



Welcome to the Mill Canyon Dinosaur Tracksite

The Mill Canyon Dinosaur Tracksite contains a diverse assemblage of fossilized tracks. More than 200 individual tracks have been discovered, including tracks from long-necked herbivorous dinosaurs, several types of carnivorous dinosaurs (including sickle-clawed "raptors"), and crocodiles. This site is one of the largest and most diverse tracksites known from the Early Cretaceous time period in North America.



Representation of the Mill Canyon Dinosaur Tracksite 112 million years ago. Original art by Brian Engh.

The **interpretive trail** is $\frac{1}{4}$ mile in length and is composed of a series of marked paths and boardwalks that form a loop around the tracksite. From the kiosk, take the marked trail down a hill and through a fence, and continue along the trail. Follow the trail from sign to sign. The tracks are fragile and can be damaged by walking on the track surface. **Please stay on the trail at all times!**



Acknowledgments to Our Scientific Partners and Sponsors

- University of Colorado at Denver
- Utah Friends of Paleontology
- National Research Institute of Cultural Heritage, Korea
- Moab Giants
- Canyonlands Natural History Association
- Topper Family Trust
- Moab Trail Mix

Translations of the onsite signs are available in Chinese, Dutch, French, German, Japanese, Navajo, and Spanish at www.blm.gov/ut/st/en/fo/moab/recreation/hiking_trails/millcanyon.html, the Moab Information Center, and the Moab Field Office.

Donations may be made in the tube to your right. All donations will go directly to the Moab Field Office Paleontology Program, which maintains this and other paleontology trails within the field office. Thank you for your visit and contribution.





Mill Canyon Dinosaur Tracksite

Site Stewardship

Dinosaur footprints are a natural, irreplaceable part of America's heritage. Please treat these resources with respect. Dinosaur footprints are protected under federal law by the Paleontological Resources Preservation Act of 2009. It is illegal to remove any fossilized vertebrate footprint, bone, or tooth from public lands or to mold, cast, or trace these fossils without a scientific research permit. Carving, collecting, defacing, or altering any of these tracks is also illegal and results in a loss to all people. Please report any of these actions to a Bureau of Land Management (BLM) ranger or other local authority. Contact the BLM Moab Field Office at (435) 259-2100.

Leave No Trace

Please avoid walking directly on the track-bearing surface at all times, as these fossils are very fragile. Hike only on established trails, on rock where designated, or in washes. Pack out and recycle your trash. Clean up after less thoughtful visitors.

The Dirt is Alive!

A living plant community called "biological soil crust" covers much of this area. Composed of algae, lichen, and bacteria, this crust provides a secure foundation for desert plants. Please stay on roads and trails to avoid trampling this important resource.

How You Can Help

If you find dinosaur fossils (footprints, bones, or teeth):

- Leave them in place.
- Document the fossils with photos and a GPS reading, if possible, so that they can be found by land managers and scientists.
- Take notes about the area—what the rocks look like, any distinguishing landmarks, proximity to roads, and other useful information.
- Contact the appropriate public land management agency (BLM, National Park Service, U.S. Forest Service, state land agency, etc.) or local museum.
- Do not make replicas, tracings, molds, or casts. These activities can damage the fossils.

The BLM has started the Canyon Country Site Stewardship Program. Volunteers monitor this site and others like it in the BLM Canyon Country District. For more information about this program, please contact the BLM Moab Field Office.

Contact Information

- BLM Moab Field Office,
82 East Dogwood, Moab, Utah 84532, (435) 259-2100
- Grand County Sheriff's Office,
25 South 100 East, Moab, Utah 84532, (435) 259-8115

Visit other dinosaur tracksites and trails on BLM lands within the Moab Field Office. Driving directions and maps can be obtained on the field office website, at the BLM Moab Field Office (82 East Dogwood, Moab, Utah 84532), or through the Moab Information Center (25 E. Center St., Moab, Utah 84532).



Dinosaur Trackways and Trails, Moab Field Office, BLM



Environment

Approximately 112 million years ago, the area where you are now standing was a mud flat where a shallow lake was drying up. The mud flat was covered by a 1-foot-thick layer of lime mud, and the mud was covered by a mat of algae. The algae formed when the mud flat was still under water. The bumps on the surface of the track layer are petrified colonies of algae. Slide marks on the track layer show that animals sometimes slid on the soft mud of the flat. A dinosaur coprolite (fossilized dung) with pieces of leaves in it was found on the track layer. From this discovery, we know that land plants grew near the lake. Seed ferns and conifers were common land plants at this time in geologic history. Fossilized tracks and traces show that this area was visited by a diverse array of dinosaurs, reptiles, birds, and mammals.

How is this Site Unique?

Many of the dinosaur tracksites in the Moab region are preserved in the Jurassic sandstones exposed in the area. At these other sites, only one or two types of animal tracks often are found preserved at any single location. The Mill Canyon Dinosaur Tracksite is Lower Cretaceous in age and represents a different environmental setting than the nearby Jurassic Period sites. This site also contains as many

Never pour anything into tracks. The resulting damage can stain or even destroy the tracks.



Fact: The two-toed dromaeosaur "raptor" tracks (above) were primarily known from South Korea and China before they were found at this site. These are some of the first trackways of this type found in North America! Unfortunately, this very unique track has been permanently damaged by an illegal attempt to make a copy, or mold, of it.



Original art by Mark Witton.

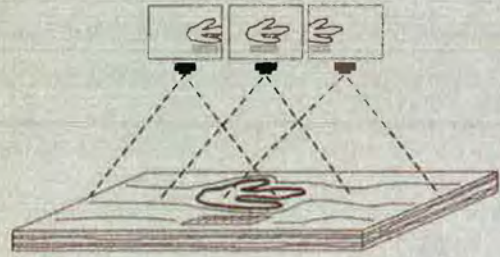
as 10 different kinds of tracks, or "ichnotaxa," representing dinosaurian, crocodilian, and avian track makers. Several of these tracks are either new to North America or are from animals not currently known to science from skeletal fossils in this area.

Why is this Site Important?

This site is the largest and most diverse tracksite known in the Cedar Mountain Formation. Collaborative research efforts indicate that the Mill Canyon Dinosaur Tracksite is one of the most significant Early Cretaceous tracksites in the world. As research continues at this and other sites, new interpretations will come to light to help us better understand the life and times of the Early Cretaceous dinosaurs of eastern Utah.



Mapping the Site



State-of-the-art technology, known as photogrammetry, was used at the Mill Canyon Dinosaur Tracksite to obtain a detailed three-dimensional (3D) image set. While researchers were investigating the site, a high-resolution digital camera was mounted on a monopod, and a remote trigger was used to take overlapping photos of the track-bearing surface. More than 1,000 photos were used to make a digital 3D reconstruction of the surface and an image map of the tracksite. This map was used to record the dinosaur footprints and other traces, and it is being used for management and interpretation of the site.

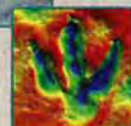
Photo Image Map of a Portion of the Mill Canyon Dinosaur Tracksite

You are here ►

Fun Fact: Paleontologists use image maps to help distinguish trackways that may be hard to follow on the ground. How many trackways can you see in the image to the right?



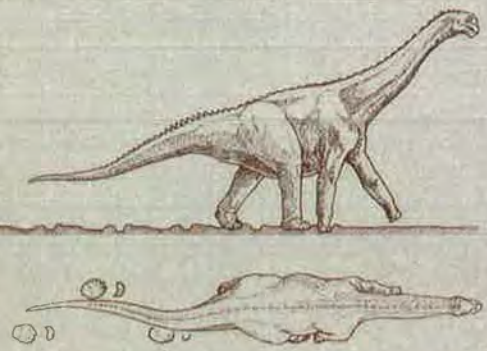
Fun Fact: Photogrammetry is the science of making measurements from photographs and is a non-invasive method of capturing detailed 3D information about a subject without directly touching it. The technique requires a series of overlapping or stereoscopic images and reference points of known length for scale.



In addition to the photo image map, 3D data from photogrammetry may be used to make topographic contour maps and color depth maps of individual tracks, trackways, or the entire track-bearing surface.



How Were the Tracks Made?



A layer of lime mud with a mat of algae on it is a very good surface for making tracks if it is moist but not saturated with water. The mud and the algal mat at the Mill Canyon Dinosaur Tracksite were in this condition when the animals walked on it, leaving well-formed tracks.

After some of the tracks were made, thin layers of pebbly sand and silt were deposited on top of the algal mat. Sauropod dinosaurs walked on the sand and mud, pressing pebbles into the algal mat and making additional tracks on it.

The tracks were not all made at the same time or even on the same day, so the track makers may not have encountered one another on the mud flat. Additional layers of sediment were deposited on the sand and mud, burying the tracks for millions of years. During this time, ground water flowed through the track layer and hardened it by replacing the lime with silica. In modern times, the site became exposed again in this dry wash. The tracks at this site were first reported to the BLM in 2009, and research began at the site in 2010.



*These images show tracks being made over time, with different animals leaving footprints on top of other, previously made tracks.
Original art by Jeff Martz.*



What Tracks Tell Us

The tracks you are viewing at the Mill Canyon Dinosaur Tracksite are a type of trace fossil—a record of the active movements and behaviors of ancient organisms.

At this site, evidence includes traces of dinosaurs, crocodiles, and birds. The study of trace fossils is known as ichnology.

Tracks are important as they often preserve information about the animal that cannot always be obtained from their bones and teeth, such as:

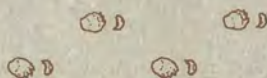
- The general type of animal
- The approximate size of the animal
- How fast it was moving
- How it walked and its gait patterns
- Which direction it was going
- Activity patterns
- Information about the ecology and environment



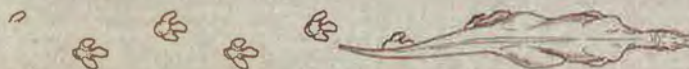
Please stay on the trail at all times. Also, please do not collect rocks or pieces of the track surface; take photos to remember your visit.



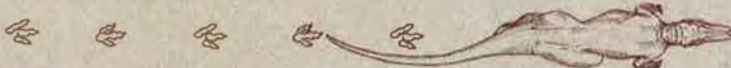
Brontopodus



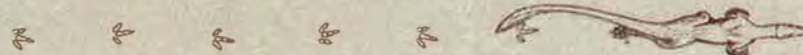
Caririchnium-like



Irenesauripus



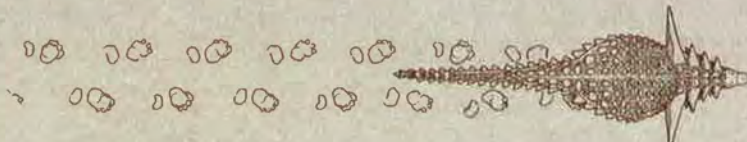
Carmelopodus-like



Dromaeosauripus

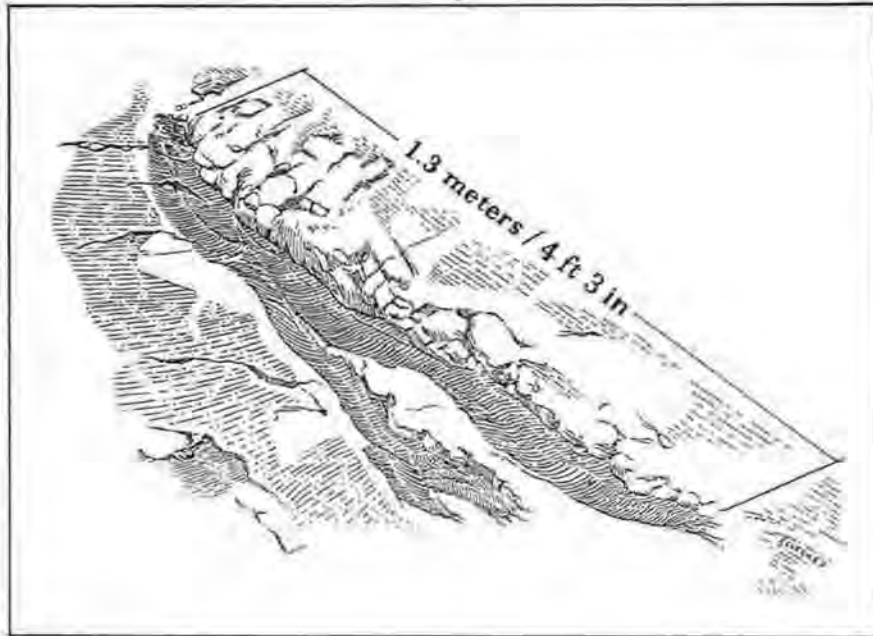
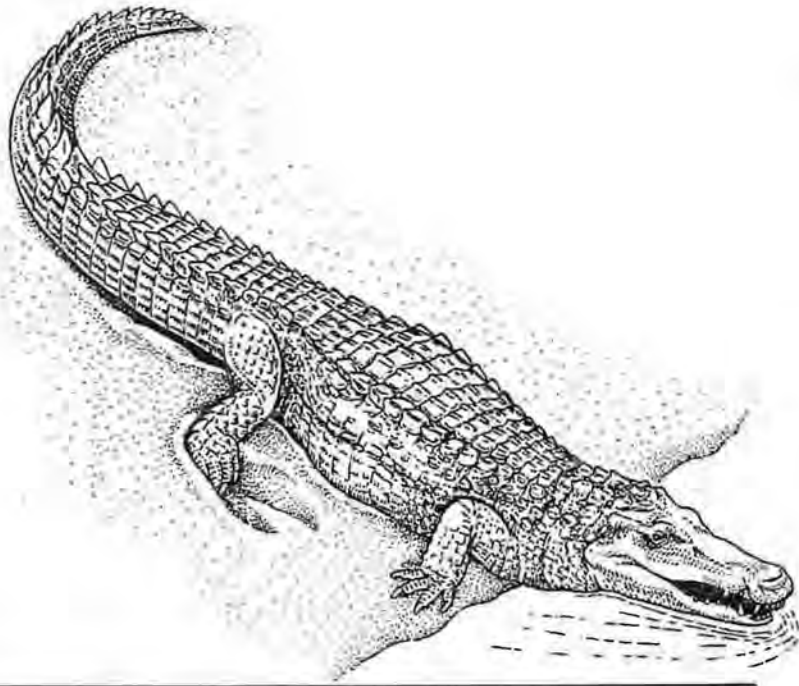


Tetrapodosaurus-like



Art by Matt Celleskey

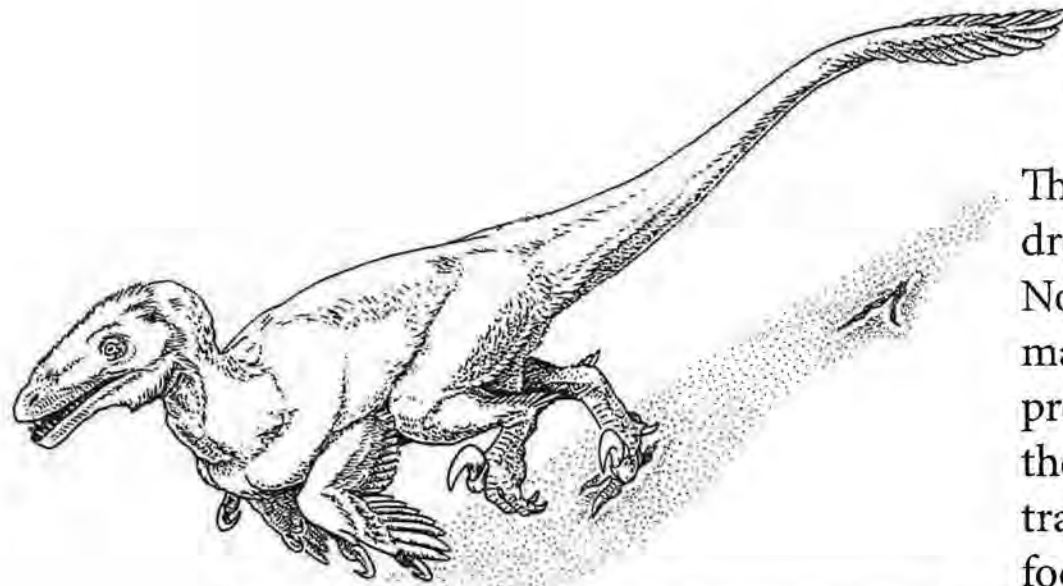
CROCODILE SLIDE



The odd-shaped trace before you may be an impression made by a crocodile sliding on its belly into shallow water, leaving at least one footprint, and possibly belly and tail slide marks behind. Such traces are also found just south of Moab in the Morrison Formation, so this would not be an unexpected trace here. Crocodiles were relatively common in the late Jurassic through the late Cretaceous periods in western North America. What does this tell us about the climate during the age of dinosaurs? Think about where crocodiles and alligators live today and imagine the Mississippi delta environment existing through Utah and up to Alberta. What an amazing place this must have been!

Name of Track: *Hatcherichnus*-like trace
Early Cretaceous (~112 million years ago)
Cedar Mountain Formation





DROMAEOSAUR TRACKS

The tracks in front of you are the first dromaeosaur tracks that have been found in North America! This short trackway was made by a dromaeosaurid theropod, probably a large *Deinonychus*. Notice that there are only two toes preserved in each track; this is because the inner toe on each foot (digit II) possessed a huge sickle claw and was held up off the ground as the animal walked. This dromaeosaur's tracks are 8.7 inches long and indicate an animal just under 4 feet tall at the hip.



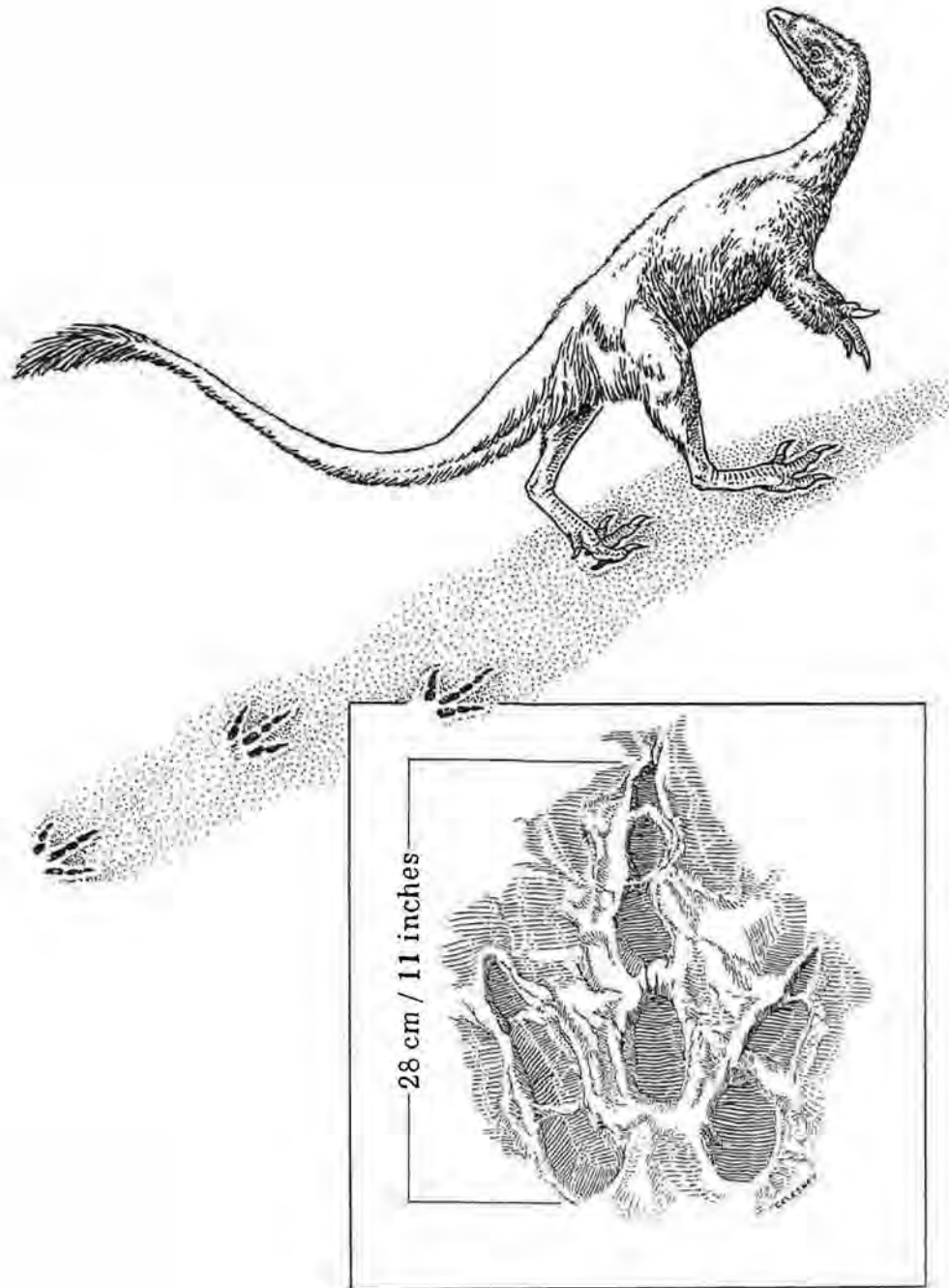
Name of Track: *Dromaeosauripus*
Early Cretaceous (~112 million years ago)
Cedar Mountain Formation

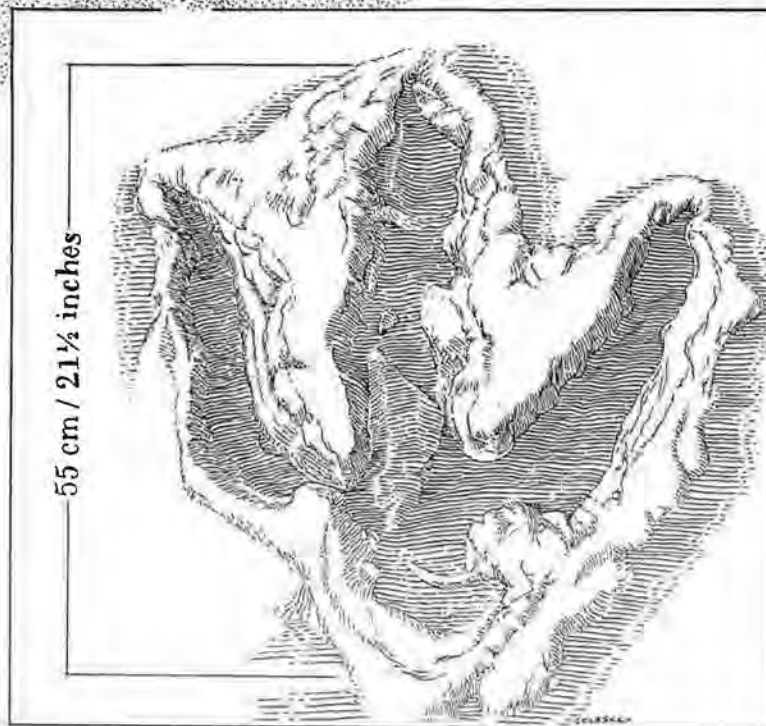
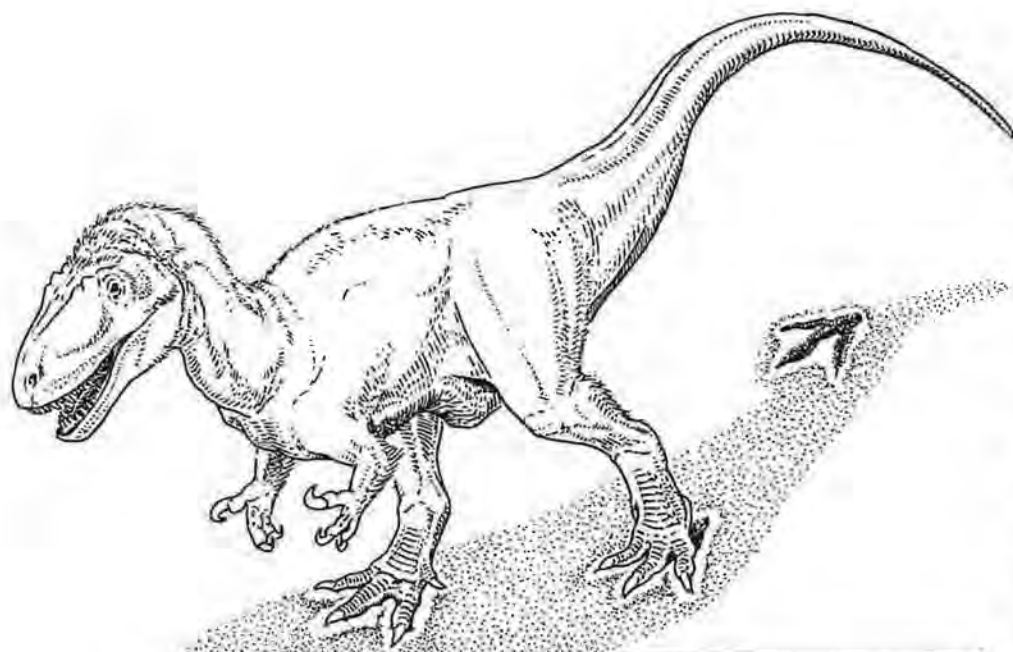


MEDIUM-SIZE THEROPOD TRACKS

The trackway in front of you is that of a medium-sized carnivorous dinosaur. Similar tracks have also been found in Wyoming. The tracks here are about 7-14 inches long and are from a dinosaur that was about 6 feet tall at the hip. We do not know exactly what kind of dinosaur made these tracks (there are several of this size and foot morphology in the Cedar Mountain Formation), but one possibility is the relatively mid-sized theropods like Ornithomimids.

Name of Track: *Carmelopodus*-like
Early Cretaceous (~112 million years ago)
Cedar Mountain Formation





LARGE THEROPOD TRACKS

The large, well-preserved tracks in front of you are the beginning of a 17-step track-way of a very large, carnivorous dinosaur. Tracks of a similar dinosaur have also been found in central Texas. The tracks here are about 16-20 inches long and are from a dinosaur that was at least 8 feet tall at the hip. The intriguing thing about these tracks is that they indicate the presence of a very large dinosaur for which we currently have no skeletal evidence. A very large meat-eater remains to be found out there.

Name of Track: *Irenesauripus*
Early Cretaceous (~112 million years ago)
Cedar Mountain Formation



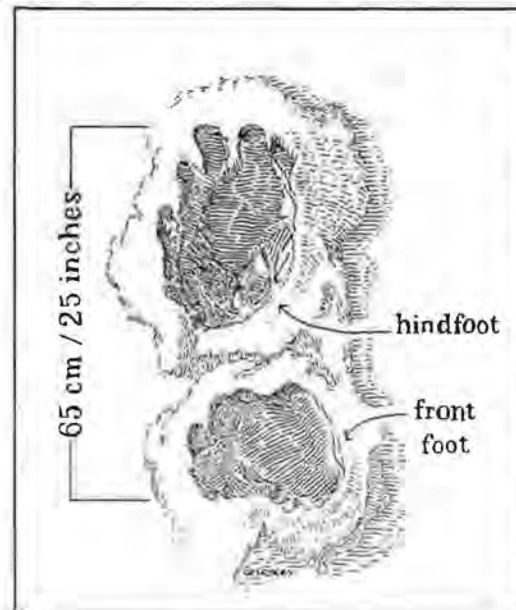
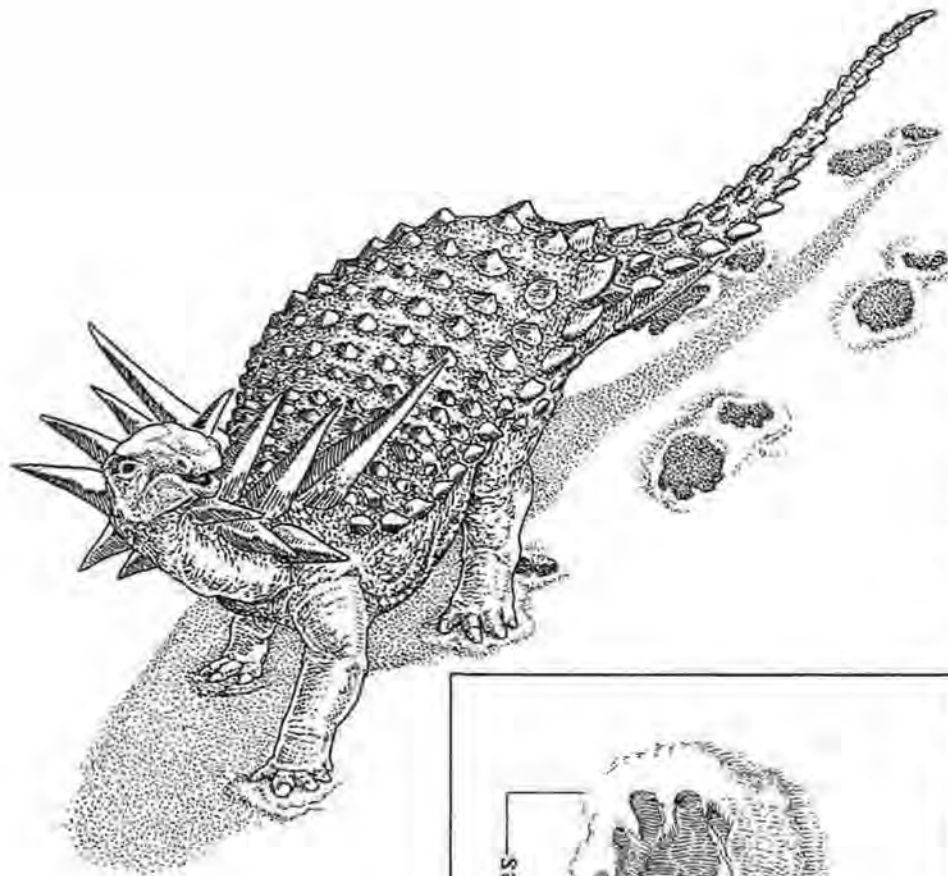
SAUROPODS OR ANKYLOSAURS?

The impressions in front of you represent the trackway of a four-legged or quadrupedal dinosaur that is walking away from you toward the hillside. These particular tracks belong to a relatively small dinosaur – about 11 feet long – leaving behind a very wide-gauge trackway. After excavation in 2013-2014, paleontologists determined that these tracks do not continue into the hillside past what you can see today.

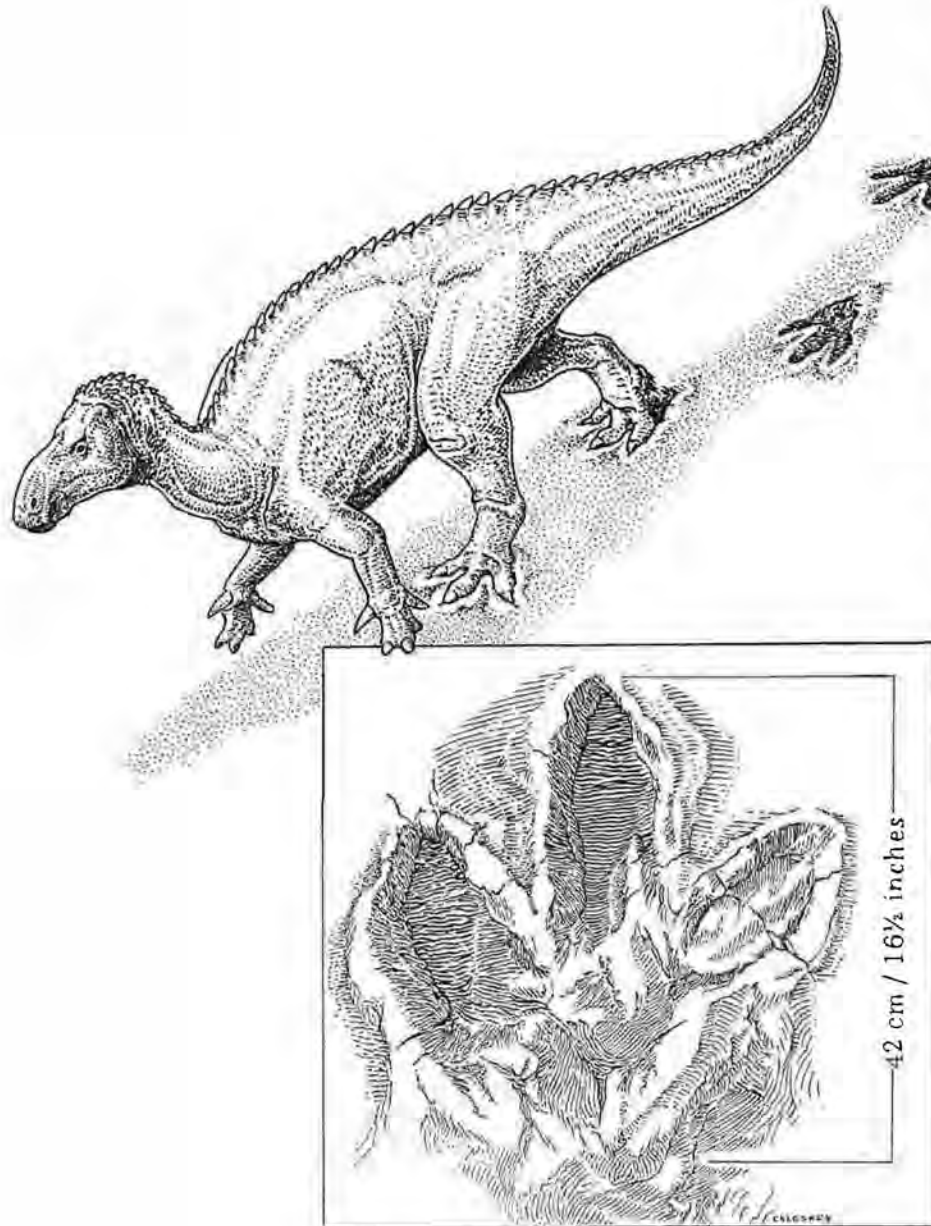
Paleontologists currently differ on their interpretation of these tracks. The feet are rotated outward, resembling the feet of a sauropod – a long-necked, plant eating dinosaur – tracksite in Spain. The handprints of this animal preserve finger impressions, something not generally found in sauropod tracks, and the toes of the hind foot are more distinct than in most sauropod tracks. Some paleontologists think these tracks resemble those of known ankylosaurs – or heavily armored dinosaurs – that were common in this area during the Early Cretaceous Period.

What kind of dinosaur do you think left these tracks behind?

Name of Track: *Sauropodichnus*-like or
Tetrapodosaurus-like
Early Cretaceous (~112 million years ago)
Cedar Mountain Formation



ORNITHOPOD TRACKS

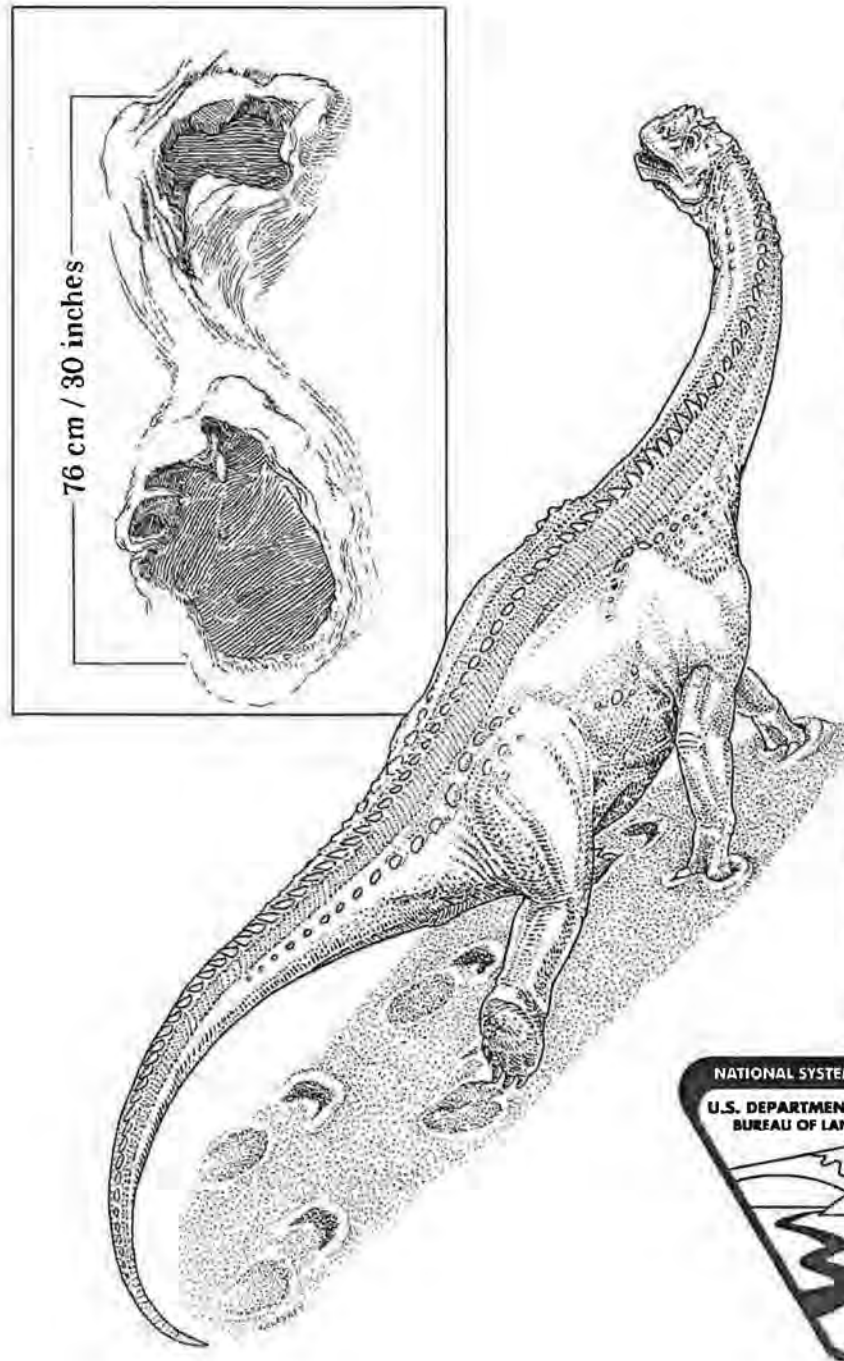


The ornithopod tracks in front of you are likely attributed to a dinosaur similar to *Iguanodon*. These herbivorous dinosaurs often walked on two feet, but had the ability to use their front feet for walking, as well. The tracks in this series have a step length of 43-45 inches (110-115 cm) and they are about 11 inches (30 cm) long and wide. Skeletal remains of dinosaurs, such as these, have not yet been discovered within the Ruby Ranch Member of the Cedar Mountain Formation where we stand. However, similar dinosaurs have been discovered in rocks that are geologically slightly older and younger. Tracks like these help our understanding of this long vanished fauna.

Name of Track: *Caririchnium*-like
Early Cretaceous (~112 million years ago)
Cedar Mountain Formation



SAUROPOD TRACKS



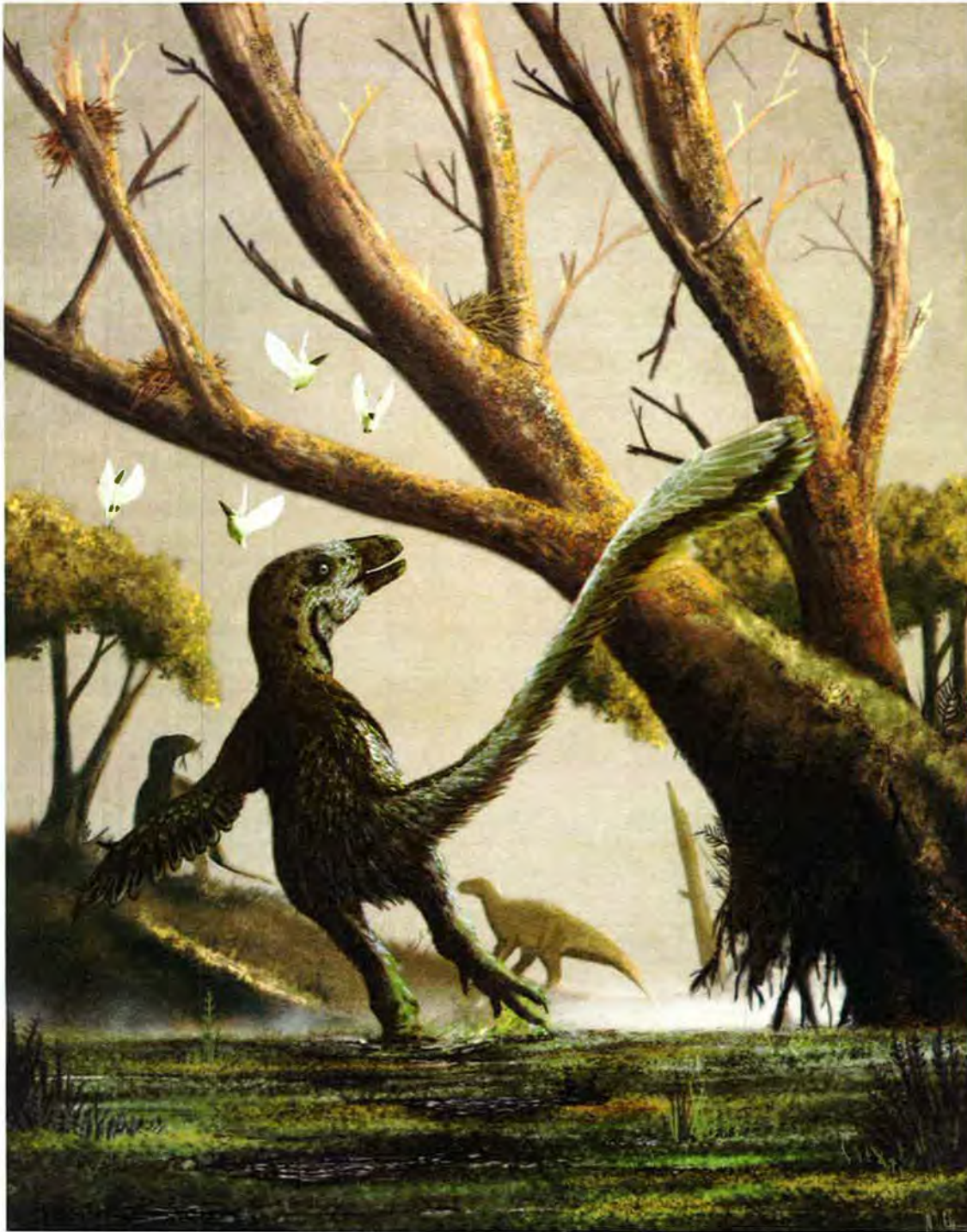
Sauropods, or long-necked, plant-eating dinosaurs, are also known from this site. These four-legged herbivores had front footprints that are slightly smaller than those of their back feet. The front feet leave behind lima bean-shaped tracks that are 8-9 inches (20-23 cm) in length, with their large hind foot tracks almost resembling those of an elephant or large dinner plates at 13-19 inches (33-48 cm) long. On a few of the hind foot tracks, you are able to see their toes jutting out to the side. One of these sauropods came through the site after a large theropod and left its track on top of the theropod track, overprinting it. These types of tracks help us gain an understanding of a series of events that one cannot get from skeletal remains – the large theropod came through followed at a later time, by a sauropod.



Name of Track: *Brontopodus*

Early Cretaceous (~112 million years ago)

Cedar Mountain Formation



Algae

The dinosaurs and other animals here walked on a mat of algae that formed in a shallow lake. The animals left tracks after the lake water receded, but before the mat dried up. The mat was then buried by layers of sand and mud. The buried mat hardened and became limestone. At a later time, the still-buried limestone was replaced by chert. The texture of the rock surface preserves the remains of this once living mat of algae.





A spring morning 112 million years ago...

This illustration was created to match the view from where you are standing right now, and several of the animals pictured are placed according to actual trackways that can be seen from this vantage point. Can you see where they left their prints? Where do you think they were headed? While we may never know what the rest of their lives were like, one thing is certain: the trackways you are looking at each record the movements of individual animals that lived in the distant past.





Paleogeographic map of North America during the Early Cretaceous, showing the Mill Canyon Dinosaur Tracksite in eastern Utah (red circle). Map by Ron Blakey.

GEOLOGY

You are currently standing on the Cedar Mountain Formation, which consists of sandstones and mudstones. It is split into three members (or subsections) in this region: Yellow Cat, Poison Strip, and Ruby Ranch. The rocks at the Mill Canyon Dinosaur Tracksite are part of the Ruby Ranch Member of the Cedar Mountain Formation, which formed about 112 million years ago.

The limey mud that the dinosaurs and other animals were walking in was deposited on the shoreline of a large lakebed, with the water sourced from a nearby river. Over time the mud turned to rock, thus preserving the footprints.

SERIES	STAGE	SYSTEM	FORMATION - MEMBER	MAP SYMBOL	THICKNESS Feet (Meters)	LITHOLOGY
Upper	Cretaceous	CRETACEOUS	Blue Gate Shale Member	KGB	500+ (150+)	uncolored uncolored
			Marcos Shale	KM	85-120 (26-37)	
			Juana Lopez Member	KJL	29-27 (9-8)	
			Tanuki Shale Member	KTS	200-400 (60-120)	
Upper	Cretaceous	CRETACEOUS	Natural Sandstone	KZ	45-110 (15-30)	uncolored uncolored
			Brushy Basin Member	JBM	250-450 (76-140)	
			Morrison Formation	JM	130-300 (40-90)	
			Soft Wash Member	JSM	20-50 (6-15)	
Middle	Cretaceous	CRETACEOUS	Tower Member	JTM	8-10 (2-12)	uncolored uncolored
			Summitville Formation	JSM	60-110 (20-34)	
			Moab Member	JM	180-400 (55-120)	
			Entrada Sandstone	JES	80-190 (30-60)	
Lower	Cretaceous	CRETACEOUS	Strick Rock Sandstone Member	JSR	200-700 (60-210)	uncolored uncolored
			Carmel Formation	JCM	220-340 (70-100)	
			Dewey Bridge Member	JDB	250-450 (80-140)	
			Navajo Sandstone	JNS	200-700 (60-210)	
Lower	Cretaceous	CRETACEOUS	Kayenta Formation	JKF	220-340 (70-100)	uncolored uncolored
			Wingate Sandstone	JWS	250-450 (80-140)	

Modified from Doelling, H.H., and Kuehne, P.A., 2013, Geologic map of the Klondike Bluffs quadrangle, Grand County, Utah: Utah Geological Survey Map 258DM, scale 1:24,000.