105.

Pashin, J.C., 2004, Cyclothems of the Black Warrior basin in Alabama: eustatic snapshots of foreland basin tectonism, in Pashin, J.C., and Gastaldo, R.A., eds., Sequence Stratigraphy, Paleoclimate, and Tectonics of Coal-Bearing Strata: American Association of Petroleum Geologists, Studies in Geology 51, p. 199–217.

Pashin, J.C., and Ettensohn, F.R., 1995, Reevaluation of the Bedford-Berea sequence in Ohio and adjacent states: Forced regression in a foreland basin: Geological Society of America Special Paper 298, 68 p.

Pashin, J.C., and Gastaldo, R.A., 2009, Carboniferous of the Black Warrior basin, in Greb, S.F., and Chesnut, D.R., Jr., Carboniferous of the Appalachian and Black Warrior Basins: Kentucky Geological Survey, Special Publication 10, Lexington, Kentucky, p. 10-21.

Patchen, D.G., Avery, K.L., and Erwin, R.B., 1985, Correlation of strati-graphic units in North America–Northern Appalachian region correlation chart. Am. Assoc. Pet. Geol., p. 1

Peavy, T., 2008, Provenance of Lower Pennsylvanian Pottsville Formation, Cahaba Synclinorium, Alabama [MSc. Thesis]: Auburn University, Auburn, AL, 106 p.

Pauli, D., 1994, Friable submarine channel sandstones in the Jackfork group, Lynn mountain syncline, Pushmataha and Le Flore counties, Oklahoma. In: Geology and Resources of the Eastern Ouachita Mountains Frontal Belt and Southeastern Arkoma Basin, Oklahoma: Part II, Contributed Papers. Guidebook – Oklahoma Geological Survey, p. 179-202.

Potter, P.E., and Pryor, W.A., 1961, Dispersal centers of Paleozoic and later clastics of the upper Mississippi Valley and adjacent areas: Geological Society of America, Bulletin, v. 72, p. 1195–1249.

Quinlan, G. M., and Beaumont, C., 1984, Appalachian Thrusting, lithospheric flexure, and the Paleozoic stratigraphy of the Eastern Interior of North America: Canadian Journal of Earth Science, vol. 21, p. 973-996.

Ratcliffe, N. M., Hames, W. E., and Stanley, R. S., 1998. Interpretation of ages of arc magmatism and collisional tectonics in the Taconian Orogen of western New England. American Journal of Earth Sciences, v. 298, p. 791–797.

Reed, J.S., Eriksson, K.A., Kowalewski, M., 2005, Climatic, depositional and burial controls on diagenesis of Appalachian Carboniferous sandstones: qualitative and quantitative methods. Sedimentary Geology v. 176, p. 225–246.

Renne, P.R., Swisher, C.C., Deino, A.L., Karner, D.B., Owens, T., and DePaolo, D.J., 1998, Intercalibration of standards, absolute ages and uncertainties in40Ar/39Ar dating. Chem. Geol., Isotopic Geoscience Section, v. 145 (1–2), p. 117–152

Reynolds, P.H., Barr, S.M., and White, C.E. 2009, Provenance of detrital muscovite in Cambrian Avalonia of Maritime Canada: 40Ar/39Ar ages and chemical compositions. Canadian Journal of Earth Sciences, v. 46, p. 169–180.

Robinson, P., Tucker, R. D., Bradley, D., Berryl, V. H. N., and Osberg, P. H., 1998, Paleozoic orogens in New England, USA. Geologiska Fo¨reningens Stockholm Forhandlingar, 120, 119–148.

Sanford, B.V., 1993, St. Lawrence platform—geology; Chapter 11. In: Stott, D.F., Aitken, J.D. (Eds.), Sedimentary cover in Canada. Geological Survey of Canada, Geology of Canada 5, p. 723–786.

Shaulis, B.J., Lapen, T.J., Casey, J.F., and Reid, D.R., 2012, Timing and rates of flysch sedimentation in the Stanley Group, Ouachita Mountains, Oklahoma and Arkansas, U.S.A.: constraints from U-Pb zircon ages of subaqueous ash-flow tuffs: Journal of Sedimentary Research, v. 82, p. 833-840.

Sheehan, L. R., 2002, Sedimentary and petrologic analysis of the Mississippian Price Formation at Sherwood Lake West Virginia. MSc. Thesis, West Virginia University, p. 132.

Shideler, G.L., 1969, Dispersal patterns of Pennsylvanian sandstones in the Michigan Basin: Journal of Sedimentary Petrology, v. 39, p. 1229–1237.

Siever, R., 1957, The silica budget in the sedimentary cycle: American Mineralogist, v. 42, p. 821–841.

Siever, R., and Potter, P.E., 1956, Sedimentary petrology, part 2, sources of basal Pennsylvanian sediments in the Eastern Interior Basin: Journal of Geology, v. 64, p. 317– 335.

Sinha, A.K., Thomas, W.A., Hatcher, R.D., Jr., and Harrison, T.M., 2012, Geodynamic evolution of the central Appalachian orogen: Geochronology and compositional diversity of magmatism from Ordovician through Devonian: American Journal of Science, v. 312, p. 907–966.

Steltenpohl, M.G., Mueller, P.M., Heatherington, A.L., Hanley, T.B., and Wooden, J.L., 2008, Gondwanan/peri-Gondwanan origin for the Uchee terrane, Alabama and Georgia: Carolina zone or Suwannee terrane(?) and its suture with Grenvillian basement of the Pine Mountain window: Geosphere, v. 4, p. 131–144.

Stone, C.G., McFarland, J.D., III, and Haley, B.R., 1981, Field guide to the Paleozoic rocks of the Ouachita Mountain and Arkansas Valley Provinces, Arkansas: Arkansas Geological Commission, Guidebook 81-1, Little Rock, Arkansas, p. 140.

Suneson, N.H., Campbell, J.A., and Tilford, M.J., 1990, Geology and resources of the frontal belt of the western Ouachita Mountains, Oklahoma: Oklahoma Geological Survey, Special Publication 90-1, Norman, Oklahoma, 196 p.

Sutherland, P.K., and Manger, W.L., 1979, Mississippian-Pennsylvanian shelf-to-basin transition, Ozark and Ouachita regions, Oklahoma and Arkansas: Oklahoma Geological Survey, Guidebook 19, Norman, Oklahoma, 81 p.

Sutherland, P.K., 1988, Late Mississippian and Pennsylvanian depositional history in the Arkoma basin area, Oklahoma and Arkansas: Geological Society of America Bulletin, v. 100, p. 1787–1802.

Sutter, J. F., Ratcliffe, N. M., and Mukasa, S. B., 1985, 40Ar/39Ar and K-Ar data bearing on the metamorphic and tectonic history of western New England: Geological Society of America Bulletin, v. 96, p. 123–136.

Swann, D.H., Lineback, J.A., and Frund, E., 1965, The Borden Siltstone (Mississippian) Delta in southwestern Illinois: Illinois State Geological Survey, Circular, v. 386, p. 20.

Tankard, A. J., 1986, Depositional response to foreland deformation in the Carboniferous of Eastern Kentucky. Bull. Am. Ass. petrol. Geol., v. 70, p. 853- 868.

Thibodeaux, B. J., 2015, Emplacement, burial history, and thermal maturation of giant deformed shale masses in the Conasauga Formation, southern Appalachian thrust belt: Stillwater, Oklahoma State University, unpublished Master's thesis, p. 64.

Thomas, W.A., 1972, Regional Paleozoic Stratigraphy in Mississippi between Ouachita and Appalachian Mountains: American Association of Petroleum Geologist Bulletin, v. 56, p. 81-106.

Thomas, W.A., 1974, Converging clastic wedges in the Mississippian of Alabama: Geol. Soc. America Spec. Paper 148, p. 187-207.

Thomas, W.A., 1976, Evolution of Ouachita Appalachian continental margin: Journal of Geology, v. 84, p. 323–342.

Thomas, W.A., 1977, Evolution of Appalachian Ouachita salients and recesses from reentrants and promontories in the continental margin: American Journal of Science, v. 277, p. 1233– 1278.

Thomas, W. A., 1984, Carboniferous tectonic framework of the continental margin of southeastern North America: Ninth International Congress on Carboniferous Stratigraphy and Geology, Compte Rendu, v. 3, p. 291-302.

Thomas, W.A., 1985, The Appalachian-Ouachita connection: Paleozoic orogenic belt at the southern margin of North America: Annual Review of Earth and Planetary Sciences, v. 13, p. 175-199.

Thomas, W.A., 1988, The Black Warrior basin. In: Sloss, L. L., (Ed.) Sedimentary cover–North American craton, U.S. Geological Society of America, The Geology of North America, D-2, p. 471–492.

Thomas, W.A., 1993, Low-angle detachment geometry of the late Precambrian-Cambrian Appalachian-Ouachita rifted margin of southeastern North America: Geology, v. 21, p. 921-924.

Thomas, W.A., 2004, Genetic relationship of rift-stage crustal structure, terrane accretion, and foreland tectonics along the southern Appalachian–Ouachita orogen. Journal of Geodynamics v. 37, p. 549–563.

Thomas, W.A., 2006, Tectonic inheritance at a continental margin: GSA Today, v. 16, no. 2, p. 4–11.

Thomas, W.A., 2011, Detrital-zircon geochronology and sedimentary provenance. Lithosphere, v. 3 (4), p. 304–308.

Thomas W.A. Schenk P.E., 1988, Late Paleozoic sedimentation along the Appalachian orogen, in Harris A.L. Fettes D.J., eds., The Caledonian-Appalachian Orogen: Geological Society of London Special Publication 38, p. 515–530.

Thomas, W.A., Becker, T.P., Samson, S.D., and Hamilton, M.A., 2004, Detrital zircon evidence of a recycled orogenic foreland provenance for Alleghanian clastic-wedge sandstones. Journal of Geology v. 112, p. 23–37.

Thomas, W. A., Gehrels, G. E., Greb, S. F., Nadon, G. C., Satkoski, A. M., and Romero, M. C., 2017, Detrital zircons and sediment dispersal in the Appalachian foreland. Geosphere, v. 13(6), p. 2206-2230.

Thompson, J. T., Johnson, H. J., Hames, W. E., and Miller, B. V., 2017, Detrital zircon and muscovite age spectra, across the Mississippian-Pennsylvanian boundary, Ouachita basin, Oklahoma: Geological Society of America, Abstracts with Programs, v. 49.

Thompson, J. T., Johnson, H. J., and Hames, W. E., 2018, Initial investigation of detrital muscovite ages for the Arkoma-Ouachita Basin, with comparison to results from the Greater Black Warrior Basin: Geological Society of America, Abstracts with Programs, v. 54.

Uddin, A., Hames, W.E., Peavy, T., and Pashin, J.C., 2016, Detrital history of the lower Pennsylvanian Pottsville Formation in the Cahaba synclinorium of Alabama, U.S.A.: Journal of Sedimentary Research, v. 86, p. 1287-1297.

van Staal, C.R., Dewey, J.F., Mac Niocaill, C., and McKerrow, W.S., 1998, The Cambrian-Silurian tectonic evolution of the northern Appalachians and British Caledonides: History of a complex, west and southwest Pacific type segment of Iapetus, in Blundell, D., and Scott, A.C., eds., Lyell: The Past is the Key to the Present: Geological Society [London] Special Publication 143, p. 199–242.

Vermeesch, P., 2004, How many grains are needed for a provenance study?: Earth and Planetary Science Letters, v. 224, p. 441-451.

Ver Straeten, C. A., 2010, Lessons from the foreland basin: Northern Appalachian basin perspectives on the Acadian orogeny: Geological Society of America Memoirs, v. 206, p. 251–282.

Viele, G.W., and Thomas, W.A., 1989, Tectonic synthesis of the Ouachita orogenic belt, in Hatcher, R.D., Jr., Thomas, W.A., and Viele, G.W., eds., The Appalachian– Ouachita orogen in the United States, The Geology of North America: Geological Society of America, v. F-2, p. 695–728.

Wanless, H.R., Baroffio, J.R., Gamble, J.C., Horne, J.C., Orlopp, D.R., Rocha-Campos, A., Souter, J.E., Trescott, P.C., Vail, R.S., and Wright, C.R., 1970, Late Paleozoic deltas in the central and eastern United States. In: Morgan, J.P.(Ed.), Deltaic Sedimentation Modern and Ancient. SEPM Special Publication 15, p. 215–245.

Williams, H., an d Hatcher, R. D. , Jr., 1983, Appalachia n suspect terrenes, in Hatcher, R. D., Jr., Williams, H., and Zietz, I., eds., Contributions to the tectonics an d geophysics of mountain chains: Geological Society of America Memoir 158, p. 33-53.

White, C.E., 2010, Stratigraphy of the Lower Paleozoic Goldenville and Halifax groups in southwestern Nova Scotia. Atlantic Geology, v. 46, p. 136–154.

White, C.E., Barr, S.M., Horne, R.J., and Hamilton, M.A., 2007, The Neoacadian orogeny in the Meguma terrane, Nova Scotia, Canada: Geological Society of America Abstracts with Programs, v. 39, no. 1, p. 69.

Whitehead, J., Reynolds, P. H., and Spray, J. G., 1995, The sub-ophiolitic metamorphic rocks of the Quebec Appalachians: Journal of Geodynamics, v. 19, p. 325–350.

Whitehead, J., Reynolds, P.H., and Spray, J.G., 1996, 40Ar/39Ar age constraints on Taconian and Acadian events in the Quebec Appalachians: Geology, v. 24, p. 359–362.

Xie, X., O'Connor, P.M., and Alseban, H., 2016, Carboniferous sediment dispersal in the Appalachian-Ouachita juncture: Provenance of selected late Mississippian sandstones in the Black Warrior Basin, Mississippi, United States: Sedimentary Geology, v. 342, p. 191-201.

Xie, X., Buratowski, G., Manger, W.L., and Zachry, D., 2018, U-Pb detrital-zircon geochronology of the middle Bloyd sandstone (Morrowan) of northern Arkansas (U.S.A.): Implications for Early Pennsylvanian sediment dispersal in the Laurentian foreland: Journal of Sedimentary Research, v. 88, no. 7, p. 795–810.

Zachry, D. L., 1983, Sedimentary framework of the Atoka Formation, Arkoma basin, Arkansas, in Houseknecht, D. W., ed., Tectonic-sedimentary evolution of the Arkoma basin: Society of Economic Paleontologists and Mineralogists, Midcontinent Section, Guidebook, v. 1, p. 34-52.

Zahid, K.M., and Barbeau, D.L., 2011, Constructing sandstone provenance and classification ternary diagrams using an electronic spreadsheet: Journal of Sedimentary Research, v. 81, p. 702–707.

Ziegler, P.A., 1988, Evolution of the Arctic-North Atlantic and the Western Tethys: American Association of Petroleum Geologists Memoir, v. 43, p. 198.

Appendix 1: Sample Locations

Sample Name	Elevation (m)	Latitude	Longitude
OK12-1	205.1	N 35° 25' 6"	W 94° 33' 57"
OK12-4	160	N 35° 10' 51"	W 94° 31' 12"
OK12-21	211.3	N 34° 55' 20"	W 95° 48' 54"
OK12-23	314.2	N 34° 46' 29"	W 95° 18' 26"
OK12-31	192.4	N 34° 37' 58"	W 95° 12' 9"
OK12-32	231.4	N 34° 34' 51"	W 95° 20' 51"
OK12-37	293.8	1401650.3	3845383.1
OK12-39	265.6	N 34° 17' 1"	W 94° 46' 41"
OK12-45	216.5	1325662	W 3857597.9
OK12-50	241.3	1332907.5	3844717.4
OK12-54	169.1	N 34° 16' 46"	W 95° 32' 51"
OK12-55	163.9	N 34° 14' 11"	W 95° 35' 43"
OK12-56	157.8	N 34° 12' 6"	W 95° 29' 52"
OK12-63	302.5	1439839.4	3840858.2

Appendix 2: Geochronology Data

These analyses were determined in the Auburn Noble Isotope Mass Analysis Lab (ANIMAL).

The GLM-110 mass spectrometer was used for the analyses, that is a 10-cm radius 90-degree sector instrument with double focusing geometry, a Nier-type source, and a single detector (an ATP discrete dynode-style electron multiplier). Samples were heated or fused for gas extraction with a CO2 laser. Operation of the laser, extraction line and mass spectrometer were fully automated. The time required for one complete analysis cycle is 20 minutes (4 minutes gettering, followed by generally 10 measurements per peak and baseline, 30 measurements of m/e=36). Sample inlet and equilibration time is 5 s for a half-sample and 20 s for an entire sample. Blanks were measured following every 5th analysis. Blank correction to 36 Ar measurements are based on an average or regression of several blanks measured for a given day of analysis. Data were reduced using an Excel spreadsheet and Isoplot (Ludwig, 2012, Sp.Pub. BGC, 75 p.).The decay constants were assigned from Steiger and Jager (1977, EPSL, v. 36, 359-362.) and the age assigned to the GA-1550 monitor for J-value calculation is from the conventional K/Ar age determination of Renne et al. (1998, Chem. Geol., v. 145, p. 117-152). Argon isotopic ratios of air are from Nier (1950; Phys. Rev., v. 77, no. 6, p. 789-793.)

Data are in volts; errors are the standard deviation (unless indicated otherwise); errors for means and plateau ages include 0.125% error (1s measurement precision) for estimating the J-value. P = Laser Power Level (10 = 100%), t = laser heating time (s). Data are corrected for blank, mass discrimination, and interfeering nuclear reactions.

As almost three years elapsed from the time of irradiaiton to analysis, these data cannot be corrected for a presence of calcium-derived 36Ar (on the basis of measured 37Ar, due to its 37-day half-life). However, the high radiogenic yields of these analyses (typically ~99%) are consistent with a phase with abundant potassium and that lacks calcium, consistent with the general crystal-chemistry of muscovite.

Median Date of Analyses:	8/9/2018	
Irradiation Package:	AU-28	
Median Date of Irradiation:	11/30/2015	
Elapsed Days:	969	
GA1550 Biotite Age (Ma):	9.879E+07	
Measured 40Ar/36Ar:	293.0	± 1.0
(36/37)Ca:	0.0003046	± 0.0000084
(39/37)Ca:	0.0007380	± 0.0000370
(40/39)K:	0	± 0.00040
(38/39)Cl:	0.01	± 0.010

OK12-1 Muscovite (au28.5b.mus), 60/80#. Pennsylvanian Atoka Formation J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	0.05637	0.000381	0.00482	0.000065	0.00004	0.000016	0.00001	0.000014	0.000005	0.000009	4.33E-16	97.2%	11.3707	371.86	± 19.45
2	2.18105	0.002163	0.17415	0.000202	0.00229	0.000033	0.00003	0.000016	0.000027	0.000009	1.68E-14	99.6%	12.4793	404.33	± 0.80
3	0.95880	0.001276	0.07106	0.000318	0.00090	0.000026	0.00004	0.000016	0.000034	0.000013	7.36E-15	98.9%	13.3494	429.41	± 2.71
4	0.64936	0.000685	0.05273	0.000225	0.00066	0.000020	0.00003	0.000014	0.000039	0.000011	4.99E-15	98.2%	12.0975	393.21	± 2.61
5	1.16381	0.001393	0.08882	0.000263	0.00114	0.000029	0.00003	0.000011	0.000006	0.000015	8.94E-15	99.9%	13.0831	421.77	± 2.14
6	0.67392	0.000801	0.04793	0.000227	0.00069	0.000027	0.00003	0.000013	0.000033	0.000011	5.18E-15	98.5%	13.8562	443.86	± 3.15
7	0.08503	0.000255	0.00614	0.000051	0.00008	0.000021	-0.00001	0.000010	0.000012	0.000008	6.53E-16	95.9%	13.2791	427.40	± 13.73
8	0.74667	0.000591	0.07000	0.000252	0.00088	0.000021	-0.00003	0.000010	0.000022	0.000009	5.74E-15	99.1%	10.5757	348.21	± 1.78
9	0.06787	0.000476	0.00504	0.000054	0.00004	0.000018	-0.00003	0.000006	0.000007	0.000008	5.21E-16	97.0%	13.0621	421.17	± 16.27
10	0.28931	0.000453	0.02539	0.000151	0.00032	0.000022	-0.00003	0.000016	0.000025	0.000009	2.22E-15	97.4%	11.1040	363.96	± 4.03
11	0.93396	0.000683	0.08042	0.000206	0.00102	0.000021	-0.00001	0.000008	0.000014	0.000010	7.17E-15	99.5%	11.5609	377.47	± 1.53
12	0.62246	0.000828	0.04791	0.000253	0.00062	0.000019	-0.00001	0.000016	0.000012	0.000009	4.78E-15	99.4%	12.9171	416.99	± 2.94
13	0.26114	0.000398	0.02264	0.000137	0.00029	0.000018	0.00000	0.000009	0.000017	0.000009	2.01E-15	98.1%	11.3126	370.14	± 4.37
14	0.81067	0.001068	0.06580	0.000193	0.00086	0.000018	0.00000	0.000015	0.000015	0.000013	6.23E-15	99.4%	12.2500	397.66	± 2.23
15	0.96400	0.001223	0.08803	0.000346	0.00113	0.000032	0.00001	0.000009	0.000041	0.000010	7.40E-15	98.7%	10.8112	355.25	± 1.84
16	0.74354	0.000674	0.06439	0.000340	0.00094	0.000032	0.00001	0.000011	0.000036	0.000010	5.71E-15	98.6%	11.3824	372.21	± 2.48
17	2.17901	0.002475	0.17657	0.000384	0.00227	0.000039	0.00000	0.000013	0.000037	0.000011	1.67E-14	99.5%	12.2789	398.50	± 1.15
18	1.31780	0.001250	0.09360	0.000289	0.00122	0.000027	-0.00005	0.000014	0.000055	0.000011	1.01E-14	98.8%	13.9033	445.20	± 1.82
19	0.23408	0.000450	0.02316	0.000127	0.00029	0.000021	0.00000	0.000016	0.000021	0.000010	1.80E-15	97.4%	9.8409	326.07	± 4.57
20	1.43806	0.001568	0.14119	0.000398	0.00177	0.000039	0.00001	0.000011	0.000053	0.000009	1.10E-14	98.9%	10.0742	333.13	± 1.20
21	0.80553	0.000763	0.06885	0.000217	0.00089	0.000029	0.00001	0.000013	0.000027	0.000010	6.19E-15	99.0%	11.5865	378.23	± 1.86
22	0.35498	0.000851	0.03267	0.000166	0.00042	0.000022	-0.00001	0.000013	0.000021	0.000010	2.73E-15	98.3%	10.6803	351.34	± 3.57
23	0.90933	0.000779	0.07513	0.000409	0.00094	0.000032	-0.00001	0.000014	0.000017	0.000009	6.98E-15	99.4%	12.0349	391.38	± 2.44
24	0.61496	0.000806	0.04951	0.000257	0.00063	0.000025	0.00001	0.000014	-0.000002	0.000008	4.72E-15	100.1%	12.4202	402.61	± 2.71
25	0.87980	0.000995	0.07020	0.000149	0.00088	0.000026	-0.00001	0.000012	0.000020	0.000009	6.76E-15	99.3%	12.4498	403.47	± 1.57
26	1.84028	0.001550	0.13133	0.000410	0.00166	0.000040	0.00000	0.000017	0.000026	0.000011	1.41E-14	99.6%	13.9533	446.61	± 1.64
27	1.18647	0.001224	0.08609	0.000343	0.00110	0.000018	0.00003	0.000016	0.000078	0.000015	9.11E-15	98.1%	13.5131	434.09	± 2.48
28	0.70040	0.001087	0.06257	0.000313	0.00077	0.000018	0.00002	0.000011	0.000034	0.000010	5.38E-15	98.6%	11.0351	361.91	± 2.49
29	1.23292	0.001543	0.10482	0.000508	0.00131	0.000037	0.00004	0.000012	0.000029	0.000010	9.47E-15	99.3%	11.6805	380.99	± 2.13
30	1.56539	0.001421	0.11259	0.000338	0.00143	0.000023	0.00003	0.000012	0.000050	0.000009	1.20E-14	99.1%	13.7724	441.48	± 1.59

31	0.98082	0.000925	0.07875	0.000268	0.00098	0.000019	0.00003	0.000012	0.000027	0.000013	7.53E-15	99.2%	12.3522	400.64 ± 2.11
32	0.55032	0.000558	0.04143	0.000159	0.00058	0.000015	0.00002	0.000015	0.000035	0.000009	4.23E-15	98.1%	13.0346	420.38 ± 2.67
33	0.91914	0.001122	0.06810	0.000170	0.00089	0.000018	0.00005	0.000009	0.000034	0.000009	7.06E-15	98.9%	13.3519	429.48 ± 1.74
34	1.05620	0.000492	0.08710	0.000263	0.00114	0.000025	0.00003	0.000015	0.000012	0.000013	8.11E-15	99.7%	12.0855	392.86 ± 1.91
35	1.08689	0.001577	0.08196	0.000192	0.00116	0.000039	0.00005	0.000012	0.000032	0.000009	8.35E-15	99.1%	13.1465	423.59 ± 1.56
36	0.35434	0.000759	0.02801	0.000156	0.00036	0.000024	0.00001	0.000010	0.000033	0.000008	2.72E-15	97.2%	12.2979	399.06 ± 3.79
37	0.62646	0.000844	0.04865	0.000181	0.00067	0.000028	0.00000	0.000011	0.000217	0.000011	4.81E-15	89.8%	11.5582	377.39 ± 2.78
38	1.09091	0.001276	0.09407	0.000283	0.00122	0.000028	0.00002	0.000010	0.000039	0.000008	8.38E-15	98.9%	11.4745	374.93 ± 1.47
39	0.56755	0.000859	0.04824	0.000289	0.00060	0.000020	0.00001	0.000017	0.000049	0.000009	4.36E-15	97.5%	11.4652	374.65 ± 2.94
40	1.97135	0.001598	0.14397	0.000136	0.00181	0.000018	0.00001	0.000011	0.000050	0.000009	1.51E-14	99.3%	13.5915	436.33 ± 0.81
41	0.48855	0.001028	0.03644	0.000248	0.00050	0.000021	-0.00001	0.000009	0.000042	0.000010	3.75E-15	97.5%	13.0679	421.33 ± 4.00
42	0.86452	0.001059	0.07390	0.000341	0.00094	0.000020	0.00002	0.000009	0.000031	0.000010	6.64E-15	98.9%	11.5722	377.81 ± 2.21
43	0.64791	0.000589	0.04911	0.000265	0.00062	0.000021	0.00002	0.000013	0.000022	0.000009	4.98E-15	99.0%	13.0625	421.18 ± 2.92
44	1.00969	0.000818	0.09637	0.000311	0.00123	0.000017	0.00003	0.000013	0.000058	0.000011	7.76E-15	98.3%	10.3003	339.95 ± 1.59
45	0.75004	0.000867	0.06203	0.000285	0.00078	0.000022	0.00001	0.000011	0.000030	0.000009	5.76E-15	98.8%	11.9500	388.90 ± 2.37
46	5.41206	0.002668	0.06269	0.000113	0.00087	0.000027	0.00005	0.000027	0.000049	0.000009	4.16E-14	99.7%	86.1001	1814.00 ± 3.51
47	0.59028	0.000899	0.05630	0.000370	0.00067	0.000032	0.00000	0.000011	0.000052	0.000010	4.53E-15	97.4%	10.2105	337.24 ± 2.86
48	0.89102	0.001144	0.07133	0.000344	0.00092	0.000017	-0.00005	0.000023	0.000036	0.000010	6.84E-15	98.8%	12.3411	400.31 ± 2.40
49	1.08933	0.000783	0.08832	0.000260	0.00111	0.000026	0.00002	0.000008	0.000036	0.000009	8.37E-15	99.0%	12.2120	396.55 ± 1.57
50	0.67090	0.000812	0.05010	0.000241	0.00059	0.000025	0.00002	0.000009	0.000030	0.000010	5.15E-15	98.7%	13.2119	425.47 ± 2.82
51	1.27738	0.001812	0.11197	0.000465	0.00140	0.000021	0.00002	0.000008	0.000039	0.000010	9.81E-15	99.1%	11.3062	369.95 ± 1.84
52	0.98411	0.001207	0.08636	0.000243	0.00105	0.000024	-0.00002	0.000016	0.000029	0.000008	7.56E-15	99.1%	11.2958	369.65 ± 1.44
53	0.22443	0.000446	0.01846	0.000101	0.00023	0.000015	-0.00002	0.000008	0.000022	0.000007	1.72E-15	97.1%	11.8023	384.57 ± 4.27
54	0.73429	0.001189	0.06077	0.000311	0.00076	0.000019	-0.00002	0.000005	0.000030	0.000009	5.64E-15	98.8%	11.9387	388.57 ± 2.52
55	1.37861	0.001822	0.11945	0.000448	0.00156	0.000044	0.00004	0.000020	0.000014	0.000008	1.06E-14	99.7%	11.5071	375.89 ± 1.64
56	2.24470	0.001461	0.15202	0.000277	0.00189	0.000035	0.00000	0.000011	0.000033	0.000010	1.72E-14	99.6%	14.7006	467.68 ± 1.09
57	1.86302	0.001481	0.12915	0.000489	0.00161	0.000032	-0.00001	0.000012	0.000047	0.000008	1.43E-14	99.3%	14.3183	456.93 ± 1.87
58	0.69626	0.000846	0.05823	0.000304	0.00073	0.000018	0.00001	0.000011	0.000038	0.000008	5.35E-15	98.4%	11.7662	383.51 ± 2.50
59	0.36320	0.000601	0.02918	0.000161	0.00036	0.000016	-0.00002	0.000011	0.000011	0.000008	2.79E-15	99.1%	12.3306	400.01 ± 3.61
60	0.98391	0.000605	0.06766	0.000321	0.00099	0.000053	-0.00001	0.000017	0.000021	0.000008	7.56E-15	99.4%	14.4497	460.63 ± 2.50
61	0.55970	0.000652	0.04648	0.000295	0.00056	0.000019	-0.00001	0.000015	0.000019	0.000008	4.30E-15	99.0%	11.9179	387.96 ± 3.00
62	1.13784	0.001378	0.09941	0.000354	0.00126	0.000027	-0.00001	0.000009	0.000008	0.000016	8.74E-15	99.8%	11.4235	373.42 ± 2.11

63	1.06659	0.000942	0.08065	0.000485	0.00098	0.000022	0.00000	0.000012	0.000035	0.000009	8.19E-15	99.0%	13.0982	422.20 ± 2.81
64	0.12747	0.000550	0.00969	0.000119	0.00011	0.000015	-0.00008	0.000020	0.000012	0.000009	9.79E-16	97.3%	12.8073	413.83 ± 10.41
65	1.04829	0.001202	0.08548	0.000665	0.00109	0.000023	-0.00002	0.000010	0.000021	0.000008	8.05E-15	99.4%	12.1900	395.91 ± 3.27
66	1.16391	0.001117	0.09332	0.000338	0.00118	0.000031	0.00000	0.000015	0.000028	0.000008	8.94E-15	99.3%	12.3842	401.57 ± 1.73
67	1.90241	0.000909	0.13748	0.000329	0.00173	0.000024	-0.00001	0.000008	0.000019	0.000009	1.46E-14	99.7%	13.7964	442.16 ± 1.25
68	1.18228	0.001370	0.09594	0.000385	0.00123	0.000024	-0.00001	0.000011	0.000022	0.000007	9.08E-15	99.4%	12.2551	397.81 ± 1.82
69	0.58679	0.000622	0.04288	0.000166	0.00057	0.000020	0.00001	0.000013	0.000014	0.000008	4.51E-15	99.3%	13.5906	436.30 ± 2.48
70	0.56003	0.000942	0.04491	0.000144	0.00054	0.000022	-0.00006	0.000018	0.000001	0.000008	4.30E-15	99.9%	12.4615	403.81 ± 2.23
71	2.84033	0.001692	0.24480	0.000523	0.00314	0.000026	0.00000	0.000024	0.000076	0.000009	2.18E-14	99.2%	11.5109	376.00 ± 0.91
72	0.91399	0.001196	0.07677	0.000300	0.00099	0.000026	0.00003	0.000011	0.000114	0.000009	7.02E-15	96.3%	11.4655	374.66 ± 1.95
73	1.25609	0.001180	0.10122	0.000178	0.00125	0.000026	0.00001	0.000016	0.000023	0.000009	9.65E-15	99.4%	12.3406	400.30 ± 1.20
74	1.11989	0.001013	0.08958	0.000456	0.00113	0.000024	0.00001	0.000013	0.000019	0.000009	8.60E-15	99.5%	12.4395	403.17 ± 2.29
75	0.46131	0.000542	0.03840	0.000182	0.00048	0.000023	0.00002	0.000014	0.000047	0.000009	3.54E-15	97.0%	11.6543	380.22 ± 2.88
76	0.88740	0.000912	0.07610	0.000317	0.00094	0.000025	0.00003	0.000013	0.000050	0.000009	6.82E-15	98.4%	11.4690	374.76 ± 1.96
77	0.25886	0.000315	0.02040	0.000125	0.00023	0.000020	0.00000	0.000010	0.000011	0.000009	1.99E-15	98.7%	12.5275	405.73 ± 5.00
78	1.24401	0.000834	0.10814	0.000462	0.00138	0.000029	0.00007	0.000014	0.000028	0.000010	9.56E-15	99.3%	11.4284	373.57 ± 1.84
79	0.37446	0.000647	0.03260	0.000151	0.00043	0.000021	0.00006	0.000018	0.000022	0.000010	2.88E-15	98.3%	11.2896	369.46 ± 3.43
80	0.86878	0.000825	0.07459	0.000209	0.00092	0.000024	0.00000	0.000016	0.000027	0.000009	6.67E-15	99.1%	11.5391	376.83 ± 1.66
81	0.86932	0.001671	0.06881	0.000241	0.00099	0.000048	0.00002	0.000013	0.000029	0.000008	6.68E-15	99.0%	12.5094	405.20 ± 2.01
82	1.34941	0.002147	0.10799	0.000301	0.00136	0.000026	0.00002	0.000012	0.000034	0.000015	1.04E-14	99.3%	12.4019	402.08 ± 1.87
83	0.67579	0.000772	0.05526	0.000171	0.00071	0.000015	0.00002	0.000011	0.000029	0.000009	5.19E-15	98.7%	12.0729	392.49 ± 2.10
84	0.80059	0.000960	0.07116	0.000302	0.00090	0.000021	0.00001	0.000012	0.000029	0.000009	6.15E-15	98.9%	11.1302	364.74 ± 2.07
85	0.20650	0.000367	0.01679	0.000137	0.00020	0.000023	0.00004	0.000017	0.000023	0.000008	1.59E-15	96.7%	11.9005	387.45 ± 5.75
86	1.20701	0.001270	0.08631	0.000281	0.00109	0.000021	0.00006	0.000018	0.000031	0.000009	9.27E-15	99.2%	13.8772	444.45 ± 1.81
87	6.14262	0.002846	0.07722	0.000150	0.00106	0.000018	0.00001	0.000012	0.000021	0.000012	4.72E-14	99.9%	79.4697	1723.68 ± 3.59
88	1.37206	0.001858	0.10937	0.000397	0.00143	0.000035	0.00004	0.000018	0.000023	0.000008	1.05E-14	99.5%	12.4837	404.46 ± 1.74
89	0.63532	0.000796	0.05199	0.000261	0.00065	0.000015	0.00000	0.000008	0.000015	0.000008	4.88E-15	99.3%	12.1381	394.40 ± 2.50
90	0.57459	0.001191	0.04673	0.000270	0.00059	0.000020	0.00000	0.000011	0.000032	0.000008	4.41E-15	98.4%	12.0929	393.08 ± 2.98
91	0.35843	0.000772	0.03113	0.000134	0.00039	0.000020	-0.00002	0.000007	0.000020	0.000008	2.75E-15	98.3%	11.3247	370.50 ± 2.98
92	1.13014	0.001248	0.08021	0.000309	0.00104	0.000024	-0.00002	0.000011	0.000014	0.000014	8.68E-15	99.6%	14.0372	448.99 ± 2.43
93	0.82017	0.001367	0.06434	0.000278	0.00079	0.000020	-0.00001	0.000012	0.000027	0.000008	6.30E-15	99.0%	12.6230	408.49 ± 2.25
94	0.58226	0.000749	0.04569	0.000279	0.00057	0.000021	0.00000	0.000017	0.000015	0.000008	4.47E-15	99.3%	12.6509	409.30 ± 3.05

95	0.71034	0.000526	0.06116	0.000252	0.00078	0.000020	0.00000	0.000008	0.000023	0.000008	5.46E-15	99.1%	11.5042	375.80 ± 2.01
96	0.48530	0.000728	0.03811	0.000154	0.00049	0.000015	0.00000	0.000011	0.000025	0.000007	3.73E-15	98.5%	12.5419	406.15 ± 2.52
97	0.78809	0.000602	0.05750	0.000240	0.00075	0.000022	0.00001	0.000015	0.000018	0.000008	6.05E-15	99.3%	13.6158	437.02 ± 2.31
98	0.78350	0.001418	0.06583	0.000317	0.00082	0.000026	-0.00002	0.000010	0.000008	0.000013	6.02E-15	99.7%	11.8682	386.50 ± 2.76
99	0.83834	0.001301	0.05939	0.000249	0.00077	0.000020	0.00001	0.000014	0.000031	0.000008	6.44E-15	98.9%	13.9638	446.91 ± 2.35
100	0.48243	0.000324	0.03950	0.000108	0.00051	0.000012	0.00000	0.000011	0.000033	0.000009	3.71E-15	98.0%	11.9665	389.38 ± 2.36
101	0.55383	0.000673	0.04849	0.000241	0.00061	0.000021	-0.00001	0.000016	0.000026	0.000009	4.25E-15	98.6%	11.2617	368.64 ± 2.64
102	1.01030	0.001345	0.08060	0.000249	0.00103	0.000022	-0.00002	0.000011	0.000015	0.000010	7.76E-15	99.6%	12.4791	404.32 ± 1.79
103	0.55381	0.000986	0.03955	0.000169	0.00046	0.000024	-0.00002	0.000007	0.000004	0.000009	4.25E-15	99.8%	13.9691	447.06 ± 3.03
104	0.42733	0.000946	0.03902	0.000241	0.00049	0.000020	0.00004	0.000021	0.000007	0.000009	3.28E-15	99.5%	10.9029	357.98 ± 3.24
105	0.53901	0.000795	0.05221	0.000292	0.00063	0.000026	0.00001	0.000014	0.000015	0.000009	4.14E-15	99.2%	10.2382	338.08 ± 2.64
106	0.27837	0.000625	0.02341	0.000107	0.00029	0.000019	0.00000	0.000011	0.000007	0.000010	2.14E-15	99.3%	11.8050	384.65 ± 4.59
107	0.88268	0.001269	0.07531	0.000376	0.00095	0.000020	-0.00005	0.000021	0.000029	0.000010	6.78E-15	99.0%	11.6066	378.82 ± 2.37
108	1.86023	0.001522	0.15061	0.000314	0.00190	0.000027	0.00002	0.000016	0.000004	0.000013	1.43E-14	99.9%	12.3439	400.39 ± 1.22
109	0.84854	0.001386	0.07198	0.000176	0.00091	0.000028	0.00000	0.000011	0.000017	0.000009	6.52E-15	99.4%	11.7206	382.17 ± 1.65
110	1.04440	0.000925	0.08336	0.000303	0.00100	0.000026	0.00000	0.000011	0.000022	0.000009	8.02E-15	99.4%	12.4502	403.48 ± 1.86
111	0.73008	0.000709	0.05911	0.000236	0.00073	0.000029	0.00000	0.000010	0.000014	0.000010	5.61E-15	99.4%	12.2835	398.64 ± 2.26
112	0.52899	0.000848	0.04193	0.000195	0.00051	0.000023	0.00000	0.000013	0.000008	0.000009	4.06E-15	99.5%	12.5555	406.54 ± 2.84

OK12-4 Muscovite (au28.5g.mus), 60/80#. Pennsylvanian Atoka Formation J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	5.36173	0.004343	0.46692	0.000638	0.00598	0.000041	0.00002	0.000012	0.000168	0.000010	4.12E-14	99.1%	11.3770	372.05	± 0.63
2	2.15462	0.001378	0.17310	0.000527	0.00227	0.000032	0.00003	0.000014	0.000094	0.000010	1.65E-14	98.7%	12.2864	398.72	± 1.38
3	1.43546	0.001511	0.12821	0.000545	0.00162	0.000033	0.00002	0.000012	0.000078	0.000012	1.10E-14	98.4%	11.0168	361.37	± 1.86
4	1.33026	0.001831	0.10840	0.000319	0.00145	0.000038	0.00002	0.000014	0.000052	0.000011	1.02E-14	98.9%	12.1309	394.19	± 1.60
5	2.49970	0.001850	0.21708	0.000531	0.00282	0.000043	0.00000	0.000013	0.000073	0.000011	1.92E-14	99.1%	11.4151	373.17	± 1.07
6	1.75579	0.001538	0.14086	0.000439	0.00176	0.000028	0.00004	0.000015	0.000058	0.000009	1.35E-14	99.0%	12.3430	400.37	± 1.45
7	1.34540	0.001100	0.11549	0.000380	0.00147	0.000028	0.00003	0.000011	0.000052	0.000011	1.03E-14	98.9%	11.5171	376.18	± 1.60
8	0.83488	0.000754	0.07107	0.000274	0.00089	0.000026	0.00002	0.000011	0.000032	0.000011	6.41E-15	98.9%	11.6166	379.11	± 2.09
9	0.84687	0.001026	0.07358	0.000478	0.00093	0.000031	0.00003	0.000015	0.000023	0.000010	6.50E-15	99.2%	11.4191	373.29	± 2.81
10	2.65762	0.001394	0.23377	0.000492	0.00326	0.000061	0.00004	0.000011	0.000080	0.000011	2.04E-14	99.1%	11.2670	368.79	± 0.92
11	2.42315	0.002314	0.19183	0.000391	0.00242	0.000046	0.00003	0.000017	0.000007	0.000017	1.86E-14	99.9%	12.6211	408.44	± 1.27
12	2.15852	0.001616	0.17570	0.000537	0.00233	0.000042	0.00000	0.000005	0.000059	0.000011	1.66E-14	99.2%	12.1867	395.82	± 1.39
13	3.44487	0.001459	0.28146	0.000579	0.00377	0.000060	0.00004	0.000013	0.000077	0.000011	2.65E-14	99.3%	12.1581	394.98	± 0.91
14	2.47888	0.001921	0.21417	0.000381	0.00290	0.000045	0.00002	0.000017	0.000072	0.000012	1.90E-14	99.1%	11.4747	374.93	± 0.91
15	2.57745	0.002890	0.20477	0.000383	0.00278	0.000060	0.00004	0.000012	0.000019	0.000017	1.98E-14	99.8%	12.5594	406.65	± 1.18
16	1.82618	0.001123	0.12913	0.000367	0.00164	0.000037	0.00004	0.000014	0.000054	0.000011	1.40E-14	99.1%	14.0191	448.48	± 1.55
17	0.61400	0.000986	0.05131	0.000260	0.00065	0.000029	-0.00003	0.000013	0.000040	0.000011	4.72E-15	98.1%	11.7376	382.67	± 2.92
18	0.59317	0.001119	0.04633	0.000170	0.00059	0.000028	-0.00001	0.000013	0.000012	0.000010	4.56E-15	99.4%	12.7254	411.46	± 2.74
19	4.60032	0.002382	0.37830	0.000429	0.00493	0.000043	0.00004	0.000013	0.000032	0.000011	3.53E-14	99.8%	12.1354	394.32	± 0.56
20	0.85801	0.001649	0.06827	0.000254	0.00082	0.000037	-0.00002	0.000019	0.000020	0.000011	6.59E-15	99.3%	12.4838	404.46	± 2.32
21	1.98573	0.001647	0.17192	0.000293	0.00224	0.000035	-0.00003	0.000010	0.000030	0.000011	1.53E-14	99.6%	11.4989	375.64	± 0.95
22	0.62358	0.001022	0.05292	0.000186	0.00066	0.000024	-0.00002	0.000015	0.000015	0.000012	4.79E-15	99.3%	11.7024	381.64	± 2.61
23	1.03442	0.001599	0.07803	0.000205	0.00098	0.000027	-0.00002	0.000013	0.000018	0.000012	7.95E-15	99.5%	13.1877	424.78	± 1.94
24	2.43385	0.001558	0.20224	0.000356	0.00255	0.000041	-0.00002	0.000012	0.000093	0.000011	1.87E-14	98.9%	11.8984	387.39	± 0.91
25	0.44198	0.000710	0.03699	0.000144	0.00047	0.000020	-0.00001	0.000010	0.000049	0.000010	3.39E-15	96.7%	11.5541	377.27	± 3.14
26	0.97023	0.000779	0.08395	0.000566	0.00103	0.000024	0.00001	0.000011	0.000011	0.000011	7.45E-15	99.7%	11.5187	376.23	± 2.85
27	1.32300	0.001412	0.11413	0.000461	0.00146	0.000021	-0.00004	0.000013	0.000023	0.000012	1.02E-14	99.5%	11.5318	376.61	± 1.86
28	2.46712	0.004583	0.20325	0.000513	0.00257	0.000032	0.00001	0.000011	0.000038	0.000011	1.90E-14	99.5%	12.0829	392.79	± 1.35
29	1.05437	0.001784	0.08163	0.000420	0.00103	0.000027	-0.00002	0.000012	0.000013	0.000012	8.10E-15	99.6%	12.8692	415.61	± 2.64
30	0.74705	0.000676	0.06112	0.000188	0.00077	0.000032	-0.00001	0.000015	0.000039	0.000011	5.74E-15	98.5%	12.0363	391.42	± 2.18

31	1.46439	0.001262	0.11886	0.000399	0.00145	0.000027	-0.00001	0.000019	0.000020	0.000010	1.12E-14	99.6%	12.2691	398.22 ± 1.62
32	1.01586	0.001471	0.07621	0.000276	0.00101	0.000026	-0.00003	0.000019	0.000027	0.000011	7.80E-15	99.2%	13.2240	425.82 ± 2.18
33	0.68074	0.001424	0.05547	0.000177	0.00069	0.000020	-0.00003	0.000016	0.000023	0.000010	5.23E-15	99.0%	12.1510	394.78 ± 2.37
34	1.74169	0.001362	0.15014	0.000290	0.00190	0.000034	-0.00005	0.000017	0.000018	0.000015	1.34E-14	99.7%	11.5653	377.60 ± 1.26
35	2.88539	0.002101	0.24012	0.000504	0.00296	0.000035	0.00003	0.000028	0.000045	0.000017	2.22E-14	99.5%	11.9608	389.22 ± 1.11
36	4.16529	0.002711	0.34936	0.000546	0.00445	0.000062	0.00000	0.000016	0.000013	0.000018	3.20E-14	99.9%	11.9119	387.78 ± 0.82
37	2.17389	0.000935	0.17358	0.000448	0.00223	0.000031	-0.00002	0.000012	0.000013	0.000010	1.67E-14	99.8%	12.5018	404.98 ± 1.19
38	3.92979	0.001502	0.33376	0.000912	0.00425	0.000035	-0.00002	0.000022	0.000021	0.000018	3.02E-14	99.8%	11.7556	383.20 ± 1.18
39	3.63312	0.002383	0.28796	0.000570	0.00363	0.000039	0.00001	0.000018	0.000072	0.000011	2.79E-14	99.4%	12.5430	406.18 ± 0.92
40	1.27006	0.001570	0.10052	0.000480	0.00123	0.000034	-0.00003	0.000015	0.000042	0.000011	9.76E-15	99.0%	12.5116	405.27 ± 2.28
41	0.70028	0.000921	0.05603	0.000320	0.00068	0.000029	-0.00001	0.000015	0.000006	0.000013	5.38E-15	99.7%	12.4658	403.94 ± 3.20
42	0.95677	0.001168	0.08243	0.000370	0.00103	0.000027	-0.00001	0.000019	0.000011	0.000010	7.35E-15	99.6%	11.5664	377.63 ± 2.14
43	1.24325	0.001907	0.10352	0.000270	0.00135	0.000030	-0.00002	0.000014	0.000044	0.000012	9.55E-15	98.9%	11.8831	386.94 ± 1.61
44	1.07837	0.001180	0.09335	0.000181	0.00114	0.000020	-0.00008	0.000025	0.000017	0.000011	8.28E-15	99.5%	11.4966	375.58 ± 1.42
45	2.19531	0.002079	0.18338	0.000587	0.00233	0.000034	-0.00005	0.000013	0.000024	0.000011	1.69E-14	99.7%	11.9328	388.40 ± 1.42
46	1.17411	0.001288	0.09604	0.000386	0.00123	0.000036	-0.00002	0.000015	0.000042	0.000010	9.02E-15	98.9%	12.0950	393.14 ± 1.95
47	1.29947	0.002021	0.11298	0.000274	0.00140	0.000038	-0.00003	0.000015	0.000039	0.000011	9.98E-15	99.1%	11.3988	372.69 ± 1.44
48	0.71972	0.000620	0.06019	0.000230	0.00077	0.000026	-0.00001	0.000017	0.000030	0.000011	5.53E-15	98.8%	11.8112	384.83 ± 2.27
49	0.49615	0.000646	0.04144	0.000262	0.00049	0.000022	-0.00002	0.000010	0.000020	0.000010	3.81E-15	98.8%	11.8319	385.44 ± 3.39
50	1.00991	0.000887	0.08691	0.000175	0.00108	0.000035	-0.00001	0.000018	-0.000031	0.000015	7.76E-15	100.9%	11.6200	379.21 ± 1.86
51	4.02505	0.003027	0.35124	0.000685	0.00470	0.000081	-0.00010	0.000021	0.000017	0.000018	3.09E-14	99.9%	11.4454	374.07 ± 0.93
52	0.78467	0.000787	0.06026	0.000347	0.00079	0.000023	-0.00002	0.000013	0.000014	0.000011	6.03E-15	99.5%	12.9552	418.09 ± 3.05
53	9.09248	0.005457	0.72981	0.001023	0.00947	0.000076	0.00000	0.000009	0.000101	0.000011	6.98E-14	99.7%	12.4179	402.55 ± 0.63
54	1.21888	0.001350	0.10469	0.000226	0.00131	0.000033	-0.00002	0.000013	-0.000009	0.000018	9.36E-15	100.2%	11.6425	379.88 ± 1.88
55	0.68297	0.000921	0.05719	0.000326	0.00074	0.000026	0.00000	0.000012	0.000021	0.000012	5.25E-15	99.1%	11.8340	385.50 ± 3.00
56	1.29978	0.001646	0.10886	0.000243	0.00137	0.000026	0.00000	0.000015	0.000032	0.000017	9.98E-15	99.3%	11.8522	386.04 ± 1.78
57	1.64941	0.001859	0.14277	0.000290	0.00181	0.000031	-0.00004	0.000011	0.000034	0.000010	1.27E-14	99.4%	11.4834	375.19 ± 1.11
58	4.08562	0.002125	0.35157	0.000332	0.00439	0.000043	-0.00001	0.000013	0.000046	0.000010	3.14E-14	99.7%	11.5820	378.10 ± 0.49
59	0.59996	0.000732	0.04913	0.000300	0.00059	0.000022	-0.00006	0.000009	0.000030	0.000012	4.61E-15	98.5%	12.0323	391.31 ± 3.35
60	1.80783	0.001093	0.15849	0.000346	0.00201	0.000039	0.00001	0.000022	0.000026	0.000011	1.39E-14	99.6%	11.3589	371.51 ± 1.09
61	1.63858	0.001703	0.13083	0.000215	0.00168	0.000027	-0.00004	0.000009	0.000030	0.000013	1.26E-14	99.5%	12.4568	403.68 ± 1.21
62	1.35182	0.001163	0.11368	0.000406	0.00141	0.000018	-0.00003	0.000014	0.000027	0.000010	1.04E-14	99.4%	11.8214	385.13 ± 1.67

63	0.93954	0.001722	0.08083	0.000255	0.00095	0.000033	-0.00002	0.000016	0.000001	0.000017	7.22E-15	100.0%	11.6205	379.23 ± 2.44
64	1.71541	0.001954	0.13727	0.000301	0.00170	0.000029	-0.00003	0.000016	0.000032	0.000010	1.32E-14	99.5%	12.4285	402.85 ± 1.21
65	5.48814	0.001931	0.44865	0.000737	0.00581	0.000041	-0.00001	0.000012	0.000032	0.000011	4.22E-14	99.8%	12.2115	396.54 ± 0.71
66	1.56822	0.001506	0.13171	0.000446	0.00162	0.000030	-0.00003	0.000010	0.000041	0.000011	1.20E-14	99.2%	11.8140	384.91 ± 1.60
67	1.34250	0.001264	0.10514	0.000400	0.00131	0.000042	-0.00003	0.000010	-0.000034	0.000019	1.03E-14	100.8%	12.7692	412.72 ± 2.39
68	0.99711	0.000928	0.08535	0.000222	0.00109	0.000031	-0.00001	0.000009	0.000000	0.000012	7.66E-15	100.0%	11.6822	381.04 ± 1.71
69	1.71377	0.001598	0.14169	0.000556	0.00181	0.000021	-0.00001	0.000012	0.000050	0.000011	1.32E-14	99.1%	11.9916	390.12 ± 1.75
70	1.52805	0.000942	0.13262	0.000391	0.00169	0.000025	-0.00001	0.000018	0.000034	0.000011	1.17E-14	99.3%	11.4462	374.09 ± 1.39
71	2.01382	0.001471	0.17194	0.000342	0.00217	0.000038	-0.00002	0.000018	0.000022	0.000011	1.55E-14	99.7%	11.6746	380.82 ± 1.02
72	2.62263	0.001255	0.22636	0.000389	0.00301	0.000074	-0.00002	0.000011	0.000045	0.000016	2.01E-14	99.5%	11.5268	376.47 ± 0.97
73	1.73911	0.001330	0.14152	0.000300	0.00179	0.000030	-0.00003	0.000013	-0.000008	0.000022	1.34E-14	100.1%	12.2884	398.78 ± 1.72
74	3.86606	0.004048	0.33709	0.000564	0.00418	0.000043	0.00000	0.000023	0.000064	0.000011	2.97E-14	99.5%	11.4130	373.11 ± 0.80
75	2.64766	0.001766	0.07694	0.000243	0.00097	0.000034	-0.00004	0.000014	0.000041	0.000012	2.03E-14	99.5%	34.2540	946.19 ± 3.31
76	1.55072	0.002089	0.13018	0.000253	0.00177	0.000048	-0.00001	0.000020	0.000003	0.000018	1.19E-14	99.9%	11.9058	387.61 ± 1.63
77	0.52550	0.000924	0.04344	0.000246	0.00050	0.000025	-0.00003	0.000017	0.000013	0.000012	4.04E-15	99.3%	12.0103	390.66 ± 3.46
78	0.79317	0.000830	0.06665	0.000371	0.00085	0.000020	-0.00001	0.000014	0.000024	0.000011	6.09E-15	99.1%	11.7935	384.31 ± 2.68
79	3.07301	0.002188	0.23627	0.000265	0.00310	0.000046	-0.00001	0.000016	0.000092	0.000010	2.36E-14	99.1%	12.8912	416.24 ± 0.69
80	3.26556	0.002720	0.26472	0.000803	0.00333	0.000051	-0.00001	0.000012	0.000051	0.000010	2.51E-14	99.5%	12.2787	398.50 ± 1.31
81	1.37526	0.001292	0.10813	0.000223	0.00133	0.000031	0.00003	0.000026	0.000000	0.000016	1.06E-14	100.0%	12.7172	411.22 ± 1.73
82	2.87345	0.002489	0.24827	0.000548	0.00316	0.000044	-0.00004	0.000021	0.000064	0.000010	2.21E-14	99.3%	11.4972	375.60 ± 0.98
83	5.42551	0.003132	0.45947	0.001011	0.00578	0.000032	-0.00001	0.000019	0.000050	0.000019	4.17E-14	99.7%	11.7759	383.80 ± 0.96
84	3.27304	0.004420	0.28398	0.000458	0.00356	0.000045	-0.00001	0.000010	-0.000002	0.000019	2.51E-14	100.0%	11.5255	376.43 ± 1.02
85	3.04432	0.001915	0.25586	0.000418	0.00332	0.000031	0.00000	0.000011	0.000048	0.000011	2.34E-14	99.5%	11.8427	385.76 ± 0.80
86	4.72873	0.003252	0.39707	0.000652	0.00505	0.000058	-0.00004	0.000019	0.000042	0.000016	3.63E-14	99.7%	11.8775	386.78 ± 0.79
87	2.83862	0.001975	0.23172	0.000526	0.00299	0.000033	-0.00004	0.000018	0.000028	0.000017	2.18E-14	99.7%	12.2144	396.62 ± 1.18
88	2.55347	0.001989	0.21238	0.000547	0.00272	0.000048	0.00000	0.000012	0.000031	0.000011	1.96E-14	99.6%	11.9791	389.75 ± 1.16
89	4.40144	0.002518	0.37747	0.000639	0.00494	0.000100	-0.00003	0.000062	0.000101	0.000016	3.38E-14	99.3%	11.5810	378.07 ± 0.80
90	2.75448	0.001818	0.23574	0.000466	0.00300	0.000036	-0.00001	0.000012	0.000071	0.000010	2.12E-14	99.2%	11.5948	378.47 ± 0.89
91	2.66576	0.001710	0.23238	0.000572	0.00292	0.000032	-0.00003	0.000012	0.000026	0.000010	2.05E-14	99.7%	11.4384	373.86 ± 1.05
92	0.37960	0.000697	0.02988	0.000068	0.00036	0.000021	-0.00002	0.000012	0.000023	0.000011	2.92E-15	98.2%	12.4801	404.35 ± 3.61
93	2.29504	0.002136	0.18057	0.000455	0.00228	0.000030	-0.00005	0.000016	0.000044	0.000011	1.76E-14	99.4%	12.6377	408.92 ± 1.26
94	0.87809	0.001245	0.07119	0.000322	0.00088	0.000029	-0.00003	0.000017	-0.000027	0.000017	6.74E-15	100.9%	12.3351	400.14 ± 2.97

95	5.46192	0.005208	0.37689	0.000478	0.00484	0.000064	0.00000	0.000012	0.000090	0.000011	4.20E-14	99.5%	14.4213	459.83 ± 0.79
96	2.75625	0.002170	0.22643	0.000424	0.00292	0.000036	-0.00002	0.000010	0.000000	0.000020	2.12E-14	100.0%	12.1724	395.40 ± 1.17
97	1.94400	0.001901	0.15090	0.000369	0.00193	0.000025	-0.00002	0.000016	-0.000012	0.000019	1.49E-14	100.2%	12.8825	416.00 ± 1.62
98	1.80249	0.001207	0.14188	0.000351	0.00181	0.000028	-0.00003	0.000013	-0.000005	0.000021	1.38E-14	100.1%	12.7040	410.84 ± 1.77
99	0.83938	0.001323	0.07178	0.000288	0.00090	0.000031	-0.00004	0.000012	0.000046	0.000011	6.45E-15	98.4%	11.5056	375.84 ± 2.20
100	3.24155	0.001954	0.26395	0.000445	0.00336	0.000035	0.00000	0.000025	0.000029	0.000014	2.49E-14	99.7%	12.2487	397.62 ± 0.89
101	1.56506	0.001172	0.13437	0.000315	0.00169	0.000023	-0.00005	0.000015	0.000051	0.000012	1.20E-14	99.0%	11.5351	376.71 ± 1.26
102	2.30069	0.001909	0.19676	0.000708	0.00252	0.000041	-0.00001	0.000014	0.000022	0.000015	1.77E-14	99.7%	11.6603	380.40 ± 1.60
103	2.63044	0.002097	0.17709	0.000472	0.00224	0.000028	-0.00003	0.000016	0.000009	0.000018	2.02E-14	99.9%	14.8386	471.54 ± 1.63
104	1.15960	0.001304	0.10011	0.000364	0.00125	0.000034	-0.00001	0.000012	-0.000024	0.000015	8.91E-15	100.6%	11.5837	378.14 ± 2.05
105	1.25980	0.001399	0.10236	0.000417	0.00129	0.000035	-0.00002	0.000018	0.000030	0.000011	9.68E-15	99.3%	12.2215	396.83 ± 1.99
106	2.01351	0.001734	0.15631	0.000204	0.00196	0.000033	-0.00002	0.000014	0.000021	0.000011	1.55E-14	99.7%	12.8415	414.81 ± 0.92
107	4.20811	0.001448	0.37003	0.000648	0.00466	0.000056	0.00000	0.000017	0.000072	0.000011	3.23E-14	99.5%	11.3145	370.20 ± 0.73
108	0.60511	0.000793	0.05231	0.000171	0.00064	0.000026	0.00001	0.000013	-0.000008	0.000010	4.65E-15	100.4%	11.5680	377.68 ± 2.30
109	3.36174	0.002783	0.27022	0.000211	0.00344	0.000041	-0.00001	0.000018	0.000128	0.000012	2.58E-14	98.9%	12.3008	399.14 ± 0.62
110	2.02329	0.001947	0.17379	0.000388	0.00218	0.000034	-0.00004	0.000013	0.000028	0.000011	1.55E-14	99.6%	11.5953	378.49 ± 1.10
111	1.54152	0.001237	0.12489	0.000290	0.00154	0.000038	-0.00002	0.000013	-0.000002	0.000015	1.18E-14	100.0%	12.3434	400.38 ± 1.49
112	2.27160	0.001974	0.18016	0.000406	0.00232	0.000028	-0.00001	0.000018	0.000047	0.000012	1.74E-14	99.4%	12.5316	405.85 ± 1.16

OK12-21 Muscovite (au28.5d.mus), 60/80#. Pennsylvanian Krebs Group J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	1.42295	0.000813	0.09926	0.000156	0.00127	0.000038	-0.00002	0.000017	0.000033	0.000013	1.09E-14	99.3%	14.2381	454.67	± 1.44
2	1.95291	0.001559	0.13739	0.000375	0.00184	0.000048	0.00002	0.000017	0.000031	0.000013	1.50E-14	99.5%	14.1481	452.13	± 1.59
3	1.36080	0.000852	0.09523	0.000381	0.00121	0.000043	0.00001	0.000021	0.000038	0.000012	1.05E-14	99.2%	14.1728	452.83	± 2.20
4	1.68986	0.001201	0.12022	0.000268	0.00155	0.000022	0.00002	0.000010	0.000021	0.000012	1.30E-14	99.6%	14.0060	448.11	± 1.43
5	1.41272	0.001184	0.11977	0.000346	0.00153	0.000033	0.00003	0.000011	0.000025	0.000012	1.09E-14	99.5%	11.7336	382.55	± 1.50
6	0.54336	0.000932	0.03928	0.000122	0.00050	0.000015	0.00004	0.000014	0.000021	0.000012	4.17E-15	98.8%	13.6714	438.60	± 3.24
7	1.17230	0.000745	0.09435	0.000292	0.00122	0.000024	0.00003	0.000027	0.000032	0.000013	9.00E-15	99.2%	12.3238	399.81	± 1.84
8	1.54530	0.001250	0.10734	0.000399	0.00140	0.000020	0.00002	0.000009	0.000034	0.000012	1.19E-14	99.4%	14.3040	456.53	± 2.04
9	0.58535	0.000559	0.04313	0.000175	0.00055	0.000024	0.00003	0.000014	0.000023	0.000013	4.50E-15	98.8%	13.4126	431.22	± 3.43
10	3.12802	0.001759	0.21963	0.000775	0.00271	0.000035	0.00002	0.000019	-0.000022	0.000016	2.40E-14	100.2%	14.2420	454.78	± 1.77
11	2.57036	0.001666	0.17941	0.000258	0.00229	0.000037	0.00004	0.000020	-0.000026	0.000019	1.97E-14	100.3%	14.3264	457.16	± 1.24
12	1.22270	0.000799	0.10999	0.000333	0.00138	0.000026	0.00003	0.000020	0.000029	0.000013	9.39E-15	99.3%	11.0391	362.04	± 1.63
13	0.77449	0.001219	0.05353	0.000201	0.00065	0.000027	0.00004	0.000014	0.000018	0.000013	5.95E-15	99.3%	14.3675	458.32	± 2.92
14	0.86069	0.001075	0.06531	0.000141	0.00078	0.000035	0.00002	0.000018	0.000022	0.000012	6.61E-15	99.2%	13.0762	421.57	± 2.03
15	1.59520	0.001396	0.11025	0.000302	0.00140	0.000017	0.00001	0.000020	0.000032	0.000013	1.23E-14	99.4%	14.3830	458.76	± 1.74
16	1.82108	0.001722	0.13530	0.000360	0.00170	0.000029	0.00004	0.000014	-0.000009	0.000017	1.40E-14	100.1%	13.4594	432.55	± 1.73
17	1.59246	0.001498	0.11329	0.000242	0.00139	0.000028	0.00001	0.000013	-0.000036	0.000021	1.22E-14	100.7%	14.0562	449.53	± 2.08
18	1.79746	0.001594	0.13001	0.000519	0.00165	0.000028	0.00002	0.000016	0.000061	0.000014	1.38E-14	99.0%	13.6880	439.08	± 2.09
19	0.27090	0.000405	0.02367	0.000132	0.00029	0.000025	0.00004	0.000024	0.000019	0.000013	2.08E-15	98.0%	11.2102	367.11	± 5.73
20	0.85294	0.000921	0.06098	0.000190	0.00089	0.000037	0.00003	0.000022	0.000012	0.000012	6.55E-15	99.6%	13.9288	445.92	± 2.42
21	1.49530	0.001056	0.10983	0.000487	0.00139	0.000036	0.00002	0.000017	0.000024	0.000012	1.15E-14	99.5%	13.5499	435.14	± 2.24
22	2.89216	0.004790	0.20837	0.000272	0.00263	0.000039	0.00001	0.000019	0.000022	0.000018	2.22E-14	99.8%	13.8484	443.64	± 1.24
23	0.54972	0.000671	0.04370	0.000138	0.00056	0.000027	0.00002	0.000019	-0.000013	0.000013	4.22E-15	100.7%	12.5781	407.20	± 3.13
24	0.93458	0.001201	0.06485	0.000277	0.00083	0.000025	0.00002	0.000020	0.000037	0.000021	7.18E-15	98.8%	14.2419	454.78	± 3.67
25	1.88891	0.002313	0.13131	0.000380	0.00165	0.000022	0.00002	0.000014	0.000033	0.000012	1.45E-14	99.5%	14.3104	456.71	± 1.69
26	1.08386	0.001260	0.08979	0.000337	0.00109	0.000027	0.00001	0.000016	0.000006	0.000013	8.33E-15	99.8%	12.0500	391.82	± 2.04
27	0.60842	0.001471	0.04592	0.000285	0.00060	0.000019	0.00003	0.000013	-0.000005	0.000013	4.67E-15	100.2%	13.2509	426.59	± 3.97
28	1.02249	0.000975	0.08460	0.000266	0.00106	0.000024	0.00000	0.000021	0.000005	0.000015	7.85E-15	99.9%	12.0686	392.37	± 2.13
29	2.38510	0.001474	0.21009	0.000589	0.00268	0.000030	0.00013	0.000029	-0.000001	0.000020	1.83E-14	100.0%	11.3527	371.33	± 1.41
30	2.24911	0.002734	0.15668	0.000430	0.00193	0.000025	0.00002	0.000020	0.000015	0.000013	1.73E-14	99.8%	14.3271	457.18	± 1.57

31	0.54313	0.000819	0.04020	0.000242	0.00050	0.000022	0.00002	0.000017	0.000028	0.000012	4.17E-15	98.5%	13.3067	428.19 ± 3.93
32	1.41308	0.001645	0.13557	0.000364	0.00166	0.000041	0.00001	0.000015	0.000036	0.000026	1.09E-14	99.2%	10.3441	341.26 ± 2.14
33	1.42018	0.001463	0.10002	0.000422	0.00132	0.000021	0.00004	0.000017	-0.000044	0.000018	1.09E-14	100.9%	14.1990	453.57 ± 2.61
34	4.68490	0.002640	0.05798	0.000118	0.00073	0.000018	0.00002	0.000017	0.000076	0.000013	3.60E-14	99.5%	80.4081	1736.74 ± 3.95
35	0.64658	0.001233	0.04514	0.000272	0.00056	0.000020	0.00001	0.000010	0.000004	0.000013	4.97E-15	99.8%	14.2988	456.38 ± 4.01
36	1.01800	0.001554	0.07427	0.000445	0.00099	0.000073	0.00008	0.000031	0.000004	0.000017	7.82E-15	99.9%	13.6909	439.16 ± 3.46
37	1.24867	0.001209	0.09585	0.000253	0.00124	0.000024	0.00004	0.000009	-0.000053	0.000019	9.59E-15	101.2%	13.0277	420.18 ± 2.25
38	1.31807	0.001033	0.10999	0.000467	0.00141	0.000037	0.00001	0.000012	0.000020	0.000014	1.01E-14	99.6%	11.9295	388.30 ± 2.06
39	0.52079	0.000553	0.03648	0.000173	0.00047	0.000020	0.00001	0.000014	-0.000028	0.000014	4.00E-15	101.6%	14.2759	455.74 ± 4.29
40	0.85510	0.001391	0.06368	0.000270	0.00084	0.000023	0.00001	0.000013	0.000030	0.000013	6.57E-15	99.0%	13.2892	427.68 ± 2.77
41	0.77665	0.000801	0.05591	0.000339	0.00071	0.000029	-0.00004	0.000024	0.000003	0.000012	5.97E-15	99.9%	13.8741	444.37 ± 3.37
42	1.39913	0.001496	0.09767	0.000331	0.00125	0.000031	0.00001	0.000016	-0.000045	0.000016	1.07E-14	100.9%	14.3246	457.11 ± 2.26
43	1.42449	0.001685	0.10008	0.000186	0.00126	0.000027	0.00004	0.000019	0.000057	0.000021	1.09E-14	98.8%	14.0655	449.79 ± 2.25
44	1.13923	0.000561	0.08033	0.000217	0.00101	0.000032	0.00004	0.000017	0.000002	0.000018	8.75E-15	100.0%	14.1765	452.93 ± 2.43
45	2.58099	0.002530	0.18018	0.000562	0.00230	0.000036	0.00003	0.000013	0.000038	0.000014	1.98E-14	99.6%	14.2625	455.36 ± 1.66
46	0.55815	0.000851	0.03983	0.000233	0.00052	0.000024	0.00003	0.000017	0.000012	0.000011	4.29E-15	99.4%	13.9248	445.81 ± 3.78
47	1.32912	0.001621	0.09810	0.000326	0.00124	0.000024	0.00001	0.000018	0.000049	0.000013	1.02E-14	98.9%	13.3993	430.84 ± 2.02
48	1.05567	0.001242	0.07404	0.000348	0.00093	0.000022	0.00002	0.000013	0.000000	0.000012	8.11E-15	100.0%	14.2582	455.24 ± 2.71
49	1.06416	0.000912	0.07436	0.000158	0.00093	0.000041	0.00004	0.000018	0.000016	0.000011	8.17E-15	99.6%	14.2476	454.94 ± 1.75
50	0.65325	0.001079	0.06340	0.000156	0.00079	0.000024	0.00005	0.000016	0.000113	0.000012	5.02E-15	94.9%	9.7784	324.18 ± 2.05
51	0.99921	0.001176	0.09935	0.000353	0.00124	0.000026	0.00003	0.000018	0.000035	0.000012	7.67E-15	99.0%	9.9537	329.49 ± 1.70
52	0.75985	0.000768	0.05282	0.000286	0.00067	0.000024	0.00003	0.000018	-0.000005	0.000012	5.84E-15	100.2%	14.3869	458.87 ± 3.29
53	0.65321	0.000694	0.04667	0.000222	0.00061	0.000030	0.00003	0.000019	0.000006	0.000012	5.02E-15	99.7%	13.9571	446.72 ± 3.20
54	1.04782	0.000746	0.07446	0.000253	0.00093	0.000027	0.00000	0.000020	0.000006	0.000011	8.05E-15	99.8%	14.0495	449.34 ± 2.14
55	0.96401	0.001092	0.06665	0.000340	0.00083	0.000033	0.00003	0.000018	0.000016	0.000013	7.40E-15	99.5%	14.3913	458.99 ± 3.01
56	2.07243	0.001402	0.14475	0.000485	0.00199	0.000045	0.00003	0.000013	-0.000026	0.000018	1.59E-14	100.4%	14.3172	456.90 ± 1.96
57	2.94716	0.001941	0.20841	0.000390	0.00274	0.000034	0.00003	0.000011	0.000030	0.000011	2.26E-14	99.7%	14.0993	450.75 ± 1.03
58	1.46425	0.001344	0.10269	0.000365	0.00127	0.000023	0.00000	0.000018	0.000018	0.000012	1.12E-14	99.6%	14.2079	453.82 ± 2.00
59	0.65372	0.000555	0.05759	0.000262	0.00078	0.000023	0.00001	0.000012	0.000016	0.000014	5.02E-15	99.3%	11.2681	368.82 ± 2.93
60	1.66853	0.001162	0.14938	0.000520	0.00186	0.000033	0.00001	0.000015	0.000018	0.000020	1.28E-14	99.7%	11.1335	364.84 ± 1.82
61	0.93863	0.001037	0.07574	0.000193	0.00095	0.000023	0.00001	0.000017	0.000018	0.000022	7.21E-15	99.4%	12.3216	399.75 ± 2.96
62	0.92312	0.001083	0.06506	0.000354	0.00082	0.000029	0.00002	0.000014	0.000016	0.000012	7.09E-15	99.5%	14.1151	451.20 ± 3.07

63	1.45874	0.000545	0.12642	0.000302	0.00157	0.000033	0.00000	0.000016	-0.000010	0.000021	1.12E-14	100.2%	11.5390	376.83 ± 1.82
64	0.71386	0.000696	0.05386	0.000272	0.00063	0.000030	0.00001	0.000013	0.000013	0.000013	5.48E-15	99.5%	13.1833	424.65 ± 3.15
65	1.39345	0.000834	0.09932	0.000359	0.00121	0.000024	0.00008	0.000025	-0.000029	0.000019	1.07E-14	100.6%	14.0296	448.78 ± 2.44
66	1.29764	0.002589	0.09000	0.000272	0.00118	0.000025	0.00004	0.000019	0.000041	0.000022	9.97E-15	99.1%	14.2847	455.99 ± 2.87
67	0.93904	0.001160	0.06563	0.000246	0.00085	0.000031	0.00000	0.000012	0.000011	0.000020	7.21E-15	99.7%	14.2583	455.24 ± 3.45
68	1.06796	0.000918	0.07485	0.000323	0.00093	0.000028	-0.00005	0.000026	-0.000005	0.000021	8.20E-15	100.1%	14.2672	455.49 ± 3.34
69	0.46046	0.000836	0.03524	0.000118	0.00040	0.000026	0.00000	0.000018	-0.000005	0.000012	3.54E-15	100.3%	13.0680	421.34 ± 3.63
70	0.83694	0.001083	0.05882	0.000260	0.00068	0.000032	0.00001	0.000020	0.000004	0.000013	6.43E-15	99.8%	14.2071	453.80 ± 2.97
71	1.99617	0.001918	0.14115	0.000422	0.00170	0.000036	-0.00003	0.000012	-0.000050	0.000021	1.53E-14	100.7%	14.1423	451.96 ± 2.00
72	2.15089	0.001158	0.14946	0.000427	0.00189	0.000029	0.00000	0.000019	0.000054	0.000010	1.65E-14	99.3%	14.2843	455.98 ± 1.47
73	0.30619	0.000264	0.02964	0.000156	0.00037	0.000022	-0.00003	0.000016	0.000021	0.000013	2.35E-15	97.9%	10.1147	334.35 ± 4.75
74	1.23355	0.001234	0.08679	0.000205	0.00119	0.000044	0.00000	0.000012	0.000031	0.000009	9.47E-15	99.3%	14.1087	451.01 ± 1.56
75	1.05507	0.001523	0.07859	0.000240	0.00099	0.000024	-0.00001	0.000009	0.000039	0.000010	8.10E-15	98.9%	13.2780	427.36 ± 1.92
76	1.40338	0.001371	0.11100	0.000277	0.00144	0.000040	-0.00002	0.000011	-0.000021	0.000016	1.08E-14	100.4%	12.6427	409.07 ± 1.79
77	0.51447	0.000850	0.03562	0.000162	0.00046	0.000023	0.00000	0.000016	0.000009	0.000011	3.95E-15	99.5%	14.3713	458.43 ± 3.65
78	1.09210	0.001650	0.09424	0.000375	0.00119	0.000038	0.00001	0.000012	0.000011	0.000011	8.39E-15	99.7%	11.5529	377.24 ± 1.99
79	1.03884	0.000693	0.08927	0.000217	0.00113	0.000033	0.00000	0.000012	-0.000024	0.000021	7.98E-15	100.7%	11.6374	379.73 ± 2.49
80	0.87097	0.001227	0.06914	0.000265	0.00091	0.000035	0.00001	0.000009	-0.000007	0.000014	6.69E-15	100.2%	12.5969	407.74 ± 2.57
81	0.65890	0.001147	0.05792	0.000295	0.00074	0.000031	-0.00001	0.000014	-0.000005	0.000011	5.06E-15	100.2%	11.3769	372.04 ± 2.71
82	1.48545	0.001145	0.10360	0.000373	0.00125	0.000035	0.00000	0.000013	0.000005	0.000012	1.14E-14	99.9%	14.3252	457.13 ± 2.00
83	1.26280	0.000844	0.11299	0.000384	0.00141	0.000038	0.00000	0.000015	0.000030	0.000011	9.70E-15	99.3%	11.0982	363.79 ± 1.59
84	1.61499	0.002787	0.11476	0.000582	0.00144	0.000037	0.00001	0.000018	0.000033	0.000012	1.24E-14	99.4%	13.9891	447.63 ± 2.61
85	0.59906	0.000586	0.05120	0.000196	0.00060	0.000022	0.00000	0.000019	-0.000008	0.000013	4.60E-15	100.4%	11.7014	381.61 ± 2.87
86	0.70196	0.000799	0.06166	0.000206	0.00079	0.000027	-0.00002	0.000017	0.000043	0.000014	5.39E-15	98.2%	11.1790	366.19 ± 2.61
87	0.97274	0.000949	0.06778	0.000288	0.00085	0.000037	0.00000	0.000016	0.000017	0.000013	7.47E-15	99.5%	14.2793	455.83 ± 2.71
88	0.41405	0.000666	0.02951	0.000177	0.00038	0.000022	0.00000	0.000013	-0.000002	0.000012	3.18E-15	100.2%	14.0295	448.77 ± 4.68
89	0.49965	0.000941	0.03538	0.000166	0.00043	0.000030	0.00000	0.000023	0.000014	0.000013	3.84E-15	99.2%	14.0059	448.10 ± 4.07
90	4.47373	0.006554	0.31537	0.001205	0.00368	0.000047	0.00002	0.000013	0.000195	0.000014	3.44E-14	98.7%	14.0034	448.03 ± 1.91
91	0.44812	0.000590	0.03872	0.000165	0.00049	0.000027	0.00000	0.000017	0.000020	0.000012	3.44E-15	98.7%	11.4193	373.30 ± 3.35
92	1.51743	0.001202	0.10823	0.000381	0.00140	0.000026	-0.00002	0.000014	0.000043	0.000020	1.17E-14	99.2%	13.9039	445.21 ± 2.35
93	1.40526	0.001410	0.11477	0.000343	0.00145	0.000032	-0.00005	0.000015	0.000039	0.000019	1.08E-14	99.2%	12.1439	394.57 ± 2.03
94	2.42846	0.002155	0.17731	0.000493	0.00224	0.000042	-0.00002	0.000012	0.000010	0.000025	1.87E-14	99.9%	13.6792	438.83 ± 1.85

95	1.48305	0.001058	0.10549	0.000290	0.00134	0.000022	-0.00001	0.000013	0.000034	0.000019	1.14E-14	99.3%	13.9639	446.91 ± 2.11
96	1.15131	0.000867	0.08205	0.000396	0.00102	0.000027	-0.00001	0.000012	0.000023	0.000018	8.84E-15	99.4%	13.9473	446.44 ± 3.00
97	0.21845	0.000431	0.01852	0.000104	0.00021	0.000024	0.00002	0.000015	-0.000003	0.000011	1.68E-15	100.4%	11.7949	384.36 ± 6.07
98	1.12054	0.003151	0.10403	0.000420	0.00132	0.000036	0.00000	0.000021	0.000011	0.000012	8.61E-15	99.7%	10.7393	353.10 ± 2.07
99	0.77274	0.002443	0.05469	0.000278	0.00062	0.000023	-0.00001	0.000013	0.000006	0.000011	5.94E-15	99.8%	14.0957	450.65 ± 3.31
100	0.67490	0.002652	0.04790	0.000172	0.00061	0.000023	-0.00001	0.000010	-0.000072	0.000019	5.18E-15	103.1%	14.0884	450.44 ± 4.41
101	0.26343	0.000276	0.01840	0.000101	0.00023	0.000018	0.00003	0.000014	0.000004	0.000014	2.02E-15	99.6%	14.2603	455.30 ± 7.44
102	1.40630	0.001202	0.10650	0.000254	0.00128	0.000026	-0.00003	0.000017	0.000029	0.000014	1.08E-14	99.4%	13.1246	422.96 ± 1.64
103	0.98830	0.000958	0.08575	0.000220	0.00104	0.000039	0.00001	0.000019	0.000025	0.000014	7.59E-15	99.3%	11.4398	373.90 ± 1.86
104	1.37630	0.001019	0.09660	0.000374	0.00120	0.000024	-0.00004	0.000010	0.000031	0.000013	1.06E-14	99.3%	14.1522	452.24 ± 2.20
105	0.62669	0.000934	0.04354	0.000243	0.00049	0.000029	-0.00001	0.000018	-0.000026	0.000020	4.81E-15	101.2%	14.3931	459.04 ± 5.08
106	0.69675	0.001124	0.06290	0.000236	0.00076	0.000034	-0.00002	0.000012	0.000016	0.000013	5.35E-15	99.3%	11.0006	360.89 ± 2.52
107	1.01613	0.001094	0.07569	0.000311	0.00093	0.000033	-0.00002	0.000015	0.000009	0.000027	7.80E-15	99.7%	13.3872	430.49 ± 3.81
108	0.73734	0.001026	0.05068	0.000197	0.00065	0.000027	-0.00001	0.000016	0.000048	0.000019	5.66E-15	98.1%	14.2694	455.55 ± 4.00
109	0.99985	0.001071	0.08031	0.000297	0.00103	0.000036	0.00002	0.000011	0.000079	0.000020	7.68E-15	97.7%	12.1602	395.04 ± 2.81
110	0.33830	0.000264	0.02734	0.000183	0.00032	0.000028	-0.00004	0.000017	0.000055	0.000020	2.60E-15	95.2%	11.7800	383.92 ± 7.62
111	0.57573	0.000520	0.04012	0.000224	0.00050	0.000038	-0.00001	0.000021	0.000069	0.000019	4.42E-15	96.4%	13.8406	443.42 ± 5.10
112	1.17192	0.001013	0.10266	0.000256	0.00129	0.000038	0.00000	0.000010	0.000089	0.000019	9.00E-15	97.8%	11.1603	365.63 ± 2.07

OK12-23 Muscovite (au28.5i.mus), 60/80#. Pennsylvanian Atoka Formation J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	7.47076	0.003740	0.52839	0.000713	0.00667	0.000080	0.00004	0.000017	0.000063	0.000016	5.74E-14	99.8%	14.1034	450.87	± 0.71
2	6.97636	0.002709	0.49391	0.000849	0.00625	0.000046	0.00001	0.000011	0.000033	0.000018	5.36E-14	99.9%	14.1049	450.91	± 0.87
3	3.69573	0.002203	0.23873	0.000639	0.00305	0.000043	0.00001	0.000007	0.000015	0.000015	2.84E-14	99.9%	15.4620	488.89	± 1.47
4	1.51851	0.001353	0.10803	0.000372	0.00139	0.000026	0.00002	0.000014	0.000035	0.000011	1.17E-14	99.3%	13.9610	446.83	± 1.87
5	1.44472	0.000997	0.10596	0.000340	0.00139	0.000025	0.00004	0.000013	0.000060	0.000011	1.11E-14	98.8%	13.4662	432.75	± 1.75
6	4.95960	0.001938	0.35056	0.000769	0.00444	0.000047	0.00002	0.000021	0.000007	0.000017	3.81E-14	100.0%	14.1418	451.95	± 1.10
7	5.41542	0.001984	0.38845	0.000688	0.00498	0.000055	0.00005	0.000019	0.000040	0.000017	4.16E-14	99.8%	13.9107	445.40	± 0.91
8	3.84799	0.003223	0.26898	0.000463	0.00354	0.000069	0.00003	0.000008	0.000056	0.000010	2.96E-14	99.6%	14.2439	454.84	± 0.94
9	1.56578	0.001720	0.11008	0.000325	0.00141	0.000023	0.00003	0.000011	0.000049	0.000011	1.20E-14	99.1%	14.0926	450.56	± 1.71
10	2.15174	0.001991	0.15310	0.000529	0.00193	0.000034	0.00002	0.000017	0.000042	0.000012	1.65E-14	99.4%	13.9738	447.19	± 1.76
11	2.69833	0.003270	0.19174	0.000302	0.00264	0.000054	0.00003	0.000022	0.000043	0.000011	2.07E-14	99.5%	14.0075	448.15	± 1.04
12	0.46178	0.000415	0.03279	0.000209	0.00044	0.000026	0.00005	0.000011	0.000014	0.000011	3.55E-15	99.1%	13.9551	446.66	± 4.28
13	1.95465	0.001760	0.13856	0.000464	0.00181	0.000034	0.00004	0.000015	0.000047	0.000011	1.50E-14	99.3%	14.0065	448.12	± 1.75
14	3.28065	0.002291	0.25468	0.000504	0.00332	0.000042	0.00004	0.000017	0.000072	0.000010	2.52E-14	99.4%	12.7985	413.57	± 0.95
15	1.53302	0.001515	0.11162	0.000405	0.00143	0.000025	0.00005	0.000017	0.000060	0.000011	1.18E-14	98.8%	13.5747	435.85	± 1.89
16	2.18284	0.002126	0.15339	0.000324	0.00211	0.000055	0.00002	0.000020	0.000062	0.000011	1.68E-14	99.2%	14.1115	451.09	± 1.24
17	4.50486	0.002889	0.31333	0.000609	0.00395	0.000040	0.00003	0.000018	0.000059	0.000010	3.46E-14	99.6%	14.3215	457.02	± 0.98
18	0.92217	0.001033	0.06481	0.000195	0.00083	0.000020	0.00005	0.000016	0.000026	0.000012	7.08E-15	99.2%	14.1100	451.05	± 2.23
19	0.66709	0.000758	0.04751	0.000189	0.00060	0.000024	0.00003	0.000012	0.000029	0.000011	5.12E-15	98.7%	13.8627	444.04	± 2.85
20	1.92744	0.001631	0.13553	0.000542	0.00170	0.000022	0.00002	0.000015	0.000041	0.000011	1.48E-14	99.4%	14.1329	451.70	± 2.02
21	1.62059	0.002329	0.11558	0.000247	0.00148	0.000032	0.00003	0.000012	0.000053	0.000011	1.24E-14	99.0%	13.8869	444.73	± 1.46
22	2.34440	0.002028	0.16919	0.000457	0.00227	0.000058	0.00001	0.000014	0.000066	0.000011	1.80E-14	99.2%	13.7407	440.58	± 1.40
23	2.17854	0.001601	0.15775	0.000483	0.00198	0.000025	0.00001	0.000010	0.000058	0.000010	1.67E-14	99.2%	13.7014	439.46	± 1.51
24	1.15232	0.001655	0.08344	0.000262	0.00107	0.000028	0.00004	0.000011	0.000051	0.000010	8.85E-15	98.7%	13.6315	437.47	± 1.90
25	1.08040	0.001306	0.08952	0.000198	0.00113	0.000023	0.00004	0.000008	0.000033	0.000010	8.30E-15	99.1%	11.9593	389.17	± 1.50
26	1.56642	0.001252	0.11153	0.000264	0.00138	0.000027	0.00004	0.000011	0.000033	0.000011	1.20E-14	99.4%	13.9575	446.73	± 1.45
27	3.35599	0.003478	0.23679	0.000516	0.00307	0.000043	0.00004	0.000010	0.000114	0.000010	2.58E-14	99.0%	14.0307	448.81	± 1.16
28	0.55569	0.001189	0.03900	0.000166	0.00053	0.000027	0.00003	0.000016	0.000033	0.000012	4.27E-15	98.3%	14.0022	448.00	± 3.64
29	0.56880	0.000655	0.04544	0.000167	0.00056	0.000030	0.00001	0.000013	0.000032	0.000012	4.37E-15	98.4%	12.3116	399.45	± 2.97
30	1.73631	0.002522	0.12635	0.000456	0.00162	0.000030	0.00003	0.000018	0.000030	0.000011	1.33E-14	99.5%	13.6723	438.63	± 1.91

31	7.97300	0.004907	0.56104	0.000913	0.00715	0.000053	0.00002	0.000021	0.000031	0.000021	6.12E-14	99.9%	14.1947	453.45 ± 0.86
32	4.29084	0.004109	0.30308	0.000494	0.00391	0.000047	0.00003	0.000018	0.000060	0.000011	3.30E-14	99.6%	14.0990	450.74 ± 0.92
33	4.90215	0.003555	0.41891	0.000878	0.00556	0.000083	0.00006	0.000018	0.000069	0.000012	3.77E-14	99.6%	11.6536	380.20 ± 0.89
34	3.00149	0.004923	0.21263	0.000612	0.00263	0.000056	0.00003	0.000013	0.000038	0.000010	2.31E-14	99.6%	14.0631	449.72 ± 1.56
35	1.78620	0.001852	0.12584	0.000378	0.00157	0.000028	0.00002	0.000011	0.000027	0.000010	1.37E-14	99.5%	14.1304	451.63 ± 1.63
36	0.98057	0.000915	0.07470	0.000299	0.00096	0.000024	-0.00002	0.000014	0.000001	0.000010	7.53E-15	100.0%	13.1220	422.89 ± 2.13
37	3.23945	0.003474	0.23180	0.000487	0.00291	0.000045	0.00002	0.000014	0.000092	0.000012	2.49E-14	99.2%	13.8574	443.89 ± 1.16
38	2.22973	0.001361	0.15780	0.000379	0.00201	0.000041	0.00000	0.000012	0.000048	0.000012	1.71E-14	99.4%	14.0401	449.07 ± 1.33
39	3.42906	0.003172	0.24149	0.000694	0.00301	0.000035	0.00004	0.000015	0.000028	0.000011	2.63E-14	99.8%	14.1659	452.63 ± 1.43
40	0.99282	0.001532	0.08192	0.000452	0.00106	0.000024	0.00002	0.000011	0.000037	0.000009	7.63E-15	98.9%	11.9869	389.98 ± 2.51
41	5.75249	0.003214	0.40594	0.000835	0.00519	0.000041	0.00000	0.000019	0.000000	0.000016	4.42E-14	100.0%	14.1705	452.76 ± 1.03
42	1.58777	0.001164	0.11573	0.000416	0.00151	0.000029	0.00003	0.000021	0.000035	0.000009	1.22E-14	99.3%	13.6289	437.39 ± 1.78
43	2.42980	0.001651	0.17072	0.000505	0.00217	0.000031	-0.00002	0.000018	0.000040	0.000012	1.87E-14	99.5%	14.1638	452.57 ± 1.54
44	4.26271	0.002620	0.30164	0.000441	0.00386	0.000025	0.00003	0.000009	0.000051	0.000010	3.27E-14	99.6%	14.0818	450.25 ± 0.78
45	1.02429	0.001544	0.07233	0.000241	0.00086	0.000034	0.00000	0.000016	0.000034	0.000009	7.87E-15	99.0%	14.0237	448.61 ± 2.05
46	1.16595	0.001428	0.09234	0.000292	0.00115	0.000025	-0.00007	0.000026	0.000020	0.000010	8.96E-15	99.5%	12.5634	406.77 ± 1.75
47	14.2714	0.005849	1.00298	0.001570	0.01304	0.000119	0.00020	0.000011	0.000185	0.000015	1.10E-13	99.6%	14.1746	452.88 ± 0.75
48	1.12366	0.001353	0.08075	0.000197	0.00104	0.000022	-0.00001	0.000008	0.000022	0.000010	8.63E-15	99.4%	13.8337	443.22 ± 1.66
49	2.56920	0.001949	0.18304	0.000469	0.00230	0.000041	0.00001	0.000013	0.000028	0.000010	1.97E-14	99.7%	13.9908	447.68 ± 1.30
50	3.61889	0.007189	0.25332	0.000320	0.00305	0.000106	-0.00004	0.000043	0.000039	0.000036	2.78E-14	99.7%	14.2404	454.73 ± 1.73
51	1.20182	0.001467	0.08533	0.000291	0.00110	0.000025	0.00001	0.000010	0.000011	0.000010	9.23E-15	99.7%	14.0468	449.26 ± 1.95
52	1.39163	0.001005	0.11596	0.000439	0.00145	0.000028	0.00000	0.000017	0.000040	0.000011	1.07E-14	99.1%	11.8980	387.38 ± 1.75
53	0.30074	0.000416	0.02287	0.000073	0.00029	0.000022	0.00001	0.000017	0.000013	0.000010	2.31E-15	98.7%	12.9839	418.92 ± 4.42
54	3.02468	0.001489	0.21284	0.000208	0.00271	0.000032	-0.00002	0.000010	0.000024	0.000017	2.32E-14	99.8%	14.1773	452.95 ± 0.90
55	0.34212	0.000284	0.02463	0.000129	0.00030	0.000015	0.00003	0.000008	0.000000	0.000011	2.63E-15	100.0%	13.8913	444.86 ± 4.74
56	2.05013	0.001323	0.15366	0.000375	0.00195	0.000026	-0.00001	0.000011	0.000025	0.000010	1.57E-14	99.6%	13.2946	427.84 ± 1.25
57	2.16098	0.001796	0.17649	0.000439	0.00227	0.000027	0.00003	0.000009	0.000042	0.000010	1.66E-14	99.4%	12.1746	395.46 ± 1.18
58	0.42053	0.000767	0.03588	0.000087	0.00046	0.000019	-0.00001	0.000013	-0.000021	0.000009	3.23E-15	101.5%	11.7215	382.20 ± 2.70
59	2.51398	0.001189	0.19690	0.000257	0.00247	0.000038	0.00001	0.000015	0.000018	0.000009	1.93E-14	99.8%	12.7407	411.90 ± 0.73
60	1.43465	0.001276	0.10188	0.000237	0.00139	0.000036	0.00002	0.000012	0.000045	0.000010	1.10E-14	99.1%	13.9519	446.57 ± 1.45
61	3.10943	0.002429	0.21992	0.000500	0.00277	0.000026	0.00001	0.000015	0.000065	0.000011	2.39E-14	99.4%	14.0519	449.41 ± 1.18
62	1.69991	0.001332	0.12390	0.000392	0.00160	0.000023	0.00000	0.000015	0.000008	0.000018	1.31E-14	99.9%	13.7004	439.43 ± 1.97

63	0.36497	0.000612	0.03002	0.000142	0.00040	0.000019	-0.00002	0.000011	0.000022	0.000010	2.80E-15	98.2%	11.9411	388.64 ± 3.66
64	1.78785	0.001481	0.12660	0.000533	0.00161	0.000023	0.00002	0.000016	0.000008	0.000010	1.37E-14	99.9%	14.1033	450.86 ± 2.09
65	0.77216	0.000688	0.05528	0.000205	0.00072	0.000019	0.00000	0.000013	0.000026	0.000009	5.93E-15	99.0%	13.8294	443.10 ± 2.35
66	1.49757	0.001625	0.10720	0.000172	0.00138	0.000026	-0.00001	0.000021	0.000025	0.000010	1.15E-14	99.5%	13.9001	445.10 ± 1.24
67	1.66709	0.000652	0.12322	0.000417	0.00155	0.000030	0.00002	0.000014	0.000036	0.000009	1.28E-14	99.4%	13.4432	432.09 ± 1.63
68	0.08282	0.000243	0.00698	0.000113	0.00003	0.000018	0.00001	0.000009	0.000027	0.000010	6.36E-16	90.2%	10.7060	352.11 ± 14.94
69	1.23310	0.001137	0.08768	0.000268	0.00111	0.000028	-0.00001	0.000007	-0.000006	0.000010	9.47E-15	100.1%	14.0644	449.76 ± 1.82
70	1.01551	0.001044	0.07414	0.000259	0.00091	0.000026	0.00002	0.000015	0.000031	0.000010	7.80E-15	99.1%	13.5753	435.86 ± 2.03
71	0.68856	0.000605	0.04928	0.000266	0.00059	0.000022	0.00000	0.000013	0.000015	0.000011	5.29E-15	99.3%	13.8809	444.56 ± 3.17
72	2.22405	0.001652	0.15840	0.000365	0.00202	0.000032	0.00001	0.000022	0.000013	0.000010	1.71E-14	99.8%	14.0170	448.42 ± 1.24
73	2.48274	0.001818	0.17737	0.000492	0.00240	0.000060	-0.00005	0.000022	0.000022	0.000010	1.91E-14	99.7%	13.9618	446.86 ± 1.39
74	1.20322	0.000884	0.10140	0.000380	0.00126	0.000027	0.00001	0.000013	0.000014	0.000010	9.24E-15	99.7%	11.8254	385.25 ± 1.77
75	1.68909	0.000770	0.12377	0.000521	0.00154	0.000025	0.00002	0.000012	0.000037	0.000011	1.30E-14	99.3%	13.5578	435.37 ± 2.04
76	1.50609	0.001015	0.10662	0.000283	0.00134	0.000031	0.00000	0.000011	0.000009	0.000014	1.16E-14	99.8%	14.1019	450.82 ± 1.73
77	3.11826	0.002576	0.23139	0.000579	0.00292	0.000041	0.00000	0.000014	0.000020	0.000017	2.40E-14	99.8%	13.4510	432.32 ± 1.35
78	0.51445	0.000746	0.03603	0.000091	0.00049	0.000025	0.00003	0.000012	0.000009	0.000011	3.95E-15	99.5%	14.2058	453.76 ± 3.22
79	0.55315	0.000769	0.04034	0.000164	0.00055	0.000021	0.00000	0.000010	0.000030	0.000011	4.25E-15	98.4%	13.4909	433.45 ± 3.16
80	1.00428	0.001208	0.08016	0.000201	0.00094	0.000032	0.00001	0.000018	0.000007	0.000008	7.71E-15	99.8%	12.5025	405.00 ± 1.49
81	1.70396	0.004183	0.12122	0.000431	0.00155	0.000031	0.00003	0.000012	0.000025	0.000011	1.31E-14	99.6%	13.9945	447.78 ± 2.11
82	0.45981	0.000602	0.03679	0.000182	0.00044	0.000026	0.00003	0.000010	0.000004	0.000011	3.53E-15	99.7%	12.4646	403.90 ± 3.63
83	0.31672	0.000451	0.02758	0.000096	0.00036	0.000021	0.00001	0.000013	0.000052	0.000013	2.43E-15	95.1%	10.9213	358.53 ± 4.87
84	0.19817	0.000465	0.01648	0.000077	0.00020	0.000022	0.00001	0.000015	0.000030	0.000010	1.52E-15	95.5%	11.4871	375.30 ± 6.39
85	0.26580	0.000507	0.02137	0.000097	0.00028	0.000026	0.00002	0.000018	0.000046	0.000011	2.04E-15	94.8%	11.7949	384.35 ± 5.38
86	0.84762	0.001258	0.06591	0.000230	0.00084	0.000023	0.00003	0.000018	0.000042	0.000012	6.51E-15	98.6%	12.6751	410.00 ± 2.36
87	1.94470	0.001396	0.13860	0.000579	0.00175	0.000031	0.00003	0.000012	0.000032	0.000011	1.49E-14	99.5%	13.9639	446.92 ± 2.04
88	0.18576	0.000299	0.01327	0.000054	0.00016	0.000022	-0.00001	0.000014	0.000033	0.000010	1.43E-15	94.7%	13.2666	427.04 ± 7.76
89	1.43499	0.001738	0.11593	0.000369	0.00146	0.000024	0.00000	0.000016	0.000053	0.000010	1.10E-14	98.9%	12.2430	397.46 ± 1.62
90	1.09554	0.001107	0.08829	0.000285	0.00116	0.000024	0.00003	0.000010	0.000045	0.000014	8.41E-15	98.8%	12.2571	397.87 ± 2.02
91	0.96607	0.001741	0.02778	0.000120	0.00038	0.000023	0.00001	0.000011	0.000026	0.000010	7.42E-15	99.2%	34.4996	951.46 ± 5.44
92	1.31270	0.001371	0.09185	0.000197	0.00117	0.000024	0.00003	0.000017	0.000044	0.000011	1.01E-14	99.0%	14.1484	452.14 ± 1.55
93	1.57502	0.001809	0.12834	0.000435	0.00161	0.000039	0.00002	0.000011	0.000044	0.000011	1.21E-14	99.2%	12.1713	395.37 ± 1.63
94	1.73399	0.001432	0.12147	0.000290	0.00151	0.000030	0.00001	0.000009	0.000089	0.000010	1.33E-14	98.5%	14.0581	449.58 ± 1.41

95	1.15355	0.002443	0.09349	0.000527	0.00117	0.000022	0.00002	0.000011	0.000013	0.000010	8.86E-15	99.7%	12.2990	399.09 ± 2.62
96	0.31707	0.000556	0.02956	0.000197	0.00037	0.000019	0.00001	0.000016	0.000044	0.000011	2.44E-15	95.9%	10.2879	339.57 ± 4.30
97	3.92497	0.002807	0.27533	0.000681	0.00347	0.000059	0.00002	0.000017	0.000057	0.000009	3.01E-14	99.6%	14.1948	453.45 ± 1.22
98	0.06084	0.000388	0.00426	0.000123	0.00005	0.000020	0.00000	0.000012	0.000015	0.000011	4.67E-16	92.7%	13.2470	426.48 ± 27.94
99	1.14635	0.002170	0.08044	0.000283	0.00102	0.000026	0.00002	0.000014	0.000033	0.000010	8.81E-15	99.2%	14.1303	451.63 ± 2.19
100	0.59627	0.000811	0.04899	0.000342	0.00061	0.000040	-0.00002	0.000013	-0.000009	0.000016	4.58E-15	100.4%	12.1718	395.38 ± 4.14
101	3.56539	0.002559	0.04446	0.000131	0.00059	0.000029	0.00002	0.000013	0.000049	0.000012	2.74E-14	99.6%	79.8644	1729.19 ± 5.51
102	0.82149	0.001458	0.05918	0.000345	0.00076	0.000026	0.00000	0.000024	0.000041	0.000011	6.31E-15	98.5%	13.6772	438.77 ± 3.26
103	0.85240	0.000774	0.06844	0.000324	0.00087	0.000023	0.00002	0.000014	0.000017	0.000011	6.55E-15	99.4%	12.3825	401.52 ± 2.46
104	2.26204	0.001254	0.15940	0.000312	0.00198	0.000028	0.00001	0.000020	0.000005	0.000016	1.74E-14	99.9%	14.1808	453.05 ± 1.33
105	0.12490	0.000385	0.00907	0.000077	0.00012	0.000022	0.00002	0.000022	-0.000005	0.000012	9.59E-16	101.2%	13.7674	441.34 ± 13.23
106	0.09171	0.000379	0.00815	0.000088	0.00008	0.000020	0.00000	0.000007	0.000007	0.000010	7.04E-16	97.6%	10.9883	360.52 ± 12.44
107	0.20045	0.000740	0.01427	0.000178	0.00018	0.000025	0.00000	0.000011	0.000023	0.000010	1.54E-15	96.7%	13.5831	436.09 ± 8.72
108	0.62448	0.000871	0.04907	0.000252	0.00056	0.000022	0.00000	0.000012	0.000005	0.000011	4.80E-15	99.8%	12.6961	410.61 ± 3.01
109	0.05352	0.000364	0.00274	0.000063	0.00005	0.000017	0.00001	0.000013	0.000034	0.000011	4.11E-16	81.1%	15.8206	498.80 ± 39.22
110	3.26946	0.001803	0.22141	0.000407	0.00287	0.000035	0.00004	0.000013	0.000030	0.000010	2.51E-14	99.7%	14.7270	468.42 ± 1.00
111	0.55951	0.000849	0.03907	0.000213	0.00049	0.000027	0.00000	0.000010	0.000014	0.000011	4.30E-15	99.3%	14.2178	454.10 ± 3.77
112	0.21732	0.000809	0.01523	0.000071	0.00018	0.000021	-0.00001	0.000016	0.000004	0.000011	1.67E-15	99.4%	14.1793	453.01 ± 7.06

OK12-31 Muscovite (au28.5k.mus), 60/80#. Mississippian Stanley Group J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	1.17895	0.000879	0.09009	0.000362	0.00127	0.000043	0.00001	0.000012	0.000068	0.000010	9.06E-15	98.3%	12.8643	415.47	± 2.03
2	1.14432	0.000812	0.09426	0.000358	0.00119	0.000032	-0.00002	0.000013	0.000037	0.000011	8.79E-15	99.0%	12.0238	391.06	± 1.90
3	2.53725	0.001903	0.19704	0.000362	0.00247	0.000025	-0.00003	0.000012	0.000050	0.000024	1.95E-14	99.4%	12.8017	413.66	± 1.43
4	0.58206	0.000586	0.04621	0.000235	0.00057	0.000029	-0.00002	0.000008	0.000009	0.000010	4.47E-15	99.5%	12.5391	406.06	± 2.91
5	1.23560	0.000485	0.08791	0.000343	0.00109	0.000017	0.00001	0.000006	0.000006	0.000010	9.49E-15	99.8%	14.0340	448.90	± 2.04
6	0.89865	0.000949	0.06374	0.000186	0.00080	0.000013	0.00000	0.000010	0.000015	0.000010	6.90E-15	99.5%	14.0285	448.74	± 2.05
7	0.41897	0.000691	0.03149	0.000169	0.00039	0.000015	0.00000	0.000008	0.000018	0.000009	3.22E-15	98.7%	13.1334	423.22	± 3.74
8	0.85355	0.000769	0.04821	0.000226	0.00059	0.000023	-0.00002	0.000015	0.000010	0.000010	6.56E-15	99.7%	17.6445	548.35	± 3.23
9	0.57458	0.001152	0.02804	0.000132	0.00038	0.000015	0.00001	0.000014	0.000013	0.000010	4.41E-15	99.4%	20.3583	619.65	± 4.56
10	1.21256	0.000779	0.10345	0.000251	0.00128	0.000034	-0.00002	0.000013	0.000034	0.000019	9.31E-15	99.2%	11.6249	379.36	± 2.00
11	0.22735	0.000360	0.01602	0.000087	0.00022	0.000019	-0.00001	0.000007	0.000004	0.000011	1.75E-15	99.4%	14.1100	451.05	± 6.94
12	0.86790	0.001076	0.06549	0.000190	0.00081	0.000022	0.00000	0.000019	0.000003	0.000010	6.67E-15	99.9%	13.2401	426.28	± 1.99
13	0.97051	0.001050	0.07774	0.000259	0.00100	0.000015	0.00001	0.000019	-0.000028	0.000019	7.45E-15	100.8%	12.4848	404.49	± 2.69
14	0.09258	0.000398	0.00645	0.000064	0.00011	0.000015	-0.00001	0.000016	-0.000007	0.000011	7.11E-16	102.3%	14.3493	457.81	± 16.71
15	1.05264	0.000824	0.07584	0.000235	0.00095	0.000024	0.00001	0.000013	0.000022	0.000010	8.09E-15	99.4%	13.7930	442.06	± 1.90
16	0.30064	0.000538	0.02092	0.000110	0.00026	0.000020	0.00000	0.000016	-0.000013	0.000011	2.31E-15	101.3%	14.3679	458.33	± 5.42
17	2.01895	0.003020	0.17516	0.001079	0.00211	0.000102	0.00000	0.000016	0.000394	0.000016	1.55E-14	94.2%	10.8622	356.77	± 2.57
18	0.44305	0.000544	0.03471	0.000162	0.00041	0.000026	0.00000	0.000015	-0.000030	0.000019	3.40E-15	102.0%	12.7637	412.57	± 5.63
19	1.74746	0.001612	0.02393	0.000089	0.00033	0.000020	0.00000	0.000014	-0.000009	0.000011	1.34E-14	100.2%	73.0133	1631.16	± 7.00
20	1.60616	0.000771	0.13010	0.000236	0.00164	0.000024	0.00000	0.000018	-0.000010	0.000016	1.23E-14	100.2%	12.3454	400.44	± 1.39
21	1.17816	0.001103	0.09542	0.000472	0.00118	0.000023	-0.00002	0.000012	-0.000004	0.000011	9.05E-15	100.1%	12.3469	400.48	± 2.28
22	2.04565	0.002373	0.15017	0.000313	0.00192	0.000041	0.00000	0.000012	0.000067	0.000010	1.57E-14	99.0%	13.4909	433.46	± 1.23
23	2.07646	0.001754	0.14486	0.000401	0.00191	0.000038	0.00001	0.000011	0.000054	0.000009	1.59E-14	99.2%	14.2242	454.28	± 1.46
24	2.17738	0.002170	0.15706	0.000504	0.00209	0.000042	0.00000	0.000011	0.000046	0.000017	1.67E-14	99.4%	13.7762	441.59	± 1.82
25	1.89562	0.001068	0.15447	0.000417	0.00197	0.000028	0.00001	0.000013	-0.000034	0.000021	1.46E-14	100.5%	12.2714	398.28	± 1.69
26	0.91322	0.001208	0.06770	0.000228	0.00093	0.000019	0.00000	0.000017	0.000030	0.000008	7.01E-15	99.0%	13.3577	429.65	± 1.95
27	1.37941	0.001405	0.10285	0.000294	0.00131	0.000023	0.00000	0.000016	0.000001	0.000016	1.06E-14	100.0%	13.4093	431.12	± 1.96
28	2.08323	0.001764	0.14704	0.000437	0.00185	0.000019	0.00002	0.000013	0.000055	0.000009	1.60E-14	99.2%	14.0576	449.57	± 1.51
29	1.30242	0.000829	0.09583	0.000373	0.00118	0.000027	0.00003	0.000017	0.000020	0.000011	1.00E-14	99.5%	13.5288	434.54	± 2.03
30	3.00534	0.001942	0.24987	0.000562	0.00321	0.000035	0.00004	0.000014	0.000129	0.000010	2.31E-14	98.7%	11.8751	386.70	± 0.99

31	1.07813	0.001167	0.08245	0.000266	0.00102	0.000021	-0.00001	0.000015	0.000106	0.000010	8.28E-15	97.1%	12.6985	410.68 ± 1.85
32	0.90298	0.001090	0.07070	0.000330	0.00094	0.000024	0.00001	0.000011	0.000109	0.000012	6.94E-15	96.4%	12.3155	399.57 ± 2.61
33	1.53455	0.001392	0.12479	0.000356	0.00161	0.000032	0.00004	0.000019	0.000036	0.000021	1.18E-14	99.3%	12.2115	396.54 ± 1.99
34	0.71739	0.000849	0.04999	0.000357	0.00067	0.000023	0.00003	0.000020	0.000044	0.000013	5.51E-15	98.2%	14.0871	450.40 ± 4.15
35	0.73383	0.000887	0.05960	0.000202	0.00074	0.000024	0.00002	0.000020	0.000038	0.000013	5.64E-15	98.5%	12.1242	393.99 ± 2.56
36	0.86677	0.002075	0.05799	0.000311	0.00077	0.000024	0.00003	0.000008	0.000048	0.000012	6.66E-15	98.4%	14.7033	467.76 ± 3.41
37	0.07272	0.000254	0.00523	0.000089	0.00008	0.000019	0.00000	0.000012	0.000018	0.000012	5.59E-16	92.5%	12.8520	415.12 ± 23.06
38	0.68810	0.000867	0.05557	0.000248	0.00066	0.000021	-0.00003	0.000016	0.000012	0.000010	5.29E-15	99.5%	12.3193	399.68 ± 2.54
39	0.52566	0.000831	0.03603	0.000170	0.00046	0.000026	-0.00003	0.000012	0.000001	0.000011	4.04E-15	100.0%	14.5836	464.40 ± 3.69
40	0.13838	0.000374	0.01006	0.000071	0.00010	0.000015	0.00000	0.000012	0.000009	0.000010	1.06E-15	98.1%	13.5003	433.72 ± 10.14
41	10.1106	0.003283	0.86879	0.001020	0.01117	0.000073	0.00000	0.000008	0.000105	0.000011	7.77E-14	99.7%	11.6020	378.68 ± 0.48
42	3.85422	0.001724	0.31102	0.000386	0.00398	0.000023	0.00001	0.000007	0.000004	0.000021	2.96E-14	100.0%	12.3885	401.69 ± 0.84
43	2.63497	0.001632	0.21242	0.000420	0.00288	0.000036	0.00000	0.000006	0.000101	0.000011	2.02E-14	98.9%	12.2641	398.07 ± 0.97
44	1.08647	0.001155	0.08710	0.000435	0.00115	0.000032	-0.00002	0.000017	0.000020	0.000013	8.35E-15	99.5%	12.4059	402.20 ± 2.52
45	1.97102	0.001740	0.17019	0.000320	0.00222	0.000029	-0.00003	0.000013	0.000041	0.000011	1.51E-14	99.4%	11.5091	375.95 ± 1.00
46	0.98407	0.000745	0.07016	0.000242	0.00092	0.000026	-0.00002	0.000014	0.000031	0.000011	7.56E-15	99.1%	13.8955	444.97 ± 2.19
47	0.72638	0.000934	0.05326	0.000282	0.00076	0.000021	-0.00003	0.000019	0.000119	0.000011	5.58E-15	95.2%	12.9767	418.71 ± 3.11
48	1.95230	0.001817	0.16488	0.000607	0.00216	0.000027	-0.00002	0.000017	0.000068	0.000012	1.50E-14	99.0%	11.7188	382.12 ± 1.62
49	1.24668	0.001677	0.10634	0.000250	0.00140	0.000036	0.00000	0.000011	0.000037	0.000011	9.58E-15	99.1%	11.6219	379.27 ± 1.45
50	0.81416	0.000845	0.07043	0.000331	0.00094	0.000028	-0.00001	0.000020	0.000033	0.000010	6.25E-15	98.8%	11.4187	373.28 ± 2.30
51	1.02883	0.000945	0.06931	0.000200	0.00096	0.000029	0.00000	0.000014	0.000013	0.000016	7.90E-15	99.6%	14.7914	470.22 ± 2.65
52	1.90145	0.001041	0.13527	0.000311	0.00170	0.000041	-0.00001	0.000014	0.000005	0.000019	1.46E-14	99.9%	14.0456	449.23 ± 1.71
53	0.70813	0.000932	0.04905	0.000211	0.00063	0.000029	-0.00001	0.000011	0.000021	0.000009	5.44E-15	99.1%	14.3116	456.74 ± 2.72
54	1.19175	0.001040	0.07774	0.000440	0.00101	0.000025	0.00000	0.000017	0.000030	0.000010	9.15E-15	99.2%	15.2152	482.04 ± 3.02
55	0.74023	0.000473	0.05163	0.000161	0.00065	0.000035	-0.00001	0.000010	0.000088	0.000010	5.69E-15	96.5%	13.8353	443.26 ± 2.38
56	1.86171	0.001554	0.12607	0.000316	0.00163	0.000036	0.00003	0.000013	0.000024	0.000009	1.43E-14	99.6%	14.7113	467.98 ± 1.42
57	3.93444	0.002653	0.34716	0.000643	0.00446	0.000045	-0.00001	0.000012	0.000173	0.000011	3.02E-14	98.7%	11.1859	366.39 ± 0.79
58	3.20848	0.001941	0.24395	0.000655	0.00325	0.000075	0.00001	0.000010	0.000028	0.000014	2.46E-14	99.7%	13.1188	422.80 ± 1.29
59	2.27804	0.001682	0.17938	0.000576	0.00231	0.000033	0.00001	0.000016	0.000042	0.000010	1.75E-14	99.5%	12.6304	408.71 ± 1.46
60	1.70539	0.001333	0.14030	0.000412	0.00174	0.000029	-0.00001	0.000014	0.000027	0.000009	1.31E-14	99.5%	12.0980	393.23 ± 1.36
61	0.73291	0.000624	0.05604	0.000271	0.00072	0.000028	0.00002	0.000015	0.000017	0.000016	5.63E-15	99.3%	12.9910	419.12 ± 3.36
62	2.30997	0.002004	0.19936	0.000431	0.00261	0.000041	0.00000	0.000014	0.000037	0.000009	1.77E-14	99.5%	11.5321	376.62 ± 0.99

63	0.96257	0.000701	0.07887	0.000322	0.00096	0.000025	0.00003	0.000017	-0.000017	0.000018	7.39E-15	100.5%	12.2044	396.33 ± 2.70
64	0.93950	0.000908	0.05766	0.000256	0.00072	0.000033	0.00001	0.000019	0.000020	0.000010	7.22E-15	99.4%	16.1928	509.02 ± 2.85
65	10.1301	0.003811	0.12711	0.000213	0.00175	0.000031	0.00003	0.000012	0.000055	0.000010	7.78E-14	99.8%	79.5698	1725.08 ± 3.01
66	2.99266	0.002067	0.23901	0.000382	0.00298	0.000033	0.00001	0.000008	0.000062	0.000010	2.30E-14	99.4%	12.4447	403.33 ± 0.82
67	7.75392	0.002627	0.65348	0.001021	0.00828	0.000072	0.00003	0.000015	0.000097	0.000010	5.96E-14	99.6%	11.8219	385.14 ± 0.64
68	2.55365	0.002118	0.20641	0.000402	0.00256	0.000051	0.00001	0.000017	0.000046	0.000010	1.96E-14	99.5%	12.3061	399.29 ± 0.97
69	3.99034	0.003933	0.28323	0.000333	0.00365	0.000037	0.00000	0.000013	0.000053	0.000015	3.06E-14	99.6%	14.0329	448.87 ± 0.86
70	2.91829	0.002107	0.20136	0.000557	0.00252	0.000034	0.00000	0.000012	0.000011	0.000009	2.24E-14	99.9%	14.4767	461.39 ± 1.38
71	0.58063	0.000840	0.04595	0.000199	0.00061	0.000031	0.00000	0.000008	0.000028	0.000011	4.46E-15	98.6%	12.4557	403.64 ± 2.90
72	1.68164	0.001787	0.15300	0.000318	0.00193	0.000034	0.00003	0.000013	0.000014	0.000010	1.29E-14	99.7%	10.9634	359.78 ± 1.04
73	1.25840	0.001103	0.08835	0.000309	0.00107	0.000034	-0.00001	0.000011	0.000011	0.000015	9.67E-15	99.7%	14.2058	453.76 ± 2.27
74	2.37175	0.002218	0.20175	0.000450	0.00253	0.000044	0.00002	0.000011	0.000037	0.000010	1.82E-14	99.5%	11.7024	381.64 ± 1.04
75	1.27316	0.001130	0.10997	0.000285	0.00140	0.000030	0.00000	0.000015	0.000021	0.000010	9.78E-15	99.5%	11.5201	376.27 ± 1.34
76	2.83125	0.002163	0.19225	0.000573	0.00246	0.000043	0.00002	0.000012	0.000030	0.000020	2.17E-14	99.7%	14.6813	467.14 ± 1.73
77	0.66575	0.001061	0.04674	0.000104	0.00058	0.000024	0.00000	0.000009	0.000036	0.000009	5.11E-15	98.4%	14.0162	448.40 ± 2.20
78	3.36948	0.003168	0.27583	0.000467	0.00344	0.000049	0.00001	0.000018	-0.000011	0.000016	2.59E-14	100.1%	12.2159	396.67 ± 0.95
79	1.39809	0.001442	0.09571	0.000312	0.00120	0.000027	0.00000	0.000014	-0.000014	0.000017	1.07E-14	100.3%	14.6070	465.05 ± 2.32
80	2.06143	0.001594	0.14119	0.000268	0.00179	0.000028	0.00001	0.000013	0.000033	0.000011	1.58E-14	99.5%	14.5312	462.93 ± 1.19
81	0.43847	0.000584	0.03524	0.000203	0.00046	0.000025	0.00000	0.000013	0.000017	0.000010	3.37E-15	98.9%	12.3023	399.18 ± 3.53
82	1.99935	0.001801	0.16635	0.000462	0.00210	0.000029	0.00001	0.000019	0.000015	0.000016	1.54E-14	99.8%	11.9924	390.14 ± 1.47
83	0.93008	0.000810	0.06597	0.000444	0.00078	0.000025	0.00000	0.000015	0.000027	0.000011	7.14E-15	99.2%	13.9785	447.33 ± 3.42
84	2.03846	0.001801	0.08633	0.000236	0.00112	0.000026	0.00000	0.000015	0.000029	0.000009	1.57E-14	99.6%	23.5148	699.18 ± 2.20
85	0.76112	0.000996	0.05471	0.000324	0.00065	0.000032	-0.00001	0.000013	0.000013	0.000009	5.85E-15	99.5%	13.8438	443.51 ± 3.15
86	4.64621	0.002050	0.33443	0.000944	0.00443	0.000087	0.00007	0.000017	0.000042	0.000009	3.57E-14	99.7%	13.8564	443.86 ± 1.30
87	0.72355	0.000691	0.06232	0.000197	0.00075	0.000019	-0.00002	0.000015	0.000038	0.000012	5.56E-15	98.5%	11.4304	373.62 ± 2.28
88	0.09426	0.000434	0.00866	0.000109	0.00012	0.000020	0.00001	0.000012	-0.000003	0.000009	7.24E-16	100.8%	10.8828	357.38 ± 11.00
89	1.44181	0.001323	0.12212	0.000257	0.00152	0.000026	0.00000	0.000012	0.000012	0.000017	1.11E-14	99.8%	11.7774	383.84 ± 1.60
90	1.81925	0.000779	0.12901	0.000584	0.00167	0.000038	-0.00001	0.000013	0.000081	0.000010	1.40E-14	98.7%	13.9169	445.58 ± 2.19
91	0.72553	0.001238	0.06390	0.000243	0.00079	0.000027	-0.00002	0.000010	0.000021	0.000011	5.57E-15	99.1%	11.2563	368.48 ± 2.22
92	0.91414	0.000623	0.06823	0.000339	0.00088	0.000030	0.00002	0.000012	0.000064	0.000010	7.02E-15	97.9%	13.1187	422.79 ± 2.61
93	0.52337	0.001085	0.04415	0.000231	0.00056	0.000026	0.00000	0.000011	0.000029	0.000009	4.02E-15	98.4%	11.6607	380.41 ± 2.87
94	0.96203	0.001163	0.05535	0.000259	0.00072	0.000027	-0.00003	0.000018	0.000019	0.000010	7.39E-15	99.4%	17.2789	538.52 ± 3.07

95	1.72199	0.001726	0.13749	0.000422	0.00173	0.000035	0.00000	0.000010	0.000023	0.000009	1.32E-14	99.6%	12.4746	404.19 ± 1.46
96	0.73239	0.001127	0.05976	0.000245	0.00072	0.000022	-0.00002	0.000011	0.000012	0.000010	5.63E-15	99.5%	12.1945	396.04 ± 2.34
97	0.29190	0.000357	0.02500	0.000155	0.00029	0.000023	0.00000	0.000015	-0.000002	0.000010	2.24E-15	100.2%	11.6774	380.90 ± 4.44
98	1.28461	0.001559	0.11371	0.000278	0.00142	0.000034	0.00001	0.000011	0.000020	0.000010	9.87E-15	99.5%	11.2466	368.19 ± 1.33
99	0.62412	0.000807	0.05462	0.000275	0.00064	0.000026	-0.00001	0.000014	0.000012	0.000009	4.79E-15	99.4%	11.3586	371.50 ± 2.48
100	0.10056	0.000360	0.00754	0.000112	0.00007	0.000020	-0.00001	0.000015	0.000019	0.000010	7.72E-16	94.5%	12.6046	407.96 ± 14.74
101	1.81302	0.002415	0.14897	0.000502	0.00190	0.000034	0.00000	0.000013	0.000021	0.000009	1.39E-14	99.7%	12.1286	394.12 ± 1.55
102	2.15070	0.002036	0.17665	0.000341	0.00225	0.000034	0.00002	0.000008	0.000032	0.000010	1.65E-14	99.6%	12.1204	393.88 ± 1.01
103	1.27125	0.000837	0.09922	0.000266	0.00124	0.000033	0.00000	0.000013	0.000020	0.000010	9.76E-15	99.5%	12.7522	412.23 ± 1.52
104	0.71556	0.001094	0.04916	0.000298	0.00065	0.000032	0.00000	0.000016	0.000014	0.000009	5.50E-15	99.4%	14.4710	461.23 ± 3.39
105	0.93448	0.001082	0.06693	0.000367	0.00086	0.000021	0.00001	0.000013	0.000043	0.000010	7.18E-15	98.6%	13.7724	441.48 ± 2.86
106	0.62150	0.000676	0.04970	0.000216	0.00063	0.000039	0.00001	0.000010	0.000018	0.000010	4.77E-15	99.1%	12.3995	402.01 ± 2.64
107	1.54487	0.001552	0.13370	0.000278	0.00168	0.000031	0.00001	0.000016	0.000008	0.000009	1.19E-14	99.8%	11.5357	376.73 ± 1.09
108	0.71748	0.000748	0.06049	0.000271	0.00074	0.000024	-0.00001	0.000013	0.000004	0.000010	5.51E-15	99.9%	11.8429	385.76 ± 2.40
109	1.39896	0.001424	0.09391	0.000260	0.00115	0.000034	0.00002	0.000012	0.000016	0.000010	1.07E-14	99.7%	14.8474	471.79 ± 1.75
110	0.91681	0.000708	0.07159	0.000239	0.00092	0.000024	0.00001	0.000016	0.000032	0.000009	7.04E-15	99.0%	12.6731	409.95 ± 1.88
111	0.92278	0.000773	0.06665	0.000405	0.00086	0.000024	0.00003	0.000013	0.000019	0.000009	7.09E-15	99.4%	13.7618	441.18 ± 3.00
112	0.35594	0.000561	0.02629	0.000151	0.00032	0.000020	0.00001	0.000014	0.000000	0.000009	2.73E-15	100.0%	13.5366	434.76 ± 4.29

OK12-32 Muscovite (au28.5m.mus), 60/80#. Pennsylvanian Atoka Formation J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	1.95216	0.002900	0.13634	0.000297	0.00178	0.000033	0.00000	0.000013	0.000030	0.000009	1.50E-14	99.5%	14.2522	455.07	± 1.35
2	2.30457	0.002406	0.16669	0.000327	0.00205	0.000033	0.00000	0.000018	0.000020	0.000009	1.77E-14	99.7%	13.7896	441.97	± 1.10
3	1.56589	0.001374	0.13230	0.000461	0.00165	0.000029	-0.00001	0.000014	0.000021	0.000008	1.20E-14	99.6%	11.7885	384.17	± 1.49
4	1.20173	0.001347	0.10339	0.000420	0.00133	0.000030	-0.00001	0.000009	0.000005	0.000008	9.23E-15	99.9%	11.6100	378.92	± 1.77
5	2.52162	0.001391	0.17895	0.000250	0.00225	0.000037	0.00000	0.000008	0.000024	0.000008	1.94E-14	99.7%	14.0512	449.39	± 0.81
6	0.95553	0.001276	0.06693	0.000256	0.00085	0.000031	-0.00006	0.000015	0.000008	0.000013	7.34E-15	99.7%	14.2394	454.71	± 2.59
7	0.47774	0.000919	0.04159	0.000305	0.00052	0.000021	-0.00002	0.000011	-0.000019	0.000008	3.67E-15	101.2%	11.4877	375.32	± 3.36
8	1.59912	0.001183	0.11494	0.000391	0.00140	0.000027	0.00001	0.000005	0.000022	0.000009	1.23E-14	99.6%	13.8558	443.85	± 1.71
9	1.65001	0.001724	0.11612	0.000504	0.00151	0.000024	0.00002	0.000013	0.000005	0.000009	1.27E-14	99.9%	14.1973	453.52	± 2.15
10	2.54207	0.001610	0.17783	0.000462	0.00222	0.000035	-0.00001	0.000013	-0.000014	0.000008	1.95E-14	100.2%	14.2947	456.27	± 1.29
11	2.99218	0.001300	0.21156	0.000585	0.00265	0.000032	0.00000	0.000011	-0.000001	0.000008	2.30E-14	100.0%	14.1436	452.00	± 1.31
12	1.28749	0.001607	0.09104	0.000339	0.00116	0.000036	-0.00001	0.000014	0.000009	0.000008	9.89E-15	99.8%	14.1143	451.17	± 1.95
13	2.03589	0.001205	0.14549	0.000507	0.00179	0.000023	-0.00001	0.000012	0.000024	0.000007	1.56E-14	99.7%	13.9443	446.36	± 1.64
14	4.07329	0.002724	0.31636	0.000779	0.00399	0.000041	-0.00001	0.000012	0.000032	0.000009	3.13E-14	99.8%	12.8456	414.93	± 1.10
15	1.41739	0.000616	0.10000	0.000290	0.00124	0.000032	0.00000	0.000012	0.000010	0.000011	1.09E-14	99.8%	14.1447	452.03	± 1.71
16	2.16955	0.001990	0.15396	0.000305	0.00195	0.000028	-0.00001	0.000011	0.000024	0.000008	1.67E-14	99.7%	14.0458	449.23	± 1.09
17	1.66288	0.001280	0.14453	0.000344	0.00180	0.000029	-0.00001	0.000014	0.000013	0.000010	1.28E-14	99.8%	11.4798	375.08	± 1.15
18	1.07358	0.001452	0.07560	0.000222	0.00097	0.000024	0.00000	0.000011	0.000015	0.000008	8.25E-15	99.6%	14.1440	452.01	± 1.78
19	0.65388	0.000925	0.04505	0.000117	0.00057	0.000019	0.00001	0.000008	0.000015	0.000009	5.02E-15	99.3%	14.4181	459.74	± 2.34
20	3.14114	0.002705	0.22085	0.000236	0.00286	0.000033	0.00000	0.000007	0.000189	0.000030	2.41E-14	98.2%	13.9705	447.10	± 1.44
21	1.79776	0.001228	0.13029	0.000415	0.00164	0.000020	-0.00001	0.000010	0.000005	0.000008	1.38E-14	99.9%	13.7879	441.92	± 1.56
22	0.15547	0.000512	0.01313	0.000075	0.00017	0.000015	-0.00001	0.000011	-0.000007	0.000007	1.19E-15	101.2%	11.8446	385.81	± 5.61
23	2.23234	0.001871	0.17946	0.000467	0.00225	0.000027	-0.00003	0.000017	0.000009	0.000009	1.71E-14	99.9%	12.4234	402.71	± 1.21
24	0.76544	0.001085	0.05382	0.000316	0.00067	0.000023	-0.00001	0.000011	0.000015	0.000008	5.88E-15	99.4%	14.1409	451.93	± 3.12
25	0.59156	0.001062	0.04163	0.000154	0.00053	0.000021	0.00001	0.000015	0.000019	0.000008	4.54E-15	99.1%	14.0759	450.09	± 2.68
26	1.04350	0.000988	0.08353	0.000396	0.00105	0.000033	0.00000	0.000015	0.000012	0.000008	8.02E-15	99.7%	12.4514	403.52	± 2.16
27	4.02191	0.002889	0.28396	0.000497	0.00349	0.000042	0.00000	0.000012	0.000028	0.000009	3.09E-14	99.8%	14.1349	451.76	± 0.91
28	1.14396	0.001089	0.08052	0.000232	0.00104	0.000018	-0.00003	0.000018	0.000018	0.000008	8.79E-15	99.5%	14.1392	451.88	± 1.66
29	0.18863	0.000386	0.01315	0.000103	0.00012	0.000017	0.00000	0.000007	-0.000001	0.000008	1.45E-15	100.2%	14.3422	457.61	± 6.95
30	0.14782	0.000482	0.01018	0.000051	0.00010	0.000018	-0.00003	0.000016	0.000006	0.000007	1.14E-15	98.7%	14.3334	457.36	± 7.34

31	1.71241	0.001623	0.11966	0.000316	0.00151	0.000026	0.00001	0.000008	0.000048	0.000007	1.32E-14	99.2%	14.1922	453.38 ± 1.40
32	1.05266	0.000721	0.07336	0.000305	0.00091	0.000020	-0.00002	0.000012	0.000003	0.000007	8.09E-15	99.9%	14.3382	457.49 ± 2.15
33	1.55161	0.001095	0.11037	0.000334	0.00142	0.000025	-0.00002	0.000014	-0.000007	0.000011	1.19E-14	100.1%	14.0586	449.60 ± 1.70
34	2.36761	0.001716	0.16510	0.000426	0.00209	0.000033	0.00001	0.000010	0.000024	0.000009	1.82E-14	99.7%	14.2972	456.34 ± 1.32
35	0.65950	0.000794	0.05180	0.000279	0.00064	0.000020	0.00002	0.000011	0.000010	0.000007	5.07E-15	99.5%	12.6731	409.95 ± 2.62
36	0.25467	0.000228	0.01957	0.000073	0.00026	0.000017	-0.00001	0.000011	-0.000006	0.000008	1.96E-15	100.7%	13.0134	419.77 ± 4.27
37	0.17672	0.000442	0.01406	0.000069	0.00017	0.000017	-0.00002	0.000013	0.000003	0.000008	1.36E-15	99.5%	12.5071	405.14 ± 5.63
38	1.85401	0.001770	0.12832	0.000485	0.00161	0.000023	-0.00001	0.000009	0.000030	0.000008	1.42E-14	99.5%	14.3784	458.63 ± 1.89
39	4.61890	0.002743	0.32562	0.000805	0.00432	0.000050	0.00000	0.000016	0.000031	0.000009	3.55E-14	99.8%	14.1562	452.36 ± 1.18
40	0.04743	0.000346	0.00322	0.000071	0.00006	0.000015	-0.00001	0.000011	0.000006	0.000009	3.64E-16	96.2%	14.1922	453.38 ± 27.77
41	0.65570	0.000777	0.05854	0.000189	0.00073	0.000022	-0.00002	0.000012	0.000015	0.000009	5.04E-15	99.3%	11.1244	364.57 ± 1.90
42	3.64057	0.001462	0.25809	0.000504	0.00335	0.000034	0.00001	0.000007	0.000014	0.000013	2.80E-14	99.9%	14.0892	450.46 ± 1.02
43	0.40610	0.000631	0.02906	0.000262	0.00037	0.000019	-0.00001	0.000016	0.000013	0.000008	3.12E-15	99.1%	13.8440	443.51 ± 4.82
44	0.02903	0.000289	0.00233	0.000065	0.00002	0.000016	-0.00002	0.000014	0.000001	0.000006	2.23E-16	99.1%	12.3355	400.15 ± 28.73
45	0.51671	0.001100	0.03676	0.000218	0.00047	0.000020	-0.00001	0.000009	0.000021	0.000008	3.97E-15	98.8%	13.8873	444.74 ± 3.54
46	0.33656	0.000784	0.02620	0.000142	0.00030	0.000019	0.00000	0.000010	0.000012	0.000007	2.59E-15	99.0%	12.7128	411.09 ± 3.48
47	2.08352	0.003072	0.17299	0.000461	0.00221	0.000043	-0.00001	0.000008	0.000007	0.000015	1.60E-14	99.9%	12.0318	391.29 ± 1.45
48	0.55247	0.000878	0.03907	0.000189	0.00048	0.000022	-0.00001	0.000012	0.000020	0.000008	4.24E-15	99.0%	13.9937	447.76 ± 2.94
49	2.45330	0.002022	0.17223	0.000432	0.00222	0.000028	-0.00001	0.000014	0.000034	0.000008	1.88E-14	99.6%	14.1869	453.23 ± 1.27
50	1.27983	0.002451	0.08963	0.000284	0.00112	0.000024	0.00001	0.000012	0.000023	0.000016	9.83E-15	99.5%	14.2022	453.66 ± 2.39
51	1.24948	0.001167	0.08832	0.000431	0.00113	0.000024	-0.00001	0.000006	0.000010	0.000008	9.60E-15	99.8%	14.1127	451.13 ± 2.41
52	13.3530	0.006029	0.97574	0.001273	0.01256	0.000087	0.00006	0.000016	0.000099	0.000024	1.03E-13	99.8%	13.6548	438.13 ± 0.65
53	1.80110	0.002259	0.12016	0.000367	0.00152	0.000034	0.00000	0.000014	0.000041	0.000012	1.38E-14	99.3%	14.8880	472.92 ± 1.84
54	0.54366	0.000880	0.04333	0.000296	0.00052	0.000018	-0.00002	0.000011	0.000013	0.000008	4.18E-15	99.3%	12.4594	403.75 ± 3.34
55	2.72457	0.002529	0.19038	0.000357	0.00244	0.000025	-0.00001	0.000008	0.000008	0.000008	2.09E-14	99.9%	14.2984	456.37 ± 1.03
56	0.83247	0.001275	0.07206	0.000309	0.00089	0.000021	0.00000	0.000010	0.000021	0.000008	6.39E-15	99.2%	11.4651	374.65 ± 2.01
57	5.97093	0.002488	0.41869	0.000746	0.00525	0.000057	-0.00001	0.000006	0.000130	0.000010	4.59E-14	99.4%	14.1695	452.73 ± 0.86
58	2.57725	0.002376	0.22950	0.000237	0.00292	0.000039	-0.00001	0.000010	0.000008	0.000007	1.98E-14	99.9%	11.2192	367.38 ± 0.60
59	1.67297	0.001609	0.13238	0.000417	0.00166	0.000024	0.00000	0.000010	0.000003	0.000012	1.29E-14	99.9%	12.6309	408.72 ± 1.60
60	5.39524	0.005296	0.37839	0.000608	0.00482	0.000057	0.00001	0.000013	0.000014	0.000014	4.14E-14	99.9%	14.2478	454.95 ± 0.93
61	3.41650	0.002732	0.23947	0.000698	0.00311	0.000054	0.00000	0.000017	0.000025	0.000009	2.62E-14	99.8%	14.2360	454.61 ± 1.42
62	5.92444	0.003135	0.41579	0.000625	0.00528	0.000040	0.00000	0.000015	0.000012	0.000012	4.55E-14	99.9%	14.2403	454.73 ± 0.77

63	9.86664	0.013109	0.69182	0.000974	0.00914	0.000126	0.00000	0.000014	0.000038	0.000012	7.58E-14	99.9%	14.2456	454.88 ± 0.90
64	4.89049	0.005666	0.39454	0.000817	0.00496	0.000041	0.00001	0.000009	0.000062	0.000013	3.76E-14	99.6%	12.3494	400.56 ± 1.00
65	3.41902	0.003828	0.24246	0.000474	0.00307	0.000044	0.00000	0.000010	0.000046	0.000008	2.63E-14	99.6%	14.0456	449.23 ± 1.06
66	0.87968	0.000419	0.07717	0.000308	0.00098	0.000028	-0.00002	0.000014	0.000030	0.000013	6.76E-15	99.0%	11.2822	369.24 ± 2.25
67	0.57991	0.000858	0.04031	0.000173	0.00053	0.000016	-0.00003	0.000012	0.000016	0.000007	4.45E-15	99.2%	14.2722	455.63 ± 2.69
68	2.00660	0.001533	0.13964	0.000356	0.00174	0.000032	0.00000	0.000007	0.000035	0.000008	1.54E-14	99.5%	14.2960	456.30 ± 1.35
69	7.72798	0.004193	0.54788	0.000821	0.00688	0.000036	0.00001	0.000011	0.000086	0.000009	5.94E-14	99.7%	14.0588	449.60 ± 0.74
70	0.38728	0.000505	0.02778	0.000084	0.00036	0.000025	0.00000	0.000010	0.000012	0.000008	2.97E-15	99.1%	13.8101	442.55 ± 3.21
71	1.19294	0.001306	0.10641	0.000228	0.00135	0.000022	-0.00001	0.000009	0.000022	0.000007	9.16E-15	99.5%	11.1513	365.37 ± 1.11
72	1.61893	0.001250	0.11415	0.000292	0.00146	0.000023	-0.00002	0.000010	0.000029	0.000009	1.24E-14	99.5%	14.1080	451.00 ± 1.42
73	1.61527	0.001055	0.11051	0.000349	0.00140	0.000030	-0.00001	0.000010	0.000022	0.000008	1.24E-14	99.6%	14.5571	463.65 ± 1.64
74	3.93145	0.002177	0.27916	0.000698	0.00347	0.000035	0.00000	0.000006	0.000019	0.000008	3.02E-14	99.9%	14.0626	449.71 ± 1.18
75	0.52396	0.000810	0.04703	0.000124	0.00061	0.000016	-0.00005	0.000014	0.000014	0.000008	4.02E-15	99.2%	11.0506	362.38 ± 1.94
76	3.74052	0.002788	0.26795	0.000591	0.00349	0.000043	0.00001	0.000011	0.000006	0.000015	2.87E-14	99.9%	13.9529	446.60 ± 1.17
77	1.29624	0.001171	0.09033	0.000455	0.00117	0.000033	0.00001	0.000009	0.000020	0.000008	9.96E-15	99.6%	14.2858	456.02 ± 2.48
78	4.29044	0.004789	0.30001	0.000507	0.00377	0.000044	0.00000	0.000014	0.000038	0.000009	3.30E-14	99.7%	14.2634	455.39 ± 0.97
79	2.01298	0.002698	0.13977	0.000370	0.00175	0.000036	0.00000	0.000019	0.000027	0.000009	1.55E-14	99.6%	14.3463	457.72 ± 1.49
80	0.25347	0.000559	0.02033	0.000080	0.00021	0.000029	0.00001	0.000015	0.000012	0.000008	1.95E-15	98.6%	12.2892	398.80 ± 4.10
81	0.29798	0.000411	0.02108	0.000110	0.00028	0.000018	0.00000	0.000014	0.000002	0.000008	2.29E-15	99.8%	14.1080	451.00 ± 4.27
82	0.79891	0.001342	0.05646	0.000268	0.00071	0.000024	-0.00001	0.000007	0.000011	0.000007	6.14E-15	99.6%	14.0936	450.59 ± 2.60
83	0.27654	0.000580	0.02496	0.000072	0.00032	0.000017	0.00001	0.000011	0.000000	0.000007	2.12E-15	100.0%	11.0768	363.15 ± 3.00
84	0.24021	0.000371	0.01758	0.000091	0.00025	0.000015	-0.00002	0.000006	0.000006	0.000008	1.85E-15	99.2%	13.5571	435.35 ± 4.92
85	5.02278	0.003858	0.35249	0.000761	0.00455	0.000034	-0.00001	0.000009	0.000023	0.000014	3.86E-14	99.9%	14.2302	454.45 ± 1.11
86	0.83977	0.001220	0.06415	0.000183	0.00084	0.000027	0.00001	0.000009	0.000090	0.000007	6.45E-15	96.8%	12.6769	410.06 ± 1.69
87	4.67869	0.001361	0.32452	0.000798	0.00413	0.000053	-0.00002	0.000009	0.000145	0.000011	3.59E-14	99.1%	14.2852	456.00 ± 1.19
88	2.33813	0.001236	0.15781	0.000391	0.00205	0.000031	-0.00001	0.000015	0.000184	0.000010	1.80E-14	97.7%	14.4707	461.23 ± 1.33
89	11.0452	0.006544	0.13743	0.000297	0.00190	0.000025	0.00000	0.000012	0.000057	0.000011	8.48E-14	99.8%	80.2507	1734.56 ± 3.93
90	3.71584	0.003452	0.26316	0.000372	0.00333	0.000042	0.00000	0.000012	0.000058	0.000007	2.85E-14	99.5%	14.0549	449.49 ± 0.81
91	7.25928	0.004624	0.64302	0.000576	0.00804	0.000049	0.00000	0.000009	0.000086	0.000014	5.58E-14	99.7%	11.2500	368.29 ± 0.46
92	3.64992	0.001713	0.25518	0.000659	0.00326	0.000033	0.00000	0.000010	0.000019	0.000014	2.80E-14	99.8%	14.2805	455.87 ± 1.30
93	2.72169	0.002465	0.19455	0.000414	0.00244	0.000031	-0.00001	0.000009	0.000010	0.000016	2.09E-14	99.9%	13.9752	447.23 ± 1.30
94	1.76434	0.001692	0.13964	0.000409	0.00174	0.000037	0.00000	0.000010	0.000012	0.000007	1.36E-14	99.8%	12.6084	408.07 ± 1.35

95	3.89927	0.004366	0.27700	0.000654	0.00361	0.000050	0.00000	0.000015	0.000021	0.000009	3.00E-14	99.8%	14.0548	449.49 ± 1.21
96	8.25713	0.008210	0.58127	0.001273	0.00758	0.000083	-0.00001	0.000010	0.000063	0.000009	6.34E-14	99.8%	14.1731	452.83 ± 1.10
97	3.10012	0.002377	0.21699	0.000539	0.00277	0.000031	-0.00001	0.000016	0.000008	0.000013	2.38E-14	99.9%	14.2759	455.74 ± 1.32
98	5.16483	0.002585	0.36337	0.000673	0.00460	0.000033	0.00000	0.000010	0.000050	0.000008	3.97E-14	99.7%	14.1732	452.84 ± 0.90
99	3.77454	0.002575	0.27030	0.000831	0.00335	0.000041	-0.00001	0.000014	0.000051	0.000008	2.90E-14	99.6%	13.9089	445.35 ± 1.44
100	3.34062	0.003041	0.27195	0.000548	0.00344	0.000034	0.00000	0.000014	0.000023	0.000010	2.57E-14	99.8%	12.2592	397.93 ± 0.95
101	1.75178	0.001836	0.12432	0.000418	0.00161	0.000026	-0.00001	0.000012	0.000011	0.000008	1.35E-14	99.8%	14.0651	449.78 ± 1.70
102	0.05588	0.000319	0.00397	0.000088	0.00002	0.000018	-0.00002	0.000014	0.000005	0.000007	4.29E-16	97.6%	13.7315	440.31 ± 19.91
103	0.33547	0.000311	0.02359	0.000102	0.00029	0.000024	0.00001	0.000015	0.000003	0.000008	2.58E-15	99.7%	14.1786	452.99 ± 3.71
104	1.90263	0.001573	0.13451	0.000419	0.00171	0.000027	0.00001	0.000014	0.000016	0.000007	1.46E-14	99.8%	14.1096	451.04 ± 1.55
105	0.02365	0.000229	0.00184	0.000083	0.00004	0.000016	-0.00001	0.000016	-0.000008	0.000013	1.82E-16	110.5%	12.8194	414.17 ± 69.85
106	1.11438	0.000948	0.07904	0.000303	0.00099	0.000024	0.00000	0.000008	-0.000018	0.000013	8.56E-15	100.5%	14.0985	450.73 ± 2.34
107	5.31828	0.004906	0.37051	0.000486	0.00486	0.000032	0.00002	0.000010	0.000194	0.000013	4.08E-14	98.9%	14.1991	453.57 ± 0.81
108	3.59782	0.002760	0.25368	0.000607	0.00324	0.000038	-0.00002	0.000014	0.000018	0.000007	2.76E-14	99.8%	14.1610	452.49 ± 1.17
109	0.17119	0.000462	0.01559	0.000074	0.00020	0.000021	-0.00001	0.000013	-0.000006	0.000008	1.31E-15	101.0%	10.9840	360.40 ± 5.46
110	0.58412	0.000584	0.04110	0.000250	0.00052	0.000022	-0.00001	0.000016	-0.000029	0.000012	4.49E-15	101.5%	14.2131	453.97 ± 3.85
111	0.01442	0.000325	0.00142	0.000068	0.00002	0.000019	0.00002	0.000013	-0.000026	0.000010	1.11E-16	154.0%	10.1665	335.92 ± 73.99
112	3.97345	0.001749	0.27887	0.000799	0.00363	0.000044	0.00000	0.000013	-0.000011	0.000011	3.05E-14	100.1%	14.2481	454.95 ± 1.38

OK12-37 Muscovite (au28.5f.mus), 60/80#. Pennsylvanian Jackfork Group J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	1.68628	0.000994	0.11726	0.000414	0.00148	0.000034	0.00001	0.000015	0.000089	0.000010	1.30E-14	98.4%	14.1555	452.34	± 1.82
2	2.48580	0.002753	0.20017	0.000587	0.00256	0.000038	-0.00001	0.000013	0.000158	0.000010	1.91E-14	98.1%	12.1852	395.77	± 1.35
3	3.12754	0.001811	0.21778	0.000354	0.00283	0.000038	0.00001	0.000015	0.000153	0.000010	2.40E-14	98.6%	14.1531	452.27	± 0.90
4	1.34915	0.000963	0.09274	0.000377	0.00118	0.000025	0.00000	0.000012	0.000057	0.000010	1.04E-14	98.8%	14.3681	458.34	± 2.17
5	2.10928	0.001973	0.17837	0.000468	0.00221	0.000021	-0.00001	0.000010	0.000071	0.000010	1.62E-14	99.0%	11.7074	381.78	± 1.21
6	1.62673	0.001057	0.12744	0.000440	0.00159	0.000024	-0.00003	0.000014	0.000027	0.000009	1.25E-14	99.5%	12.7027	410.80	± 1.60
7	1.51570	0.001076	0.10675	0.000208	0.00137	0.000022	0.00002	0.000015	0.000034	0.000010	1.16E-14	99.3%	14.1054	450.92	± 1.30
8	1.38261	0.001843	0.09748	0.000382	0.00123	0.000026	-0.00001	0.000017	0.000030	0.000008	1.06E-14	99.4%	14.0927	450.56	± 2.04
9	4.86841	0.001892	0.28507	0.000487	0.00422	0.000049	-0.00002	0.000011	0.000068	0.000012	3.74E-14	99.6%	17.0071	531.19	± 1.01
10	2.89676	0.001312	0.24572	0.000715	0.00316	0.000035	-0.00001	0.000021	0.000073	0.000016	2.23E-14	99.3%	11.7010	381.60	± 1.30
11	1.11790	0.001215	0.09540	0.000498	0.00117	0.000027	0.00001	0.000010	0.000037	0.000010	8.59E-15	99.0%	11.6034	378.72	± 2.26
12	2.05067	0.001939	0.16613	0.000192	0.00210	0.000025	0.00002	0.000015	0.000028	0.000010	1.58E-14	99.6%	12.2942	398.95	± 0.82
13	2.42272	0.002226	0.17346	0.000378	0.00219	0.000030	0.00001	0.000013	0.000014	0.000013	1.86E-14	99.8%	13.9437	446.34	± 1.29
14	1.11891	0.000929	0.08675	0.000346	0.00109	0.000022	0.00002	0.000015	0.000040	0.000008	8.59E-15	98.9%	12.7608	412.48	± 1.93
15	1.66780	0.001747	0.14352	0.000452	0.00177	0.000032	-0.00001	0.000009	0.000041	0.000009	1.28E-14	99.3%	11.5350	376.71	± 1.40
16	0.82202	0.000857	0.06594	0.000240	0.00085	0.000030	0.00003	0.000011	0.000017	0.000009	6.31E-15	99.4%	12.3910	401.76	± 1.98
17	1.75666	0.001715	0.14041	0.000221	0.00179	0.000032	0.00003	0.000016	0.000063	0.000010	1.35E-14	98.9%	12.3782	401.39	± 1.01
18	2.09436	0.002291	0.18042	0.000433	0.00227	0.000031	0.00003	0.000009	0.000056	0.000010	1.61E-14	99.2%	11.5167	376.17	± 1.12
19	1.61423	0.001482	0.11325	0.000343	0.00141	0.000023	0.00005	0.000010	0.000036	0.000008	1.24E-14	99.3%	14.1599	452.46	± 1.60
20	1.68012	0.002058	0.12652	0.000456	0.00160	0.000030	0.00002	0.000016	0.000036	0.000010	1.29E-14	99.4%	13.1952	424.99	± 1.79
21	3.05636	0.002413	0.25785	0.000764	0.00327	0.000024	0.00000	0.000011	0.000061	0.000010	2.35E-14	99.4%	11.7833	384.01	± 1.24
22	3.62097	0.001763	0.31049	0.000615	0.00388	0.000034	0.00000	0.000011	0.000068	0.000011	2.78E-14	99.4%	11.5976	378.55	± 0.85
23	3.61615	0.003389	0.29288	0.000810	0.00375	0.000042	0.00006	0.000019	0.000032	0.000009	2.78E-14	99.7%	12.3150	399.56	± 1.20
24	1.10734	0.000922	0.09061	0.000346	0.00115	0.000021	0.00003	0.000022	0.000013	0.000010	8.51E-15	99.7%	12.1792	395.60	± 1.85
25	0.58808	0.000644	0.04849	0.000239	0.00060	0.000022	-0.00002	0.000007	0.000018	0.000009	4.52E-15	99.1%	12.0170	390.86	± 2.74
26	0.60505	0.000780	0.04845	0.000311	0.00066	0.000025	-0.00001	0.000014	0.000057	0.000010	4.65E-15	97.2%	12.1423	394.52	± 3.37
27	1.65568	0.002077	0.14435	0.000270	0.00185	0.000022	-0.00001	0.000009	0.000046	0.000009	1.27E-14	99.2%	11.3763	372.03	± 1.04
28	3.09965	0.001984	0.26339	0.000572	0.00333	0.000051	-0.00001	0.000008	0.000074	0.000011	2.38E-14	99.3%	11.6852	381.13	± 0.96
29	0.84607	0.001139	0.06420	0.000258	0.00078	0.000022	-0.00002	0.000012	0.000028	0.000011	6.50E-15	99.0%	13.0509	420.84	± 2.38
30	1.94089	0.001691	0.15542	0.000532	0.00199	0.000034	-0.00002	0.000012	0.000005	0.000015	1.49E-14	99.9%	12.4778	404.29	± 1.70

31	1.18414	0.001197	0.09075	0.000301	0.00118	0.000029	-0.00001	0.000013	0.000044	0.000008	9.10E-15	98.9%	12.9043	416.62 ± 1.71
32	1.91471	0.001841	0.13473	0.000321	0.00170	0.000029	-0.00001	0.000015	0.000023	0.000010	1.47E-14	99.6%	14.1599	452.46 ± 1.35
33	0.69556	0.000834	0.05923	0.000135	0.00076	0.000031	0.00000	0.000014	0.000035	0.000010	5.34E-15	98.5%	11.5713	377.78 ± 1.89
34	3.26610	0.002562	0.23008	0.000501	0.00293	0.000035	-0.00001	0.000020	0.000075	0.000009	2.51E-14	99.3%	14.0986	450.73 ± 1.11
35	5.35477	0.002666	0.36998	0.000545	0.00475	0.000041	0.00005	0.000013	0.000177	0.000010	4.11E-14	99.0%	14.3313	457.30 ± 0.76
36	3.53868	0.004297	0.29829	0.000799	0.00382	0.000044	0.00001	0.000015	0.000080	0.000010	2.72E-14	99.3%	11.7836	384.02 ± 1.18
37	1.91966	0.001841	0.14158	0.000380	0.00180	0.000029	-0.00002	0.000009	0.000012	0.000010	1.47E-14	99.8%	13.5343	434.69 ± 1.40
38	2.35263	0.000952	0.16645	0.000341	0.00210	0.000027	0.00000	0.000014	0.000022	0.000010	1.81E-14	99.7%	14.0949	450.62 ± 1.09
39	1.43182	0.000419	0.12338	0.000421	0.00160	0.000022	-0.00001	0.000011	0.000036	0.000011	1.10E-14	99.3%	11.5200	376.27 ± 1.56
40	1.63716	0.001129	0.11610	0.000224	0.00149	0.000023	0.00000	0.000010	0.000048	0.000011	1.26E-14	99.1%	13.9799	447.37 ± 1.28
41	0.21941	0.000427	0.01659	0.000118	0.00024	0.000020	0.00000	0.000015	0.000010	0.000009	1.69E-15	98.7%	13.0557	420.98 ± 6.25
42	1.27104	0.001234	0.10297	0.000254	0.00128	0.000022	-0.00001	0.000008	0.000033	0.000011	9.76E-15	99.2%	12.2476	397.59 ± 1.47
43	1.67655	0.001356	0.14109	0.000509	0.00175	0.000031	0.00002	0.000007	0.000021	0.000008	1.29E-14	99.6%	11.8377	385.61 ± 1.54
44	2.78150	0.001554	0.19889	0.000283	0.00254	0.000039	0.00001	0.000013	0.000009	0.000014	2.14E-14	99.9%	13.9720	447.14 ± 0.96
45	4.91504	0.002274	0.34449	0.000810	0.00436	0.000045	0.00000	0.000014	0.000030	0.000014	3.78E-14	99.8%	14.2423	454.79 ± 1.16
46	1.68286	0.001567	0.11716	0.000369	0.00146	0.000024	0.00000	0.000014	0.000054	0.000010	1.29E-14	99.0%	14.2268	454.35 ± 1.73
47	3.21111	0.002573	0.24695	0.000523	0.00316	0.000037	0.00000	0.000012	0.000084	0.000018	2.47E-14	99.2%	12.9030	416.59 ± 1.18
48	1.77965	0.001335	0.15446	0.000199	0.00195	0.000033	0.00001	0.000018	0.000139	0.000012	1.37E-14	97.7%	11.2556	368.46 ± 0.92
49	3.80178	0.002189	0.30280	0.000615	0.00381	0.000039	0.00001	0.000009	0.000071	0.000010	2.92E-14	99.4%	12.4859	404.52 ± 0.91
50	2.01897	0.001643	0.16242	0.000339	0.00199	0.000026	0.00000	0.000010	0.000046	0.000010	1.55E-14	99.3%	12.3464	400.47 ± 1.08
51	3.58206	0.002332	0.25082	0.000657	0.00321	0.000033	0.00000	0.000010	0.000073	0.000010	2.75E-14	99.4%	14.1952	453.46 ± 1.29
52	0.80666	0.001037	0.06189	0.000269	0.00082	0.000019	0.00000	0.000016	0.000047	0.000010	6.20E-15	98.3%	12.8084	413.86 ± 2.50
53	2.01201	0.001554	0.08095	0.000333	0.00100	0.000020	0.00001	0.000013	0.000038	0.000009	1.55E-14	99.4%	24.7148	728.52 ± 3.23
54	2.80220	0.001787	0.21859	0.000453	0.00279	0.000029	-0.00003	0.000015	0.000157	0.000011	2.15E-14	98.3%	12.6076	408.05 ± 1.02
55	1.77993	0.002254	0.12564	0.000331	0.00141	0.000037	0.00002	0.000014	0.000053	0.000010	1.37E-14	99.1%	14.0426	449.14 ± 1.54
56	1.71691	0.001573	0.13539	0.000458	0.00170	0.000031	0.00002	0.000005	0.000058	0.000012	1.32E-14	99.0%	12.5544	406.51 ± 1.65
57	1.55225	0.000711	0.12319	0.000551	0.00161	0.000031	0.00000	0.000010	0.000046	0.000010	1.19E-14	99.1%	12.4891	404.61 ± 2.00
58	1.89196	0.001391	0.15398	0.000627	0.00196	0.000026	0.00000	0.000013	0.000061	0.000010	1.45E-14	99.1%	12.1710	395.36 ± 1.77
59	1.80410	0.001340	0.15401	0.000284	0.00196	0.000034	0.00000	0.000016	0.000035	0.000010	1.39E-14	99.4%	11.6478	380.03 ± 0.99
60	1.44761	0.001096	0.12147	0.000405	0.00153	0.000026	-0.00001	0.000016	0.000056	0.000012	1.11E-14	98.9%	11.7818	383.97 ± 1.62
61	0.19834	0.000689	0.01538	0.000091	0.00025	0.000013	-0.00001	0.000016	0.000087	0.000010	1.52E-15	87.0%	11.2162	367.29 ± 7.11
62	1.47607	0.001124	0.12793	0.000349	0.00165	0.000030	-0.00001	0.000011	0.000040	0.000011	1.13E-14	99.2%	11.4463	374.09 ± 1.35

63	1.36943	0.001214	0.11790	0.000490	0.00149	0.000026	-0.00002	0.000007	0.000054	0.000009	1.05E-14	98.8%	11.4787	375.05 ± 1.78
64	2.22900	0.001950	0.19231	0.000452	0.00244	0.000037	-0.00001	0.000014	0.000065	0.000010	1.71E-14	99.1%	11.4914	375.42 ± 1.07
65	3.01672	0.001295	0.26183	0.000642	0.00332	0.000047	0.00000	0.000015	0.000058	0.000009	2.32E-14	99.4%	11.4562	374.39 ± 1.00
66	0.74297	0.000721	0.05952	0.000203	0.00075	0.000020	-0.00001	0.000012	0.000016	0.000009	5.71E-15	99.4%	12.4015	402.07 ± 1.99
67	1.53724	0.001362	0.13289	0.000468	0.00167	0.000029	0.00002	0.000014	0.000045	0.000008	1.18E-14	99.1%	11.4675	374.72 ± 1.49
68	3.19848	0.002093	0.26005	0.000651	0.00344	0.000058	0.00000	0.000012	0.000076	0.000009	2.46E-14	99.3%	12.2131	396.59 ± 1.09
69	0.82403	0.001116	0.07079	0.000271	0.00086	0.000018	0.00002	0.000019	0.000048	0.000010	6.33E-15	98.3%	11.4385	373.86 ± 2.03
70	2.18640	0.001382	0.15458	0.000471	0.00201	0.000026	0.00000	0.000011	0.000044	0.000008	1.68E-14	99.4%	14.0607	449.66 ± 1.50
71	0.34962	0.000651	0.03075	0.000114	0.00040	0.000018	-0.00002	0.000009	0.000011	0.000009	2.69E-15	99.0%	11.2584	368.54 ± 3.17
72	2.04227	0.002327	0.17888	0.000524	0.00224	0.000046	0.00003	0.000008	0.000039	0.000011	1.57E-14	99.4%	11.3527	371.33 ± 1.31
73	1.69325	0.001207	0.15015	0.000512	0.00193	0.000029	0.00003	0.000021	0.000062	0.000010	1.30E-14	98.9%	11.1554	365.49 ± 1.44
74	0.86564	0.000917	0.07455	0.000199	0.00094	0.000017	-0.00002	0.000010	0.000012	0.000010	6.65E-15	99.6%	11.5627	377.53 ± 1.65
75	3.98225	0.002767	0.29251	0.000640	0.00363	0.000044	0.00001	0.000013	0.000046	0.000015	3.06E-14	99.7%	13.5675	435.64 ± 1.11
76	1.16945	0.001101	0.09492	0.000458	0.00119	0.000019	0.00002	0.000013	0.000031	0.000011	8.98E-15	99.2%	12.2232	396.88 ± 2.24
77	1.07577	0.000956	0.08815	0.000342	0.00110	0.000024	0.00002	0.000014	0.000002	0.000009	8.26E-15	100.0%	12.1982	396.15 ± 1.89
78	1.37336	0.001823	0.10948	0.000312	0.00138	0.000021	-0.00001	0.000010	0.000060	0.000010	1.05E-14	98.7%	12.3824	401.51 ± 1.56
79	1.01492	0.000699	0.08706	0.000340	0.00104	0.000025	0.00000	0.000008	0.000027	0.000010	7.80E-15	99.2%	11.5653	377.60 ± 1.85
80	2.57714	0.001456	0.20604	0.000404	0.00263	0.000042	-0.00001	0.000011	0.000021	0.000010	1.98E-14	99.8%	12.4782	404.30 ± 0.95
81	1.18510	0.000996	0.09680	0.000248	0.00118	0.000015	0.00000	0.000011	0.000032	0.000012	9.10E-15	99.2%	12.1454	394.61 ± 1.57
82	0.53669	0.000712	0.04209	0.000174	0.00056	0.000024	-0.00001	0.000010	0.000027	0.000009	4.12E-15	98.5%	12.5633	406.77 ± 2.66
83	1.09258	0.000855	0.08081	0.000240	0.00098	0.000026	-0.00002	0.000013	0.000032	0.000010	8.39E-15	99.1%	13.4043	430.98 ± 1.74
84	0.39188	0.001017	0.03434	0.000183	0.00044	0.000024	-0.00002	0.000014	0.000003	0.000008	3.01E-15	99.8%	11.3871	372.35 ± 3.24
85	1.89407	0.001511	0.14892	0.000418	0.00187	0.000037	-0.00002	0.000008	0.000078	0.000008	1.45E-14	98.8%	12.5652	406.82 ± 1.31
86	0.97569	0.001435	0.07010	0.000288	0.00090	0.000019	-0.00008	0.000019	0.000026	0.000008	7.49E-15	99.2%	13.8093	442.53 ± 2.25
87	3.36388	0.002344	0.23312	0.000582	0.00300	0.000029	0.00000	0.000009	0.000027	0.000010	2.58E-14	99.8%	14.3963	459.13 ± 1.26
88	2.81221	0.002127	0.18581	0.000525	0.00244	0.000032	0.00002	0.000019	0.000159	0.000009	2.16E-14	98.3%	14.8822	472.76 ± 1.48
89	2.40571	0.002007	0.19750	0.000365	0.00250	0.000025	0.00001	0.000009	0.000066	0.000010	1.85E-14	99.2%	12.0819	392.76 ± 0.93
90	1.65936	0.001277	0.11790	0.000231	0.00148	0.000017	0.00001	0.000013	0.000014	0.000011	1.27E-14	99.8%	14.0403	449.08 ± 1.28
91	0.76132	0.000998	0.06825	0.000275	0.00083	0.000023	-0.00002	0.000010	0.000003	0.000010	5.85E-15	99.9%	11.1434	365.13 ± 2.11
92	0.85302	0.000900	0.05730	0.000315	0.00076	0.000022	0.00000	0.000013	0.000015	0.000010	6.55E-15	99.5%	14.8103	470.75 ± 3.10
93	0.67600	0.000990	0.05277	0.000147	0.00074	0.000034	0.00000	0.000013	-0.000006	0.000009	5.19E-15	100.3%	12.8100	413.90 ± 2.09
94	1.00429	0.000998	0.07229	0.000278	0.00089	0.000024	-0.00001	0.000009	0.000031	0.000009	7.71E-15	99.1%	13.7647	441.26 ± 2.11

95	2.28222	0.001343	0.16411	0.000317	0.00206	0.000021	-0.00002	0.000010	0.000006	0.000011	1.75E-14	99.9%	13.8954	444.97 ± 1.09
96	1.01279	0.001195	0.07168	0.000519	0.00093	0.000048	0.00000	0.000009	0.000022	0.000008	7.78E-15	99.4%	14.0405	449.08 ± 3.49
97	0.66833	0.000832	0.05742	0.000200	0.00073	0.000020	-0.00002	0.000009	0.000009	0.000011	5.13E-15	99.6%	11.5928	378.41 ± 2.29
98	1.20441	0.001251	0.08152	0.000204	0.00100	0.000025	-0.00001	0.000012	0.000018	0.000011	9.25E-15	99.6%	14.7111	467.97 ± 1.77
99	1.01460	0.000670	0.07042	0.000308	0.00088	0.000024	-0.00007	0.000018	0.000007	0.000009	7.79E-15	99.8%	14.3779	458.61 ± 2.39
100	2.88158	0.011834	0.20053	0.000733	0.00258	0.000035	0.00000	0.000014	0.000037	0.000009	2.21E-14	99.6%	14.3152	456.85 ± 2.56
101	0.50516	0.000837	0.03970	0.000172	0.00046	0.000024	-0.00005	0.000013	-0.000002	0.000009	3.88E-15	100.1%	12.7228	411.38 ± 2.85
102	1.34235	0.001520	0.10921	0.000440	0.00135	0.000028	-0.00003	0.000010	0.000025	0.000009	1.03E-14	99.4%	12.2234	396.89 ± 1.87
103	1.29616	0.000689	0.11136	0.000407	0.00144	0.000031	0.00001	0.000009	0.000019	0.000010	9.96E-15	99.6%	11.5900	378.33 ± 1.65
104	2.39707	0.001237	0.16600	0.000405	0.00213	0.000032	-0.00002	0.000012	0.000050	0.000009	1.84E-14	99.4%	14.3501	457.83 ± 1.26
105	0.38929	0.000880	0.03325	0.000198	0.00042	0.000018	0.00000	0.000008	-0.000009	0.000010	2.99E-15	100.7%	11.7077	381.79 ± 3.85
106	1.44825	0.001821	0.10335	0.000370	0.00132	0.000016	0.00001	0.000019	-0.000033	0.000013	1.11E-14	100.7%	14.0129	448.30 ± 2.08
107	1.65626	0.001045	0.12242	0.000326	0.00155	0.000031	0.00001	0.000015	0.000006	0.000010	1.27E-14	99.9%	13.5159	434.17 ± 1.43
108	1.98666	0.002344	0.17512	0.000663	0.00229	0.000071	0.00003	0.000014	0.000045	0.000011	1.53E-14	99.3%	11.2687	368.84 ± 1.60
109	0.82744	0.000717	0.06590	0.000254	0.00085	0.000027	-0.00001	0.000013	-0.000004	0.000010	6.36E-15	100.1%	12.5556	406.54 ± 2.15
110	0.88049	0.001166	0.07460	0.000354	0.00098	0.000022	0.00001	0.000017	0.000025	0.000009	6.76E-15	99.2%	11.7054	381.72 ± 2.19
111	0.78980	0.000878	0.06450	0.000410	0.00080	0.000024	0.00000	0.000014	0.000023	0.000009	6.07E-15	99.1%	12.1400	394.46 ± 2.92
112	0.41089	0.000655	0.03584	0.000272	0.00047	0.000016	0.00002	0.000008	0.000011	0.000008	3.16E-15	99.2%	11.3715	371.88 ± 3.70

OK12-39 Muscovite (au28.5c.mus), 60/80#. Pennsylvanian Jackfork Group J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	4.82010	0.003021	0.42486	0.000597	0.00542	0.000049	-0.00206	0.006663	0.000277	0.000011	3.70E-14	98.3%	11.1523	365.40	± 0.63
2	3.80287	0.002653	0.32212	0.000452	0.00408	0.000047	0.00631	0.009788	0.000175	0.000009	2.92E-14	98.7%	11.6467	380.00	± 0.67
3	7.08748	0.006826	0.54195	0.001041	0.00714	0.000119	0.02126	0.007379	0.000363	0.000012	5.44E-14	98.5%	12.8837	416.03	± 0.93
4	1.48908	0.001761	0.10420	0.000537	0.00137	0.000033	0.00747	0.008175	0.000113	0.000009	1.14E-14	97.8%	13.9770	447.29	± 2.58
5	1.29737	0.001797	0.11206	0.000294	0.00143	0.000028	0.00460	0.008863	0.000169	0.000010	9.97E-15	96.2%	11.1351	364.88	± 1.44
6	3.50618	0.001679	0.30016	0.000696	0.00375	0.000034	0.00310	0.007630	0.000180	0.000009	2.69E-14	98.5%	11.5042	375.80	± 0.96
7	1.15725	0.000814	0.08187	0.000287	0.00105	0.000026	-0.01840	0.009311	0.000079	0.000011	8.89E-15	97.9%	13.8286	443.08	± 2.15
8	5.43993	0.003951	0.48201	0.000517	0.00621	0.000079	-0.00191	0.005354	0.000133	0.000010	4.18E-14	99.3%	11.2038	366.92	± 0.53
9	3.04222	0.001710	0.27261	0.000715	0.00358	0.000075	0.00307	0.008482	0.000033	0.000012	2.34E-14	99.7%	11.1249	364.58	± 1.08
10	1.99870	0.001827	0.14363	0.000371	0.00180	0.000033	0.00516	0.006262	0.000068	0.000011	1.54E-14	99.0%	13.7790	441.66	± 1.45
11	1.77484	0.001248	0.14708	0.000373	0.00201	0.000057	0.00357	0.009151	0.000015	0.000018	1.36E-14	99.8%	12.0390	391.50	± 1.60
12	2.14377	0.002157	0.17027	0.000474	0.00213	0.000036	-0.00423	0.007725	0.000031	0.000011	1.65E-14	99.6%	12.5345	405.93	± 1.37
13	0.16601	0.000379	0.01409	0.000085	0.00022	0.000022	0.01129	0.008329	0.000024	0.000010	1.28E-15	96.3%	11.3515	371.29	± 8.02
14	2.52196	0.001578	0.21048	0.000704	0.00263	0.000041	0.00333	0.007663	0.000052	0.000019	1.94E-14	99.4%	11.9106	387.75	± 1.61
15	2.94450	0.001551	0.21453	0.000556	0.00293	0.000079	0.01117	0.005370	0.000127	0.000012	2.26E-14	98.8%	13.5556	435.30	± 1.29
16	3.89367	0.003077	0.29604	0.000644	0.00389	0.000050	-0.00780	0.008556	0.000021	0.000013	2.99E-14	99.8%	13.1291	423.09	± 1.08
17	0.71754	0.000962	0.06059	0.000285	0.00077	0.000026	0.00669	0.008424	0.000036	0.000014	5.51E-15	98.6%	11.6769	380.89	± 3.01
18	1.17602	0.001911	0.10273	0.000261	0.00132	0.000032	0.00005	0.007819	0.000043	0.000017	9.03E-15	98.9%	11.3246	370.50	± 2.02
19	3.90549	0.004379	0.27786	0.000625	0.00376	0.000058	0.00352	0.008363	0.000039	0.000017	3.00E-14	99.7%	14.0154	448.37	± 1.28
20	2.74134	0.001979	0.23970	0.000771	0.00324	0.000062	-0.01541	0.014736	0.000212	0.000022	2.11E-14	97.7%	11.1687	365.88	± 1.55
21	4.86487	0.004067	0.41726	0.000934	0.00523	0.000047	-0.00661	0.006919	0.000259	0.000012	3.74E-14	98.4%	11.4741	374.91	± 0.95
22	1.57612	0.001938	0.13904	0.000365	0.00184	0.000044	0.00275	0.008898	0.000072	0.000011	1.21E-14	98.7%	11.1841	366.34	± 1.34
23	1.77897	0.001380	0.15805	0.000572	0.00196	0.000027	0.01080	0.007636	0.000045	0.000012	1.37E-14	99.3%	11.1790	366.19	± 1.57
24	0.82103	0.000883	0.06855	0.000281	0.00088	0.000023	0.00596	0.007157	0.000147	0.000021	6.31E-15	94.8%	11.3516	371.29	± 3.45
25	1.90125	0.001587	0.14090	0.000392	0.00179	0.000031	0.01272	0.005979	0.000083	0.000011	1.46E-14	98.8%	13.3279	428.80	± 1.47
26	3.60476	0.002663	0.00260	0.000100	0.00243	0.000043	0.01545	0.007989	0.012474	0.000088	2.77E-14	-2.2%	-30.9152		
27	1.89883	0.001303	0.15580	0.000272	0.00198	0.000028	0.00593	0.010276	0.000104	0.000018	1.46E-14	98.4%	11.9945	390.20	± 1.38
28	2.96054	0.002798	0.25958	0.000687	0.00329	0.000024	0.00359	0.007379	0.000204	0.000012	2.27E-14	98.0%	11.1739	366.03	± 1.16
29	2.47894	0.001394	0.18242	0.000335	0.00231	0.000017	0.01293	0.008177	0.000057	0.000012	1.90E-14	99.4%	13.5045	433.84	± 1.06
30	0.84695	0.000850	0.07274	0.000280	0.00097	0.000025	0.00692	0.005798	0.000059	0.000011	6.51E-15	98.0%	11.4145	373.16	± 2.15

31	2.33560	0.001113	0.18645	0.000444	0.00238	0.000034	0.00095	0.007811	0.000161	0.000012	1.79E-14	98.0%	12.2725	398.32 ± 1.17
32	3.59933	0.002298	0.31910	0.000460	0.00412	0.000043	0.00371	0.008084	0.000090	0.000008	2.76E-14	99.3%	11.1975	366.73 ± 0.64
33	1.01871	0.001274	0.07689	0.000288	0.00103	0.000029	-0.00243	0.006310	0.000305	0.000011	7.82E-15	91.1%	12.0752	392.56 ± 2.20
34	0.63348	0.000815	0.03957	0.000196	0.00053	0.000028	0.00951	0.008607	0.000174	0.000013	4.87E-15	92.0%	14.7313	468.54 ± 4.09
35	1.33065	0.001495	0.11793	0.000227	0.00145	0.000029	-0.01325	0.009807	-0.000019	0.000012	1.02E-14	100.3%	11.2728	368.97 ± 1.30
36	0.29192	0.000520	0.02590	0.000186	0.00033	0.000021	-0.01482	0.008302	0.000007	0.000009	2.24E-15	98.8%	11.1290	364.70 ± 4.58
37	1.19570	0.001116	0.10655	0.000353	0.00137	0.000040	-0.04226	0.011864	0.000046	0.000019	9.18E-15	98.6%	11.0558	362.53 ± 2.15
38	0.89692	0.001250	0.07860	0.000371	0.00100	0.000026	-0.00323	0.006446	0.000007	0.000018	6.89E-15	99.7%	11.3805	372.15 ± 2.85
39	1.16923	0.001592	0.10351	0.000462	0.00134	0.000029	0.01235	0.010500	0.000111	0.000011	8.98E-15	97.3%	10.9910	360.60 ± 2.05
40	0.92078	0.001272	0.08019	0.000327	0.00104	0.000031	-0.00105	0.005758	-0.000008	0.000016	7.07E-15	100.3%	11.4818	375.14 ± 2.56
41	1.11725	0.001216	0.07853	0.000294	0.00104	0.000027	-0.00028	0.010039	0.000037	0.000011	8.58E-15	99.0%	14.0877	450.42 ± 2.29
42	2.53755	0.001127	0.18526	0.000530	0.00236	0.000052	0.00147	0.009068	0.000044	0.000012	1.95E-14	99.5%	13.6277	437.36 ± 1.42
43	1.86135	0.001654	0.14358	0.000479	0.00186	0.000028	0.01815	0.007189	0.000029	0.000010	1.43E-14	99.6%	12.9167	416.98 ± 1.62
44	4.04110	0.003135	0.29303	0.000572	0.00386	0.000047	0.01932	0.004464	0.000068	0.000012	3.10E-14	99.5%	13.7287	440.23 ± 1.01
45	2.08801	0.002441	0.18535	0.000559	0.00237	0.000043	-0.00284	0.008133	0.000075	0.000015	1.60E-14	98.9%	11.1437	365.14 ± 1.44
46	1.96189	0.001661	0.14001	0.000352	0.00179	0.000036	-0.00126	0.007265	0.000041	0.000011	1.51E-14	99.4%	13.9255	445.83 ± 1.40
47	2.43386	0.002056	0.19649	0.000418	0.00263	0.000041	0.01205	0.008206	0.000546	0.000013	1.87E-14	93.4%	11.5714	377.78 ± 1.14
48	0.91161	0.001199	0.06733	0.000326	0.00084	0.000025	0.00131	0.004509	0.000040	0.000010	7.00E-15	98.7%	13.3651	429.86 ± 2.64
49	1.95261	0.001219	0.16222	0.000291	0.00203	0.000047	0.01189	0.008338	-0.000003	0.000017	1.50E-14	100.1%	12.0442	391.66 ± 1.27
50	3.77963	0.003038	0.26969	0.000472	0.00342	0.000058	0.03052	0.005305	0.000033	0.000021	2.90E-14	99.8%	13.9895	447.64 ± 1.13
51	2.48814	0.002215	0.21436	0.000754	0.00270	0.000035	0.01945	0.009149	0.000112	0.000012	1.91E-14	98.7%	11.4625	374.57 ± 1.48
52	3.53711	0.003197	0.29646	0.000623	0.00375	0.000033	0.00611	0.005009	0.000018	0.000017	2.72E-14	99.9%	11.9152	387.88 ± 1.05
53	0.94488	0.001174	0.07075	0.000230	0.00090	0.000031	-0.00431	0.006516	0.000039	0.000011	7.26E-15	98.7%	13.1864	424.74 ± 2.16
54	1.09927	0.001218	0.09059	0.000346	0.00118	0.000030	0.02062	0.005731	0.000066	0.000012	8.44E-15	98.4%	11.9416	388.65 ± 2.07
55	1.10402	0.001000	0.08336	0.000267	0.00114	0.000038	0.01575	0.009406	0.000052	0.000012	8.48E-15	98.7%	13.0777	421.61 ± 2.00
56	2.68410	0.001359	0.21901	0.000454	0.00275	0.000034	0.00930	0.009129	0.000039	0.000011	2.06E-14	99.6%	12.2072	396.41 ± 0.99
57	1.75983	0.002199	0.15515	0.000447	0.00194	0.000026	0.00527	0.007272	0.000057	0.000018	1.35E-14	99.1%	11.2377	367.92 ± 1.64
58	3.60458	0.003799	0.29052	0.000788	0.00367	0.000041	0.00338	0.008837	0.000014	0.000017	2.77E-14	99.9%	12.3941	401.86 ± 1.30
59	2.43869	0.002764	0.20690	0.000325	0.00276	0.000036	-0.00227	0.007163	0.000071	0.000010	1.87E-14	99.1%	11.6838	381.09 ± 0.89
60	1.79994	0.002239	0.13973	0.000458	0.00176	0.000041	0.01405	0.006814	0.000043	0.000016	1.38E-14	99.4%	12.8010	413.64 ± 1.82
61	1.73934	0.001899	0.12800	0.000479	0.00166	0.000037	0.00055	0.007362	0.000039	0.000011	1.34E-14	99.3%	13.4996	433.70 ± 1.90
62	2.76580	0.001296	0.23317	0.000541	0.00290	0.000039	0.01849	0.004283	0.000058	0.000011	2.12E-14	99.4%	11.7963	384.40 ± 1.03

63	1.62313	0.001515	0.13619	0.000534	0.00170	0.000031	-0.00244	0.005471	0.000040	0.000011	1.25E-14	99.3%	11.8291	385.36 ± 1.75
64	2.66534	0.002464	0.22356	0.000469	0.00285	0.000047	0.01137	0.006739	0.000050	0.000011	2.05E-14	99.5%	11.8609	386.29 ± 1.01
65	0.27391	0.000648	0.02147	0.000114	0.00024	0.000029	-0.01184	0.007170	0.000031	0.000010	2.10E-15	96.6%	12.3270	399.90 ± 4.93
66	0.99839	0.001074	0.07512	0.000155	0.00102	0.000042	-0.00807	0.008830	-0.000002	0.000015	7.67E-15	100.1%	13.2910	427.74 ± 2.16
67	1.05255	0.001723	0.07702	0.000303	0.00095	0.000026	-0.00747	0.009374	0.000026	0.000010	8.08E-15	99.3%	13.5680	435.65 ± 2.26
68	0.84959	0.000952	0.07491	0.000277	0.00097	0.000034	0.01264	0.008184	-0.000001	0.000018	6.53E-15	100.1%	11.3410	370.98 ± 2.74
69	0.97044	0.000871	0.07714	0.000296	0.00101	0.000029	0.02133	0.008276	0.000065	0.000011	7.45E-15	98.0%	12.3300	399.99 ± 2.12
70	2.01590	0.002337	0.17178	0.000297	0.00216	0.000037	-0.03418	0.007843	0.000077	0.000012	1.55E-14	98.9%	11.6025	378.70 ± 1.03
71	0.86463	0.001198	0.07313	0.000278	0.00097	0.000038	0.00108	0.006985	0.000046	0.000010	6.64E-15	98.4%	11.6391	379.77 ± 2.05
72	2.02916	0.002511	0.15209	0.000377	0.00193	0.000028	0.00097	0.008746	0.000037	0.000017	1.56E-14	99.5%	13.2704	427.15 ± 1.58
73	0.69799	0.001160	0.05629	0.000353	0.00075	0.000023	-0.03648	0.005624	0.000200	0.000010	5.36E-15	91.6%	11.3514	371.29 ± 3.18
74	1.02629	0.001163	0.09094	0.000279	0.00105	0.000047	-0.00813	0.007580	0.000012	0.000010	7.88E-15	99.7%	11.2475	368.22 ± 1.58
75	1.71828	0.001538	0.14600	0.000429	0.00182	0.000019	-0.04146	0.014039	0.000044	0.000010	1.32E-14	99.2%	11.6793	380.96 ± 1.36
76	1.12270	0.001545	0.10044	0.000242	0.00125	0.000034	0.00034	0.009534	0.000021	0.000009	8.62E-15	99.5%	11.1164	364.33 ± 1.35
77	1.51662	0.001360	0.13268	0.000483	0.00167	0.000031	-0.02105	0.007342	0.000042	0.000015	1.16E-14	99.2%	11.3362	370.84 ± 1.79
78	0.84700	0.000820	0.07525	0.000471	0.00095	0.000027	-0.01934	0.006865	0.000030	0.000009	6.51E-15	99.0%	11.1394	365.01 ± 2.62
79	0.90397	0.000912	0.08048	0.000327	0.00104	0.000028	-0.00397	0.012026	-0.000011	0.000014	6.94E-15	100.4%	11.2327	367.78 ± 2.24
80	0.79243	0.001255	0.07062	0.000360	0.00090	0.000028	-0.00608	0.006670	0.000037	0.000011	6.09E-15	98.6%	11.0680	362.89 ± 2.44
81	1.02466	0.001444	0.09002	0.000354	0.00123	0.000036	-0.00523	0.007303	0.000041	0.000009	7.87E-15	98.8%	11.2485	368.25 ± 1.82
82	0.82463	0.001415	0.06947	0.000204	0.00089	0.000025	0.00155	0.007747	-0.000022	0.000022	6.33E-15	100.8%	11.8701	386.56 ± 3.33
83	0.85137	0.001253	0.07568	0.000272	0.00094	0.000026	-0.00834	0.007727	0.000023	0.000010	6.54E-15	99.2%	11.1587	365.58 ± 1.89
84	0.10788	0.000464	0.00964	0.000090	0.00015	0.000018	-0.00420	0.006846	0.000006	0.000010	8.29E-16	98.4%	11.0118	361.22 ± 10.66
85	2.99463	0.002740	0.26622	0.000408	0.00334	0.000046	-0.00414	0.008019	0.000071	0.000010	2.30E-14	99.3%	11.1698	365.91 ± 0.75
86	0.58737	0.000986	0.05084	0.000460	0.00064	0.000031	-0.01282	0.003480	0.000017	0.000009	4.51E-15	99.1%	11.4506	374.22 ± 3.91
87	0.66336	0.001187	0.04984	0.000276	0.00067	0.000021	-0.00407	0.004128	0.000017	0.000011	5.10E-15	99.2%	13.2077	425.35 ± 3.20
88	1.29769	0.001218	0.09973	0.000281	0.00126	0.000027	-0.02285	0.010690	0.000014	0.000013	9.97E-15	99.7%	12.9702	418.52 ± 1.78
89	1.91200	0.001629	0.13498	0.000319	0.00168	0.000038	-0.01343	0.007689	-0.000015	0.000016	1.47E-14	100.2%	14.1647	452.60 ± 1.57
90	0.47634	0.000580	0.04055	0.000251	0.00051	0.000023	-0.07488	0.013619	0.000015	0.000011	3.66E-15	99.1%	11.6375	379.73 ± 3.56
91	1.17329	0.001449	0.08426	0.000297	0.00110	0.000030	-0.01094	0.006767	0.000027	0.000010	9.01E-15	99.3%	13.8319	443.17 ± 2.00
92	1.49525	0.000906	0.11229	0.000362	0.00143	0.000023	-0.00876	0.004746	0.000051	0.000010	1.15E-14	99.0%	13.1801	424.56 ± 1.65
93	1.24229	0.001934	0.10939	0.000403	0.00141	0.000033	-0.01289	0.005472	0.000020	0.000010	9.54E-15	99.5%	11.3014	369.81 ± 1.71
94	0.20677	0.000518	0.01570	0.000105	0.00023	0.000019	-0.01637	0.006297	-0.000002	0.000009	1.59E-15	100.3%	13.1735	424.37 ± 6.03

95	1.67337	0.001200	0.14020	0.000282	0.00177	0.000026	-0.01905	0.005912	0.000050	0.000010	1.29E-14	99.1%	11.8308	385.41 ± 1.07
96	1.67399	0.001445	0.13385	0.000519	0.00182	0.000038	0.00197	0.008953	0.000025	0.000009	1.29E-14	99.6%	12.4510	403.51 ± 1.74
97	0.64609	0.000798	0.04835	0.000153	0.00063	0.000023	-0.01773	0.004522	0.000020	0.000011	4.96E-15	99.1%	13.2388	426.24 ± 2.62
98	2.22204	0.002618	0.15880	0.000517	0.00198	0.000027	-0.01214	0.005920	0.000013	0.000010	1.71E-14	99.8%	13.9688	447.05 ± 1.66
99	1.24336	0.001183	0.10691	0.000382	0.00138	0.000028	-0.02284	0.007715	0.000004	0.000020	9.55E-15	99.9%	11.6176	379.14 ± 2.31
100	0.23110	0.000633	0.00422	0.000079	0.00008	0.000019	-0.02319	0.009132	0.000024	0.000011	1.78E-15	96.9%	53.0582	1310.91 ± 31.47
101	2.18754	0.001575	0.18194	0.000463	0.00232	0.000034	-0.01469	0.008211	0.000074	0.000010	1.68E-14	99.0%	11.9033	387.53 ± 1.16
102	0.77200	0.000647	0.06592	0.000150	0.00088	0.000024	-0.00695	0.008714	0.000024	0.000010	5.93E-15	99.1%	11.6037	378.73 ± 1.74
103	2.10404	0.001393	0.16479	0.000327	0.00205	0.000030	-0.01727	0.010814	0.000013	0.000009	1.62E-14	99.8%	12.7454	412.04 ± 1.00
104	0.19699	0.000479	0.00096	0.000067	0.00009	0.000020	-0.01872	0.006820	0.000012	0.000010	1.51E-15	98.1%	201.8349	2926.19 212.257
105	2.13700	0.001281	0.18893	0.000426	0.00256	0.000048	-0.00782	0.005938	0.000103	0.000010	1.64E-14	98.6%	11.1494	365.31 ± 1.00
106	1.99715	0.002534	0.16273	0.000393	0.00201	0.000031	-0.01860	0.007987	0.000007	0.000015	1.53E-14	99.9%	12.2592	397.93 ± 1.40
107	0.80613	0.001062	0.06201	0.000278	0.00080	0.000023	-0.01665	0.008488	0.000039	0.000010	6.19E-15	98.6%	12.8124	413.97 ± 2.50
108	0.96375	0.001801	0.08111	0.000319	0.00103	0.000024	-0.00640	0.006770	0.000000	0.000018	7.40E-15	100.0%	11.8815	386.89 ± 2.70
109	0.98793	0.001118	0.08777	0.000289	0.00112	0.000029	-0.05219	0.013162	0.000041	0.000011	7.59E-15	98.8%	11.1184	364.39 ± 1.78
110	1.02198	0.001485	0.08866	0.000330	0.00110	0.000027	-0.00452	0.006551	0.000002	0.000009	7.85E-15	100.0%	11.5208	376.29 ± 1.81
111	0.78980	0.000878	0.06450	0.000410	0.00080	0.000024	0.00000	0.000014	0.000023	0.000009	6.07E-15	99.1%	12.1400	394.46 ± 2.92
112	0.41089	0.000655	0.03584	0.000272	0.00047	0.000016	0.00002	0.000008	0.000011	0.000008	3.16E-15	99.2%	11.3715	371.88 ± 3.70

OK12-45 Muscovite (au28.5h.mus), 60/80#. Pennsylvanian Atoka Formation J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	1.23057	0.001268	0.10040	0.000391	0.00132	0.000026	0.00002	0.000012	0.000024	0.000009	9.45E-15	99.4%	12.1874	395.84	± 1.82
2	1.44122	0.001593	0.09951	0.000368	0.00127	0.000026	0.00001	0.000010	0.000024	0.000010	1.11E-14	99.5%	14.4113	459.55	± 2.03
3	1.17337	0.001028	0.05856	0.000256	0.00076	0.000024	0.00002	0.000010	0.000019	0.000010	9.01E-15	99.5%	19.9432	608.92	± 3.14
4	0.67243	0.001160	0.05473	0.000376	0.00068	0.000022	0.00000	0.000011	0.000018	0.000010	5.16E-15	99.2%	12.1891	395.89	± 3.37
5	0.68686	0.001113	0.05425	0.000319	0.00068	0.000020	0.00000	0.000013	0.000020	0.000009	5.28E-15	99.1%	12.5537	406.49	± 2.93
6	3.67650	0.003572	0.27543	0.000583	0.00346	0.000034	0.00002	0.000011	0.000018	0.000013	2.82E-14	99.9%	13.3288	428.82	± 1.10
7	2.39205	0.001961	0.17302	0.000425	0.00227	0.000060	-0.00002	0.000013	0.000037	0.000009	1.84E-14	99.5%	13.7624	441.19	± 1.26
8	0.40662	0.000862	0.02785	0.000210	0.00033	0.000014	0.00000	0.000012	0.000020	0.000009	3.12E-15	98.5%	14.3868	458.86	± 4.74
9	1.11907	0.001111	0.07771	0.000189	0.00100	0.000023	0.00002	0.000010	0.000013	0.000009	8.60E-15	99.7%	14.3518	457.88	± 1.64
10	0.77672	0.000762	0.05279	0.000374	0.00066	0.000019	0.00000	0.000009	0.000001	0.000009	5.97E-15	99.9%	14.7056	467.82	± 3.69
11	4.05871	0.003146	0.28824	0.000827	0.00360	0.000037	0.00000	0.000014	0.000079	0.000010	3.12E-14	99.4%	13.9996	447.93	± 1.38
12	1.96919	0.002018	0.13870	0.000344	0.00170	0.000025	0.00001	0.000012	0.000014	0.000009	1.51E-14	99.8%	14.1684	452.70	± 1.36
13	1.38632	0.001614	0.09570	0.000207	0.00122	0.000018	0.00000	0.000010	0.000015	0.000009	1.06E-14	99.7%	14.4392	460.34	± 1.46
14	1.80156	0.001842	0.15426	0.000262	0.00193	0.000030	0.00000	0.000010	0.000033	0.000010	1.38E-14	99.5%	11.6160	379.10	± 0.97
15	3.19040	0.002983	0.22794	0.000630	0.00290	0.000035	0.00001	0.000014	0.000055	0.000009	2.45E-14	99.5%	13.9255	445.82	± 1.36
16	0.12834	0.000338	0.00931	0.000055	0.00012	0.000013	0.00001	0.000012	0.000015	0.000009	9.86E-16	96.4%	13.3019	428.05	± 9.42
17	1.79210	0.000791	0.14275	0.000329	0.00177	0.000023	-0.00003	0.000009	0.000004	0.000008	1.38E-14	99.9%	12.5461	406.27	± 1.09
18	0.64483	0.000942	0.06499	0.000326	0.00080	0.000023	-0.00002	0.000010	0.000001	0.000009	4.95E-15	99.9%	9.9158	328.34	± 2.22
19	2.75445	0.001501	0.20587	0.000768	0.00265	0.000040	-0.00001	0.000010	0.000028	0.000010	2.12E-14	99.7%	13.3398	429.13	± 1.69
20	2.36242	0.004955	0.16957	0.000463	0.00210	0.000051	-0.00001	0.000013	0.000031	0.000019	1.81E-14	99.6%	13.8781	444.48	± 1.86
21	2.53409	0.001894	0.22057	0.000823	0.00282	0.000031	0.00000	0.000015	0.000124	0.000009	1.95E-14	98.6%	11.3224	370.43	± 1.48
22	2.54551	0.001912	0.17842	0.000432	0.00222	0.000029	-0.00003	0.000006	0.000017	0.000010	1.96E-14	99.8%	14.2383	454.68	± 1.26
23	0.79789	0.001206	0.03860	0.000140	0.00052	0.000024	-0.00001	0.000012	0.000001	0.000008	6.13E-15	100.0%	20.6655	627.54	± 3.11
24	1.56991	0.001225	0.12676	0.000336	0.00160	0.000019	0.00000	0.000012	0.000008	0.000009	1.21E-14	99.8%	12.3658	401.03	± 1.30
25	0.56175	0.001177	0.04135	0.000266	0.00051	0.000024	0.00001	0.000007	0.000005	0.000010	4.31E-15	99.7%	13.5471	435.06	± 3.68
26	2.83176	0.002117	0.19673	0.000317	0.00250	0.000045	-0.00003	0.000013	0.000016	0.000012	2.18E-14	99.8%	14.3705	458.41	± 1.01
27	0.83395	0.000682	0.05865	0.000183	0.00074	0.000019	0.00000	0.000011	0.000003	0.000010	6.41E-15	99.9%	14.2040	453.71	± 2.16
28	1.12558	0.000846	0.07898	0.000323	0.00099	0.000024	-0.00001	0.000010	0.000000	0.000009	8.65E-15	100.0%	14.2510	455.03	± 2.19
29	1.21326	0.001057	0.08794	0.000173	0.00111	0.000022	-0.00001	0.000013	0.000002	0.000008	9.32E-15	99.9%	13.7892	441.96	± 1.31
30	0.37680	0.000719	0.02951	0.000174	0.00037	0.000023	-0.00004	0.000013	0.000010	0.000009	2.89E-15	99.2%	12.6653	409.72	± 3.78

31	2.62801	0.001409	0.18572	0.000309	0.00231	0.000042	-0.00001	0.000009	0.000012	0.000010	2.02E-14	99.9%	14.1309	451.64 ± 0.94
32	1.54769	0.001701	0.10861	0.000383	0.00141	0.000030	-0.00003	0.000010	0.000023	0.000008	1.19E-14	99.6%	14.1871	453.23 ± 1.82
33	1.64661	0.002070	0.11479	0.000414	0.00145	0.000025	-0.00002	0.000012	0.000023	0.000010	1.26E-14	99.6%	14.2851	456.00 ± 1.92
34	0.88428	0.001176	0.06226	0.000308	0.00080	0.000026	-0.00001	0.000010	0.000012	0.000010	6.79E-15	99.6%	14.1442	452.02 ± 2.76
35	0.84630	0.000923	0.06263	0.000231	0.00080	0.000037	-0.00002	0.000010	0.000021	0.000008	6.50E-15	99.3%	13.4113	431.18 ± 2.09
36	2.06602	0.002370	0.14479	0.000484	0.00186	0.000026	0.00000	0.000018	0.000017	0.000009	1.59E-14	99.8%	14.2349	454.58 ± 1.72
37	2.07967	0.001658	0.14348	0.000602	0.00183	0.000031	0.00002	0.000016	0.000017	0.000010	1.60E-14	99.8%	14.4602	460.93 ± 2.07
38	1.78141	0.001211	0.12608	0.000337	0.00164	0.000032	-0.00002	0.000011	0.000003	0.000009	1.37E-14	100.0%	14.1229	451.42 ± 1.42
39	0.16707	0.000635	0.01324	0.000060	0.00019	0.000015	-0.00002	0.000009	0.000004	0.000008	1.28E-15	99.3%	12.5324	405.87 ± 6.54
40	1.55256	0.000823	0.07720	0.000298	0.00101	0.000030	-0.00001	0.000010	0.000025	0.000008	1.19E-14	99.5%	20.0142	610.76 ± 2.57
41	1.32057	0.001311	0.10175	0.000241	0.00130	0.000021	-0.00002	0.000007	0.000008	0.000009	1.01E-14	99.8%	12.9551	418.09 ± 1.36
42	0.95767	0.001256	0.06671	0.000272	0.00087	0.000022	-0.00006	0.000021	0.000014	0.000009	7.36E-15	99.6%	14.2935	456.24 ± 2.36
43	1.17444	0.001185	0.08193	0.000174	0.00102	0.000024	-0.00001	0.000010	0.000013	0.000009	9.02E-15	99.7%	14.2859	456.02 ± 1.51
44	1.00843	0.000807	0.07124	0.000290	0.00090	0.000017	-0.00002	0.000010	0.000007	0.000009	7.75E-15	99.8%	14.1259	451.50 ± 2.22
45	0.33257	0.000680	0.02354	0.000143	0.00032	0.000019	-0.00001	0.000008	0.000008	0.000009	2.55E-15	99.3%	14.0300	448.79 ± 4.49
46	2.02148	0.001423	0.14297	0.000330	0.00183	0.000032	-0.00002	0.000015	0.000027	0.000009	1.55E-14	99.6%	14.0838	450.31 ± 1.25
47	2.37679	0.001948	0.16648	0.000336	0.00211	0.000040	-0.00001	0.000009	0.000026	0.000008	1.83E-14	99.7%	14.2310	454.47 ± 1.09
48	0.99467	0.001254	0.06993	0.000321	0.00090	0.000026	0.00001	0.000006	0.000019	0.000008	7.64E-15	99.4%	14.1431	451.99 ± 2.42
49	0.57416	0.000703	0.04403	0.001399	0.00058	0.000018	0.00001	0.000017	0.000021	0.000008	4.41E-15	98.9%	12.8999	416.50 ± 13.50
50	0.64238	0.001059	0.04562	0.000163	0.00058	0.000024	-0.00001	0.000011	0.000003	0.000013	4.93E-15	99.9%	14.0616	449.68 ± 3.28
51	1.22602	0.000718	0.08844	0.000271	0.00112	0.000027	0.00000	0.000014	0.000029	0.000008	9.42E-15	99.3%	13.7652	441.27 ± 1.65
52	0.56845	0.000664	0.04123	0.000143	0.00050	0.000022	0.00002	0.000014	0.000027	0.000009	4.37E-15	98.6%	13.5926	436.36 ± 2.57
53	2.04333	0.000921	0.14424	0.000502	0.00186	0.000022	0.00001	0.000012	0.000048	0.000008	1.57E-14	99.3%	14.0678	449.86 ± 1.68
54	2.02612	0.001190	0.15947	0.000592	0.00206	0.000022	0.00001	0.000012	0.000005	0.000013	1.56E-14	99.9%	12.6965	410.62 ± 1.72
55	0.46501	0.000861	0.03231	0.000149	0.00044	0.000015	-0.00001	0.000010	0.000019	0.000009	3.57E-15	98.8%	14.2211	454.19 ± 3.56
56	1.22425	0.001276	0.08737	0.000336	0.00123	0.000045	0.00001	0.000015	0.000004	0.000008	9.40E-15	99.9%	13.9992	447.91 ± 1.96
57	1.79361	0.001077	0.12629	0.000268	0.00163	0.000023	0.00000	0.000011	0.000008	0.000009	1.38E-14	99.9%	14.1840	453.14 ± 1.20
58	0.97076	0.000563	0.06779	0.000359	0.00086	0.000022	-0.00001	0.000009	0.000023	0.000008	7.46E-15	99.3%	14.2183	454.11 ± 2.66
59	1.35931	0.001025	0.09697	0.000396	0.00119	0.000027	0.00000	0.000010	0.000023	0.000009	1.04E-14	99.5%	13.9484	446.48 ± 2.08
60	0.62395	0.000899	0.04348	0.000172	0.00054	0.000017	0.00003	0.000013	0.000020	0.000008	4.79E-15	99.1%	14.2176	454.09 ± 2.53
61	1.84838	0.001226	0.12939	0.000292	0.00163	0.000030	0.00000	0.000009	0.000016	0.000007	1.42E-14	99.8%	14.2495	454.99 ± 1.20
62	1.68213	0.002209	0.14601	0.000277	0.00182	0.000040	0.00000	0.000012	0.000298	0.000048	1.29E-14	94.8%	10.9175	358.42 ± 3.30

63	1.25808	0.001015	0.11219	0.000412	0.00148	0.000028	0.00001	0.000014	0.000031	0.000008	9.66E-15	99.3%	11.1312	364.77 ± 1.53
64	2.05173	0.001937	0.18318	0.000633	0.00246	0.000062	0.00001	0.000007	0.000030	0.000009	1.58E-14	99.6%	11.1518	365.38 ± 1.39
65	0.93361	0.001385	0.06481	0.000200	0.00085	0.000024	0.00003	0.000013	0.000022	0.000008	7.17E-15	99.3%	14.3063	456.59 ± 1.94
66	0.39192	0.000857	0.02805	0.000114	0.00035	0.000013	0.00002	0.000017	0.000011	0.000008	3.01E-15	99.2%	13.8534	443.78 ± 3.32
67	1.30388	0.000884	0.09182	0.000339	0.00116	0.000018	0.00001	0.000009	0.000013	0.000007	1.00E-14	99.7%	14.1587	452.43 ± 1.84
68	2.03410	0.001665	0.14435	0.000376	0.00179	0.000022	0.00002	0.000010	0.000020	0.000007	1.56E-14	99.7%	14.0504	449.36 ± 1.32
69	1.13847	0.001274	0.07983	0.000307	0.00101	0.000031	0.00000	0.000014	0.000004	0.000008	8.74E-15	99.9%	14.2462	454.90 ± 2.03
70	1.41350	0.001541	0.09938	0.000265	0.00122	0.000025	0.00000	0.000014	0.000000	0.000009	1.09E-14	100.0%	14.2224	454.23 ± 1.57
71	0.85510	0.000723	0.07133	0.000227	0.00091	0.000033	0.00002	0.000008	0.000006	0.000008	6.57E-15	99.8%	11.9646	389.33 ± 1.70
72	2.38537	0.001732	0.16971	0.000303	0.00217	0.000025	-0.00001	0.000015	0.000024	0.000014	1.83E-14	99.7%	14.0141	448.34 ± 1.16
73	0.80764	0.001034	0.05611	0.000149	0.00075	0.000036	0.00001	0.000014	0.000010	0.000009	6.20E-15	99.6%	14.3380	457.49 ± 2.03
74	1.23562	0.001630	0.08690	0.000211	0.00114	0.000016	0.00002	0.000005	0.000019	0.000010	9.49E-15	99.5%	14.1539	452.29 ± 1.65
75	2.45733	0.001793	0.17784	0.000371	0.00224	0.000031	0.00000	0.000020	0.000023	0.000009	1.89E-14	99.7%	13.7800	441.69 ± 1.09
76	1.10218	0.000762	0.09549	0.000323	0.00121	0.000023	-0.00004	0.000012	0.000006	0.000008	8.47E-15	99.8%	11.5221	376.33 ± 1.55
77	0.40343	0.000472	0.02789	0.000118	0.00035	0.000015	0.00002	0.000012	0.000011	0.000009	3.10E-15	99.2%	14.3484	457.78 ± 3.54
78	1.69404	0.001172	0.11916	0.000235	0.00155	0.000023	0.00002	0.000009	0.000020	0.000009	1.30E-14	99.6%	14.1658	452.63 ± 1.17
79	1.02292	0.001208	0.07160	0.000297	0.00090	0.000018	0.00004	0.000014	0.000030	0.000009	7.86E-15	99.1%	14.1634	452.56 ± 2.29
80	0.66633	0.000614	0.05916	0.000246	0.00080	0.000028	0.00006	0.000019	0.000018	0.000009	5.12E-15	99.2%	11.1755	366.08 ± 2.14
81	0.91204	0.001298	0.06377	0.000340	0.00079	0.000018	0.00001	0.000011	0.000016	0.000009	7.01E-15	99.5%	14.2271	454.36 ± 2.85
82	1.16049	0.001598	0.08219	0.000287	0.00096	0.000026	0.00002	0.000014	0.000019	0.000010	8.91E-15	99.5%	14.0529	449.44 ± 2.02
83	0.61635	0.000756	0.04320	0.000214	0.00052	0.000016	0.00001	0.000014	0.000018	0.000010	4.73E-15	99.1%	14.1414	451.94 ± 3.15
84	0.54613	0.000711	0.03776	0.000091	0.00045	0.000014	0.00001	0.000013	0.000019	0.000009	4.19E-15	99.0%	14.3155	456.85 ± 2.65
85	0.76893	0.001107	0.05299	0.000167	0.00064	0.000018	0.00001	0.000013	0.000013	0.000009	5.91E-15	99.5%	14.4388	460.33 ± 2.29
86	0.78467	0.000847	0.06287	0.000137	0.00078	0.000016	0.00003	0.000007	0.000027	0.000009	6.03E-15	99.0%	12.3564	400.76 ± 1.72
87	0.98851	0.001180	0.07569	0.000388	0.00094	0.000021	0.00000	0.000008	0.000014	0.000009	7.59E-15	99.6%	13.0070	419.58 ± 2.48
88	0.70435	0.000904	0.05443	0.000307	0.00069	0.000025	0.00002	0.000013	0.000028	0.000009	5.41E-15	98.8%	12.7880	413.27 ± 2.88
89	0.36114	0.000633	0.02507	0.000202	0.00030	0.000017	0.00002	0.000013	0.000015	0.000009	2.77E-15	98.7%	14.2244	454.28 ± 5.11
90	1.03458	0.001189	0.08132	0.000264	0.00098	0.000021	-0.00001	0.000008	0.000023	0.000009	7.95E-15	99.3%	12.6384	408.94 ± 1.80
91	0.81917	0.000884	0.06761	0.000318	0.00093	0.000034	0.00000	0.000013	0.000026	0.000009	6.29E-15	99.1%	12.0028	390.45 ± 2.31
92	0.51320	0.000678	0.04432	0.000266	0.00052	0.000022	0.00001	0.000009	0.000000	0.000010	3.94E-15	100.0%	11.5781	377.98 ± 3.15
93	0.91186	0.001021	0.07323	0.000256	0.00090	0.000020	0.00003	0.000009	0.000018	0.000008	7.00E-15	99.4%	12.3788	401.41 ± 1.81
94	0.04128	0.000213	0.00263	0.000060	0.00001	0.000012	0.00003	0.000011	0.000019	0.000009	3.17E-16	86.3%	13.5778	435.94 ± 35.14

95	0.75397	0.000895	0.05295	0.000280	0.00064	0.000018	0.00002	0.000009	0.000023	0.000009	5.79E-15	99.1%	14.1094	451.03 ± 2.94
96	0.56014	0.001053	0.04236	0.000168	0.00051	0.000017	0.00002	0.000016	0.000014	0.000010	4.30E-15	99.3%	13.1263	423.01 ± 2.91
97	0.37415	0.000655	0.02561	0.000096	0.00033	0.000019	0.00001	0.000009	0.000021	0.000008	2.87E-15	98.3%	14.3614	458.15 ± 3.54
98	1.34287	0.001511	0.09361	0.000275	0.00121	0.000026	0.00000	0.000009	0.000022	0.000008	1.03E-14	99.5%	14.2762	455.75 ± 1.67
99	0.68185	0.000944	0.04818	0.000160	0.00063	0.000019	0.00002	0.000009	0.000028	0.000007	5.24E-15	98.8%	13.9813	447.41 ± 2.16
100	1.00355	0.001384	0.07020	0.000390	0.00090	0.000024	0.00000	0.000013	0.000019	0.000008	7.71E-15	99.4%	14.2146	454.01 ± 2.84
101	0.58434	0.001004	0.04186	0.000236	0.00054	0.000013	0.00003	0.000008	0.000035	0.000008	4.49E-15	98.2%	13.7115	439.74 ± 3.23
102	0.87224	0.001299	0.05995	0.000332	0.00074	0.000029	0.00001	0.000010	-0.000008	0.000021	6.70E-15	100.3%	14.5492	463.43 ± 4.23
103	0.47574	0.000703	0.03876	0.000294	0.00052	0.000016	0.00001	0.000011	0.000018	0.000007	3.65E-15	98.9%	12.1410	394.48 ± 3.51
104	0.04642	0.000250	0.00331	0.000101	0.00008	0.000011	0.00000	0.000010	0.000011	0.000007	3.57E-16	92.8%	13.0256	420.12 ± 23.75
105	0.59148	0.000398	0.04151	0.000101	0.00053	0.000008	0.00003	0.000009	0.000014	0.000007	4.54E-15	99.3%	14.1459	452.07 ± 1.92
106	0.31835	0.000586	0.02216	0.000088	0.00031	0.000021	0.00002	0.000012	0.000014	0.000006	2.45E-15	98.7%	14.1786	452.99 ± 3.40
107	0.47715	0.000783	0.03314	0.000164	0.00043	0.000014	0.00000	0.000008	0.000012	0.000009	3.67E-15	99.3%	14.2955	456.29 ± 3.46
108	1.21900	0.001405	0.08622	0.000267	0.00112	0.000019	0.00003	0.000010	-0.000007	0.000012	9.36E-15	100.2%	14.1383	451.85 ± 1.97
109	0.56963	0.000670	0.05600	0.000381	0.00072	0.000020	0.00000	0.000008	0.000040	0.000008	4.38E-15	97.9%	9.9625	329.76 ± 2.76
110	0.64660	0.001013	0.04571	0.000232	0.00061	0.000020	0.00001	0.000010	0.000018	0.000007	4.97E-15	99.2%	14.0288	448.75 ± 2.82
111	1.76775	0.001159	0.12510	0.000342	0.00160	0.000022	0.00002	0.000012	-0.000023	0.000013	1.36E-14	100.4%	14.1311	451.65 ± 1.61
112	1.08172	0.001164	0.07622	0.000253	0.00094	0.000018	0.00000	0.000013	0.000007	0.000006	8.31E-15	99.8%	14.1664	452.65 ± 1.75

OK12-50 Muscovite (au28.5l.mus), 60/80#. Pennsylvanian Jackfork Group J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	2.40648	0.001785	0.16714	0.000359	0.00217	0.000033	0.00000	0.000008	0.000051	0.000010	1.85E-14	99.4%	14.3080	456.64	± 1.18
2	0.45451	0.000898	0.03745	0.000187	0.00052	0.000021	0.00001	0.000008	0.000028	0.000009	3.49E-15	98.2%	11.9132	387.82	± 3.19
3	1.06390	0.001278	0.07684	0.000254	0.00101	0.000019	0.00002	0.000017	0.000030	0.000009	8.17E-15	99.2%	13.7311	440.30	± 1.90
4	2.06862	0.000759	0.14505	0.000376	0.00186	0.000036	0.00001	0.000020	0.000021	0.000008	1.59E-14	99.7%	14.2193	454.14	± 1.30
5	1.48977	0.001276	0.10650	0.000417	0.00134	0.000027	0.00001	0.000009	0.000020	0.000009	1.14E-14	99.6%	13.9325	446.02	± 1.97
6	1.22436	0.001219	0.10461	0.000162	0.00130	0.000038	0.00001	0.000013	0.000014	0.000008	9.40E-15	99.7%	11.6655	380.55	± 1.01
7	1.93585	0.001917	0.13613	0.000430	0.00167	0.000026	0.00001	0.000014	0.000032	0.000008	1.49E-14	99.5%	14.1512	452.22	± 1.60
8	0.98517	0.000625	0.06837	0.000275	0.00085	0.000024	0.00001	0.000016	0.000025	0.000009	7.57E-15	99.2%	14.2990	456.39	± 2.26
9	0.69106	0.000728	0.04845	0.000245	0.00064	0.000019	0.00001	0.000010	0.000016	0.000009	5.31E-15	99.3%	14.1661	452.64	± 2.91
10	3.03790	0.001497	0.21329	0.000581	0.00271	0.000039	0.00000	0.000017	0.000011	0.000008	2.33E-14	99.9%	14.2280	454.39	± 1.31
11	0.25058	0.000303	0.02113	0.000084	0.00036	0.000025	0.00002	0.000018	0.000006	0.000009	1.92E-15	99.3%	11.7711	383.66	± 4.28
12	4.20698	0.002140	0.34278	0.000684	0.00435	0.000030	0.00002	0.000011	0.000042	0.000009	3.23E-14	99.7%	12.2370	397.28	± 0.86
13	2.45065	0.001636	0.17326	0.000429	0.00221	0.000029	0.00000	0.000007	0.000015	0.000008	1.88E-14	99.8%	14.1190	451.31	± 1.24
14	0.51696	0.000462	0.03619	0.000149	0.00046	0.000019	0.00001	0.000011	0.000006	0.000008	3.97E-15	99.7%	14.2377	454.66	± 2.89
15	0.39871	0.000821	0.03384	0.000186	0.00046	0.000016	0.00002	0.000013	-0.000008	0.000016	3.06E-15	100.6%	11.7807	383.94	± 4.99
16	1.22205	0.000982	0.08540	0.000288	0.00107	0.000024	0.00001	0.000014	0.000009	0.000008	9.39E-15	99.8%	14.2803	455.86	± 1.83
17	4.46668	0.002363	0.35298	0.000583	0.00453	0.000033	-0.00002	0.000010	0.000090	0.000009	3.43E-14	99.4%	12.5786	407.21	± 0.75
18	0.94174	0.001559	0.06673	0.000315	0.00085	0.000022	0.00001	0.000012	0.000015	0.000010	7.23E-15	99.5%	14.0465	449.25	± 2.68
19	2.54381	0.002789	0.17926	0.000455	0.00224	0.000025	0.00000	0.000011	0.000018	0.000009	1.95E-14	99.8%	14.1615	452.51	± 1.33
20	2.48957	0.001817	0.17522	0.000547	0.00224	0.000035	0.00002	0.000015	0.000028	0.000008	1.91E-14	99.7%	14.1601	452.47	± 1.52
21	0.74655	0.000705	0.05214	0.000285	0.00066	0.000024	0.00002	0.000010	0.000014	0.000008	5.73E-15	99.4%	14.2387	454.69	± 2.93
22	0.65911	0.001072	0.05366	0.000215	0.00057	0.000035	0.00000	0.000009	0.000018	0.000009	5.06E-15	99.2%	12.1806	395.64	± 2.30
23	0.99674	0.000772	0.07010	0.000329	0.00088	0.000024	0.00001	0.000009	0.000017	0.000008	7.66E-15	99.5%	14.1462	452.08	± 2.43
24	0.74789	0.000899	0.05363	0.000324	0.00067	0.000027	-0.00001	0.000015	0.000015	0.000009	5.74E-15	99.4%	13.8620	444.02	± 3.17
25	1.68256	0.001320	0.16505	0.000416	0.00210	0.000037	-0.00001	0.000011	0.000024	0.000008	1.29E-14	99.6%	10.1505	335.43	± 1.01
26	1.80769	0.001140	0.12935	0.000307	0.00165	0.000027	0.00002	0.000009	0.000013	0.000009	1.39E-14	99.8%	13.9449	446.38	± 1.28
27	6.62092	0.002823	0.47111	0.000681	0.00613	0.000095	0.00001	0.000008	0.000044	0.000017	5.09E-14	99.8%	14.0262	448.68	± 0.76
28	2.02916	0.001534	0.14313	0.000278	0.00178	0.000031	0.00001	0.000012	0.000027	0.000008	1.56E-14	99.6%	14.1218	451.39	± 1.09
29	2.49849	0.001650	0.17523	0.000443	0.00218	0.000044	0.00001	0.000016	0.000025	0.000008	1.92E-14	99.7%	14.2169	454.07	± 1.26
30	0.72375	0.001096	0.05044	0.000215	0.00062	0.000024	0.00004	0.000015	0.000001	0.000013	5.56E-15	99.9%	14.3393	457.53	± 3.15

31	0.56393	0.000815	0.03997	0.000113	0.00050	0.000021	0.00003	0.000012	0.000022	0.000008	4.33E-15	98.8%	13.9430	446.32 ± 2.40
32	0.95496	0.001190	0.06573	0.000215	0.00085	0.000028	0.00003	0.000008	0.000021	0.000009	7.34E-15	99.3%	14.4336	460.18 ± 2.04
33	1.41839	0.001126	0.09981	0.000418	0.00122	0.000024	0.00004	0.000013	0.000028	0.000010	1.09E-14	99.4%	14.1293	451.60 ± 2.14
34	3.24190	0.002316	0.22926	0.000711	0.00291	0.000026	0.00005	0.000017	0.000028	0.000010	2.49E-14	99.7%	14.1047	450.90 ± 1.49
35	1.24147	0.002038	0.08658	0.000276	0.00109	0.000030	0.00001	0.000015	0.000015	0.000008	9.54E-15	99.6%	14.2863	456.03 ± 1.87
36	2.16079	0.001420	0.15364	0.000507	0.00191	0.000032	0.00002	0.000013	0.000039	0.000010	1.66E-14	99.5%	13.9900	447.65 ± 1.63
37	0.61379	0.000980	0.04418	0.000195	0.00055	0.000017	0.00003	0.000008	0.000026	0.000010	4.71E-15	98.8%	13.7208	440.01 ± 2.92
38	1.07502	0.000689	0.07506	0.000369	0.00096	0.000022	0.00001	0.000011	0.000013	0.000009	8.26E-15	99.6%	14.2689	455.54 ± 2.56
39	1.22881	0.000863	0.08700	0.000355	0.00111	0.000023	0.00005	0.000009	0.000021	0.000009	9.44E-15	99.5%	14.0534	449.45 ± 2.12
40	1.03537	0.000692	0.07322	0.000349	0.00093	0.000015	0.00001	0.000011	0.000003	0.000009	7.95E-15	99.9%	14.1304	451.63 ± 2.47
41	1.91322	0.001693	0.13314	0.000338	0.00182	0.000049	0.00003	0.000011	0.000018	0.000009	1.47E-14	99.7%	14.3287	457.23 ± 1.39
42	1.24526	0.000907	0.08819	0.000262	0.00109	0.000023	-0.00003	0.000013	0.000022	0.000010	9.56E-15	99.5%	14.0461	449.24 ± 1.72
43	0.94283	0.001211	0.06655	0.000291	0.00084	0.000023	-0.00001	0.000013	0.000021	0.000008	7.24E-15	99.3%	14.0728	450.00 ± 2.38
44	1.17825	0.001030	0.08207	0.000308	0.00102	0.000031	-0.00001	0.000011	0.000028	0.000008	9.05E-15	99.3%	14.2533	455.10 ± 1.99
45	0.97101	0.001524	0.06835	0.000316	0.00084	0.000021	-0.00003	0.000008	0.000008	0.000008	7.46E-15	99.8%	14.1723	452.81 ± 2.48
46	0.79009	0.000818	0.05591	0.000309	0.00070	0.000017	-0.00003	0.000011	0.000024	0.000008	6.07E-15	99.1%	14.0029	448.02 ± 2.86
47	2.99172	0.001486	0.21402	0.000375	0.00270	0.000051	-0.00003	0.000013	0.000024	0.000008	2.30E-14	99.8%	13.9447	446.37 ± 0.89
48	0.38875	0.000788	0.03122	0.000138	0.00036	0.000019	-0.00002	0.000012	0.000028	0.000008	2.99E-15	97.9%	12.1853	395.78 ± 3.14
49	0.59564	0.000841	0.04905	0.000267	0.00061	0.000027	-0.00002	0.000016	0.000019	0.000008	4.58E-15	99.0%	12.0254	391.11 ± 2.75
50	0.57049	0.000468	0.04530	0.000130	0.00055	0.000023	-0.00005	0.000011	0.000006	0.000009	4.38E-15	99.7%	12.5565	406.57 ± 2.21
51	1.97187	0.002711	0.14078	0.000439	0.00176	0.000023	0.00001	0.000007	0.000052	0.000009	1.51E-14	99.2%	13.8967	445.01 ± 1.64
52	2.00601	0.000685	0.14071	0.000395	0.00175	0.000028	0.00000	0.000010	0.000039	0.000009	1.54E-14	99.4%	14.1741	452.87 ± 1.41
53	0.65595	0.000853	0.05244	0.000247	0.00065	0.000014	0.00000	0.000007	0.000016	0.000008	5.04E-15	99.3%	12.4179	402.55 ± 2.45
54	1.00671	0.000936	0.07182	0.000377	0.00087	0.000022	-0.00002	0.000013	0.000012	0.000010	7.73E-15	99.7%	13.9683	447.04 ± 2.70
55	0.42542	0.000864	0.03765	0.000227	0.00044	0.000014	-0.00002	0.000014	0.000021	0.000008	3.27E-15	98.6%	11.1376	364.96 ± 3.13
56	1.53456	0.001225	0.10787	0.000452	0.00134	0.000013	-0.00003	0.000008	0.000007	0.000008	1.18E-14	99.9%	14.2062	453.77 ± 2.05
57	2.94323	0.002079	0.23504	0.000633	0.00299	0.000033	-0.00001	0.000015	0.000038	0.000011	2.26E-14	99.6%	12.4741	404.18 ± 1.21
58	0.79040	0.001417	0.05603	0.000169	0.00070	0.000017	0.00000	0.000016	0.000009	0.000010	6.07E-15	99.7%	14.0573	449.56 ± 2.28
59	0.70098	0.000805	0.04989	0.000249	0.00060	0.000018	-0.00002	0.000015	0.000024	0.000011	5.38E-15	99.0%	13.9090	445.36 ± 3.14
60	0.39551	0.000906	0.02924	0.000131	0.00038	0.000020	0.00004	0.000021	-0.000001	0.000010	3.04E-15	100.0%	13.5269	434.48 ± 3.80
61	2.57492	0.001359	0.18249	0.000361	0.00234	0.000032	-0.00002	0.000010	0.000010	0.000011	1.98E-14	99.9%	14.0936	450.59 ± 1.08
62	1.00978	0.001003	0.09118	0.000301	0.00114	0.000018	-0.00001	0.000009	0.000022	0.000011	7.76E-15	99.4%	11.0037	360.98 ± 1.71

63	1.35177	0.001180	0.11520	0.000193	0.00129	0.000040	-0.00001	0.000011	-0.000009	0.000009	1.04E-14	100.2%	11.7341	382.57 ± 1.07
64	0.39027	0.000561	0.02750	0.000088	0.00034	0.000019	-0.00002	0.000011	0.000020	0.000010	3.00E-15	98.5%	13.9733	447.18 ± 3.78
65	0.58827	0.000523	0.04116	0.000220	0.00056	0.000018	-0.00002	0.000007	0.000021	0.000010	4.52E-15	98.9%	14.1391	451.87 ± 3.43
66	0.32097	0.000445	0.02653	0.000098	0.00037	0.000017	-0.00001	0.000008	0.000009	0.000010	2.47E-15	99.2%	11.9992	390.34 ± 3.98
67	1.15387	0.001548	0.10076	0.000577	0.00124	0.000025	0.00001	0.000013	0.000005	0.000009	8.86E-15	99.9%	11.4376	373.84 ± 2.37
68	0.37960	0.000845	0.03028	0.000175	0.00038	0.000021	0.00001	0.000014	0.000010	0.000009	2.92E-15	99.2%	12.4414	403.23 ± 3.75
69	0.51146	0.001289	0.04193	0.000247	0.00055	0.000015	0.00004	0.000016	0.000007	0.000010	3.93E-15	99.6%	12.1509	394.77 ± 3.35
70	1.14972	0.001112	0.08892	0.000377	0.00112	0.000022	0.00001	0.000008	0.000010	0.000009	8.83E-15	99.7%	12.8948	416.35 ± 2.07
71	0.77420	0.000952	0.05328	0.000195	0.00067	0.000029	0.00001	0.000011	0.000032	0.000009	5.95E-15	98.8%	14.3513	457.86 ± 2.36
72	2.60257	0.002281	0.19127	0.000400	0.00240	0.000042	0.00000	0.000012	0.000021	0.000011	2.00E-14	99.8%	13.5743	435.84 ± 1.13
73	1.07942	0.001127	0.07512	0.000187	0.00094	0.000023	0.00001	0.000014	-0.000008	0.000010	8.29E-15	100.2%	14.3700	458.39 ± 1.73
74	1.86467	0.001993	0.13052	0.000508	0.00164	0.000033	0.00000	0.000009	0.000030	0.000010	1.43E-14	99.5%	14.2177	454.09 ± 1.97
75	0.39825	0.000910	0.02729	0.000124	0.00035	0.000018	0.00001	0.000011	0.000040	0.000008	3.06E-15	97.1%	14.1654	452.62 ± 3.77
76	0.68261	0.001087	0.06076	0.000253	0.00079	0.000027	0.00000	0.000015	0.000011	0.000010	5.24E-15	99.5%	11.1808	366.24 ± 2.33
77	0.63754	0.001119	0.04489	0.000189	0.00061	0.000021	0.00000	0.000014	0.000002	0.000009	4.90E-15	99.9%	14.1891	453.29 ± 2.84
78	0.41675	0.000611	0.03259	0.000169	0.00043	0.000021	0.00004	0.000020	0.000012	0.000008	3.20E-15	99.2%	12.6841	410.26 ± 3.21
79	1.74655	0.001231	0.12345	0.000463	0.00157	0.000027	0.00000	0.000024	0.000022	0.000008	1.34E-14	99.6%	14.0960	450.66 ± 1.84
80	0.45948	0.000916	0.03332	0.000205	0.00043	0.000019	-0.00001	0.000008	0.000005	0.000009	3.53E-15	99.7%	13.7459	440.72 ± 3.91
81	0.60964	0.001091	0.05369	0.000269	0.00070	0.000018	-0.00001	0.000008	0.000015	0.000008	4.68E-15	99.3%	11.2695	368.87 ± 2.48
82	0.31662	0.000443	0.02685	0.000194	0.00036	0.000017	0.00000	0.000012	0.000020	0.000009	2.43E-15	98.2%	11.5780	377.98 ± 4.34
83	1.20026	0.001001	0.08515	0.000335	0.00103	0.000030	0.00000	0.000014	0.000028	0.000008	9.22E-15	99.3%	13.9981	447.88 ± 2.03
84	0.21465	0.000351	0.01516	0.000055	0.00023	0.000019	-0.00001	0.000010	0.000003	0.000009	1.65E-15	99.5%	14.0880	450.43 ± 5.84
85	1.81506	0.001847	0.12807	0.000291	0.00159	0.000034	-0.00003	0.000014	0.000022	0.000008	1.39E-14	99.6%	14.1212	451.37 ± 1.28
86	1.42215	0.001407	0.10029	0.000301	0.00129	0.000030	-0.00001	0.000014	0.000019	0.000008	1.09E-14	99.6%	14.1230	451.42 ± 1.62
87	0.32755	0.000379	0.02972	0.000224	0.00038	0.000023	0.00001	0.000020	0.000018	0.000007	2.52E-15	98.4%	10.8413	356.15 ± 3.65
88	0.29801	0.000336	0.02151	0.000082	0.00027	0.000016	-0.00002	0.000010	0.000000	0.000008	2.29E-15	100.0%	13.8555	443.84 ± 3.88
89	0.63971	0.000970	0.04431	0.000378	0.00059	0.000018	-0.00001	0.000008	0.000016	0.000008	4.91E-15	99.3%	14.3313	457.30 ± 4.36
90	0.41008	0.000601	0.02856	0.000146	0.00039	0.000021	0.00001	0.000013	0.000014	0.000008	3.15E-15	99.0%	14.2187	454.12 ± 3.60
91	0.54357	0.000888	0.03939	0.000179	0.00052	0.000016	-0.00001	0.000012	0.000033	0.000009	4.18E-15	98.2%	13.5522	435.21 ± 2.97
92	1.66559	0.000990	0.11743	0.000791	0.00155	0.000069	0.00001	0.000026	0.000068	0.000022	1.28E-14	98.8%	14.0135	448.32 ± 3.53
93	0.61936	0.000712	0.05032	0.000226	0.00067	0.000025	0.00001	0.000014	0.000011	0.000008	4.76E-15	99.5%	12.2415	397.41 ± 2.38
94	0.60304	0.001047	0.04355	0.000187	0.00055	0.000020	0.00001	0.000010	0.000008	0.000009	4.63E-15	99.6%	13.7924	442.04 ± 2.80

95	1.02804	0.001048	0.07931	0.000329	0.00101	0.000022	0.00001	0.000014	0.000041	0.000008	7.90E-15	98.8%	12.8105	413.92 ± 2.01
96	0.37569	0.000861	0.02578	0.000133	0.00036	0.000019	-0.00001	0.000010	0.000013	0.000007	2.89E-15	99.0%	14.4277	460.01 ± 3.78
97	1.06350	0.001254	0.08572	0.000211	0.00115	0.000020	0.00002	0.000013	0.000011	0.000008	8.17E-15	99.7%	12.3699	401.15 ± 1.44
98	0.13238	0.000598	0.00962	0.000070	0.00012	0.000020	-0.00001	0.000014	-0.000007	0.000010	1.02E-15	101.5%	13.7591	441.10 ± 10.85
99	1.30602	0.001047	0.09143	0.000210	0.00121	0.000050	0.00000	0.000015	0.000012	0.000008	1.00E-14	99.7%	14.2450	454.87 ± 1.37
100	1.98497	0.002200	0.13834	0.000379	0.00177	0.000036	0.00000	0.000011	0.000027	0.000009	1.52E-14	99.6%	14.2905	456.15 ± 1.48
101	1.06737	0.001379	0.08651	0.000440	0.00105	0.000025	0.00002	0.000013	0.000020	0.000008	8.20E-15	99.4%	12.2693	398.22 ± 2.29
102	0.14156	0.000414	0.01057	0.000085	0.00013	0.000019	0.00000	0.000011	0.000010	0.000007	1.09E-15	97.8%	13.1025	422.33 ± 7.55
103	1.35164	0.000826	0.09478	0.000258	0.00118	0.000030	0.00001	0.000006	0.000017	0.000009	1.04E-14	99.6%	14.2073	453.80 ± 1.55
104	2.05715	0.000958	0.14648	0.000447	0.00188	0.000025	0.00003	0.000010	0.000012	0.000010	1.58E-14	99.8%	14.0199	448.50 ± 1.53
105	0.88220	0.001000	0.06145	0.000269	0.00075	0.000024	0.00002	0.000015	0.000017	0.000008	6.78E-15	99.4%	14.2742	455.69 ± 2.43
106	0.82143	0.000820	0.05476	0.000207	0.00070	0.000026	0.00000	0.000012	0.000012	0.000008	6.31E-15	99.6%	14.9392	474.35 ± 2.31
107	0.30859	0.000660	0.02099	0.000104	0.00030	0.000018	0.00002	0.000009	-0.000012	0.000009	2.37E-15	101.2%	14.7037	467.77 ± 4.68
108	0.22314	0.000384	0.01551	0.000084	0.00020	0.000017	0.00002	0.000007	0.000001	0.000007	1.71E-15	99.9%	14.3681	458.34 ± 4.98
109	0.63802	0.000725	0.04459	0.000175	0.00055	0.000022	0.00003	0.000014	0.000000	0.000008	4.90E-15	100.0%	14.3090	456.67 ± 2.57
110	2.29893	0.001505	0.16214	0.000337	0.00216	0.000040	0.00001	0.000011	0.000031	0.000009	1.77E-14	99.6%	14.1220	451.39 ± 1.11
111	2.14040	0.001601	0.14929	0.000366	0.00195	0.000032	0.00001	0.000008	0.000055	0.000009	1.64E-14	99.2%	14.2274	454.37 ± 1.31
112	1.84958	0.001593	0.13078	0.000340	0.00161	0.000017	0.00000	0.000011	0.000043	0.000014	1.42E-14	99.3%	14.0440	449.18 ± 1.59

OK12-54 Muscovite (au28.5e.mus), 60/80#. Mississippian Stanley Group J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	7.90380	0.005007	0.58290	0.001093	0.00735	0.000079	0.00004	0.000016	0.000055	0.000014	6.07E-14	99.8%	13.5314	434.61	± 0.89
2	3.85505	0.004697	0.28857	0.000630	0.00381	0.000076	-0.00001	0.000019	0.000074	0.000009	2.96E-14	99.4%	13.2836	427.53	± 1.12
3	2.14224	0.001505	0.14660	0.000279	0.00198	0.000030	0.00001	0.000016	0.000486	0.000011	1.65E-14	93.3%	13.6329	437.51	± 1.18
4	2.24077	0.002022	0.14342	0.000401	0.00181	0.000035	0.00001	0.000015	0.000074	0.000009	1.72E-14	99.0%	15.4717	489.16	± 1.57
5	1.14253	0.000924	0.07969	0.000338	0.00101	0.000024	0.00003	0.000016	0.000032	0.000013	8.78E-15	99.2%	14.2196	454.15	± 2.53
6	1.33414	0.001222	0.10607	0.000433	0.00136	0.000030	0.00001	0.000011	0.000034	0.000016	1.02E-14	99.3%	12.4842	404.47	± 2.25
7	1.08069	0.000957	0.07145	0.000277	0.00102	0.000038	0.00001	0.000010	0.000039	0.000009	8.30E-15	98.9%	14.9610	474.96	± 2.28
8	3.99416	0.002272	0.24992	0.000407	0.00319	0.000028	0.00000	0.000015	0.000330	0.000011	3.07E-14	97.6%	15.5917	492.48	± 0.96
9	0.27283	0.000575	0.02228	0.000092	0.00027	0.000016	0.00001	0.000012	0.000028	0.000009	2.10E-15	96.9%	11.8703	386.56	± 4.23
10	1.55378	0.001556	0.09888	0.000391	0.00127	0.000031	-0.00002	0.000016	0.000093	0.000009	1.19E-14	98.2%	15.4369	488.20	± 2.21
11	3.20936	0.002390	0.21137	0.000404	0.00280	0.000048	0.00001	0.000010	0.000023	0.000016	2.47E-14	99.8%	15.1516	480.27	± 1.23
12	1.13871	0.002030	0.06984	0.000336	0.00085	0.000029	-0.00001	0.000012	-0.000010	0.000014	8.75E-15	100.3%	16.3047	512.08	± 3.21
13	1.54042	0.000933	0.10562	0.000561	0.00134	0.000034	0.00002	0.000012	0.000042	0.000009	1.18E-14	99.2%	14.4677	461.14	± 2.62
14	0.88966	0.001527	0.05711	0.000393	0.00073	0.000024	0.00003	0.000016	0.000036	0.000010	6.83E-15	98.8%	15.3939	487.01	± 3.83
15	2.89265	0.002944	0.27214	0.000661	0.00344	0.000044	0.00001	0.000015	0.000082	0.000010	2.22E-14	99.2%	10.5407	347.16	± 0.99
16	3.82740	0.002755	0.27808	0.000693	0.00347	0.000030	0.00000	0.000015	0.000045	0.000009	2.94E-14	99.7%	13.7155	439.86	± 1.18
17	2.06560	0.001752	0.14278	0.000461	0.00182	0.000029	0.00004	0.000011	-0.000008	0.000013	1.59E-14	100.1%	14.4668	461.12	± 1.75
18	3.41030	0.002095	0.24037	0.000690	0.00301	0.000018	0.00004	0.000011	0.000072	0.000009	2.62E-14	99.4%	14.0989	450.74	± 1.37
19	2.25074	0.002336	0.16492	0.000244	0.00216	0.000035	0.00001	0.000017	0.000026	0.000015	1.73E-14	99.7%	13.5999	436.57	± 1.15
20	6.80613	0.005818	0.41950	0.000871	0.00555	0.000074	0.00005	0.000017	0.000011	0.000017	5.23E-14	100.0%	16.2168	509.68	± 1.21
21	0.97416	0.000947	0.09240	0.000340	0.00117	0.000029	0.00001	0.000014	0.000011	0.000010	7.48E-15	99.7%	10.5094	346.22	± 1.66
22	1.83807	0.001139	0.13721	0.000501	0.00174	0.000030	0.00003	0.000013	-0.000004	0.000014	1.41E-14	100.1%	13.3962	430.75	± 1.86
23	1.03197	0.001388	0.08181	0.000247	0.00106	0.000024	0.00000	0.000014	0.000021	0.000009	7.93E-15	99.4%	12.5399	406.09	± 1.74
24	1.16698	0.001188	0.08259	0.000239	0.00107	0.000019	0.00001	0.000016	0.000177	0.000010	8.96E-15	95.5%	13.4956	433.59	± 1.80
25	2.99401	0.002202	0.21559	0.000571	0.00274	0.000037	0.00001	0.000015	0.000043	0.000009	2.30E-14	99.6%	13.8289	443.08	± 1.29
26	1.43709	0.001249	0.08890	0.000256	0.00119	0.000022	0.00004	0.000016	0.000009	0.000010	1.10E-14	99.8%	16.1356	507.45	± 1.85
27	1.02954	0.001657	0.06988	0.000312	0.00087	0.000024	0.00001	0.000013	0.000048	0.000015	7.91E-15	98.6%	14.5309	462.92	± 3.04
28	2.66940	0.001720	0.17168	0.000570	0.00215	0.000030	0.00002	0.000021	0.000072	0.000010	2.05E-14	99.2%	15.4243	487.85	± 1.75
29	0.77181	0.000662	0.04603	0.000326	0.00059	0.000025	0.00000	0.000011	0.000036	0.000013	5.93E-15	98.6%	16.5324	518.30	± 4.57
30	1.18487	0.001037	0.07160	0.000288	0.00093	0.000022	0.00002	0.000016	0.000039	0.000010	9.10E-15	99.0%	16.3878	514.35	± 2.47

31	0.73439	0.001090	0.05349	0.000298	0.00068	0.000023	0.00001	0.000011	-0.000025	0.000010	5.64E-15	101.0%	13.7295	440.26 ± 3.10
32	2.29317	0.002672	0.17595	0.000498	0.00237	0.000056	0.00003	0.000018	0.000027	0.000010	1.76E-14	99.7%	12.9879	419.03 ± 1.40
33	1.80875	0.000958	0.11327	0.000370	0.00148	0.000023	0.00003	0.000009	0.000038	0.000009	1.39E-14	99.4%	15.8707	500.18 ± 1.82
34	2.88052	0.001747	0.19758	0.000334	0.00252	0.000031	0.00002	0.000014	0.000056	0.000014	2.21E-14	99.4%	14.4955	461.92 ± 1.06
35	1.62406	0.001067	0.10251	0.000325	0.00133	0.000026	0.00001	0.000021	-0.000028	0.000014	1.25E-14	100.5%	15.8429	499.41 ± 2.07
36	1.15565	0.001163	0.08468	0.000233	0.00104	0.000023	0.00001	0.000015	0.000015	0.000009	8.88E-15	99.6%	13.5954	436.44 ± 1.62
37	1.11043	0.000964	0.07512	0.000431	0.00096	0.000021	0.00003	0.000011	0.000005	0.000016	8.53E-15	99.9%	14.7628	469.42 ± 3.38
38	0.77467	0.000967	0.05871	0.000263	0.00078	0.000019	0.00005	0.000016	0.000007	0.000008	5.95E-15	99.7%	13.1604	423.99 ± 2.38
39	0.64689	0.000966	0.04265	0.000275	0.00054	0.000025	0.00000	0.000013	0.000003	0.000008	4.97E-15	99.9%	15.1471	480.15 ± 3.65
40	1.45291	0.001933	0.10529	0.000231	0.00135	0.000032	0.00000	0.000016	-0.000016	0.000015	1.12E-14	100.3%	13.7994	442.25 ± 1.78
41	2.06182	0.001883	0.14883	0.000448	0.00196	0.000035	0.00000	0.000014	0.000030	0.000015	1.58E-14	99.6%	13.7942	442.10 ± 1.70
42	0.28312	0.000646	0.01890	0.000083	0.00024	0.000019	-0.00001	0.000014	0.000019	0.000009	2.17E-15	98.0%	14.6754	466.97 ± 5.14
43	0.67061	0.001042	0.04824	0.000387	0.00061	0.000020	0.00001	0.000018	0.000020	0.000009	5.15E-15	99.1%	13.7799	441.69 ± 4.06
44	1.63459	0.001487	0.10559	0.000427	0.00134	0.000033	0.00003	0.000019	0.000021	0.000010	1.26E-14	99.6%	15.4230	487.81 ± 2.22
45	2.22855	0.001896	0.15769	0.000353	0.00206	0.000024	-0.00002	0.000016	0.000215	0.000011	1.71E-14	97.1%	13.7288	440.24 ± 1.26
46	1.23611	0.001553	0.09078	0.000264	0.00119	0.000031	0.00003	0.000011	0.000021	0.000009	9.49E-15	99.5%	13.5477	435.08 ± 1.66
47	1.72461	0.002694	0.13155	0.000545	0.00159	0.000022	0.00001	0.000021	0.000016	0.000010	1.32E-14	99.7%	13.0731	421.48 ± 1.99
48	0.45234	0.000721	0.03316	0.000218	0.00042	0.000018	0.00002	0.000017	0.000011	0.000008	3.47E-15	99.3%	13.5463	435.04 ± 3.66
49	0.78421	0.000915	0.05258	0.000201	0.00068	0.000024	0.00003	0.000013	0.000045	0.000007	6.02E-15	98.3%	14.6601	466.54 ± 2.27
50	0.29786	0.000478	0.01905	0.000085	0.00022	0.000018	0.00002	0.000015	0.000046	0.000008	2.29E-15	95.4%	14.9178	473.76 ± 4.63
51	1.31400	0.001042	0.11458	0.000441	0.00144	0.000034	0.00002	0.000012	0.000056	0.000008	1.01E-14	98.7%	11.3232	370.46 ± 1.62
52	0.63004	0.001113	0.04484	0.000264	0.00058	0.000015	0.00004	0.000008	0.000197	0.000009	4.84E-15	90.7%	12.7495	412.15 ± 3.36
53	1.65824	0.001497	0.11540	0.000292	0.00142	0.000033	-0.00002	0.000013	0.000003	0.000016	1.27E-14	100.0%	14.3621	458.17 ± 1.80
54	1.27412	0.001076	0.08568	0.000374	0.00112	0.000032	0.00001	0.000015	0.000237	0.000009	9.79E-15	94.5%	14.0529	449.44 ± 2.34
55	1.39168	0.001758	0.06863	0.000335	0.00085	0.000024	0.00004	0.000019	0.000016	0.000010	1.07E-14	99.7%	20.2071	615.75 ± 3.37
56	0.22671	0.000300	0.01657	0.000093	0.00023	0.000016	0.00002	0.000018	0.000025	0.000008	1.74E-15	96.7%	13.2333	426.08 ± 5.24
57	0.06009	0.000297	0.00465	0.000096	0.00007	0.000019	0.00001	0.000008	0.000004	0.000009	4.62E-16	97.8%	12.6325	408.77 ± 19.80
58	1.12760	0.001146	0.08202	0.000367	0.00105	0.000029	-0.00001	0.000009	-0.000012	0.000009	8.66E-15	100.3%	13.7471	440.76 ± 2.30
59	4.45166	0.003114	0.30046	0.000649	0.00401	0.000063	0.00001	0.000019	0.000055	0.000009	3.42E-14	99.6%	14.7618	469.39 ± 1.11
60	1.08096	0.001007	0.06552	0.000168	0.00082	0.000036	0.00001	0.000012	0.000017	0.000009	8.30E-15	99.5%	16.4228	515.31 ± 1.86
61	0.73494	0.001147	0.04383	0.000295	0.00052	0.000024	-0.00001	0.000013	-0.000006	0.000008	5.65E-15	100.2%	16.7679	524.70 ± 4.01
62	1.07262	0.000843	0.09559	0.000311	0.00127	0.000034	-0.00001	0.000018	-0.000027	0.000015	8.24E-15	100.7%	11.2209	367.43 ± 1.92

63	7.27714	0.005279	0.51906	0.000724	0.00691	0.000077	0.00005	0.000018	0.000165	0.000009	5.59E-14	99.3%	13.9259	445.84 ± 0.72
64	0.44722	0.000527	0.03248	0.000104	0.00044	0.000029	0.00001	0.000020	-0.000003	0.000009	3.44E-15	100.2%	13.7670	441.32 ± 2.94
65	1.08383	0.001242	0.07055	0.000228	0.00085	0.000023	0.00004	0.000017	0.000018	0.000011	8.32E-15	99.5%	15.2882	484.07 ± 2.18
66	1.14241	0.001520	0.08629	0.000292	0.00101	0.000022	0.00000	0.000012	0.000007	0.000008	8.77E-15	99.8%	13.2152	425.57 ± 1.79
67	1.31423	0.001034	0.10459	0.000463	0.00124	0.000031	-0.00001	0.000011	0.000008	0.000008	1.01E-14	99.8%	12.5441	406.21 ± 1.96
68	0.99864	0.000957	0.06290	0.000221	0.00081	0.000022	-0.00001	0.000013	0.000034	0.000009	7.67E-15	99.0%	15.7174	495.95 ± 2.26
69	0.29303	0.000510	0.01876	0.000078	0.00023	0.000026	-0.00001	0.000013	0.000005	0.000008	2.25E-15	99.5%	15.5384	491.01 ± 4.70
70	0.92648	0.000799	0.06261	0.000262	0.00074	0.000026	0.00001	0.000018	0.000010	0.000009	7.12E-15	99.7%	14.7496	469.05 ± 2.38
71	1.09638	0.001301	0.06476	0.000229	0.00084	0.000025	0.00001	0.000009	0.000206	0.000010	8.42E-15	94.4%	15.9891	503.43 ± 2.46
72	1.01328	0.001796	0.07291	0.000353	0.00091	0.000031	0.00001	0.000012	0.000034	0.000009	7.78E-15	99.0%	13.7610	441.15 ± 2.58
73	1.24334	0.001259	0.09275	0.000172	0.00116	0.000021	0.00001	0.000007	0.000007	0.000010	9.55E-15	99.8%	13.3826	430.36 ± 1.34
74	1.79830	0.001092	0.10696	0.000305	0.00130	0.000030	0.00002	0.000020	-0.000017	0.000015	1.38E-14	100.3%	16.8128	525.92 ± 2.00
75	0.83409	0.000379	0.05705	0.000206	0.00069	0.000020	0.00002	0.000023	0.000010	0.000010	6.41E-15	99.6%	14.5671	463.93 ± 2.34
76	0.85867	0.001226	0.06197	0.000272	0.00076	0.000020	0.00001	0.000022	0.000005	0.000008	6.60E-15	99.8%	13.8317	443.16 ± 2.38
77	0.29940	0.000683	0.02261	0.000242	0.00028	0.000023	0.00002	0.000010	0.000004	0.000008	2.30E-15	99.6%	13.1938	424.95 ± 5.80
78	2.20093	0.001306	0.15226	0.000390	0.00190	0.000028	0.00001	0.000013	0.000013	0.000015	1.69E-14	99.8%	14.4307	460.10 ± 1.53
79	1.22178	0.001262	0.09439	0.000248	0.00120	0.000022	0.00000	0.000016	-0.000008	0.000009	9.38E-15	100.2%	12.9435	417.75 ± 1.49
80	2.08009	0.001823	0.16162	0.000674	0.00201	0.000029	0.00002	0.000016	0.000045	0.000008	1.60E-14	99.4%	12.7880	413.27 ± 1.84
81	0.02845	0.000333	0.00278	0.000104	0.00002	0.000018	0.00003	0.000014	0.000004	0.000009	2.19E-16	96.0%	9.8208	325.47 ± 33.98
82	2.51759	0.001534	0.22622	0.000409	0.00286	0.000042	-0.00001	0.000012	0.000028	0.000009	1.93E-14	99.7%	11.0923	363.61 ± 0.79
83	3.16727	0.003630	0.21343	0.000497	0.00266	0.000034	0.00000	0.000009	0.000052	0.000009	2.43E-14	99.5%	14.7680	469.57 ± 1.29
84	0.98805	0.001328	0.06455	0.000245	0.00082	0.000030	0.00001	0.000017	-0.000010	0.000014	7.59E-15	100.3%	15.3061	484.57 ± 2.84
85	1.09042	0.001926	0.06703	0.000326	0.00083	0.000026	0.00001	0.000009	-0.000011	0.000017	8.38E-15	100.3%	16.2678	511.07 ± 3.51
86	0.42430	0.000782	0.03593	0.000246	0.00045	0.000025	0.00003	0.000016	-0.000069	0.000014	3.26E-15	104.8%	11.8078	384.73 ± 4.64
87	0.91091	0.001158	0.07258	0.000373	0.00089	0.000037	0.00002	0.000015	0.000026	0.000010	7.00E-15	99.1%	12.4423	403.26 ± 2.53
88	1.02870	0.000729	0.06943	0.000270	0.00086	0.000025	0.00001	0.000012	0.000040	0.000008	7.90E-15	98.9%	14.6486	466.22 ± 2.14
89	0.99263	0.000787	0.04762	0.000248	0.00053	0.000035	-0.00002	0.000015	0.000007	0.000009	7.62E-15	99.8%	20.7997	630.98 ± 3.70
90	1.18615	0.001419	0.07976	0.000377	0.00099	0.000030	0.00003	0.000016	0.000015	0.000009	9.11E-15	99.6%	14.8140	470.86 ± 2.53
91	0.42353	0.000624	0.02758	0.000170	0.00031	0.000020	0.00003	0.000012	-0.000006	0.000009	3.25E-15	100.4%	15.3572	485.99 ± 4.33
92	0.97061	0.001400	0.06936	0.000282	0.00088	0.000024	0.00000	0.000016	0.000003	0.000008	7.46E-15	99.9%	13.9794	447.35 ± 2.23
93	0.40727	0.000815	0.03035	0.000165	0.00037	0.000018	0.00001	0.000018	0.000020	0.000009	3.13E-15	98.6%	13.2271	425.90 ± 3.83
94	0.29387	0.000315	0.02121	0.000091	0.00025	0.000026	-0.00002	0.000023	0.000007	0.000009	2.26E-15	99.3%	13.7562	441.02 ± 4.42

95	0.91510	0.000666	0.05873	0.000261	0.00073	0.000030	-0.00001	0.000011	0.000014	0.000009	7.03E-15	99.5%	15.5085	490.18 ± 2.66
96	0.29341	0.000457	0.01906	0.000079	0.00025	0.000019	0.00000	0.000009	0.000009	0.000009	2.25E-15	99.1%	15.2546	483.14 ± 4.75
97	0.56709	0.001007	0.04163	0.000170	0.00054	0.000026	0.00000	0.000017	0.000009	0.000009	4.36E-15	99.5%	13.5594	435.41 ± 2.77
98	0.51837	0.000628	0.03347	0.000198	0.00041	0.000019	0.00000	0.000018	0.000006	0.000010	3.98E-15	99.7%	15.4382	488.23 ± 4.01
99	0.79618	0.000798	0.05272	0.000255	0.00063	0.000020	0.00001	0.000014	0.000021	0.000009	6.12E-15	99.2%	14.9848	475.63 ± 2.83
100	0.66320	0.000695	0.04654	0.000188	0.00059	0.000020	0.00002	0.000007	0.000015	0.000010	5.09E-15	99.3%	14.1540	452.30 ± 2.77
101	0.93912	0.001316	0.06411	0.000254	0.00080	0.000024	0.00001	0.000006	0.000023	0.000009	7.21E-15	99.3%	14.5419	463.23 ± 2.36
102	0.51994	0.000627	0.03666	0.000222	0.00042	0.000020	0.00002	0.000016	0.000001	0.000009	3.99E-15	100.0%	14.1766	452.94 ± 3.63
103	0.83803	0.000747	0.06640	0.000240	0.00087	0.000037	0.00003	0.000012	0.000007	0.000009	6.44E-15	99.7%	12.5888	407.50 ± 2.03
104	0.70903	0.000715	0.04885	0.000297	0.00061	0.000024	0.00000	0.000015	0.000006	0.000009	5.45E-15	99.7%	14.4780	461.43 ± 3.33
105	1.13871	0.000889	0.07875	0.000362	0.00096	0.000022	0.00001	0.000012	0.000023	0.000009	8.75E-15	99.4%	14.3738	458.50 ± 2.39
106	0.95338	0.001166	0.06757	0.000285	0.00091	0.000045	0.00001	0.000016	0.000009	0.000013	7.32E-15	99.7%	14.0674	449.85 ± 2.69
107	1.23331	0.000968	0.09201	0.000183	0.00111	0.000030	0.00006	0.000015	0.000035	0.000008	9.47E-15	99.2%	13.2934	427.81 ± 1.24
108	0.52968	0.000646	0.03547	0.000218	0.00043	0.000027	0.00000	0.000012	0.000004	0.000010	4.07E-15	99.8%	14.8976	473.19 ± 3.93
109	1.12715	0.000854	0.08185	0.000214	0.00098	0.000020	0.00001	0.000014	0.000014	0.000009	8.66E-15	99.6%	13.7212	440.02 ± 1.57
110	0.34954	0.000545	0.02143	0.000094	0.00017	0.000024	0.00000	0.000013	0.000020	0.000008	2.68E-15	98.3%	16.0398	504.83 ± 4.14
111	0.38099	0.000757	0.02568	0.000144	0.00031	0.000020	0.00000	0.000013	-0.000008	0.000009	2.93E-15	100.6%	14.8369	471.49 ± 4.40
112	0.73002	0.000887	0.05467	0.000217	0.00062	0.000021	0.00001	0.000010	0.000021	0.000008	5.61E-15	99.1%	13.2372	426.19 ± 2.30

OK12-55 Muscovite (au28.5j.mus), 60/80#. Pennsylvanian Atoka Formation J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	1.70321	0.001726	0.12093	0.000391	0.00156	0.000020	0.00000	0.000014	0.000023	0.000009	1.31E-14	99.6%	14.0266	448.69	± 1.68
2	0.78529	0.000880	0.05496	0.000274	0.00071	0.000023	0.00000	0.000012	0.000031	0.000008	6.03E-15	98.8%	14.1243	451.46	± 2.73
3	0.47557	0.000983	0.03699	0.000223	0.00048	0.000016	0.00002	0.000011	0.000011	0.000008	3.65E-15	99.3%	12.7649	412.60	± 3.29
4	1.64617	0.001271	0.11599	0.000480	0.00147	0.000028	0.00000	0.000012	0.000025	0.000008	1.26E-14	99.6%	14.1297	451.61	± 2.02
5	0.83815	0.000597	0.05972	0.000277	0.00075	0.000030	0.00001	0.000004	0.000030	0.000007	6.44E-15	99.0%	13.8870	444.73	± 2.42
6	2.21907	0.001196	0.17926	0.000676	0.00224	0.000028	0.00005	0.000021	0.000036	0.000009	1.70E-14	99.5%	12.3200	399.70	± 1.60
7	0.28968	0.000563	0.02112	0.000148	0.00029	0.000015	-0.00002	0.000014	0.000003	0.000007	2.23E-15	99.7%	13.6729	438.65	± 4.59
8	0.55745	0.000740	0.04167	0.000365	0.00056	0.000022	-0.00001	0.000010	0.000018	0.000007	4.28E-15	99.0%	13.2483	426.51	± 4.17
9	1.10911	0.001416	0.07841	0.000228	0.00101	0.000024	-0.00001	0.000009	0.000022	0.000007	8.52E-15	99.4%	14.0636	449.74	± 1.67
10	0.82455	0.001035	0.05771	0.000276	0.00076	0.000011	0.00000	0.000010	0.000013	0.000008	6.33E-15	99.5%	14.2210	454.19	± 2.58
11	0.32396	0.000649	0.02266	0.000128	0.00029	0.000017	-0.00001	0.000012	0.000015	0.000008	2.49E-15	98.6%	14.0925	450.56	± 4.19
12	0.63146	0.000573	0.04585	0.000234	0.00058	0.000019	-0.00003	0.000015	0.000022	0.000006	4.85E-15	99.0%	13.6321	437.48	± 2.64
13	0.79459	0.000849	0.06164	0.000307	0.00081	0.000020	-0.00001	0.000008	0.000015	0.000007	6.10E-15	99.4%	12.8199	414.19	± 2.39
14	2.41426	0.001410	0.17021	0.000429	0.00221	0.000028	-0.00001	0.000009	0.000037	0.000008	1.85E-14	99.5%	14.1193	451.32	± 1.26
15	0.80259	0.001148	0.05854	0.000235	0.00079	0.000021	0.00001	0.000012	0.000041	0.000009	6.16E-15	98.5%	13.5039	433.83	± 2.38
16	0.66753	0.000909	0.05044	0.000224	0.00064	0.000024	-0.00001	0.000008	0.000000	0.000008	5.13E-15	100.0%	13.2321	426.05	± 2.49
17	0.59108	0.001186	0.04169	0.000317	0.00054	0.000018	-0.00001	0.000014	0.000004	0.000008	4.54E-15	99.8%	14.1535	452.28	± 3.98
18	1.62346	0.002017	0.11585	0.000426	0.00148	0.000019	-0.00001	0.000014	0.000013	0.000008	1.25E-14	99.8%	13.9790	447.34	± 1.85
19	1.78801	0.001385	0.12724	0.000335	0.00159	0.000020	-0.00003	0.000006	0.000024	0.000008	1.37E-14	99.6%	13.9960	447.83	± 1.37
20	0.67348	0.000880	0.04765	0.000337	0.00062	0.000017	0.00002	0.000010	0.000020	0.000007	5.17E-15	99.1%	14.0115	448.26	± 3.52
21	0.93186	0.000987	0.06707	0.000356	0.00083	0.000013	-0.00001	0.000013	0.000010	0.000007	7.16E-15	99.7%	13.8499	443.68	± 2.61
22	0.87059	0.001354	0.06636	0.000316	0.00087	0.000021	-0.00001	0.000015	0.000051	0.000008	6.69E-15	98.3%	12.8920	416.27	± 2.42
23	0.71155	0.000869	0.05079	0.000326	0.00065	0.000025	-0.00001	0.000009	0.000009	0.000009	5.47E-15	99.6%	13.9579	446.75	± 3.35
24	0.69286	0.000958	0.05298	0.000238	0.00072	0.000017	-0.00002	0.000010	0.000023	0.000006	5.32E-15	99.0%	12.9513	417.98	± 2.29
25	1.95865	0.001272	0.13591	0.000293	0.00177	0.000032	-0.00002	0.000011	0.000020	0.000008	1.50E-14	99.7%	14.3669	458.30	± 1.17
26	0.69687	0.000717	0.04828	0.000257	0.00063	0.000017	-0.00002	0.000012	0.000012	0.000008	5.35E-15	99.5%	14.3608	458.13	± 2.91
27	1.57866	0.002493	0.11167	0.000472	0.00144	0.000021	-0.00002	0.000014	0.000013	0.000007	1.21E-14	99.8%	14.1034	450.87	± 2.11
28	0.67711	0.000872	0.04761	0.000272	0.00063	0.000020	-0.00001	0.000009	0.000026	0.000008	5.20E-15	98.9%	14.0649	449.78	± 3.05
29	0.80977	0.000974	0.06505	0.000287	0.00084	0.000020	-0.00001	0.000006	0.000003	0.000007	6.22E-15	99.9%	12.4339	403.01	± 2.15
30	0.57270	0.000878	0.04151	0.000319	0.00054	0.000016	-0.00001	0.000010	0.000006	0.000009	4.40E-15	99.7%	13.7563	441.02	± 3.99

31	0.13548	0.000524	0.01086	0.000077	0.00014	0.000015	-0.00002	0.000010	0.000004	0.000012	1.04E-15	99.1%	12.3563	400.76 ± 11.28
32	6.14334	0.003561	0.43437	0.000800	0.00549	0.000055	-0.00001	0.000011	0.000028	0.000008	4.72E-14	99.9%	14.1242	451.45 ± 0.89
33	1.51885	0.002404	0.10705	0.000374	0.00137	0.000023	0.00000	0.000012	0.000014	0.000007	1.17E-14	99.7%	14.1505	452.20 ± 1.84
34	2.84451	0.001268	0.22530	0.000352	0.00293	0.000029	0.00000	0.000011	0.000049	0.000009	2.18E-14	99.5%	12.5607	406.69 ± 0.76
35	1.17109	0.001372	0.09866	0.000205	0.00129	0.000031	0.00000	0.000013	0.000029	0.000009	9.00E-15	99.3%	11.7849	384.06 ± 1.26
36	0.13644	0.000545	0.00887	0.000074	0.00014	0.000015	0.00000	0.000010	-0.000001	0.000009	1.05E-15	100.2%	15.3792	486.60 ± 10.16
37	0.19747	0.000529	0.01617	0.000136	0.00021	0.000014	0.00002	0.000011	0.000021	0.000007	1.52E-15	96.8%	11.8247	385.23 ± 5.66
38	2.69891	0.001448	0.18986	0.000474	0.00245	0.000025	-0.00001	0.000009	0.000009	0.000013	2.07E-14	99.9%	14.2017	453.64 ± 1.34
39	0.45850	0.000789	0.03671	0.000201	0.00051	0.000018	0.00001	0.000010	0.000017	0.000008	3.52E-15	98.9%	12.3509	400.60 ± 3.12
40	0.19354	0.000487	0.01597	0.000076	0.00025	0.000017	0.00001	0.000014	0.000025	0.000009	1.49E-15	96.1%	11.6523	380.16 ± 5.61
41	0.21982	0.000373	0.01687	0.000099	0.00026	0.000017	0.00000	0.000015	0.000027	0.000012	1.69E-15	96.3%	12.5538	406.49 ± 7.48
42	0.19460	0.000414	0.01546	0.000138	0.00025	0.000014	0.00003	0.000013	0.000027	0.000008	1.49E-15	96.0%	12.0755	392.57 ± 6.34
43	0.78480	0.000655	0.06036	0.000326	0.00083	0.000019	0.00002	0.000016	0.000006	0.000013	6.03E-15	99.8%	12.9745	418.65 ± 3.06
44	3.19526	0.001781	0.23389	0.000444	0.00294	0.000029	0.00001	0.000013	0.000028	0.000009	2.45E-14	99.7%	13.6262	437.31 ± 0.94
45	1.96235	0.002103	0.16970	0.000519	0.00215	0.000025	0.00003	0.000016	0.000029	0.000008	1.51E-14	99.6%	11.5131	376.06 ± 1.31
46	2.37724	0.002659	0.12700	0.000287	0.00160	0.000035	0.00001	0.000008	0.000031	0.000008	1.83E-14	99.6%	18.6457	574.98 ± 1.56
47	0.73487	0.000894	0.06145	0.000357	0.00081	0.000025	-0.00001	0.000012	0.000018	0.000009	5.64E-15	99.3%	11.8700	386.56 ± 2.68
48	0.42971	0.000849	0.03006	0.000171	0.00040	0.000019	0.00001	0.000008	0.000013	0.000009	3.30E-15	99.1%	14.1650	452.61 ± 3.92
49	0.48905	0.000808	0.03589	0.000322	0.00046	0.000017	0.00001	0.000011	0.000022	0.000008	3.76E-15	98.7%	13.4437	432.11 ± 4.46
50	1.10268	0.001367	0.08728	0.000376	0.00118	0.000021	-0.00001	0.000011	0.000029	0.000010	8.47E-15	99.2%	12.5377	406.02 ± 2.14
51	0.67558	0.000825	0.05018	0.000177	0.00065	0.000024	0.00001	0.000008	0.000030	0.000009	5.19E-15	98.7%	13.2884	427.66 ± 2.30
52	1.20850	0.001334	0.09649	0.000506	0.00123	0.000024	0.00001	0.000006	0.000042	0.000008	9.28E-15	99.0%	12.3954	401.89 ± 2.32
53	1.93545	0.002029	0.16687	0.000436	0.00210	0.000032	0.00003	0.000011	0.000036	0.000009	1.49E-14	99.5%	11.5350	376.71 ± 1.19
54	0.79437	0.002011	0.06406	0.000263	0.00092	0.000068	0.00002	0.000015	0.000011	0.000019	6.10E-15	99.6%	12.3514	400.61 ± 3.50
55	0.60733	0.000707	0.04745	0.000233	0.00062	0.000021	0.00002	0.000015	0.000027	0.000008	4.66E-15	98.7%	12.6289	408.67 ± 2.63
56	0.29848	0.000467	0.02414	0.000100	0.00035	0.000012	0.00002	0.000015	0.000011	0.000010	2.29E-15	98.9%	12.2318	397.13 ± 4.38
57	1.29405	0.001212	0.11094	0.000479	0.00140	0.000024	0.00001	0.000006	0.000016	0.000011	9.94E-15	99.6%	11.6226	379.29 ± 1.94
58	0.20108	0.000561	0.01604	0.000113	0.00016	0.000032	0.00001	0.000014	0.000002	0.000009	1.54E-15	99.7%	12.5041	405.05 ± 6.36
59	0.70634	0.001123	0.05992	0.000218	0.00080	0.000019	0.00000	0.000009	0.000018	0.000009	5.43E-15	99.3%	11.7000	381.57 ± 2.09
60	4.56431	0.002572	0.31986	0.000484	0.00409	0.000040	0.00000	0.000008	0.000018	0.000014	3.51E-14	99.9%	14.2531	455.10 ± 0.84
61	1.01529	0.000766	0.08444	0.000256	0.00107	0.000024	0.00002	0.000011	0.000021	0.000010	7.80E-15	99.4%	11.9516	388.95 ± 1.64
62	1.61733	0.000911	0.13456	0.000409	0.00169	0.000029	-0.00001	0.000009	0.000029	0.000011	1.24E-14	99.5%	11.9567	389.10 ± 1.43

63	1.52170	0.001569	0.11862	0.000348	0.00153	0.000023	0.00001	0.000017	0.000007	0.000010	1.17E-14	99.9%	12.8104	413.91 ± 1.53
64	0.25234	0.000382	0.02057	0.000097	0.00026	0.000017	0.00002	0.000014	0.000017	0.000010	1.94E-15	98.0%	12.0245	391.08 ± 4.86
65	0.32401	0.000804	0.02292	0.000140	0.00032	0.000020	0.00000	0.000012	-0.000002	0.000009	2.49E-15	100.2%	14.1376	451.83 ± 4.83
66	1.41079	0.001621	0.11883	0.000321	0.00149	0.000023	0.00002	0.000015	0.000014	0.000010	1.08E-14	99.7%	11.8367	385.58 ± 1.38
67	0.44051	0.000489	0.03525	0.000192	0.00045	0.000021	-0.00001	0.000011	0.000017	0.000009	3.38E-15	98.9%	12.3576	400.79 ± 3.35
68	1.90989	0.001731	0.13672	0.000477	0.00176	0.000034	0.00001	0.000006	0.000009	0.000009	1.47E-14	99.9%	13.9498	446.52 ± 1.72
69	0.95220	0.000900	0.06664	0.000215	0.00086	0.000019	0.00002	0.000014	0.000006	0.000009	7.31E-15	99.8%	14.2650	455.43 ± 2.00
70	2.01652	0.001122	0.14155	0.000445	0.00180	0.000028	-0.00001	0.000012	0.000006	0.000009	1.55E-14	99.9%	14.2343	454.56 ± 1.58
71	4.49331	0.004616	0.16136	0.000434	0.00222	0.000032	-0.00001	0.000010	0.000017	0.000009	3.45E-14	99.9%	27.8156	802.20 ± 2.36
72	0.70352	0.000886	0.05785	0.000200	0.00077	0.000014	0.00002	0.000012	0.000018	0.000008	5.40E-15	99.2%	12.0677	392.34 ± 1.93
73	1.23325	0.001320	0.10571	0.000237	0.00132	0.000025	-0.00001	0.000011	0.000021	0.000009	9.47E-15	99.5%	11.6088	378.88 ± 1.24
74	1.06177	0.001654	0.08469	0.000361	0.00106	0.000022	-0.00001	0.000010	0.000019	0.000010	8.16E-15	99.5%	12.4717	404.11 ± 2.18
75	0.78624	0.000921	0.05522	0.000183	0.00070	0.000018	0.00002	0.000012	0.000020	0.000010	6.04E-15	99.3%	14.1324	451.69 ± 2.33
76	0.79156	0.000774	0.06144	0.000292	0.00077	0.000027	0.00001	0.000009	0.000015	0.000009	6.08E-15	99.4%	12.8114	413.94 ± 2.45
77	0.85956	0.001254	0.07126	0.000251	0.00091	0.000023	0.00000	0.000011	0.000021	0.000009	6.60E-15	99.3%	11.9772	389.70 ± 1.97
78	0.41240	0.000944	0.03031	0.000084	0.00040	0.000015	0.00000	0.000007	0.000018	0.000009	3.17E-15	98.7%	13.4357	431.88 ± 3.28
79	0.07534	0.000269	0.00618	0.000060	0.00007	0.000012	0.00001	0.000008	0.000016	0.000009	5.79E-16	93.8%	11.4292	373.59 ± 14.23
80	0.33265	0.000609	0.02644	0.000105	0.00032	0.000017	0.00001	0.000011	0.000020	0.000009	2.56E-15	98.2%	12.3531	400.66 ± 3.67
81	0.13045	0.000366	0.01038	0.000071	0.00009	0.000019	0.00001	0.000011	-0.000003	0.000008	1.00E-15	100.6%	12.5725	407.03 ± 8.32
82	2.63736	0.001820	0.18623	0.000399	0.00240	0.000031	0.00000	0.000010	-0.000007	0.000016	2.03E-14	100.1%	14.1616	452.51 ± 1.30
83	0.42838	0.000989	0.03566	0.000209	0.00048	0.000017	0.00001	0.000016	0.000011	0.000008	3.29E-15	99.2%	11.9193	388.00 ± 3.25
84	0.25402	0.000555	0.01898	0.000065	0.00027	0.000020	-0.00001	0.000012	0.000012	0.000009	1.95E-15	98.6%	13.1957	425.00 ± 4.62
85	1.07433	0.000832	0.07200	0.000236	0.00093	0.000019	-0.00001	0.000011	0.000008	0.000008	8.25E-15	99.8%	14.8861	472.87 ± 1.87
86	0.36535	0.000460	0.02615	0.000118	0.00036	0.000017	0.00000	0.000008	0.000005	0.000011	2.81E-15	99.6%	13.9156	445.54 ± 4.65
87	0.06930	0.000343	0.00580	0.000059	0.00009	0.000013	-0.00001	0.000011	0.000009	0.000008	5.32E-16	96.2%	11.4917	375.43 ± 14.50
88	1.49171	0.001226	0.12871	0.000531	0.00163	0.000037	-0.00001	0.000009	0.000012	0.000008	1.15E-14	99.8%	11.5631	377.54 ± 1.71
89	0.35164	0.000559	0.02827	0.000164	0.00038	0.000015	-0.00001	0.000013	0.000011	0.000009	2.70E-15	99.1%	12.3234	399.80 ± 3.86
90	0.51933	0.001058	0.03694	0.000189	0.00046	0.000017	0.00000	0.000011	0.000010	0.000007	3.99E-15	99.4%	13.9810	447.40 ± 3.12
91	0.65916	0.000894	0.04699	0.000225	0.00072	0.000035	0.00000	0.000009	0.000009	0.000008	5.06E-15	99.6%	13.9704	447.10 ± 2.81
92	0.14420	0.000534	0.01130	0.000072	0.00014	0.000017	0.00000	0.000010	0.000006	0.000007	1.11E-15	98.8%	12.6146	408.25 ± 6.54
93	0.02668	0.000235	0.00211	0.000074	0.00005	0.000019	0.00000	0.000013	0.000000	0.000009	2.05E-16	100.0%	12.6334	408.80 ± 41.82
94	1.57699	0.001472	0.11321	0.000415	0.00144	0.000029	-0.00003	0.000009	0.000057	0.000008	1.21E-14	98.9%	13.7802	441.70 ± 1.83

95	0.93609	0.000989	0.06660	0.000419	0.00084	0.000015	0.00000	0.000015	0.000019	0.000008	7.19E-15	99.4%	13.9701	447.09 ± 3.11
96	2.03415	0.001519	0.14420	0.000519	0.00179	0.000037	0.00000	0.000011	0.000009	0.000008	1.56E-14	99.9%	14.0889	450.45 ± 1.74
97	0.13103	0.000407	0.00975	0.000062	0.00019	0.000025	0.00000	0.000010	0.000009	0.000008	1.01E-15	98.0%	13.1715	424.31 ± 8.18
98	0.61510	0.001079	0.02247	0.000100	0.00035	0.000026	0.00001	0.000011	0.000010	0.000008	4.72E-15	99.5%	27.2476	788.92 ± 4.81
99	0.78185	0.001304	0.06676	0.000310	0.00090	0.000028	-0.00002	0.000009	0.000033	0.000008	6.01E-15	98.8%	11.5651	377.60 ± 2.19
100	0.58460	0.000348	0.04083	0.000301	0.00054	0.000029	-0.00001	0.000014	0.000008	0.000008	4.49E-15	99.6%	14.2629	455.37 ± 3.85
101	0.20980	0.000439	0.01645	0.000098	0.00025	0.000028	0.00000	0.000013	0.000010	0.000008	1.61E-15	98.5%	12.5689	406.93 ± 5.51
102	1.24408	0.000962	0.08796	0.000298	0.00115	0.000025	0.00003	0.000016	0.000010	0.000008	9.56E-15	99.8%	14.1115	451.09 ± 1.81
103	1.18506	0.001414	0.08386	0.000286	0.00114	0.000030	-0.00001	0.000012	0.000012	0.000014	9.10E-15	99.7%	14.0888	450.45 ± 2.30
104	0.70786	0.000770	0.05146	0.000222	0.00070	0.000025	0.00001	0.000013	0.000021	0.000008	5.44E-15	99.1%	13.6352	437.57 ± 2.44
105	0.77573	0.000989	0.06685	0.000378	0.00091	0.000029	-0.00001	0.000009	-0.000001	0.000008	5.96E-15	100.0%	11.6044	378.75 ± 2.49
106	0.45503	0.000731	0.03160	0.000216	0.00046	0.000023	-0.00001	0.000011	0.000003	0.000009	3.50E-15	99.8%	14.3730	458.48 ± 4.19
107	0.24608	0.000269	0.02079	0.000133	0.00031	0.000025	-0.00007	0.000020	0.000017	0.000008	1.89E-15	98.0%	11.5991	378.60 ± 4.37
108	0.45768	0.000823	0.03122	0.000106	0.00047	0.000025	0.00001	0.000010	0.000008	0.000009	3.52E-15	99.5%	14.5874	464.50 ± 3.19
109	0.58621	0.001158	0.04165	0.000252	0.00055	0.000026	0.00000	0.000011	0.000008	0.000007	4.50E-15	99.6%	14.0150	448.36 ± 3.25
110	0.17103	0.000496	0.01394	0.000091	0.00021	0.000024	-0.00001	0.000008	0.000003	0.000008	1.31E-15	99.4%	12.1986	396.16 ± 6.03
111	0.65445	0.000595	0.05127	0.000152	0.00067	0.000027	0.00001	0.000013	-0.000006	0.000008	5.03E-15	100.2%	12.7644	412.58 ± 1.98
112	0.70974	0.000805	0.05699	0.000258	0.00077	0.000024	-0.00001	0.000008	0.000011	0.000008	5.45E-15	99.6%	12.3990	402.00 ± 2.29

OK12-56 Muscovite (au28.5a.mus), 60/80#. Pennsylvanian Jackfork Group J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	1.54891	0.001401	0.10779	0.000329	0.00138	0.000030	-0.00002	0.000015	0.000014	0.000015	1.19E-14	99.7%	14.3319	457.32	± 1.94
2	2.60871	0.002217	0.18510	0.000283	0.00241	0.000036	-0.00001	0.000017	0.000047	0.000015	2.00E-14	99.5%	14.0191	448.48	± 1.10
3	3.62852	0.002690	0.31533	0.000615	0.00402	0.000042	0.00000	0.000026	0.000034	0.000015	2.79E-14	99.7%	11.4749	374.94	± 0.91
4	3.19872	0.002069	0.23056	0.000613	0.00298	0.000049	-0.00005	0.000015	0.000139	0.000015	2.46E-14	98.7%	13.6948	439.27	± 1.36
5	6.76103	0.004318	0.46685	0.000550	0.00594	0.000049	-0.00001	0.000020	0.000064	0.000016	5.19E-14	99.7%	14.4415	460.40	± 0.70
6	1.18769	0.001213	0.10250	0.000242	0.00133	0.000033	0.00001	0.000022	0.000032	0.000016	9.12E-15	99.2%	11.4958	375.55	± 1.76
7	2.08446	0.001535	0.14549	0.000444	0.00184	0.000040	0.00000	0.000018	0.000070	0.000025	1.60E-14	99.0%	14.1863	453.21	± 2.15
8	1.36270	0.001611	0.09884	0.000284	0.00127	0.000036	-0.00006	0.000035	0.000064	0.000026	1.05E-14	98.6%	13.5968	436.48	± 2.82
9	1.16826	0.000981	0.08313	0.000243	0.00101	0.000035	0.00001	0.000014	0.000050	0.000026	8.97E-15	98.7%	13.8771	444.45	± 3.28
10	0.93527	0.001289	0.09231	0.000332	0.00114	0.000029	-0.00002	0.000010	0.000016	0.000025	7.18E-15	99.5%	10.0788	333.27	± 2.90
11	1.37483	0.000870	0.11641	0.000354	0.00151	0.000036	0.00002	0.000030	0.000054	0.000026	1.06E-14	98.8%	11.6721	380.75	± 2.44
12	3.47609	0.002417	0.24402	0.000490	0.00323	0.000048	0.00000	0.000017	0.000052	0.000025	2.67E-14	99.6%	14.1825	453.10	± 1.36
13	1.46649	0.001889	0.10360	0.000247	0.00131	0.000042	-0.00005	0.000023	0.000050	0.000025	1.13E-14	99.0%	14.0127	448.30	± 2.55
14	1.60324	0.001169	0.11241	0.000242	0.00149	0.000044	0.00004	0.000016	0.000046	0.000016	1.23E-14	99.2%	14.1423	451.97	± 1.68
15	2.30262	0.001288	0.16072	0.000357	0.00207	0.000042	-0.00003	0.000025	0.000017	0.000015	1.77E-14	99.8%	14.2953	456.29	± 1.37
16	0.73962	0.000757	0.05119	0.000202	0.00065	0.000041	0.00004	0.000021	0.000058	0.000014	5.68E-15	97.7%	14.1128	451.13	± 3.14
17	4.50666	0.002354	0.31588	0.000602	0.00404	0.000063	0.00001	0.000021	0.000005	0.000016	3.46E-14	100.0%	14.2622	455.35	± 1.02
18	5.44127	0.004250	0.37725	0.000516	0.00501	0.000106	0.00002	0.000018	0.000096	0.000017	4.18E-14	99.5%	14.3484	457.78	± 0.84
19	4.02267	0.003858	0.27951	0.000857	0.00359	0.000058	0.00002	0.000019	0.000050	0.000014	3.09E-14	99.6%	14.3385	457.50	± 1.55
20	2.45442	0.001734	0.17209	0.000500	0.00212	0.000027	0.00000	0.000024	0.000047	0.000014	1.89E-14	99.4%	14.1821	453.09	± 1.57
21	4.16802	0.003068	0.35905	0.000548	0.00457	0.000055	-0.00002	0.000035	0.000048	0.000013	3.20E-14	99.7%	11.5693	377.72	± 0.73
22	1.07988	0.001289	0.08704	0.000384	0.00113	0.000031	-0.00001	0.000015	0.000021	0.000014	8.29E-15	99.4%	12.3365	400.18	± 2.39
23	0.96725	0.000965	0.06688	0.000133	0.00078	0.000030	-0.00004	0.000019	0.000016	0.000012	7.43E-15	99.5%	14.3899	458.95	± 1.93
24	0.97434	0.000610	0.06794	0.000335	0.00087	0.000025	-0.00001	0.000028	-0.000026	0.000018	7.48E-15	100.8%	14.3412	457.58	± 3.36
25	1.37535	0.001187	0.09519	0.000394	0.00135	0.000043	-0.00001	0.000026	0.000067	0.000014	1.06E-14	98.6%	14.2407	454.74	± 2.40
26	0.35429	0.000858	0.02507	0.000115	0.00032	0.000024	-0.00005	0.000012	-0.000006	0.000012	2.72E-15	100.5%	14.1300	451.62	± 5.23
27	2.92339	0.001638	0.20544	0.000451	0.00251	0.000037	0.00003	0.000021	0.000069	0.000014	2.25E-14	99.3%	14.1312	451.65	± 1.20
28	2.01639	0.001431	0.14188	0.000208	0.00188	0.000029	-0.00002	0.000022	0.000051	0.000013	1.55E-14	99.2%	14.1050	450.91	± 1.14
29	3.77600	0.002951	0.27582	0.000771	0.00344	0.000033	-0.00001	0.000018	-0.000009	0.000024	2.90E-14	100.1%	13.6902	439.14	± 1.52
30	1.61551	0.001417	0.14357	0.000408	0.00182	0.000034	-0.00001	0.000021	-0.000041	0.000023	1.24E-14	100.8%	11.2524	368.36	± 1.89

31	1.67070	0.001388	0.11747	0.000367	0.00144	0.000030	0.00000	0.000020	-0.000037	0.000022	1.28E-14	100.7%	14.2226	454.23 ± 2.28
32	1.33764	0.001676	0.09419	0.000208	0.00117	0.000035	0.00002	0.000016	0.000037	0.000014	1.03E-14	99.2%	14.0860	450.37 ± 1.83
33	2.42506	0.001496	0.16740	0.000458	0.00220	0.000039	-0.00010	0.000035	0.000044	0.000014	1.86E-14	99.5%	14.4088	459.48 ± 1.52
34	8.80412	0.004581	0.61774	0.000567	0.00788	0.000073	-0.00001	0.000018	0.000051	0.000019	6.76E-14	99.8%	14.2276	454.38 ± 0.56
35	0.76610	0.001446	0.05384	0.000257	0.00071	0.000032	-0.00001	0.000013	0.000027	0.000015	5.88E-15	98.9%	14.0788	450.17 ± 3.46
36	1.66839	0.001219	0.11658	0.000306	0.00143	0.000033	0.00000	0.000020	0.000025	0.000014	1.28E-14	99.6%	14.2476	454.94 ± 1.68
37	2.25553	0.001362	0.15837	0.000630	0.00206	0.000042	0.00002	0.000016	0.000021	0.000015	1.73E-14	99.7%	14.2042	453.71 ± 2.03
38	2.65302	0.001473	0.21386	0.000500	0.00269	0.000036	-0.00003	0.000025	0.000002	0.000012	2.04E-14	100.0%	12.4025	402.10 ± 1.11
39	0.98347	0.001432	0.09617	0.000324	0.00122	0.000028	0.00000	0.000019	0.000055	0.000013	7.55E-15	98.4%	10.0576	332.63 ± 1.84
40	0.88482	0.001395	0.06299	0.000237	0.00079	0.000036	-0.00002	0.000022	0.000030	0.000011	6.80E-15	99.0%	13.9060	445.27 ± 2.50
41	1.79313	0.001556	0.14335	0.000336	0.00183	0.000040	-0.00001	0.000017	0.000040	0.000016	1.38E-14	99.3%	12.4254	402.76 ± 1.46
42	1.46839	0.000905	0.12824	0.000339	0.00162	0.000050	-0.00001	0.000024	0.000013	0.000012	1.13E-14	99.7%	11.4195	373.30 ± 1.37
43	0.78141	0.001160	0.06330	0.000207	0.00082	0.000036	-0.00002	0.000028	0.000021	0.000013	6.00E-15	99.2%	12.2487	397.62 ± 2.50
44	2.21071	0.001155	0.17579	0.000435	0.00225	0.000043	0.00000	0.000020	0.000076	0.000020	1.70E-14	99.0%	12.4485	403.43 ± 1.50
45	1.83890	0.001970	0.14337	0.000424	0.00180	0.000033	-0.00002	0.000019	0.000027	0.000015	1.41E-14	99.6%	12.7707	412.77 ± 1.63
46	0.67333	0.000753	0.04750	0.000376	0.00057	0.000022	0.00000	0.000023	0.000013	0.000015	5.17E-15	99.4%	14.0943	450.61 ± 4.71
47	0.98019	0.001094	0.06022	0.000189	0.00084	0.000029	-0.00002	0.000014	0.000309	0.000024	7.53E-15	90.7%	14.7625	469.41 ± 4.17
48	1.60522	0.001628	0.11374	0.000219	0.00137	0.000028	-0.00001	0.000018	0.000033	0.000013	1.23E-14	99.4%	14.0280	448.73 ± 1.44
49	1.01742	0.000736	0.07169	0.000362	0.00087	0.000034	-0.00006	0.000033	0.000023	0.000012	7.81E-15	99.3%	14.0977	450.70 ± 2.82
50	0.94543	0.000998	0.08085	0.000454	0.00104	0.000035	-0.00005	0.000016	0.000017	0.000015	7.26E-15	99.5%	11.6322	379.57 ± 2.80
51	6.07945	0.003317	0.42553	0.000463	0.00544	0.000040	0.00000	0.000019	0.000081	0.000014	4.67E-14	99.6%	14.2306	454.46 ± 0.64
52	1.50598	0.001606	0.10552	0.000293	0.00143	0.000046	0.00008	0.000027	0.000015	0.000013	1.16E-14	99.7%	14.2312	454.48 ± 1.79
53	1.08970	0.001019	0.09529	0.000314	0.00117	0.000027	0.00001	0.000022	0.000057	0.000016	8.37E-15	98.5%	11.2586	368.55 ± 2.10
54	2.46560	0.002232	0.17289	0.000328	0.00218	0.000035	0.00002	0.000017	0.000071	0.000015	1.89E-14	99.1%	14.1397	451.89 ± 1.26
55	2.78807	0.001504	0.23314	0.000498	0.00295	0.000043	-0.00003	0.000019	0.000044	0.000015	2.14E-14	99.5%	11.9024	387.51 ± 1.06
56	2.89917	0.001746	0.20509	0.000563	0.00260	0.000036	0.00002	0.000028	0.000084	0.000015	2.23E-14	99.1%	14.0151	448.36 ± 1.45
57	1.61012	0.001260	0.10199	0.000287	0.00135	0.000037	-0.00001	0.000022	0.000533	0.000015	1.24E-14	90.2%	14.2411	454.75 ± 2.04
58	3.88281	0.002422	0.32436	0.000890	0.00416	0.000059	0.00001	0.000015	0.000782	0.000016	2.98E-14	94.0%	11.2582	368.53 ± 1.21
59	3.10700	0.001527	0.21720	0.000498	0.00280	0.000038	-0.00001	0.000018	0.000054	0.000015	2.39E-14	99.5%	14.2315	454.48 ± 1.26
60	1.94992	0.001293	0.13757	0.000504	0.00164	0.000034	0.00001	0.000019	0.000047	0.000013	1.50E-14	99.3%	14.0725	449.99 ± 1.91
61	2.01170	0.001785	0.16327	0.000447	0.00206	0.000035	-0.00002	0.000015	0.000047	0.000016	1.55E-14	99.3%	12.2365	397.27 ± 1.47
62	0.05462	0.000331	0.00513	0.000083	0.00008	0.000035	0.00000	0.000022	0.000018	0.000016	4.20E-16	90.0%	9.5916	318.50 ± 31.15

63	0.85951	0.001020	0.07437	0.000441	0.00089	0.000044	0.00000	0.000023	0.000003	0.000014	6.60E-15	99.9%	11.5462	377.04 ± 2.90
64	2.11498	0.001687	0.18249	0.000351	0.00228	0.000063	-0.00001	0.000031	-0.000043	0.000023	1.62E-14	100.6%	11.5896	378.32 ± 1.47
65	0.80387	0.001420	0.05781	0.000251	0.00069	0.000047	-0.00004	0.000023	-0.000094	0.000026	6.17E-15	103.4%	13.9042	445.22 ± 4.76
66	1.81090	0.001324	0.12702	0.000401	0.00167	0.000036	0.00000	0.000019	0.000083	0.000012	1.39E-14	98.6%	14.0624	449.70 ± 1.74
67	3.20981	0.001700	0.21876	0.000562	0.00296	0.000032	-0.00002	0.000013	0.000761	0.000018	2.47E-14	93.0%	13.6446	437.84 ± 1.45
68	3.59582	0.002942	0.26980	0.000438	0.00345	0.000053	-0.00002	0.000010	0.000016	0.000014	2.76E-14	99.9%	13.3100	428.28 ± 0.93
69	0.33278	0.000381	0.03379	0.000226	0.00057	0.000035	0.00002	0.000020	0.000014	0.000014	2.56E-15	98.7%	9.7237	322.52 ± 4.50
70	1.62886	0.000983	0.11695	0.000351	0.00150	0.000027	-0.00001	0.000022	0.000061	0.000017	1.25E-14	98.9%	13.7732	441.50 ± 1.94
71	1.92891	0.001487	0.15497	0.000407	0.00193	0.000035	-0.00002	0.000013	0.000048	0.000015	1.48E-14	99.3%	12.3550	400.72 ± 1.45
72	0.89728	0.000977	0.06227	0.000173	0.00081	0.000026	0.00000	0.000017	-0.000014	0.000020	6.89E-15	100.4%	14.4087	459.48 ± 3.38
73	0.86057	0.000970	0.08513	0.000230	0.00107	0.000032	0.00000	0.000019	0.000064	0.000015	6.61E-15	97.8%	9.8870	327.47 ± 1.95
74	1.49234	0.001304	0.11911	0.000371	0.00150	0.000031	0.00002	0.000011	0.000305	0.000015	1.15E-14	94.0%	11.7709	383.65 ± 1.80
75	2.48548	0.001346	0.16615	0.000549	0.00216	0.000036	0.00003	0.000024	0.000348	0.000017	1.91E-14	95.9%	14.3398	457.54 ± 1.86
76	0.15831	0.000459	0.00830	0.000106	0.00015	0.000035	-0.00001	0.000022	-0.000009	0.000024	1.22E-15	101.6%	19.0656	586.04 ± 27.18
77	1.20583	0.001240	0.10091	0.000335	0.00131	0.000039	-0.00002	0.000017	0.000015	0.000014	9.26E-15	99.6%	11.9049	387.58 ± 1.88
78	0.88645	0.000333	0.09393	0.000244	0.00113	0.000031	-0.00001	0.000021	-0.000001	0.000015	6.81E-15	100.0%	9.4371	313.79 ± 1.75
79	2.55240	0.001463	0.24232	0.000638	0.00311	0.000043	0.00003	0.000027	-0.000025	0.000023	1.96E-14	100.3%	10.5330	346.93 ± 1.32
80	3.09157	0.002430	0.22624	0.000465	0.00293	0.000047	-0.00002	0.000024	-0.000006	0.000026	2.37E-14	100.1%	13.6651	438.42 ± 1.45
81	1.33154	0.001516	0.09321	0.000340	0.00122	0.000030	-0.00002	0.000019	0.000037	0.000016	1.02E-14	99.2%	14.1684	452.70 ± 2.40
82	0.77548	0.001405	0.05357	0.000256	0.00063	0.000034	0.00009	0.000026	0.000009	0.000017	5.96E-15	99.7%	14.4285	460.04 ± 3.76
83	1.96121	0.001808	0.15576	0.000564	0.00202	0.000058	0.00003	0.000017	0.000048	0.000015	1.51E-14	99.3%	12.5009	404.96 ± 1.77
84	2.31954	0.002571	0.16437	0.000411	0.00206	0.000038	-0.00004	0.000017	-0.000006	0.000026	1.78E-14	100.1%	14.1120	451.11 ± 1.92
85	1.43302	0.001074	0.10045	0.000291	0.00130	0.000039	0.00002	0.000018	-0.000043	0.000023	1.10E-14	100.9%	14.2656	455.45 ± 2.55
86	1.17578	0.002032	0.08408	0.000271	0.00112	0.000040	0.00010	0.000042	0.000023	0.000016	9.03E-15	99.4%	13.9040	445.22 ± 2.47
87	0.37354	0.000479	0.03098	0.000150	0.00045	0.000036	0.00002	0.000022	-0.000008	0.000016	2.87E-15	100.6%	12.0590	392.09 ± 5.34
88	1.48037	0.000724	0.10167	0.000348	0.00128	0.000040	0.00002	0.000019	0.000042	0.000022	1.14E-14	99.2%	14.4397	460.35 ± 2.59
89	0.82484	0.000912	0.06325	0.000189	0.00074	0.000029	-0.00002	0.000017	0.000037	0.000022	6.34E-15	98.7%	12.8667	415.54 ± 3.60
90	0.38698	0.000539	0.02713	0.000150	0.00031	0.000025	0.00004	0.000016	0.000076	0.000022	2.97E-15	94.2%	13.4393	431.98 ± 8.29
91	2.56819	0.001821	0.19380	0.000479	0.00245	0.000027	0.00001	0.000019	0.000129	0.000023	1.97E-14	98.5%	13.0557	420.98 ± 1.59
92	1.19953	0.001312	0.08998	0.000393	0.00111	0.000031	0.00001	0.000011	0.000091	0.000021	9.21E-15	97.8%	13.0322	420.31 ± 2.94
93	0.11449	0.000437	0.00997	0.000103	0.00013	0.000023	-0.00003	0.000021	-0.000018	0.000014	8.79E-16	104.6%	11.4811	375.12 ± 14.05
94	2.22339	0.001969	0.16499	0.000316	0.00205	0.000034	0.00001	0.000025	-0.000003	0.000015	1.71E-14	100.0%	13.4761	433.03 ± 1.25

95	3.23130	0.001765	0.23102	0.000530	0.00294	0.000045	0.00002	0.000010	0.000036	0.000015	2.48E-14	99.7%	13.9410	446.26 ± 1.22
96	0.09742	0.000248	0.00813	0.000074	0.00010	0.000022	-0.00001	0.000027	0.000005	0.000013	7.48E-16	98.4%	11.8018	384.56 ± 15.69
97	0.76999	0.001097	0.05679	0.000169	0.00065	0.000035	0.00003	0.000024	-0.000019	0.000016	5.91E-15	100.7%	13.5578	435.37 ± 3.07
98	0.23657	0.000232	0.01951	0.000141	0.00018	0.000034	0.00000	0.000017	-0.000068	0.000019	1.82E-15	108.4%	12.1273	394.08 ± 9.94
99	1.28290	0.000907	0.08987	0.000267	0.00110	0.000036	0.00007	0.000023	0.000025	0.000014	9.85E-15	99.4%	14.1908	453.34 ± 2.03
100	1.39114	0.001283	0.10213	0.000518	0.00122	0.000037	0.00002	0.000017	0.000015	0.000015	1.07E-14	99.7%	13.5787	435.96 ± 2.63
101	1.04675	0.000699	0.08628	0.000394	0.00111	0.000021	0.00001	0.000018	0.000019	0.000025	8.04E-15	99.5%	12.0654	392.28 ± 3.37
102														
103														
104														
105														
106														
107														
108														
109														
110														
111														
112														

OK12-63 Muscovite (au28.5o.mus), 60/80#. Mississippian Stanley Group J = 0.00111024 ± 0.000006

#	40 V	±	39 V	±	38 V	±	37 V	±	36 V	±	Moles 40Ar	% Rad	R	Age (Ma)	
1	3.17096	0.001932	0.22549	0.000679	0.00306	0.000038	0.00000	0.000017	0.000105	0.000009	2.44E-14	99.0%	13.9247	445.80	± 1.43
2	1.86622	0.001658	0.15669	0.000568	0.00200	0.000031	-0.00003	0.000014	0.000028	0.000020	1.43E-14	99.6%	11.8577	386.20	± 1.91
3	0.70061	0.001242	0.05918	0.000236	0.00077	0.000028	-0.00001	0.000013	0.000053	0.000008	5.38E-15	97.8%	11.5728	377.82	± 2.16
4	0.81127	0.000976	0.06845	0.000206	0.00092	0.000033	-0.00003	0.000013	0.000034	0.000009	6.23E-15	98.8%	11.7044	381.69	± 1.78
5	0.56703	0.000963	0.04667	0.000195	0.00061	0.000023	-0.00003	0.000009	0.000031	0.000009	4.36E-15	98.4%	11.9546	389.04	± 2.50
6	1.20775	0.000847	0.09270	0.000254	0.00121	0.000028	-0.00002	0.000010	0.000068	0.000009	9.28E-15	98.3%	12.8114	413.94	± 1.52
7	0.78494	0.000697	0.06700	0.000328	0.00085	0.000027	0.00001	0.000013	0.000062	0.000010	6.03E-15	97.7%	11.4412	373.94	± 2.42
8	0.49299	0.000696	0.04165	0.000216	0.00052	0.000029	-0.00001	0.000010	0.000013	0.000011	3.79E-15	99.2%	11.7454	382.90	± 3.25
9	0.04914	0.000410	0.00464	0.000066	0.00006	0.000022	-0.00001	0.000012	0.000013	0.000011	3.77E-16	92.3%	9.7754	324.09	± 24.86
10	0.40896	0.001100	0.03347	0.000145	0.00042	0.000020	0.00001	0.000013	0.000005	0.000011	3.14E-15	99.6%	12.1715	395.37	± 3.74
11	1.13287	0.000715	0.09916	0.000455	0.00125	0.000023	0.00000	0.000012	0.000014	0.000011	8.70E-15	99.6%	11.3836	372.24	± 2.03
12	0.67499	0.000697	0.05033	0.000305	0.00068	0.000015	0.00001	0.000009	0.000063	0.000010	5.18E-15	97.2%	13.0422	420.60	± 3.25
13	0.62007	0.000828	0.05287	0.000273	0.00066	0.000025	-0.00001	0.000015	0.000017	0.000012	4.76E-15	99.2%	11.6343	379.63	± 2.95
14	1.06480	0.000805	0.08299	0.000219	0.00111	0.000026	-0.00004	0.000016	0.000071	0.000010	8.18E-15	98.0%	12.5768	407.16	± 1.62
15	0.93476	0.000927	0.07000	0.000280	0.00092	0.000031	-0.00003	0.000017	0.000030	0.000011	7.18E-15	99.1%	13.2289	425.96	± 2.28
16	2.83317	0.002225	0.19863	0.000394	0.00255	0.000030	0.00001	0.000012	0.000034	0.000011	2.18E-14	99.6%	14.2138	453.98	± 1.11
17	0.81593	0.001098	0.06972	0.000286	0.00091	0.000025	-0.00002	0.000009	0.000043	0.000010	6.27E-15	98.5%	11.5233	376.36	± 2.11
18	0.88532	0.001447	0.06988	0.000214	0.00090	0.000027	-0.00001	0.000016	0.000014	0.000011	6.80E-15	99.5%	12.6088	408.09	± 2.04
19	0.58789	0.000407	0.03988	0.000196	0.00052	0.000024	-0.00001	0.000013	0.000032	0.000010	4.52E-15	98.4%	14.5028	462.13	± 3.34
20	0.74500	0.000601	0.05713	0.000268	0.00073	0.000017	-0.00002	0.000012	0.000014	0.000010	5.72E-15	99.5%	12.9695	418.50	± 2.63
21	3.24857	0.002115	0.22791	0.000840	0.00287	0.000034	-0.00001	0.000015	0.000055	0.000010	2.50E-14	99.5%	14.1822	453.09	± 1.75
22	1.04537	0.000898	0.08736	0.000384	0.00111	0.000022	-0.00001	0.000010	0.000018	0.000011	8.03E-15	99.5%	11.9049	387.58	± 2.13
23	0.38831	0.000679	0.03211	0.000149	0.00041	0.000018	-0.00001	0.000011	0.000022	0.000010	2.98E-15	98.3%	11.8937	387.25	± 3.52
24	0.68157	0.000881	0.05410	0.000239	0.00071	0.000014	-0.00001	0.000009	0.000005	0.000010	5.24E-15	99.8%	12.5716	407.01	± 2.54
25	0.33967	0.000826	0.02820	0.000126	0.00035	0.000019	0.00000	0.000011	0.000030	0.000009	2.61E-15	97.4%	11.7363	382.63	± 3.68
26	0.50925	0.000790	0.04237	0.000163	0.00058	0.000012	-0.00002	0.000011	0.000008	0.000011	3.91E-15	99.6%	11.9648	389.33	± 2.92
27	0.87102	0.001028	0.07353	0.000230	0.00096	0.000023	0.00000	0.000015	0.000034	0.000010	6.69E-15	98.8%	11.7083	381.81	± 1.88
28	0.72684	0.000728	0.06285	0.000291	0.00083	0.000022	0.00001	0.000011	0.000023	0.000010	5.58E-15	99.1%	11.4556	374.37	± 2.35
29	0.22936	0.000276	0.01853	0.000090	0.00027	0.000031	0.00001	0.000012	0.000018	0.000010	1.76E-15	97.7%	12.0970	393.20	± 5.50
30	0.91362	0.001046	0.07443	0.000233	0.00101	0.000019	0.00002	0.000009	0.000081	0.000010	7.02E-15	97.4%	11.9555	389.06	± 1.89

31	2.54570	0.002607	0.20322	0.000216	0.00258	0.000035	0.00000	0.000013	-0.000002	0.000018	1.96E-14	100.0%	12.5268	405.71 ± 1.03
32	1.25713	0.001303	0.09650	0.000290	0.00120	0.000025	0.00001	0.000013	0.000047	0.000008	9.66E-15	98.9%	12.8848	416.06 ± 1.56
33	0.42774	0.000678	0.03563	0.000156	0.00043	0.000020	0.00000	0.000018	0.000022	0.000008	3.29E-15	98.5%	11.8243	385.22 ± 2.93
34	0.61432	0.001088	0.04984	0.000161	0.00064	0.000028	-0.00007	0.000024	0.000028	0.000009	4.72E-15	98.6%	12.1580	394.98 ± 2.27
35	0.63411	0.000879	0.05479	0.000296	0.00067	0.000022	-0.00001	0.000013	0.000034	0.000008	4.87E-15	98.4%	11.3900	372.43 ± 2.57
36	0.53469	0.000697	0.04462	0.000171	0.00056	0.000018	-0.00001	0.000009	0.000020	0.000010	4.11E-15	98.9%	11.8461	385.86 ± 2.61
37	0.36726	0.000525	0.03165	0.000149	0.00038	0.000024	-0.00001	0.000010	0.000019	0.000008	2.82E-15	98.5%	11.4260	373.50 ± 3.18
38	1.65342	0.001624	0.14509	0.000419	0.00183	0.000024	0.00000	0.000014	0.000061	0.000010	1.27E-14	98.9%	11.2721	368.94 ± 1.31
39	0.31245	0.000668	0.02326	0.000094	0.00028	0.000017	0.00001	0.000013	0.000026	0.000010	2.40E-15	97.5%	13.0941	422.09 ± 4.43
40	0.56242	0.000922	0.03271	0.000113	0.00045	0.000019	-0.00001	0.000009	0.000063	0.000009	4.32E-15	96.7%	16.6243	520.80 ± 3.27
41	0.42082	0.000619	0.03579	0.000156	0.00046	0.000021	0.00001	0.000015	0.000055	0.000009	3.23E-15	96.2%	11.3051	369.92 ± 3.00
42	2.42087	0.001727	0.21352	0.000425	0.00273	0.000036	0.00000	0.000011	0.000048	0.000008	1.86E-14	99.4%	11.2718	368.94 ± 0.87
43	0.32000	0.000408	0.02705	0.000102	0.00036	0.000027	0.00002	0.000010	-0.000004	0.000008	2.46E-15	100.4%	11.8287	385.34 ± 3.37
44	0.40206	0.000615	0.03478	0.000241	0.00043	0.000016	-0.00002	0.000017	0.000043	0.000008	3.09E-15	96.8%	11.1928	366.59 ± 3.55
45	1.17054	0.001151	0.10186	0.000402	0.00127	0.000030	-0.00002	0.000012	0.000027	0.000008	8.99E-15	99.3%	11.4120	373.08 ± 1.72
46	0.23805	0.000307	0.01921	0.000097	0.00023	0.000019	-0.00001	0.000022	0.000006	0.000008	1.83E-15	99.2%	12.2970	399.03 ± 4.48
47	0.87220	0.001080	0.06255	0.000127	0.00079	0.000021	0.00000	0.000017	0.000023	0.000009	6.70E-15	99.2%	13.8368	443.31 ± 1.72
48	2.23027	0.001322	0.18539	0.000578	0.00249	0.000049	-0.00003	0.000016	0.000070	0.000008	1.71E-14	99.1%	11.9183	387.97 ± 1.31
49	0.40700	0.000634	0.02762	0.000114	0.00034	0.000020	-0.00001	0.000012	0.000016	0.000009	3.13E-15	98.8%	14.5577	463.67 ± 3.72
50	2.78477	0.000880	0.09807	0.000329	0.00131	0.000029	-0.00002	0.000012	0.000038	0.000008	2.14E-14	99.6%	28.2786	812.94 ± 2.84
51	2.39179	0.001923	0.18643	0.000297	0.00232	0.000038	-0.00002	0.000019	0.000077	0.000008	1.84E-14	99.1%	12.7082	410.96 ± 0.84
52	1.50685	0.001210	0.12537	0.000195	0.00156	0.000039	0.00002	0.000015	0.000052	0.000009	1.16E-14	99.0%	11.8975	387.36 ± 0.98
53	0.79407	0.000615	0.06574	0.000298	0.00086	0.000032	0.00001	0.000014	0.000058	0.000009	6.10E-15	97.8%	11.8169	385.00 ± 2.28
54	0.88293	0.001251	0.06256	0.000269	0.00081	0.000026	0.00000	0.000009	0.000155	0.000012	6.78E-15	94.8%	13.3791	430.26 ± 2.71
55	2.50334	0.001633	0.20172	0.000557	0.00260	0.000032	0.00002	0.000012	0.000057	0.000011	1.92E-14	99.3%	12.3264	399.89 ± 1.26
56	0.65792	0.001243	0.04443	0.000166	0.00056	0.000024	-0.00002	0.000011	0.000027	0.000009	5.05E-15	98.8%	14.6284	465.66 ± 2.77
57	0.58105	0.000938	0.04199	0.000303	0.00050	0.000012	-0.00003	0.000015	0.000038	0.000009	4.46E-15	98.1%	13.5721	435.77 ± 3.87
58	2.02542	0.001881	0.16342	0.000733	0.00200	0.000031	0.00002	0.000011	0.000068	0.000008	1.56E-14	99.0%	12.2716	398.29 ± 1.90
59	0.56650	0.000422	0.05245	0.000274	0.00064	0.000017	0.00001	0.000018	0.000038	0.000009	4.35E-15	98.0%	10.5853	348.50 ± 2.55
60	3.92459	0.002533	0.30229	0.000891	0.00379	0.000043	0.00002	0.000010	0.000083	0.000008	3.01E-14	99.4%	12.9013	416.54 ± 1.29
61	2.75980	0.002065	0.08652	0.000357	0.00110	0.000011	0.00000	0.000009	0.000069	0.000009	2.12E-14	99.3%	31.6608	889.57 ± 3.86
62	1.76186	0.001428	0.15061	0.000287	0.00187	0.000029	0.00000	0.000010	0.000030	0.000008	1.35E-14	99.5%	11.6393	379.78 ± 0.95

63	2.04112	0.001616	0.17551	0.000499	0.00217	0.000030	-0.00002	0.000018	0.000011	0.000009	1.57E-14	99.8%	11.6105	378.93 ± 1.23
64	0.80617	0.000771	0.06350	0.000135	0.00075	0.000021	0.00000	0.000014	0.000015	0.000010	6.19E-15	99.5%	12.6256	408.57 ± 1.73
65	1.05670	0.003107	0.08598	0.000435	0.00098	0.000021	0.00000	0.000011	-0.000060	0.000074	8.12E-15	101.7%	12.2897	398.82 ± 8.59
66	0.38382	0.000556	0.02709	0.000156	0.00034	0.000030	0.00007	0.000019	-0.000016	0.000009	2.95E-15	101.2%	14.1666	452.65 ± 4.12
67	2.56448	0.002686	0.22145	0.000632	0.00284	0.000030	0.00001	0.000011	0.000025	0.000011	1.97E-14	99.7%	11.5471	377.07 ± 1.25
68	0.72783	0.000586	0.04722	0.000213	0.00070	0.000019	0.00002	0.000013	0.000313	0.000008	5.59E-15	87.3%	13.4531	432.38 ± 2.85
69	4.52991	0.003233	0.36243	0.000736	0.00454	0.000044	0.00003	0.000015	0.000074	0.000010	3.48E-14	99.5%	12.4382	403.14 ± 0.91
70	1.97150	0.001479	0.15858	0.000622	0.00199	0.000036	0.00000	0.000016	0.000022	0.000008	1.51E-14	99.7%	12.3921	401.80 ± 1.69
71	1.75366	0.001356	0.14100	0.000261	0.00178	0.000029	0.00000	0.000011	0.000082	0.000011	1.35E-14	98.6%	12.2663	398.14 ± 1.11
72	1.97257	0.001704	0.15931	0.000535	0.00202	0.000045	-0.00001	0.000012	0.000024	0.000009	1.52E-14	99.6%	12.3367	400.19 ± 1.50
73	0.57759	0.000641	0.05062	0.000364	0.00065	0.000021	0.00001	0.000013	-0.000011	0.000009	4.44E-15	100.6%	11.4100	373.02 ± 3.25
74	0.75468	0.001321	0.06580	0.000236	0.00084	0.000029	0.00002	0.000007	-0.000017	0.000009	5.80E-15	100.7%	11.4690	374.76 ± 2.02
75	1.24203	0.001147	0.10367	0.000237	0.00133	0.000034	0.00001	0.000011	0.000050	0.000009	9.54E-15	98.8%	11.8372	385.59 ± 1.30
76	0.54114	0.000874	0.04500	0.000146	0.00060	0.000026	0.00002	0.000015	0.000016	0.000007	4.16E-15	99.1%	11.9187	387.98 ± 2.13
77	1.67985	0.001451	0.14574	0.000297	0.00187	0.000025	0.00001	0.000010	0.000020	0.000008	1.29E-14	99.7%	11.4859	375.26 ± 0.98
78	2.74816	0.001504	0.20650	0.000519	0.00274	0.000045	0.00003	0.000009	0.000031	0.000008	2.11E-14	99.7%	13.2636	426.95 ± 1.17
79	1.29463	0.000822	0.08905	0.000253	0.00116	0.000029	0.00002	0.000016	0.000031	0.000009	9.94E-15	99.3%	14.4348	460.22 ± 1.66
80	3.22167	0.001115	0.25567	0.000631	0.00322	0.000033	0.00003	0.000010	0.000103	0.000009	2.47E-14	99.1%	12.4823	404.42 ± 1.08
81	1.44082	0.001102	0.10059	0.000412	0.00142	0.000032	0.00001	0.000014	0.000020	0.000008	1.11E-14	99.6%	14.2658	455.45 ± 2.06
82	1.63948	0.001572	0.12409	0.000305	0.00155	0.000031	0.00000	0.000012	0.000025	0.000010	1.26E-14	99.5%	13.1523	423.76 ± 1.34
83	1.21641	0.000867	0.08554	0.000286	0.00112	0.000033	0.00001	0.000011	0.000021	0.000010	9.34E-15	99.5%	14.1481	452.13 ± 1.89
84	0.63251	0.001003	0.05356	0.000228	0.00071	0.000020	0.00002	0.000016	0.000025	0.000010	4.86E-15	98.8%	11.6734	380.78 ± 2.55
85	2.26190	0.001624	0.15746	0.000403	0.00213	0.000036	0.00003	0.000010	0.000041	0.000011	1.74E-14	99.5%	14.2883	456.09 ± 1.40
86	2.62413	0.001760	0.21092	0.000480	0.00259	0.000034	-0.00001	0.000009	0.000014	0.000013	2.02E-14	99.8%	12.4220	402.67 ± 1.13
87	0.48571	0.000602	0.02972	0.000157	0.00046	0.000021	0.00000	0.000013	0.000495	0.000012	3.73E-15	69.9%	11.4246	373.45 ± 5.05
88	1.58287	0.000993	0.14215	0.000413	0.00182	0.000036	0.00001	0.000016	0.000050	0.000017	1.22E-14	99.1%	11.0312	361.80 ± 1.58
89	0.66561	0.000863	0.05740	0.000271	0.00072	0.000018	0.00002	0.000008	0.000021	0.000009	5.11E-15	99.1%	11.4877	375.32 ± 2.41
90	1.35004	0.001242	0.11828	0.000379	0.00151	0.000025	0.00002	0.000012	0.000002	0.000016	1.04E-14	99.9%	11.4081	372.97 ± 1.78
91	3.09634	0.002652	0.21370	0.000792	0.00266	0.000036	0.00002	0.000014	0.000032	0.000010	2.38E-14	99.7%	14.4450	460.50 ± 1.81
92	1.01910	0.001167	0.08553	0.000311	0.00108	0.000027	0.00001	0.000009	0.000039	0.000010	7.83E-15	98.9%	11.7814	383.96 ± 1.88
93	0.53001	0.000480	0.04350	0.000237	0.00057	0.000023	0.00001	0.000017	0.000028	0.000009	4.07E-15	98.4%	11.9959	390.24 ± 2.99
94	1.22937	0.001191	0.10406	0.000290	0.00133	0.000030	0.00001	0.000010	0.000025	0.000010	9.44E-15	99.4%	11.7427	382.82 ± 1.46

95	1.59304	0.001253	0.11549	0.000304	0.00148	0.000024	0.00001	0.000014	0.000007	0.000010	1.22E-14	99.9%	13.7768	441.60 ± 1.47
96	0.85383	0.000996	0.07204	0.000146	0.00092	0.000036	0.00007	0.000020	0.000016	0.000010	6.56E-15	99.4%	11.7863	384.10 ± 1.56
97	0.84119	0.001077	0.06908	0.000388	0.00088	0.000017	-0.00002	0.000014	0.000035	0.000009	6.46E-15	98.8%	12.0262	391.13 ± 2.63
98	2.03341	0.000879	0.14664	0.000367	0.00188	0.000032	-0.00002	0.000014	0.000030	0.000010	1.56E-14	99.6%	13.8060	442.43 ± 1.30
99	0.59962	0.000656	0.04440	0.000243	0.00060	0.000013	-0.00004	0.000007	0.000021	0.000009	4.61E-15	99.0%	13.3648	429.85 ± 3.05
100	1.30063	0.001175	0.11290	0.000404	0.00143	0.000027	-0.00003	0.000014	0.000058	0.000009	9.99E-15	98.7%	11.3691	371.81 ± 1.60
101	0.72527	0.001207	0.05841	0.000233	0.00080	0.000034	-0.00001	0.000015	0.000106	0.000010	5.57E-15	95.7%	11.8794	386.83 ± 2.35
102	1.62812	0.001944	0.04956	0.000217	0.00065	0.000021	-0.00001	0.000013	0.000098	0.000010	1.25E-14	98.2%	32.2694	903.02 ± 4.50
103	0.56987	0.000749	0.04991	0.000181	0.00060	0.000019	-0.00004	0.000016	0.000011	0.000013	4.38E-15	99.4%	11.3508	371.27 ± 2.95
104	0.92400	0.000553	0.07428	0.000190	0.00093	0.000032	-0.00002	0.000008	0.000033	0.000009	7.10E-15	98.9%	12.3077	399.34 ± 1.61
105	1.09926	0.001134	0.08844	0.000380	0.00111	0.000026	-0.00002	0.000012	0.000016	0.000009	8.44E-15	99.6%	12.3749	401.30 ± 2.04
106	1.79088	0.000702	0.12343	0.000310	0.00161	0.000035	-0.00004	0.000014	0.000014	0.000009	1.38E-14	99.8%	14.4753	461.36 ± 1.37
107	2.04680	0.001730	0.13949	0.000301	0.00180	0.000030	-0.00002	0.000013	0.000024	0.000018	1.57E-14	99.7%	14.6232	465.51 ± 1.62
108	1.26067	0.000880	0.08501	0.000359	0.00109	0.000023	-0.00004	0.000007	0.000010	0.000015	9.68E-15	99.8%	14.7964	470.36 ± 2.60
109	0.46823	0.000522	0.02732	0.000151	0.00040	0.000022	-0.00004	0.000019	0.000194	0.000010	3.60E-15	87.8%	15.0465	477.35 ± 4.58
110	1.31949	0.001681	0.11039	0.000403	0.00143	0.000039	-0.00001	0.000012	0.000026	0.000011	1.01E-14	99.4%	11.8847	386.99 ± 1.77
111	1.28838	0.001190	0.10190	0.000339	0.00131	0.000028	-0.00001	0.000015	0.000014	0.000012	9.90E-15	99.7%	12.6023	407.90 ± 1.78
112	0.95256	0.000893	0.08113	0.000394	0.00101	0.000018	0.00000	0.000010	0.000008	0.000010	7.32E-15	99.8%	11.7131	381.95 ± 2.21