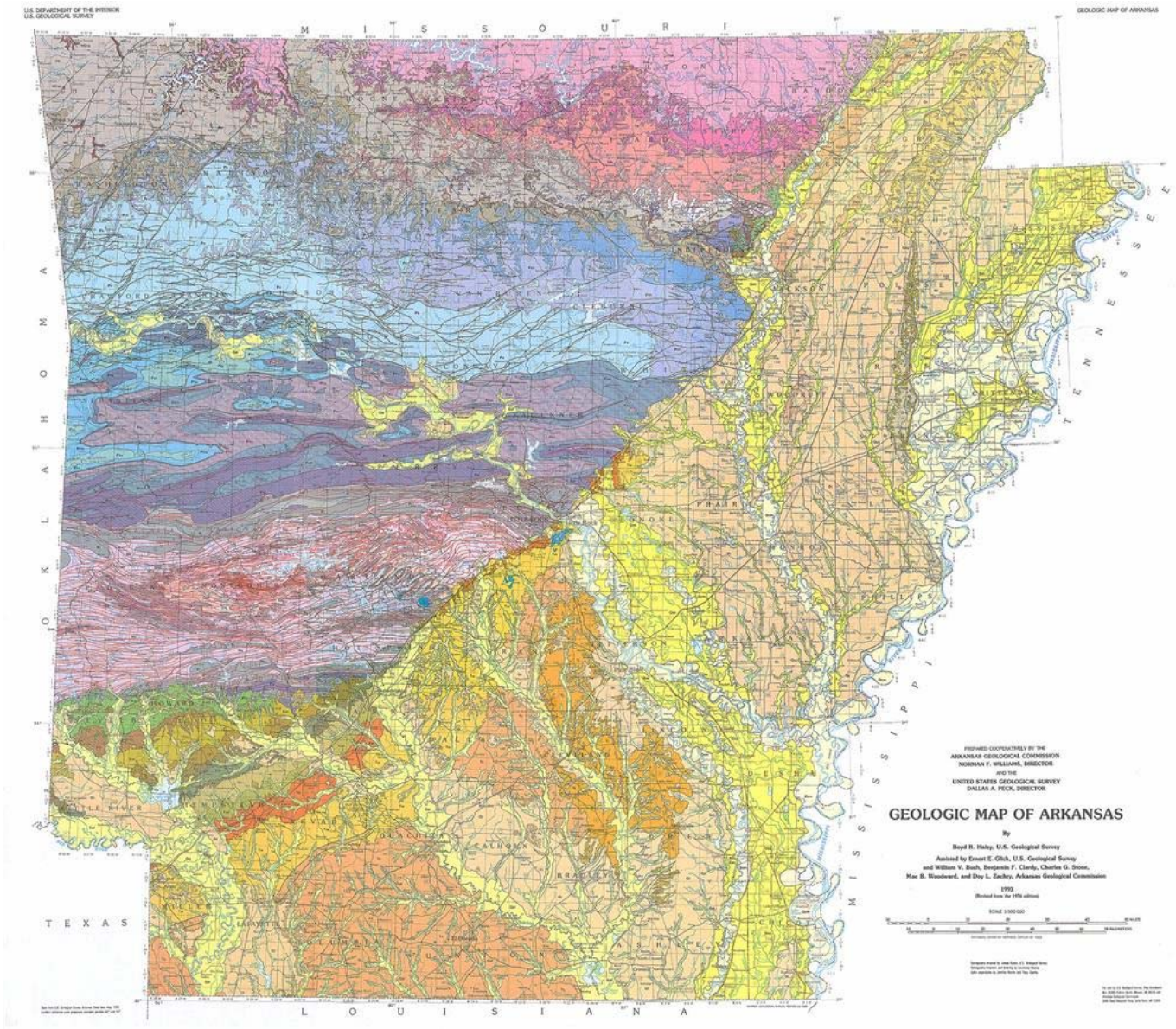
BUFFALO RIVER GUIDE no. 2

AN AMATEUR'S REVIEW OF OUTDOOR TOPICS
FOR THE
2005
T254 OZARK CANOE EXPEDITION

GEOLOGY OF THE BUFFALO RIVER AREA



Geology of Arkansas

Rocks are generally placed into 1 of 3 major categories: igneous, metamorphic, or sedimentary. Igneous rocks have solidified from molten or partly molten mineral matter. Metamorphic rocks have been altered in the solid state from some pre-existing condition in response to significant changes in temperature, pressure, or chemical environment. Sedimentary rocks are composed of particles of sediment, which are derived by the weathering and/or the erosion of pre-existing rock. Most superficial rocks in Arkansas are sedimentary, but there are some igneous rocks (with adjacent contact metamorphic rocks) and very low grade regional metamorphic rocks in Arkansas also.

A sedimentary rock consists of two components: the particles and the cement that holds them together. However, the unconsolidated sediments of eastern Arkansas are considered sedimentary rocks. Sedimentary rocks are classified as clastic (rocks made up of grains of sand, silt, and clay) or chemical (rocks made up of shell fragments, saline water deposits, and other materials that are deposited from solution). The most common clastic sedimentary rocks are shales, siltstones, and sandstones. The most common chemical sedimentary rocks are limestone and dolostone.

To understand how sedimentary rocks form, we must account for the processes that create the original particles of sediment, the mechanisms of sediment transport, the processes of deposition or precipitation of a given sediment, and what has happened to the sediment over time. By studying rocks and depositional systems (the processes by which sediments are deposited), geologists recognize that most of the sedimentary rocks in the Paleozoic Highlands of Arkansas are marine. In the southern and eastern parts of the state, the sedimentary deposits are predominantly fluvial (fresh-water processes).

The exposures of igneous rocks in Arkansas are less than 0.1 percent of the entire area of the state. Most are exposed over 15 square miles, principally in Pulaski, Saline, Hot Spring, Garland, and Pike Counties. A few small igneous dikes and sills are present outside the Ouachita region, mostly in the Arkansas Valley, and in at least one case, in the Boston Mountains. Except for some localized contact metamorphism adjacent to the larger igneous intrusions, only very low grade metamorphic rocks are present in the state.

Arkansas is divided into a highland area in the northwest and a lowland region in the south and east. The rocks in the highland area are dominated by well-lithified sandstones, shales, limestones, and dolostones of Paleozoic age. A thin drape of younger unconsolidated clays, sands, and gravel, termed alluvium, is often found in valley floors and associated with the streams and rivers. The sedimentary deposits of the lowlands are mainly unconsolidated clay, sand, and gravel of Quaternary age, poorly consolidated deposits of clay, sand, silt, limestone, and lignite of Tertiary age, and consolidated (to a limited extent) deposits of Cretaceous marl, chalk, limestone, sand, and gravel (see **Geologic Map of Arkansas**).

When most of the sediments that compose the rocks in the highland region of Arkansas were being deposited, north Arkansas was a shallow south-sloping sea floor (continental shelf), the Arkansas River Valley was near the edge of the shelf, and the Ouachita area was a deep abyssal plain (see **General Geologic History**). An abyssal plain is the relatively smooth and deep (more than 3,000 feet below sea level) parts of the ocean floor where accumulating sediments have buried the pre-existing topography. In the late Paleozoic Era, a broad uplift domed the Ozark strata with little structural disruption. Simultaneously, a collision of two of the earth's mobile continental plates compressed the sediments of the abyssal plain into the Ouachita Mountains. This multimillion-year-long process folded and faulted the Ouachita strata into a structurally complex mountain chain. The Arkansas River Valley area is the transition zone between the structurally simple Ozarks and the structurally complex Ouachitas with subdued characteristics in each region.

Today, the rocks of the Ozarks tilt slightly to the south and have a dendritic drainage pattern. Since shales and siltstones erode faster than sandstones and limestones, the basic topography is flat-topped mountains with stepped flanks. By contrast, the topographic expression of the Ouachitas is controlled not only by the erosional resistance of the rocks, but also by their internal structure. The strata are complexly folded and frequently faulted. The mountains are mostly east-west-trending ridges supported by erosionally resistant rocks and separated by less resistant rocks. The Arkansas River Valley is characterized by much less intensely folded and faulted strata than the Ouachita region. Erosional processes left the synclines as mountains and the anticlines as valleys.

The rocks and sediments of the Mississippi River Alluvial Plain and West Gulf Coastal Plain (both in the south and east portion of the state) are much younger than those of the Interior Highlands. The Cretaceous-age rocks of southwest Arkansas were deposited in and along the margin of a shallow sea. The

Tertiary-age materials of southern Arkansas represent marginal marine conditions, both on- and off-shore deposits. The unconsolidated Quaternary sediments of eastern Arkansas were deposited by water released during the interglacial phases of the Ice Age. Crowley's Ridge is an isolated erosional remnant carved by rivers, possibly with structural control from ancient seismic activity. Significant deposits of wind-blown dust (loess) were also deposited across Arkansas during the Quaternary.

Arkansas' rocks, minerals, fossils, fossil fuels, and its water resources resulted from prolonged episodes of deposition, mountain building, and erosion. The interaction of these and other processes was variable throughout Arkansas. Long-term changes in climate were also significant,

Modified from AGC Bulletin 24: Mineral, Fossil-Fuel, and Water Resources of Arkansas, 1997

BUFFALO RIVER - NATURE & SCIENCE

Geologic Activity

Physical time travel to the past is still in the realm of science fiction, but a float trip down the Buffalo River can take you back to ancient times when the Ozarks were being formed and shaped. The Ozarks are commonly referred to as the Ozark Physiographic region. The Ozarks are generally not considered true mountains by geologists because they did not form from compressive folding or block faulting. Instead, the Ozarks topography was formed on a doming up of Precambrian basement rock. These basement rocks are mostly granites, but there are some basalts and rhyolites. They are exposed at the surface in the St. Francios mountains in southeast Missouri and can be seen at places such as Johnson Shut-In's and Elephant Rocks State Parks. The Ozark Plateau is composed chiefly of shallow marine limestones, dolomites, sandstones and shales from the Paleozoic era. It is generally characterized by karst topography with many caves, sinkholes, losing streams and springs. The plateau can be subdivided into four subunits. The St. Francois Mountains, in southeast Missouri, which consist of Pre-Cambrian igneous basement rocks. The Salem Plateau dolomites, limestones, and sandstones, ranging in age from Cambrian to Silurian, form the first ring around the igneous core. The Springfield Plateau limestones of Mississippian and Devonian age form the second ring. The Boston Mountains sandstones, limestones, and shales of Mississippian and Pennsylvanian ages form a high escarpment on the southern edge of the area. Along the course of the Buffalo River, the Salem and Springfield Plateaus are generally not well developed. This is because of the steep and heavy dissection of the area by the river and tributary springs. Some areas of the watershed have good examples of the Springfield Plateau. Most notably, this can be seen around Marble Falls, St. Joe, and Big Flat. The best example of the Salem Plateau in the area is between Yellville and Cotter.

The Buffalo River source is in the Boston Mountains at an elevation of approximately 2400 feet above mean sea level. From here, it flows northerly for nearly twenty miles (32 km) in a narrow canyon like course until it reaches the broad, flat-floored Boxley Valley. Boxley Valley is formed in the Mississippian Boone limestone. The Boone is the premier cave forming strata in Arkansas. Nearly all of the state's largest and most complex cave systems are found in this unit. After flowing another eight miles in Boxley Valley, the waters of Buffalo River first encounter the Ordovician strata of the Everton formation, near the town of Ponca. These rocks tend to be more resistant to erosion than the Boone

limestone, and once again the river takes on more of a canyon like morphology. The bluffs in this section of the river are among the highest in the central highlands of the United States. The river continues to flow through pre-Mississippian rocks, except for some short stretches near Sneed's Creek and Pruitt for the next forty-eight miles until it once again encounters rocks from the Boone formation near Richland Creek. Once again the river valley becomes broad and flat-bottomed. There are still spectacular bluffs on the outside of bends on this section. A couple of miles above the town of Gilbert, after flowing for seventeen miles through the Mississippian strata, the waters once again carve into Silurian and Ordovician rocks. The Buffalo River finishes its traverse to the White River at 400 feet above mean sea level mostly in these older strata.

The bluffs which line the outside of bends on the Buffalo River offer a chance to look at various rock strata which cover a time period of over two hundred million years. There are many interesting features in this section. There are several faults alongside the river and some nice unconformity surfaces. Ancient sinkholes, algal stromatolites, and orthocone cephalopod fossils can be seen in the Ordovician and Silurian formations. Crinoids, Blastoids, and many other shallow marine fossils are abundant in the Mississippian limestones. Plant fossils can be seen in some of the Pennsylvanian formations. The various colors of stains running down the bluffs make the river especially scenic. Any float trip down the Buffalo River can be a very rewarding experience for those interested in geology.