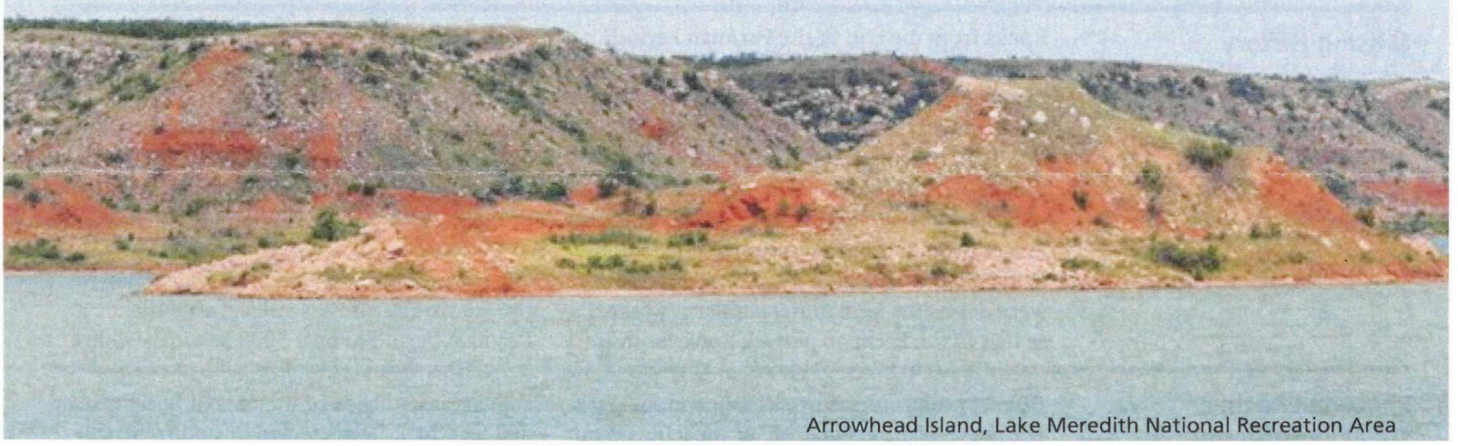
Lake Meredith Alibates Flint Quarries

National Park Service
U.S. Department of the Interior

Lake Meredith National Recreation Area
Alibates Flint Quarries National Monument

Geology of Lake Meredith and Alibates Flint Quarries



Arrowhead Island, Lake Meredith National Recreation Area

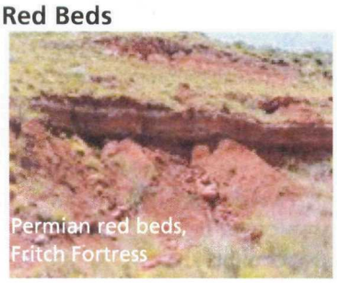
Lake Meredith National Recreation Area and Alibates Flint Quarries National Monument are located in the Texas Panhandle along the rugged Canadian River Breaks. Millions of years of erosion have carved a series of canyons, mesas, and draws through a landscape of relatively flat plains. The rocks revealed in these two National Park Service units capture a story nearly 300 million years in the making.

Permian Period:

The exposed geology of these parks date back to the beginning of the Permian Period, around 290 million years ago, which is older than the dinosaurs. Rocks from the Permian Period make up the Quartermaster Formation. Older rocks are not exposed in either park.

As the Permian Period progressed, the Earth underwent numerous changes in climate, which produced several different rock deposits. Throughout this period, the Texas Panhandle was close to an interior seaway.

Red Beds

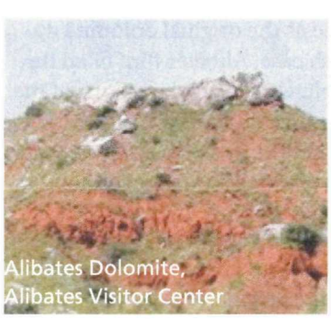


Permian red beds, Fritch Fortress

In colder periods, polar ice caps grew larger. Receding water brought this area above sea-level. Rivers and streams dominated the region. Meandering across the Texas Panhandle, they lost energy and deposited hundreds of feet of shale, sandstone, and mudstone. These rocks can be seen throughout both parks as the Permian red beds. These "Beds" get their red coloration from the metallic minerals in the rocks which have rusted. These rocks are relatively soft and can erode away one grain at a time from rain and flash flooding. Horizontal beds/ribbons of white-gray colored rocks deposited within the red beds are ash from distant volcanoes, and clays brought to the area from hurricanes.

Similar to making a cake, the first or oldest layers are found on the bottom, with younger layers above them. This oldest layer of geologic cake is found at the base and sides of the Canadian River Breaks.

Dolomite



Alibates Dolomite, Alibates Visitor Center

Our next layer of geologic cake records warming temperatures around the Earth during the late Permian, around 260 million years ago. This warming melted ice in the Polar Regions, causing the oceans to rise and placing this area below sea-level. This transition can be observed in the thinner layer of Alibates Dolomite, a gray colored rock found on the mesa tops throughout both parks. Dolomite is formed from the organic material (plankton, shelled animals, algae, corals) in the shallow sea. This sea stretched from the Arctic Ocean near Alaska, covering the interior of Canada and the United States before connecting to the Pacific Ocean in Mexico. Organisms that created the dolomite can be preserved as fossils within the rock. Due to its hardness, the dolomite resists erosion. This acts as a "caprock" and slows the erosion of the softer red beds, resulting in the rugged mesas around Lake Meredith and Alibates Flint Quarries. When the underlying rock eventually erodes, removing the support for the dolomite, the dolomite fractures into the numerous white boulders that are found on the sides of mesas throughout both parks.

Gypsum

Gypsum, Plum Creek

Sea-levels fluctuated as the climate changed many times throughout the Permian Period. When sea-levels dropped during colder periods, saltwater was trapped in low lying basins. As water evaporated in the basin, salt and organic material was left behind. Over time, this material would form beds of Gypsum within the Permian red beds. Outcrops can be found at Dolomite Point and Plum Creek.

Today, when water flows over these gypsum layers, salt can dissolve from the rock and be carried with the flowing water. If you have ever wondered why the Canadian River has a salty taste, it is due to gypsum beds that the river has traveled through in Texas and New Mexico. When these gypsum beds dissolve in water, the rocks above can collapse into these new voids, creating chimneys and depressions on the surface.

Fossils and Petrified Wood

Fossilized Algae, Quarries Tour

Fossils are a fantastic resource to geologists as they help uncover what the conditions were millions of years ago.

Within the dolomite, thin layers of fossilized algae can be observed. Algae today needs sunlight to carry out photosynthesis for survival, these 260 million year old algae needed the sun as well. Knowing this, geologists can assume that the saltwater, where the dolomite formed, must have been shallow or the algae would not have received enough sunlight to survive. Other clues are the fossilized coral polyps, also found in shallow waters.

Petrified wood can be found along the Canadian River in the Southwest section of Lake Meredith NRA. They are found in Triassic rocks that geologists have been able to link with petrified wood from the Chinle Formation of Petrified Forest National Park in Arizona.

Missing History

?

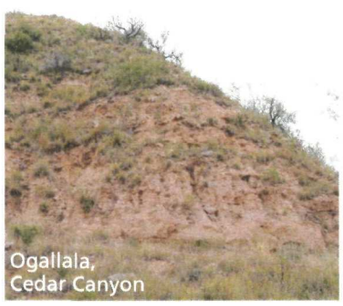
Rocks from the end of the Permian Period until about 12 million years ago are not found in most areas of Lake Meredith or anywhere in Alibates Flint Quarries. What happened?

This is known as an unconformity, where a section of the geologic history of the area is no longer present. Imagine trying to read a book with chapters that have been removed. Rocks were deposited here under similar processes as that of the Permian period, however those rocks were later removed by millions of years of erosion, erasing the history from our parks.

To find rocks from the ages of dinosaurs, the Triassic Period, you must travel to the southwest section of Lake Meredith NRA or outside of the park.

What we do know is that forces have caused the area to rise above sea-level after the Permian Period to over 3000 feet in elevation.

Pliocene Epoch: Ogallala Formation



Ogallala, Cedar Canyon

Some of the youngest rocks found at the parks are the Ogallala Formation, or the icing on our cake. They are composed of rounded river rocks and sediments ranging from sand-sized to larger than your hand. They originated from the Rocky Mountains of Colorado and New Mexico from 12 – 2 million years ago. The formation covered portions of the great plains, extending from central Texas to southern South Dakota. The Ogallala covered the Permian rocks of the Texas Panhandle like a layer of icing, burying the older layers. The rocks filled in old valleys and covered hills. In some areas, outside of the park, it became over 500 feet thick. This created an aquifer which has been utilized for drinking water for parts of the Texas Panhandle.

Some of these rounded river rocks would later be used by Indigenous people as tools for the excavation and shaping of Alibates Flint. Fossils can be found within the Ogallala Formation of numerous animals including; mammoths, turtles, fish, insects, petrified wood, bison, and other mammals.

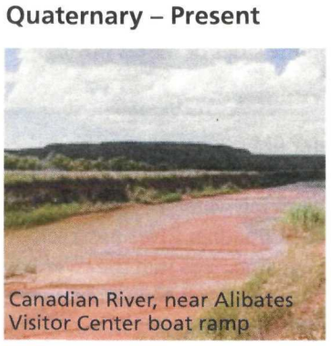
Alibates Flint

Alibates flint shards, Quarries tour

Visible quartz crystals and flint

Alibates Flint has caught the attention of people for thousands of years. You can find the flint at the tops of mesas within both parks. The flint is known as agatized dolomite, or chert, where the minerals in the dolomite have been replaced with quartz crystals from silica-rich water. The quartz crystals are so small that even with a microscope you can't see the individual crystals. This is one of the reasons why Alibates Flint is so hard, harder than steel. Where there are cracks or voids in the dolomite, the quartz crystals grew larger. While some people find this beautiful, the larger crystals make poor quality flint for stone tools. This is why most rocks found today surrounding the quarries have visible crystals in them. Indigenous people broke off the "garbage" and took the best quality stones. The variety of colors and layering in the flint is due to the trace elements and minerals found in the original dolomite. The silica-rich water can even turn fossils, found in the dolomite, into Alibates flint. But where did the silica-rich water come from? There are many theories, but this remains a geologic mystery. There are three primary theories. One, an eruption of the Yellowstone super-volcano around 675,000 years ago provided a silica in ash. A three-foot bed of Yellowstone ash can be found in several locations around Lake Meredith. When rain fell onto the ash, it could dissolve some of the ash into a silica-rich solution. A second theory is that a silica rich material was brought here during the Ogallala Formation. A third possibility is that Alibates Flint formed at the same time as the original dolomite was forming. In each case, Alibates flint filled the cracks or completely replaced portions of the dolomite. The process is complex and requires near-perfect conditions, which is why Alibates Flint only formed along a small section of the Canadian River Breaks.

Quaternary – Present



Canadian River, near Alibates Visitor Center boat ramp

Around 2.6 million years ago, the last Ice Age began. The Ice Age brought high-moisture to the area, giving more energy to local rivers. Instead of the rivers meandering and dropping sediments, they carved through the rocks forming canyons. The Canadian River has carved out more than 200 feet of rock creating the Canadian River Breaks. Numerous side canyons and mesas (breaks) were carved out of the underlying Permian rock as high-volumes of water cut its way to the main canyon and river valley.

Lake Meredith was created by the Sanford Dam to utilize this extensive canyon system to supply drinking water for eleven cities including Amarillo and Lubbock.

Geology is not something that only occurred in the past. Geologic processes are constant forces that continue to change the landscape today. Sand and mud are brought in by the Canadian River. Winds can carry sand from miles away and remove rock one grain at a time. Erosion causes sections of hills and rocks to slump, continuing to form an ever rugged and changing landscape.