Geologic Road, Trail, and Lake Guides to Utah's Parks and Monuments
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# *GEOLOGIC ROAD GUIDE TO THE SHAFER TRAIL, ISLAND IN THE SKY DISTRICT, CANYONLANDS NATIONAL PARK, UTAH*

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**OVERVIEW OF THE ROAD:** The Shafer Trail offers an excellent opportunity to observe nearly the complete succession of rocks exposed in the Canyonlands region of Utah. The trail is actually a dirt road that begins near the top of the Jurassic Navajo Sandstone and descends to the Permian Cutler Formation. The Shafer Trail road was originally built by uranium miners to transport ore extracted from the Triassic Chinle Formation during the middle part of the twentieth century. The mining road followed the path of a large natural rockfall that buried part of the typically cliff-forming Wingate Sandstone. Although the road has been greatly improved by the National Park Service, the Shafer Trail is still extremely steep and it travels along the tops of sheer cliffs. All of the stops listed in this guide can be accessed by parking in a pullout along the trail and walking to a viewpoint or rock face. **It is very important to drive slowly and pay attention to the road and other drivers while traveling along this trail. The Shafer Trail is slippery and often impassible when wet or icy.**

**TO USE THIS GUIDE**: Begin at the Island in the Sky Visitor Center. Travel northeast to the Shafer Trail (and White Rim Trail) turnoff. To reach the turnoff from the Visitor Center you must travel back toward the entrance to the park. The turnoff is on the right as you drive away from the Visitor Center. The thickness of the formations encountered along the trail, their weathering profile, their characteristic features, and their interpreted depositional environments are shown in **Figure 1,** and supplemental notes to Figure 1. The road log highlights a series of stops along the Shafer Trail from which the more characteristic and interesting features of each formation can be observed. The road log is best used in conjunction with Figure 1.

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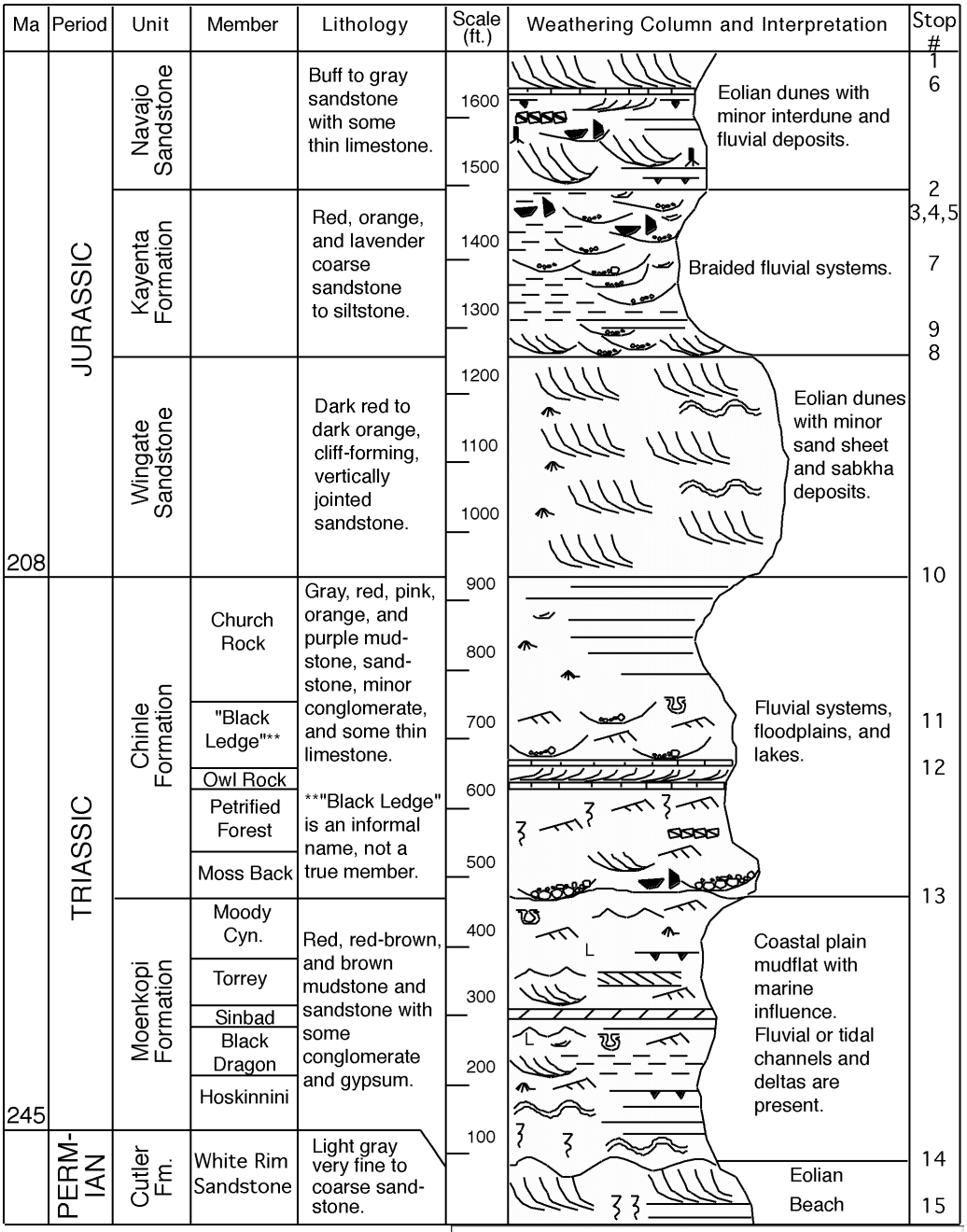



*Figure 1. Stratigraphic column of formations along the Shafer Trail. Column includes rock descriptions, formation thicknesses, weathering profile, characteristic features, and interpretation of depositional environments. Supplemental notes to figure 1 are included on the next two pages.*

*Supplemental notes to figure 1.*

Navajo Sandstone

205+ feet thick (top eroded)

Common features include:

- 95+ feet: Not measured in detail. Primarily cross-bedded sandstone.
- 85-95 feet: Limestone layers with small-scale cross-bedded sandstone and mud-cracked mudstone. Bedded and nodular chert in limestones.
- 80-85 feet: Very fine sandstone to siltstone that is horizontally laminated. Soil horizon with pedogenic carbonate nodules at 85 feet.
- 75-80 feet: Small-scale channels with rip-up clasts.
- 25-75 feet: Dominantly large-scale trough cross-beds with some smaller troughs at about 50 feet and from 65-75 feet. Mainly very fine to fine sandstone, grayish white or pinkish white. Root casts at 50 feet. Carbonate nodules from 65-75 feet.
- 0-25 feet: One-foot-thick beds of very fine to fine sandstone, mud-cracked clay lenses.

Interpretation of depositional environment:

Eolian dunes with minor interdune and fluvial deposits.

Kayenta Formation

225 feet thick

Common features include:

- 125-225 feet: Like 0-45 feet. Mud-pebble conglomerate common at the base of channels in this interval.
- 45-125 feet: Channelized sandstone. Channel widths of about 100 feet and depths of about 10 feet. Horizontally laminated interbeds of mudstone more common than below. Clay drapes on cross-beds near top of interval. Wedge and planar tabular cross-bedding in sandstone in channels. Some deformed and overturned cross-beds.
- 0-45 feet: Channelized sandstone. Channel widths of about 200 feet and depths of about 25 feet. Trough cross-bedding in channels. Minor horizontal sandstone and mudstone beds.

Interpretation of depositional environment:

Braided fluvial systems.

Wingate Sandstone

270 feet thick

Common features include:

- 225-270 feet: Not accessible for detailed description.
- 0-225 feet: Primarily cross-bedded very fine to fine sandstone. East to southeasterly dipping cross-beds. About 1/5 of total thickness is composed of 5- to 10-feet-thick massive beds. About 1/10 of total thickness is composed of 5-feet-thick very fine sandstone to siltstone layers with adhesion ripples and wavy bedding separated by 5-feet-thick cross-bedded very fine to fine sandstone layers.

Interpretation of depositional environment:

Eolian dunes with minor sand sheet and sabkha deposits.

Chinle Formation

455 feet thick

Common features include:

- 250-455 feet: Church Rock Member: Pink, red, and orange nonresistant fine sandstone to mudstone. Primarily covered. Minor horizontally laminated beds about 5 feet thick at 275 and 290 feet. Clay drapes and adhesion ripples in very fine sandstone at 380 feet.
- 160-250 feet: Black Ledge: Resistant, channelized very fine to fine sandstone, black weathered color. Channel sizes decrease toward top of unit. Load casts at about 230 feet. Current ripples common from 235 to 250 feet.
- 140-160 feet: Owl Rock Member. Cross-bedded very fine sandstone and thin limestone beds. Sets about 5 feet

thick.

65-140 feet: Petrified Forest Member: Red and purple very fine sandstone and mudstone with ripple marks and green to reddish purple very fine sandstone to mudstone with crayfish burrows. Soil horizons with pedogenic carbonate nodules.

0-65 feet: Moss Back Member: Channelized, trough cross-bedded, fine- to medium-grained sandstone. Mud rip-up clasts present at the base of channels. Minor red, rippled very fine sandstone.

Interpretation of depositional environment:

Fluvial complex.

Moenkopi Formation

440 feet thick

Common features include:

325-440 feet: Moody Canyon Member: Primarily red-brown nonresistant siltstone to very fine sandstone. Wave and current ripples from 325 to 340'. Adhesion ripples and load casts at 355 feet.

228-325 feet: Torrey Member: Reddish brown very fine to fine sandstone. Current and wave ripples, parting lineation, planar cross-bedding, trough cross-bedding. Interbedded layers of very fine sandstone and mudstone with mud cracks.

225-228 feet: Sinbad Limestone Member: Gold-colored, resistant dolomite.

115-225 feet: Black Dragon Member: Reddish brown very fine sandstone (resistant) and very fine sandstone to mudstone (nonresistant). Parting lineation, adhesion ripples, load casts, flaser bedding, current ripples, wave ripples, trough cross-beds.

0-115 feet: Hoskinnini Member: Brownish red very fine to fine micaceous sandstone. Abundant small-scale wavy beds, heavily bioturbated. Minor large-scale wavy beds. Some layers bleached to white or light pink. Pockets of isolated coarse quartz grains.

Interpretation of depositional environment:

Continental mudflat with minor marine limestone, fluvial or tidal channels, and deltas.

White Rim Sandstone

45 feet thick

Common features include:

20-45 feet: Small-scale, low-angle cross-beds from 20 to 25 feet overlain by high-angle, large-scale cross-beds from 25 to 45 feet. Primarily very fine to fine sandstone with minor horizontally laminated or massive beds of coarse to very coarse sandstone.

0-20 feet: Interlayered massive and burrowed fine sandstone. Soft-sediment deformation features, pockets of coarse to very coarse sandstone.

Interpretation of depositional environment:

Eolian at top, beach at base.

| STOP # | DISTANCE FROM VISITOR CENTER | DESCRIPTION |
|---|---|---|
| STOP 1 | 1.0 mile | The turnoff to the Shafer Trail is surrounded by stabilized Quaternary wind-blown sand dunes that were deposited on top of the Lower Jurassic Navajo Sandstone. The upper and lower parts of the Navajo Sandstone were also deposited as wind-blown dunes. The Navajo Sandstone is currently being eroded and its sand recycled into modern dunes.<br><br>As you make the turn onto the Shafer Trail road from the main park road, the grayish-white cliff straight in front of you is composed of the Navajo Sandstone. |
| STOP 2 | 1.6 miles | Navajo Sandstone forms the cliff on the right (uphill) side of the road (**Photo 1**). Eolian cross-bedded sandstone is exposed in the lower part of the cliff. Large-scale, high-angle, tabular and trough cross-bedding are common in the eolian portions of the Navajo Sandstone. The upper part of the cliff shown in Photo 1 mainly represents deposition in and adjacent to interdune ponds within the Navajo erg. Mud-cracked mudstone (**Photo 2**), thin limestone layers, root casts and small fluvial channels are common in the interdune pond and associated strata. The interdune pond deposits are typically red or green in color. Post-depositional compaction has compressed and wrinkled infilled mud cracks.<br><br>The Navajo Sandstone is approximately 205 feet thick along the Shafer Trail. At this stop the road runs along the |

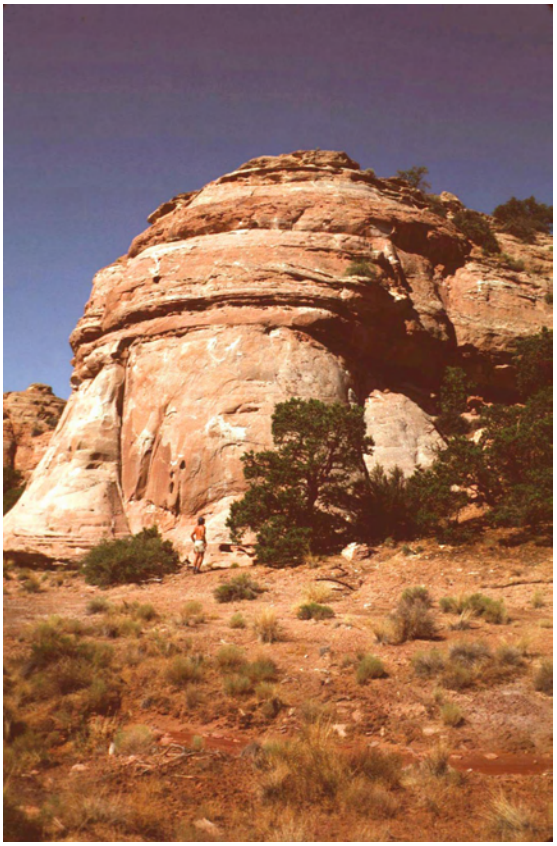


*Photo 1. Navajo Sandstone at STOP 2.*

contact between the Navajo Sandstone and the underlying Lower Jurassic Kayenta Formation.

STOP 3 1.7 miles

The Kayenta Formation is about 225 feet thick along the Shafer Trail. It is composed of red, orange, and lavender mudstone and sandstone. It contains abundant channels. Trough, wedge-shaped, and tabular cross-beds are all common within the Kayenta. Mud cracks are present within red flood-plain deposits at this site. The sandstone that fills the mud cracks is bleached to a greenish hue making the cracks easy to identify in the rock face. Some of the channels in the Kayenta contain mud-pebbles derived from erosion of the streams' flood-plains. Near the center of the formation, mud drapes mantle cross-beds indicating repeated variation in the strength of the flow in the fluvial systems that deposited the sediment.

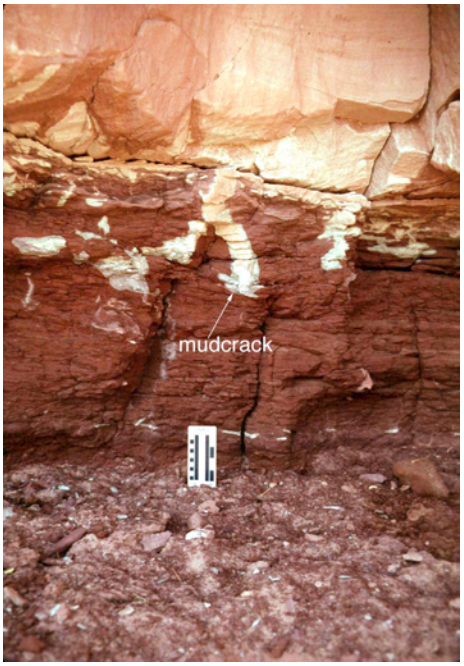



*Photo 2. Mud-cracked mudstone at STOP 2.*

From this point forward, the road runs just beneath the Navajo/Kayenta contact. The contact between the two formations is sharp.

STOP 4 1.9 miles

Park your car where safe and walk toward the cliff on the left side of the road. From this vantage point you can see the cliff-forming Navajo Sandstone, Kayenta Formation, and Wingate Sandstone (**Photo 3**). The Navajo and Wingate Sandstones primarily reflect eolian deposition in sandy desert environments. In contrast, the Kayenta Formation represents deposition in fluvial environments, mainly by braided streams.

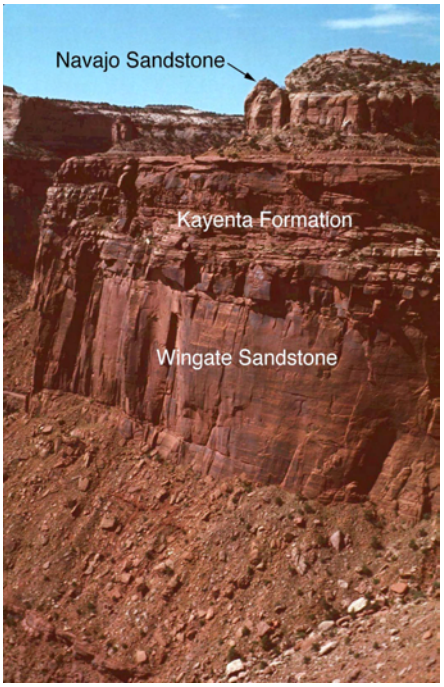



*Photo 3. Jurassic sandstones at STOP 4.*

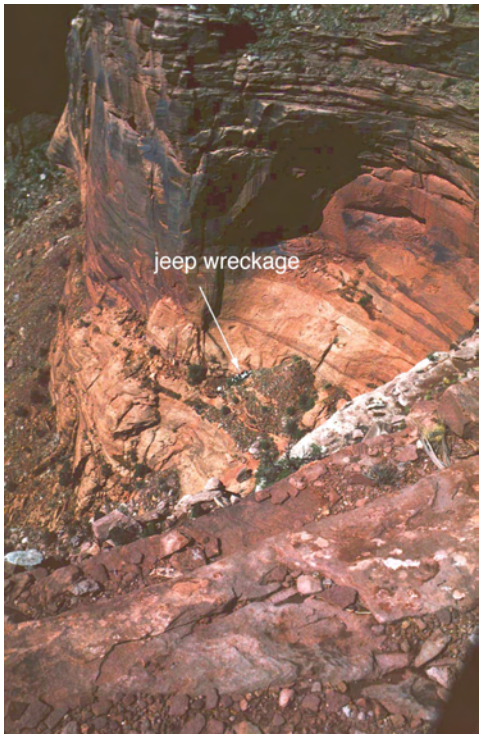



*Photo 4. Jeep wreck at STOP 4.*

If you look over the cliff edge near this site you may see a wrecked jeep perched on a ledge in the lower part of the Wingate Sandstone (**Photo 4**).

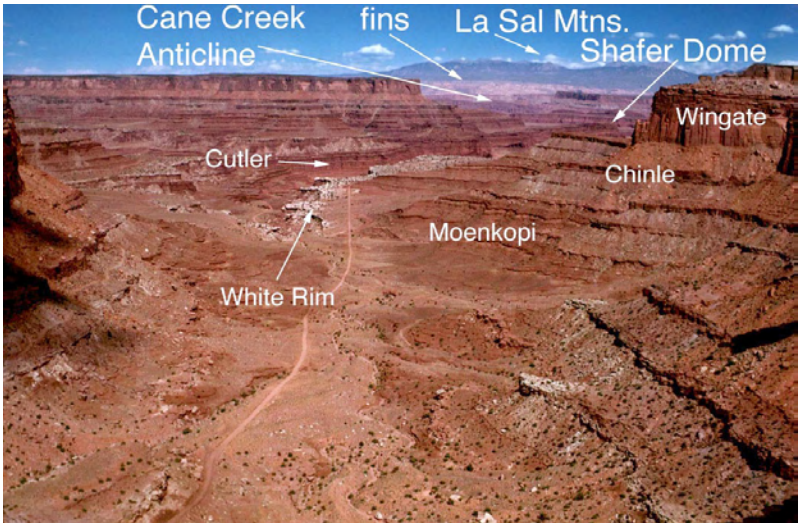



*Photo 5. Panoramic view of the formations and scenery along the Shafer Trail at STOP 5 described below.*

The rock face on the right side of the road between this stop and the next contains resistant sandy channels and nonresistant floodplain deposits that are typical of the Kayenta Formation. The floodplain deposits include red mudstone cut by mud cracks filled with greenish-yellow sandstone.

STOP 5 2.6 miles

Pull off on the left side of the road. This site is an excellent location to view the stratigraphy of the Shafer Trail area (**Figure 1, Photo 5**). At this location the road still lies within the Kayenta Formation.

In the distance you can see the La Sal Mountains east of Moab, Utah, the fins eroded in the Navajo Sandstone to the west of Moab, and two salt-cored anticlines. The salt-cored anticlines are expressed as dome-like upwarpings of rock. The salt is not exposed at the surface, but it is present in Pennsylvanian rocks in the subsurface. The northeastern salt anticline is known as the Cane Creek Anticline. The southwestern salt anticline is called the Shafer Dome.

Shafer Canyon (in which you are now driving) cuts down into the Shafer Dome. In the lower part of the canyon a Permian unit informally referred to as the Shafer Limestone forms the grass-covered, resistant bench that you can see in the distance. The arrow that points to the Shafer Dome in Photo 5 also points to the top of the Shafer Limestone. The Shafer Limestone is the

oldest unit that is easily accessible in this area. Although older rocks are present, they lie below sheer cliffs and are inaccessible at most locations. In Shafer Canyon, the Shafer Limestone is part of Cutler Formation, undivided.

The red and purple cliffs above the Shafer Limestone are also part of the Cutler Formation, undivided. The prominent, bright white bench with a road on top of it is upheld by the Lower Permian White Rim Sandstone. The top of the White Rim Sandstone is approximately located at the intersection of the Shafer Trail (the road you are on now), the White Rim Trail (the road heading to the south along the White Rim Sandstone bench), and the Potash Road (the road heading deeper into Shafer Canyon and then toward the east where it runs along the Colorado River toward Moab).

The White Rim Sandstone is overlain by the Lower to Middle Triassic Moenkopi Formation, a red-brown slope and cliff-forming unit. The Permian-Triassic boundary, an erosional unconformity expressed throughout the world, occurs between the White Rim and the Moenkopi. A white cliff-forming conglomeratic sandstone occurs at the base of the Upper Triassic Chinle Formation, which overlies the Moenkopi. Above the white cliff, the Chinle Formation forms pastel-colored slopes.

The Chinle is overlain by the Lower Jurassic Wingate Sandstone, which forms a massive orange cliff. The slabby brown cliffs above the Wingate are the Kayenta Formation (the same unit that is exposed in the cliff along the road at your current location). The white, gray or buff, cliff-forming unit that forms rounded knobs at the top of the cliffs is the Lower Jurassic Navajo Sandstone.

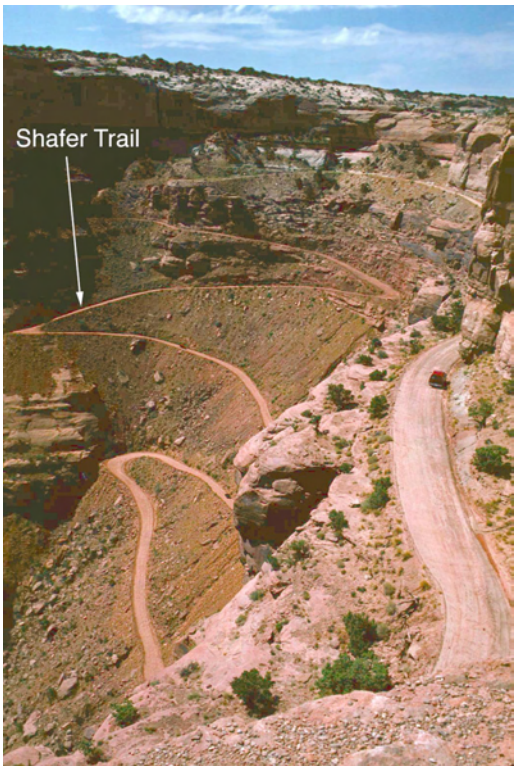


*Photo 6. Panoramic view of the Navajo Sandstone from the Shafer Overlook at STOP 6.*

STOP 6 3.3 miles

A small footpath intersects the right side of the Shafer Trail at this location. The path leads to the Shafer Overlook; a point-of-interest located along the main, paved park road. At the Overlook **(Photo 6)** you can see rocks that represent deposition in three different environments that coexisted

within the Navajo erg (sandy desert). First, grayish-white, cross-bedded sandstone represents deposition by migrating wind-blown dunes. Second, the mud-cracked layers, along with limestone containing bedded and nodular chert, represent deposition in and adjacent to an interdune pond. Finally, red sand-sheet deposits reflect eolian deposition on dry interdunes or flat-lying areas surrounding the dune field. The sand-sheet deposits contain pinstripe lamination, or translatent strata (**Photo 7**). This sedimentary structure is a product of eolian ripple migration. Laminae within translatent strata coarsen upward, but the upward coarsening may be difficult to see because the laminae are only a few grains thick. Translatent strata are characteristic of eolian environments and are not observed in rocks formed in other depositional environments.

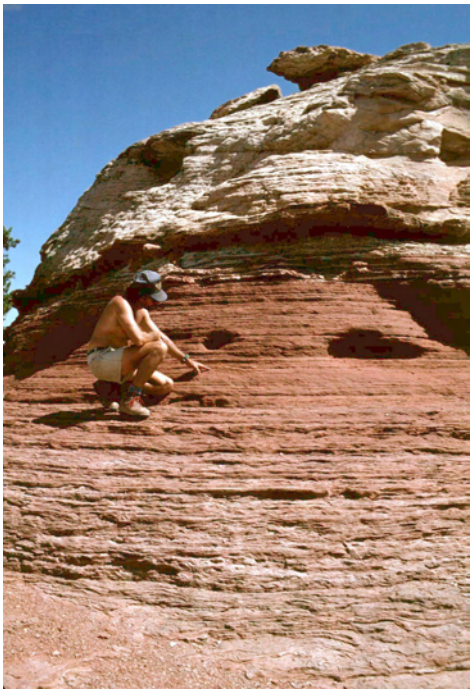


*Photo 7. Sheet –sand deposits in the Navajo Sandstone at STOP 6.*

STOP 7 3.8 miles

Channels are abundant in the Kayenta Formation at this location (**Photo 8**). These channels in the central part of the Kayenta are interpreted to be the product of deposition by braided streams (**Photo 9**).

At this point the road makes its first major turn to the left and you begin driving down the switchbacks that take you through the most resistant rocks ex-


*Photo 8. Channel in Kayenta Fm. at STOP 7.*

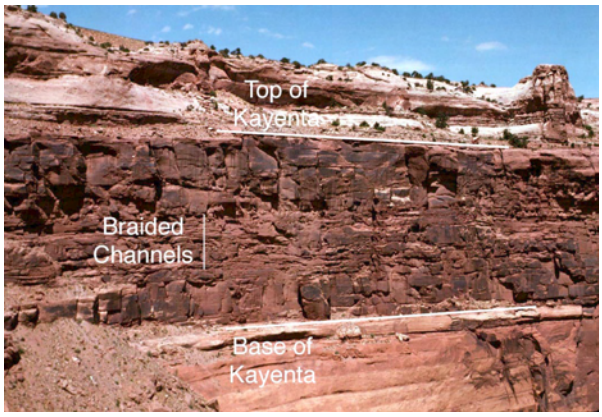



*Photo 9. Braided stream deposits at STOP 7.*

posed in Shafer Canyon.

STOP 8 4.1 miles The contact between the brown, slabby Kayenta Formation (above), and the orange, massive Wingate Sandstone (below) occurs at about the level of the road at this location. It is difficult to see the contact along the road because it is covered with fallen rock debris. The contact between the two formations is flat and sharp in Shafer Canyon and it represents an erosional surface.

It is difficult to observe the Wingate Sandstone right along the Shafer Trail because it was only possible to build a road through this extremely resistant, cliff-forming unit where it was already fractured, weathered, and broken apart. The Lower Jurassic Wingate Sandstone is about 270 feet thick in Shafer Canyon. It is dark red to dark orange in color and it contains abundant and prominent vertical joints. It is mainly composed of very fine to fine sandstone. Trough and tabular cross-bedding, contorted cross-bedding, small-scale wavy bedding, adhesion ripples, and translatent strata are all common in the Wingate Sandstone. The Wingate Sandstone was deposited in a sandy desert environment.

STOP 9 4.4 miles Look straight ahead to see fluvial cross-bedding preserved in the Kayenta Formation in the cliff above the road (**Photo 10**).


*Photo 10. Fluvial cross-bedding in the Kayenta Formation at STOP 9.*

STOP 10 4.6 miles

There is a very small pull-out on the right side of the Shafer Trail at this location. This turnout is at approximately the same elevation as the contact between the Wingate Sandstone and the Triassic Chinle Formation. Look to the right and behind you to see the contact more clearly (**Photo 11**). The Wingate Sandstone (above) is orange and resistant, and the Chinle Formation (below) is reddish brown and easily erodes to form slopes.

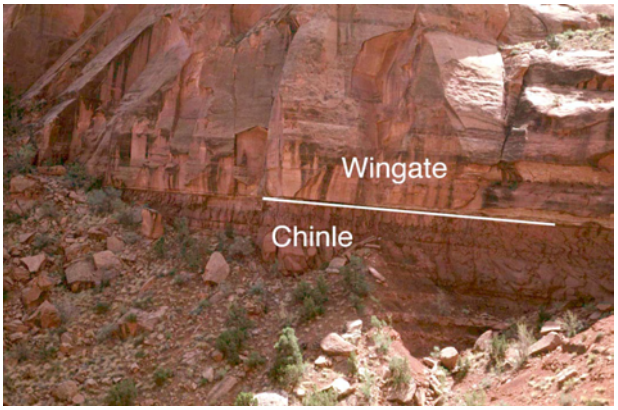



*Photo 11. Contact between the Chinle Formation and the Wingate Sandstone at STOP 10.*

The Upper Triassic Chinle Formation is 455 feet thick and contains four members in Shafer Canyon (**Photo 12**). The uppermost and youngest is the Church Rock Member (205 feet thick). It is the reddish-brown slope-forming sandstone and mudstone directly beneath the Wingate Sandstone. The base of the Church Rock Member is marked by a prominent cliff-forming sandstone locally known as the Black Ledge (90 feet thick). The underlying Owl Rock Member is 20 feet thick, and consists of sandstones, mudstones, and thin limestones. The Petrified Forest Member (75 feet thick) forms the pastel-colored slopes below the Owl Rock Member. The lowermost unit is the Moss Back Member (65 feet thick), a resistant fluvial sandstone. Although they are missing at this location, two additional members


*Photo 12. Members of the Chinle Formation as viewed from STOP 10.*

are present beneath the Moss Back Member in other parts of southeastern Utah: the Monitor Butte Member and the underlying Shinarump Member.

*Photo 13. Owl Rock Member of the Chinle Formation at STOP 11.*

STOP 11 4.9 miles

Lateral accretion sets in fluvial sandstone in the uppermost part of the Owl Rock Member can be seen straight ahead on the left side of the road (**Photo 13**). Lateral accretion sets form as point bars migrate toward the center of meandering stream channels while erosion occurs on the cut-bank side. The geologist in the photo is pointing to the base of the channel. The arrow in the photo points from the base of the channel toward the upper surface of the point bar deposit. Dashed lines on the photo mark the trend of contacts between successively younger lateral accretion beds.

STOP 12 5.1 miles

Burrows, probably made by crayfish, are present in Owl Rock Member mudstone directly beneath the Black Ledge (**Photos 14 and 15**). A fallen block

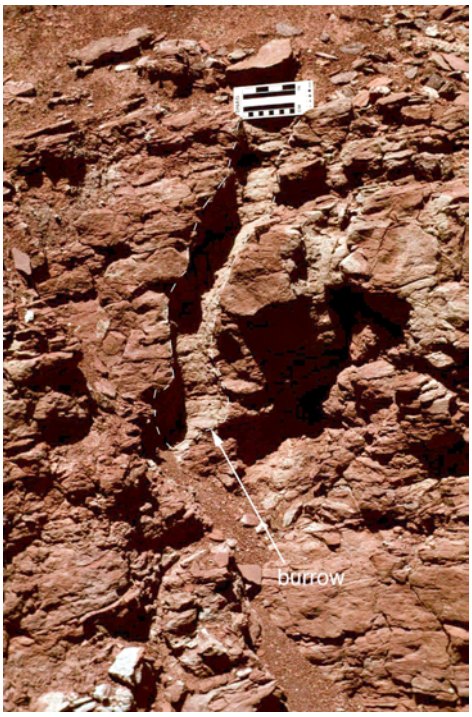
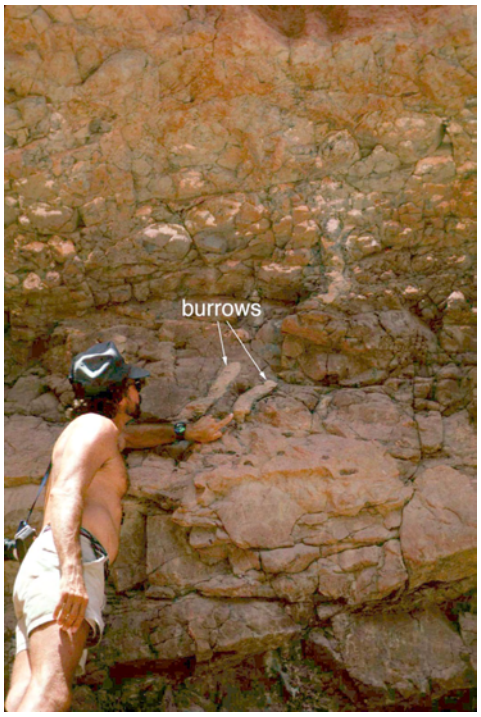



*Photo 14 (left). Burrows in the Owl Rock Member of the Chinle Formation at STOP 12.*

*Photo 15 (right). Burrows in the Owl Rock Member of the Chinle Formation at STOP 12.*



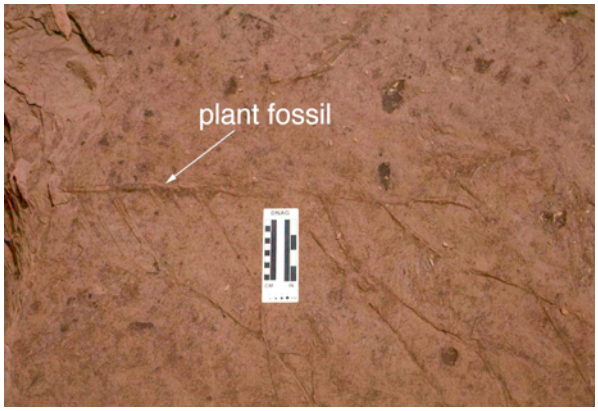



*Photo 16. Plant fossil (conifer fronds) in the Owl Rock Member of the Chinle Formation at STOP 12.*

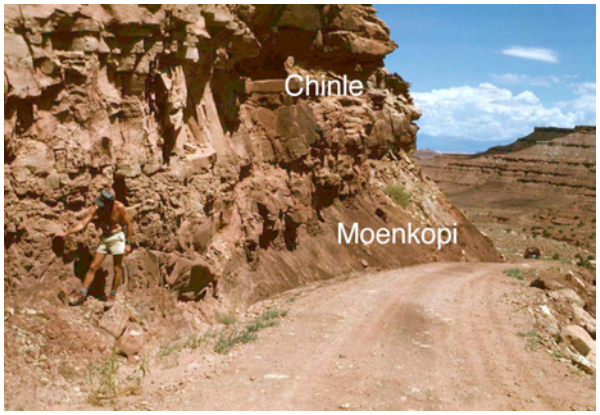



*Photo 17. Contact between the Chinle and Moenkopi Formations at STOP 13 described below.*

of Black Ledge (?) sandstone on the right side of the road contains imprints of conifer fronds (**Photo 16**).

STOP 13 5.2 miles

Contact between the Upper Triassic Chinle Formation and the underlying Lower-Middle Triassic Moenkopi Formation (**Photo 17**). This contact is an erosional unconformity. The Moss Back Member, the basal member of the Chinle at this location, contains fluvial cross-bedding. The geologist in the photo is pointing to the contact between the Chinle and Moenkopi Formations.

The Moenkopi Formation is 440 feet thick in Shafer Canyon. It contains five members (**Photo 18**). The uppermost and youngest is the reddish-brown, slope-forming Moody Canyon Member that is composed of sandstones and mudstones. The Moody Canyon is 115 feet thick and is underlain by the resistant, reddish-brown sandstone of the Torrey Member (100 feet thick). The Sinbad Limestone Member is very thin in Shafer Canyon, but it forms a gold-colored resistant ledge about 3 feet high. The Black Dragon Member (110 feet thick) underlies the Sinbad and it forms slopes and ledges near the base of the Moenkopi. The basal and oldest unit in the Moenkopi is the Hoskinnini Member. The

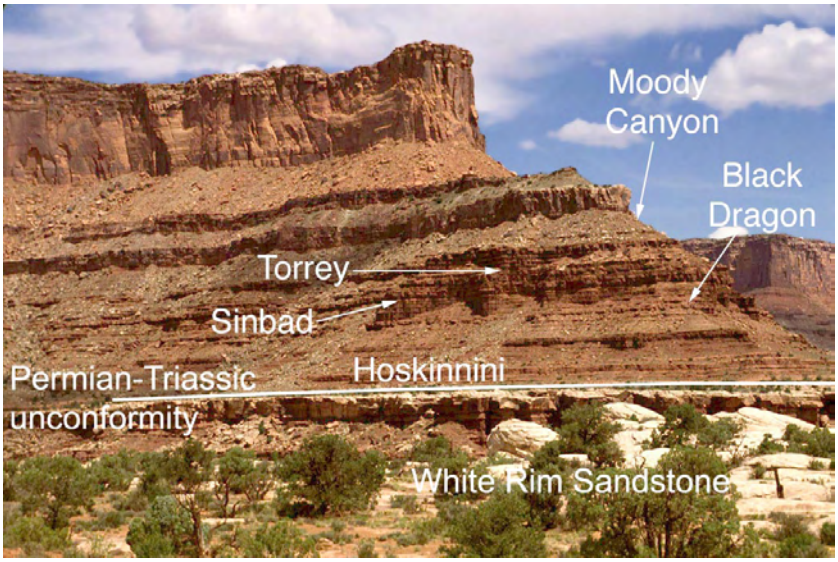



*Photo 18. Moenkopi Formation and underlying White Rim Sandstone as viewed from STOP 14. This STOP is described on next page.*

Hoskinnini is 115 feet thick and is characterized by large and small-scale wavy bedding. The Hoskinnini Member is separated from the Permian White Rim Sandstone by the Permian-Triassic unconformity.

STOP 14 6.3 miles

This stop is located at the intersection of the Shafer Trail (on which you have been traveling, the White Rim Trail (straight ahead along the relatively flat surface), and the Potash Road (down the hill to the left). The Shafer Trail ends here at the top of the White Rim Sandstone. The White Rim is composed of very fine to coarse, quartz-rich sand, and is approximately 45 feet thick at this location. If you turn left onto the Potash Road and continue on 0.1 mile you will intersect the base of the White Rim Sandstone. The upper part of the White Rim Sandstone contains abundant high-angle cross-bedding and was deposited in a sandy desert environment. The White Rim is underlain by the red mudstones and sandstones of the Cutler Formation, undivided (**Photo 19**).

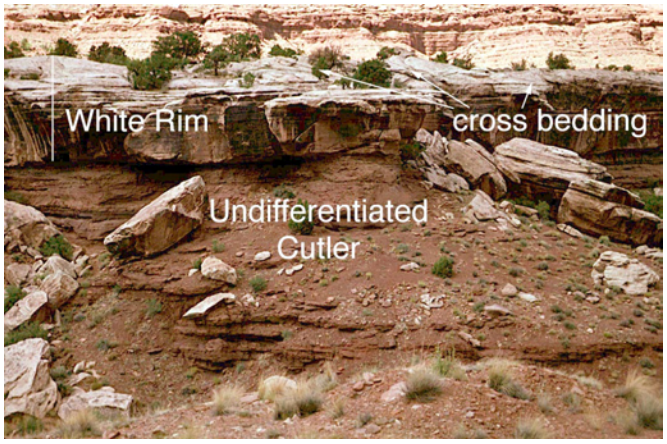



*Photo 19. White Rim Sandstone and Cutler Formation between STOP 14 and STOP 15.*

STOP 15 6.4 miles

On Potash Road. Near its base, the Permian White Rim Sandstone exhibits characteristics that suggest deposition along a shoreline (planar bedding, abundant vertical burrows, and small-scale cross-bedding) (**Photo 20**).

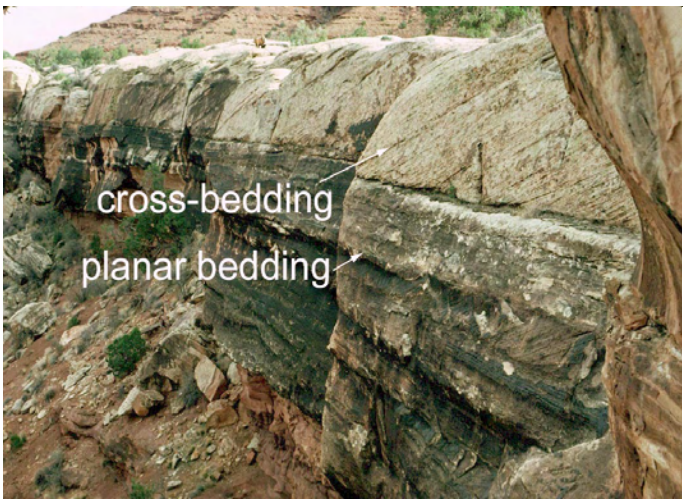



*Photo 20. Planar and cross-bedding in the White Rim Sandstone at STOP 20.*

**END OF GUIDE:** You are now below the base of the Shafer Trail. You can return to Island in the Sky by driving back up the trail to the main park road. When you reach the main park road, turn left to either return to the Visitor Center or journey farther into the park. You can also return to Moab by traveling back up the Shafer Trail, turning to the right when you reach the main park road, exiting the park, and then continuing on to Moab on paved roads. If you would like a bit more adventure on your trip to Moab, you can continue straight ahead on the Potash Road. The Potash road travels through beautiful scenery as it winds its way along the north side of the Colorado River. You must have a have a high-clearance vehicle to return to Moab along the mainly dirt Potash road. If you take this route, you will intersect Highway 191 just north of Moab. When you intersect the highway, turn right to get to town. The trip around Island in the Sky on the White Rim Trail is recommended only for those with high-clearance four-wheel drive vehicles and prior back-country driving experience in difficult terrain. The White Rim Trail trip takes 1-2 days to complete. Backcountry camping permits are required for camping in designated sites along the trail. Permits are available at the Island in the Sky Visitor Center.