

## RED RIVER GORGE GEOLOGY

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The geologic story of the Red River Gorge area began over 300 million years ago during the Carboniferous Period of the Paleozoic Era. Paleozoic sediments that eroded from the ancestral Appalachian Mountains located to north and east in Pennsylvania were transported by rivers flowing south into eastern Kentucky where these rivers emptied into a shallow sea. Here, during a portion of the Carboniferous Period called the Pennsylvanian Age, a river delta plain was formed. Layer upon layer of quartz sand and gravel sediments built up in this delta plain and eventually formed a thick deposit. Over time this thick deposit of quartz sand and gravel became consolidated and cemented into a quartzose sandstone that has been designated by geologists as the Corbin Sandstone Member of the Lee Formation.

But the formation of the Corbin Sandstone is just the beginning of the Red River Gorge geologic story. The entire Eastern Kentucky area was uplifted to form the Cumberland Plateau. This uplifting resulted in an extensive vertical fracturing of the Corbin Sandstone. As the uplifted plateau was subjected to weathering and erosion, clifflines formed along the vertical fractures. In many places the crisscross pattern of these fractures results in a saw tooth cliff outline of alternating dihedrals and arêtes that is very conducive to climbing. In several places this pattern of fracturing has also resulted in free standing pinnacles.

Outcroppings of Corbin Sandstone extend in a southwesterly direction from just south of Interstate 64 near Morehead, Kentucky all the way to the Tennessee border. It is estimated that there is a little over 3,000 miles of cliffline within Daniel Boone National Forest alone. This is one of the things that make this area unique in the world for climbing. There exists literally lifetimes of possibilities for the exploration of new crags and the development of new routes. Here the "Golden Age" of climbing never seems to end.

The texture of the Corbin Sandstone varies from fine to coarse grain and sometimes contains quartz pebbles in layers of sandstone conglomerate. Dependent on the grain size and the amount of cementation the quality of the rock varies widely. In many places the rock is solid, featureless, and thus un-climbable. The upper part of the Corbin Sandstone especially tends to be of the solid and featureless variety except where dissected by crack systems. This is why a majority of routes at the Red do not top out. In other places the cliffline contains vertical bands of sandy, chossy, breakdown where only the grunge climber dares. The best rock exists between the extremes of solid smooth and sandy choss where the effects of weathering have created ideal features for climbing.

Where the Corbin Sandstone is fine grained and strongly cemented the rock has a limestone like quality. Though true solution features are rare, the Undertow Wall at the Motherlode exhibits tufa like formations. More common is a slightly coarser grained stone where differential weathering creates pockets and other features. An important aspect of this weathering is the effect of ground water percolation and mineralization. The high iron content of the Corbin sediments is what imparts the cliffs with their orangish hues. As ground water percolates down through the rock it dissolves and then subsequently precipitates this iron and other minerals such as manganese. The tendency is for mineral precipitation to occur in thin layers of finer

grained sediments resulting in the common dark burgundy to black edges or where softer material above has weathered away, dark vertical plates. The precipitation of minerals also creates a harder patina at the cliff face that after differential weathering results in the creation of vertical plates. Through a geologic process called Liesegang weathering, mineralization and precipitation has resulted in the creation of iron oxide tubes. These may exist as a single dark ring or multiple concentric rings and depending on which angle they intersect with the cliff face form radical slopers or crimps.

Lastly, weathering of softer bedrock at the base of the Corbin Sandstone has resulted in the creation of overhangs and rock shelters. It is routes on this wildly overhanging rock that drew the attention of the world rock climbing community to the area. But don't be fooled into the misperception that hard rock climbing at the Red consists of nothing but overhanging jug hauls. Mother Nature's combination of fracturing and weathering provides one of the widest variations of climbs anywhere, from desperate technical face climbs to splitter roof cracks and manky off widths.