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Larry E. Davis

College of St. Benedict / St. John's University, ldavis@csbsju.edu

Robert L. Eves

Southern Utah University, eves@suu.edu

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## On The Outcrop

# Swimming Reptile Tracks in the Lower Triassic Moenkopi Formation, Capitol Reef National Park, UT

Larry E. Davis<sup>1</sup> and Robert L. Eves<sup>2</sup>

<sup>1</sup>Bryce Canyon Natural History Association

Bryce Canyon National Park

Bryce, UT 84764 USA

[ldavis@csbsju.edu](mailto:ldavis@csbsju.edu)

<sup>2</sup>Department of Physical Science

Southern Utah University

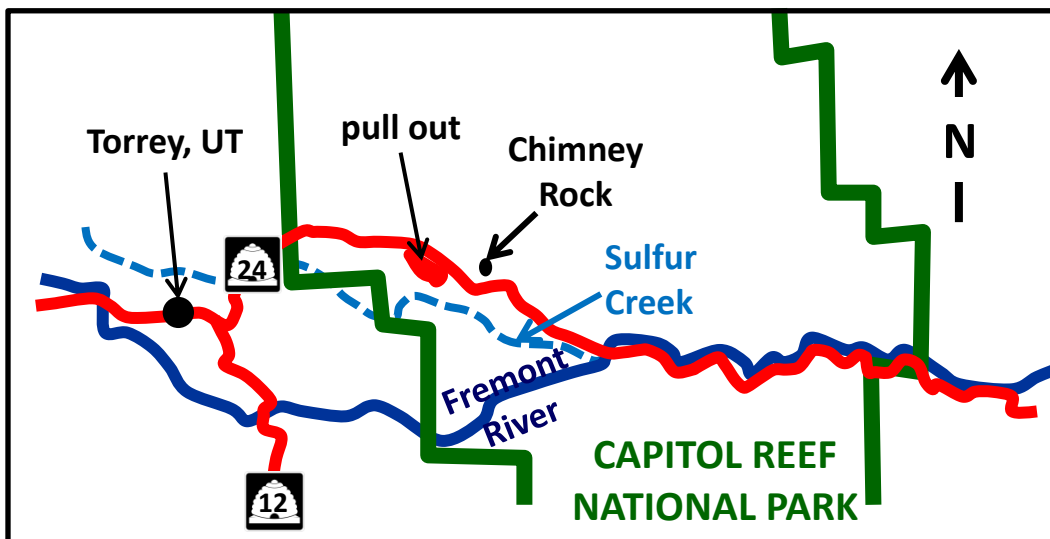
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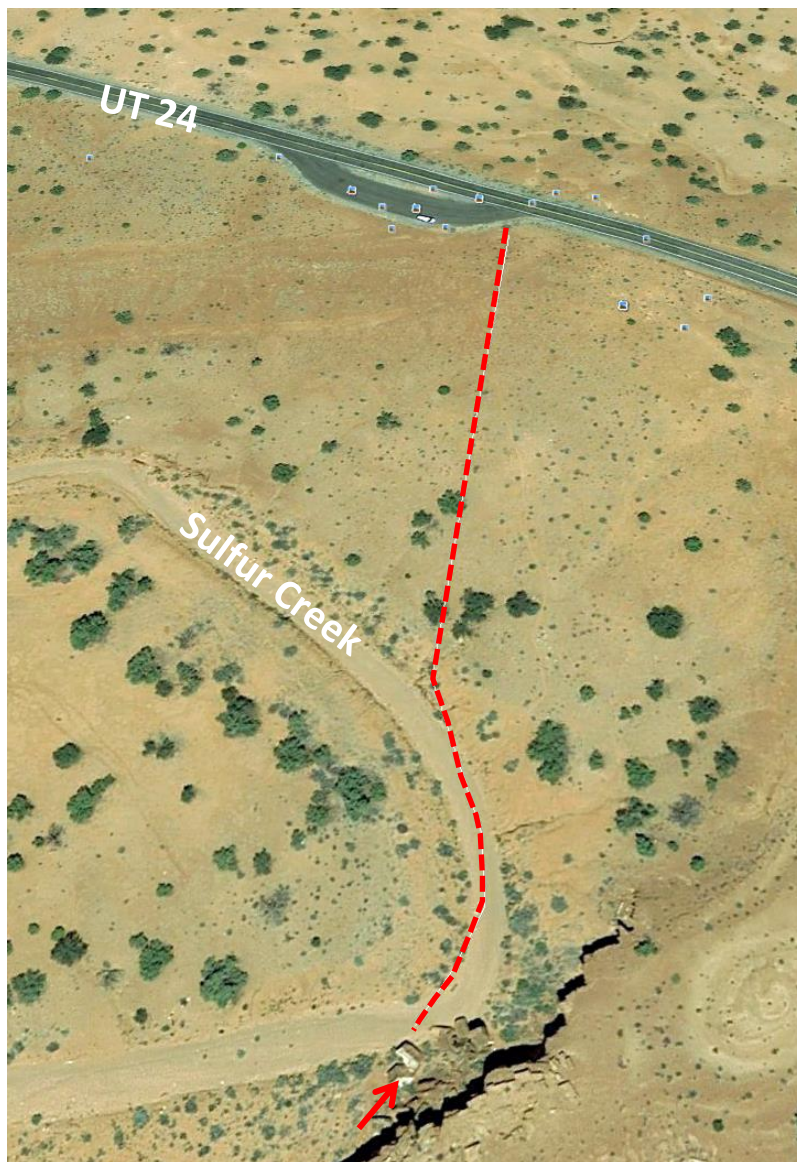
[eves@suu.edu](mailto:eves@suu.edu)

## LOCATION

Near mile post 76, locate a pullout on State Road (SR) 24 along the right hand side of the road. At the east end of the pullout there is an interpretive sign and you will see a social (unofficial) trail trending southeast toward a dry wash. Walk approximately 600 feet (183 meters) across the flat and into Sulfur Creek (dry wash) to a point where large blocks of the Torrey Member of the Early Triassic Moenkopi Formation (~240 million-years-old) have broken free of the cliff (fig. 1 and 2). The GPS location is 38°18'54.69"N / 111°18'31.72"W. Tracks are located on the east side of several of the large blocks of Moenkopi Formation.



**Figure 1.** Generalized road map to trackway. See figure 2 for more details regarding route from pull out to trackway.



**Figure 2.** Google Earth map of route to trackway. Red arrow marks the blocks of Moenkopi Formation which have tumbled down next to the dry wash of Sulfur Creek. The tracks are on the east (cliff) side of the blocks. Continuing along Sulfur Creek, one can observe well-preserved sedimentary structures and ancient stream channels in the cliffs next to the wash.

## GENERAL GEOLOGY

The Lower Triassic Moenkopi Formation is one of the red bed units that characterize the lower Mesozoic rocks of the Colorado Plateau. The formation is named for outcrops in Moenkopi Wash in north-central Arizona (Ward, 1901). Outcrops of the Moenkopi Formation cover a broad area of the southwestern United States (northwestern New Mexico, northern Arizona, Nevada, southeastern California, southern Utah, and western Colorado). The Moenkopi typically weathers to form red-brown to chocolate-brown slopes and benches across wide exposure belts or irregular cliffs and slopes on canyon walls, such as along the Vermilion and Chocolate Cliffs of northern Arizona (fig. 3). In the Cathedral Valley region of Capitol Reef National Park, the Moenkopi forms tall monuments, spires and hoodoos (Stewart, et al., 1972).





**Figure 3.** Looking southeast at exposures of the Moenkopi Formation along Sulfur Creek in Capitol Reef National Park. This is the site of the swimming reptile tracks, which can be observed on the back side of the tumbled blocks in the foreground. Also note the abundant sedimentary structures preserved in the blocks.

The Moenkopi Formation preserves extensive ancient tidal and nearshore deposits in the western portions of the outcrop area and onshore continental deposits to the east. In Capitol Reef National Park four different members of the Moenkopi are recognized, and, in ascending order, are the Black Dragon Member, the Sinbad Limestone Member, the Torrey Member, and the Moody Canyon Member. The Black Dragon Member was deposited under marine conditions, which preserve a shallowing upwards sequence and is capped by transitional beach sands and continental fluvial deposits. The Sinbad Limestone Member represents a return to shallow marine conditions, followed by fluvial, clastic deposition. The Moody Canyon Member represents another marine transgression with widespread, low-energy conditions, producing a generally "structure-less" mudstone. Cyclic alternation of supratidal to subtidal deposits resulted in interbedded mud and sand beds throughout much of the Moenkopi (Blakey, 1973). During the initial deposition of the Black Dragon Member, the climate was mostly hot and dry, but by the time of deposition of the Sinbad Limestone Member the climate was progressively wetter, although still likely arid (Blakey, 1973). Much of the Moenkopi is characterized by thinly bedded mudstones and fine-grained sandstones, containing a wide variety of sedimentary

structures, particularly ripple marks and trace fossils. Secondary gypsum veins, locally termed ‘chicken-wire gypsum’ cross cut the formation.

## SITE DESCRIPTION

Detailed studies of the Torrey Member of the Moenkopi Formation have demonstrated an abundance of pre-dinosaurian tetrapod tracks preserved as “casts” (positive relief) or impressions (negative relief). The Torrey Member was deposited as muds, silts, and fine sands on a broad, flat-lying coastal delta plain. The resulting mudstones, siltstones, and fine-grained sandstones contain abundant ripple marks (sedimentary structures) and tetrapod tracks. The tracks likely belong to the ichnofossil *Chirotherium* (‘hand-beast’) made by a pseudosuchian archosaur, related to ancestors of crocodiles. Typically, *Chirotherium* is represented by a pentadactyle (5-digits) trace, but the Capitol Reef tracks demonstrate the reptile was actually swimming because only three toe marks are preserved (fig. 4). Each track is slightly offset to the right, indicating a current at the time the tracks were made. The current caused the track-maker to wander, not necessarily in a straight line, and tracks disappear and reappear as the animal ‘bobs’ above the bottom.



**Figure 4.** Toe marks of a swimming reptile in the Moenkopi Formation in Capitol Reef National Park.

**NOTE: This site is located within Capitol Reef National Park, please do not deface or attempt to remove specimens from the park. Take only pictures, leave only footprints.**

## REFERENCES CITED

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