Capitol Rock

Montana Geology 2014

Montana Bureau of Mines and Geology

January

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Capitol Rock, one of ten National Natural Landmarks in Montana, was named for its resemblance to the U.S. Capitol Building. It is located in the Long Pine Hills in Custer National Forest, 30 miles southeast of the town of Ekalaka and 2 miles west of the Montana–South Dakota border (fig. 1).

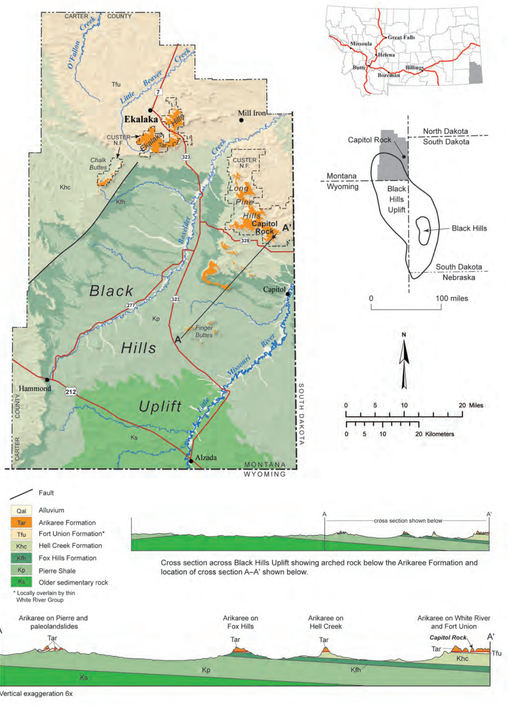

Figure 1. Geologic map and cross section, southeastern Montana. Diagrammatic cross section A–A' (cut-away view into earth along line A–A' on map) shows sedimentary beds below the Arikaree Formation (Tar) arched by the Black Hills Uplift. Red line indicates the erosional unconformity that separates horizontal Arikaree Formation from underlying tilted beds.

Native People

In 1982, a Paleo-Indian site was discovered by U.S. Bureau of Land Management archeologists near Mill Iron, Montana (fig. 1), just north of the Long Pine Hills where Capitol Rock is located. The artifacts from the site establish that native people in the area developed tools and were bison hunters 11,000 years ago. Subsequently the Crow, Northern Cheyenne, Mandan/Hiatsa, and Lakota Sioux lived in the area at different times.

Capitol, Montana

The community of Capitol, originally named Capitol Rock, is located 9 miles south of the landmark, where the Little Missouri River crosses the Montana–South Dakota border. U.S. military expeditions reported grizzly bears along that part of the Little Missouri River in the late 1860s, as well as numerous Indian trails and Sioux burial scaffolds. The area was settled in the 1880s, primarily by Norwegian immigrants who farmed and ranched there. The settlers met with several severe winters, but the winter of 1886–1887 was disastrous. Temperatures fell to below -40°F, and snow was persistently 4–5 feet deep. Cattle starved and froze. Famed western artist Charlie Russell memorialized the devastation in his painting "Waiting for a Chinook" (fig. 2). Many people in the region died or left the area, but despite this hardship the community persisted. The Capitol post office and elementary school were established in 1891 and functioned for decades. The post office closed in 1982, after 91 years of serving the community, and only two of the town buildings remain today.

Figure 2. Waiting for a Chinook (The Last of 5000), Charles M. Russell, Watercolor, 1887. Used with permission from the Montana Stockgrowers Association, Helena, Montana, L1953.01.01.

Southeastern Montana Fossils

Professor Elmer Riggs of the Chicago Field Museum brought a fossil-collecting party to the area in 1904. They excavated a *Triceratops* skull from about 5 miles west of Chalk Buttes (fig. 1) from the Cretaceous Hell Creek Formation. The spectacular fossil was prepared and exhibited. Many paleontologists subsequently visited the area, and many local people became amateur paleontologists as a result of the discovery. Walter Peck, one of the local residents, found another *Triceratops* skull in the mid 1930s, a few miles to the west of the 1904 site. In 1939 he collected a duck-billed dinosaur *Anatosaurus (Trachodon)*, and in 1940 he collected the skull of a previously unknown bonehead dinosaur. It was sent to the American Museum of Natural History in New York City where it was prepared, studied, and named *Pachycephalosaurus*. In 1941 Walter Peck and Dr. David Dunkle of the Cleveland Museum of Natural History collected a skull of a carnivorous dinosaur just south of the Long Pine Hills (fig. 1), not far from the Capitol Rock area. It turned out to be a new species and was named *Gorgosarus lancensis*. It is exhibited at the Cleveland Museum of Natural History.

Many other fossils have been collected from southeastern Montana, including numerous types of snails, clams, and ammonites from the marine Cretaceous Pierre Shale. Fossil lobsters and crabs have also been found in the Pierre Shale in southeastern Montana. Fragments of a saber-toothed cat skull from the Oligocene (Tertiary) White River Group were found on the west side of the Long Pine Hills, and a beaver jaw was found in the Arikaree Formation in the Chalk Buttes. The fossil jaw is now at the American Museum of Natural History. These are just a few of the many fossils that have been found in the area. Interest in the fossils led to the development of a local Geology Club in 1934.

Carter County Museum

In 1936, the Geology Club was incorporated as the Carter County Geological Society "to discover, excavate, and preserve fossils, fossil bones, and human artifacts; to advance the science of archaeology and paleontology; to collect and preserve objects of historic, artistic and scientific interest." For decades these collections, including early dinosaur discoveries, were housed in the basement of Ekalaka High School. Partly through the efforts of Walter Peck, a State Senator and avid collector, the Montana Legislature passed a bill authorizing counties to levy up to $500,000 for the acquisition and support of historical and scientific museums. As a result, the historical and paleontological collections were given to Carter County and became the Carter County Museum, the first county museum in Montana. Walter Peck was the first Carter County Museum Director, succeeded by Marshall Lambert. Under Lambert's directorship, the collections were moved from the high school to a 1926 fireproof stone building in the 1970s, which allowed rare specimens to stay in southeastern Montana. The Carter County Museum is now one of 13 museums on the Montana Dinosaur Trail; one of the rare specimens on exhibit at the museum today is a duck-billed *Hadrosaur*, one of only five in the country (fig. 3). Although an amateur paleontologist, Marshall Lambert became so respected by the scientific community that in 1993 the Marshall Lambert Symposium was held in his honor. In 1996 he received the Harrell L. Strimple Award presented by the Society of Vertebrate Paleontology, one of the leading paleontological societies in the U.S.

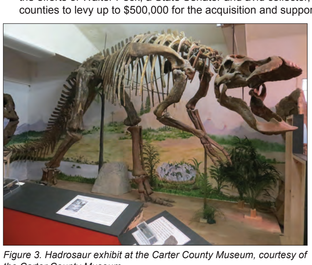

Figure 3. Hadrosaur exhibit at the Carter County Museum, courtesy of the Carter County Museum.

Geology

Most of Capitol Rock is the Arikaree Formation, which in Montana is only found in the southeastern part of the State. It is a light-colored, volcanic-ash-rich sandstone or quartzite, deposited millions of years after the dinosaur extinction. Its resistance to erosion left it as a caprock that preserved the underlying rock in the Long Pine Hills, Ekalaka Hills, Finger Buttes, and other scattered hills and buttes in southeastern Montana (fig. 1). Many springs emerge from below the Arikaree Formation, supporting the tree growth in this part of Montana where trees are otherwise sparse—this formation may be the reason that we have Custer National Forest in southeastern Montana. The Arikaree Formation contains abundant erionite, a zeolite mineral. Research is underway to determine if fibers from the Arikaree Formation erionite pose a health hazard similar to the inhalation hazard from some types of asbestos.

Capitol Rock displays nearly horizontal sedimentary beds typical of much of eastern Montana. However, in many nearby areas the sedimentary beds below the Arikaree Formation dip steeply—even vertically—in sharp contrast to the typical horizontal beds (fig. 4). The first geologist to report on the unusual steeply dipping beds in the late 1800s concluded that they were tectonic fault blocks. By 1923, however, another geologist observed that beds below the steeply dipping beds were only slightly tilted, and the overlying Arikaree Formation was always flat-lying. Based on this observation he correctly interpreted the steeply dipping beds as ancient landslides. Only the rocks involved in these ancient landslides dip steeply, because they were tilted by the rotation of the landslide blocks. The overlying Arikaree Formation is horizontal, because it was deposited later (fig. 4).

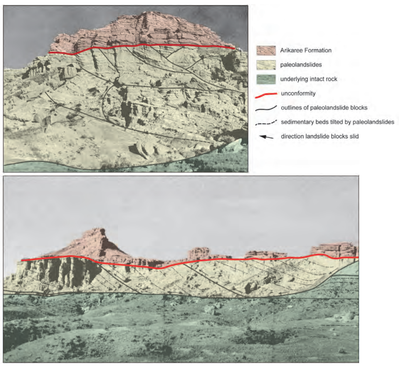

Figure 4. Fossil landslide deposits overlain by the Arikaree Formation in the Finger Buttes (Gill, 1962).

Hundreds of these ancient landslides have been identified in southeastern Montana and northwestern South Dakota. In Montana most of the landslides are in the Long Pine Hills (the location of Capitol Rock) and nearby Finger Buttes to the southwest (fig. 1). The age of the landslides is bracketed between the age of the youngest rocks tilted in the slumps, and the age of undisturbed Arikaree Formation that overlies them horizontally. The landslides in Long Pine Hills and Finger Buttes are probably Oligocene (about 25–30 million years old). Sufficient topographic relief must have existed for landslides to form, perhaps similar to that of the Long Pine Hills today, and numerous earthquakes may have trigged the landslides.

Earthquakes indicate pulses of earth movement, and the rocks provide evidence that this part of southeastern Montana experienced uplift centered in the Black Hills area of South Dakota during the Tertiary Period. The Black Hills uplift extended into Montana, arching the geologic units into a broad, gentle fold (fig. 1). Near the most pronounced part of the arch in Montana, the Arikaree Formation rests on the Cretaceous Pierre Formation. Away from the center of the arch, the Arikaree Formation rests on successively younger units including the Cretaceous Fox Hills and Hell Creek Formations, the Paleocene (Tertiary) Fort Union Formation, and the Oligocene (Tertiary) White River Group. This indicates that the underlying units, uplifted in the arch, were beveled by erosion prior to deposition of the Arikaree Formation. The relation between the flat-lying Arikaree Formation (fig. 5) and the underlying rocks that were arched and eroded is called an angular unconformity. Angular unconformities also exist between older Tertiary and Cretaceous rocks in the area, indicating earlier movement on the Black Hills uplift, but the most pronounced angular unconformity exposed in southeastern Montana is at the base of the Arikaree Formation.

The Arikareean North American Land Mammal age was named for the fossil mammals in the Arikaree Formation. These mammals include camels, rhinos, three-toed horses, hippo-like and deer-like animals, horned rodents, and carnivores, including saber-toothed cats and beardogs. Many of these types of Arikareean mammals likely inhabited southeastern Montana, but the only mammal fossils found in the limited exposures of the Arikaree Formation in Montana are from a beaver and a primitive horse.

Although the Arikaree Formation once blanketed the area, all that is left of it in southeastern Montana are remnants that cap scattered buttes, including the picturesque Capitol Rock.

Figure 5. Capitol Rock showing horizontal Arikaree Formation. Photo courtesy of Mariah Leuschen, Custer and Gallatin National Forests, R1, U.S. Forest Service.

Acknowledgments

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Sources

Arguimbau, E., Baumler, E., Porsild, C., and Shovers, B., 2009, Montana place names from Alzada to Zortman: Helena, Montana, Montana Historical Society Press, 350 p.

Bauer, C.M., 1924, The Ekalaka lignite field, southeastern Montana: U.S. Geological Survey Bulletin 751-F, p. 231–267.

Carter County Museum, http://cartercountymuseum.org/ [Accessed 8-15-13]

Castleberry, V., 1978, Carter County area, *in* Carter County Geological Society, Shifting Scenes, v. 1: Billings, Artcraft Printers, p. 125–128.

Denson, N.M., Bachman, G.O., and Zeller, H.D., 1959, Uranium-bearing lignite in northwestern South Dakota and adjacent states, *in* Uranium in coal in the western United States: U.S. Geological Survey Bulletin 1055, p. 11–57.

Denson, N.M., and Gill, J.R., 1965, Uranium-bearing lignite and carbonaceous shale in the southwestern part of the Williston Basin—A regional study: U.S. Geological Survey Professional Paper 463, 75 p.

Gill, J.R., 1962, Tertiary landslides, northwestern South Dakota and southeastern Montana: Geological Society of America Bulletin, v. 73, p. 725–736.

Holland, F.D., Jr., and Hartman, J.H., 1996, Presentation of the Harrell L. Strimple Award of the Paleontological Society to Marshall E. Lambert: Journal of Paleontology, v. 70, p. 708–709.

Kihm, A.J., and Hartman, J.H., 1993, eds., The Marshall Lambert Symposium, contributions and road log: North Dakota Geological Society, 88 p.

Lambert, M.E., 1978a, Marshall E. Lambert, an autobiography, *in* Carter County Geological Society, Shifting Scenes, v. 1: Billings, Artcraft Printers, p. 814–816.

Lambert, M.E., 1978b, Southeastern Montana—The fossil story, *in* Carter County Geological Society, Shifting Scenes, v. 2: Billings, Artcraft Printers, p. 814–816.

Lambert, M.E., 1978c, Carter County Museum, *in* Carter County Geological Society, Shifting Scenes, v. 2: Billings, Artcraft Printers, p. 816.

Lee, B., and Williams, D., 1964, Last Grass Frontier: The South Dakota stock growers heritage: Sturgis, South Dakota, Black Hills Publishers, *in* Gangloff, D., Trail drives and roundups: The western South Dakota cattle industry, the closing of the open range, and the roundup of 1902: Mountains of History 2.0, Teaching American History through the Black Hills, http://moh.tie.net/content/research/default.htm [Accessed 8-15-13]

Melum, B.K., and I.K., 1978, Our Life, *in* Carter County Geological Society, Shifting Scenes, v. 2: Billings, Artcraft Printers, p. 566–567.

Montana Dinosaur Trail, http://mtdinotrail.org/ [Accessed 8-15-13]

Prothero, D.R., 2006, After the Dinosaurs—The age of Mammals: Bloomington and Indianapolis, Indiana University Press, 362 p.

Triplett, J., Saini-Eidukat, B., Feit, S., and Dolezal, D., 2010, Identification and characterization of fibrous zeolites in western North Dakota: Institute on Lake Superior Geology Proceedings, 56th Annual Meeting, International Falls, Minnesota, v. 56, part 1, p. 65–66.

Vuke, S.M., Wilde, E.M., Bergantino, R.N., and Colton, R.B., 2001, Geologic map of the Ekalaka 30' x 60' quadrangle, eastern Montana and adjacent North and South Dakota: Montana Bureau of Mines and Geology Open-File Report 430, 11 p., 1 sheet, scale 1:100,000.

Vuke, S.M., Wilde, E.M., Bergantino, R.N., and Colton, R.B., 2001, Geologic map of the Alzada 30' x 60' quadrangle, eastern Montana: Montana Bureau of Mines and Geology Open-File Report 433, 9 p., 1 sheet, scale 1:100,000.

Wood, H.E., 1945, Late Miocene beaver from southeastern Montana: American Museum Novitates, no. 1299.

Montana Bureau of Mines and Geology

Montana Tech of The University of Montana

Scope and Organization

The Montana Bureau of Mines and Geology (MBMG) was established in 1919 as a non-regulatory public service and research agency for the State of Montana, to conduct and publish investigations of Montana geology, including mineral and fuel resources, geologic mapping, and groundwater quality and quantity. In accordance with the enabling act, the MBMG conducts research and provides information.

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