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FIRST REPORT ON DINOSAUR TRACKS FROM THE BURRO CANYON FORMATION, SAN JUAN COUNTY, UTAH, USA – EVIDENCE OF A DIVERSE, HITHERTO UNKNOWN LOWER CRETACEOUS DINOSAUR FAUNA

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Abstract: The newly discovered White Mesa tracksite in the Burro Canyon Formation represents a snapshot of a diverse, Lower Cretaceous dinosaur fauna from south-eastern Utah. The tracks were found at a construction site where the sandstone had been bulldozed and broken up. All tracks were found as deep, well-preserved natural casts on the underside of the sandstone slabs. Individual theropod tracks are 19–57 cm in length; one peculiar track shows evidence of a possible pathological swelling in the middle of digit III and an apparently didactyl track is tentatively assigned to a dromaeosaurid. Individual sauropod tracks are found with pes lengths of 36–72 cm, and interestingly, three distinct shapes of manus tracks, ranging from wide banana shaped to rounded and hoof-like. Ornithopods are represented with individual tracks 18–37 cm in length; a single track can possibly be attributed to the thyreophoran ichnogenus *Deltapodus*. Zircon U-Pb dating places the track-bearing layer in the Barremian, contemporary to the lower Yellow Cat Member of the Cedar Mountain Formation, which has a similar faunal composition based on both tracks and body fossils. This new track-fauna demonstrates the existence of a diverse dinosaurian assemblage in the lower part of the Burro Canyon Formation, which hitherto is not known to yield skeletal remains.

Key words: Dinosaur tracks, Lower Cretaceous, Barremian, Utah, pathology, dinosaur fauna.

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INTRODUCTION

Lower Cretaceous tetrapod tracks from eastern Utah are known from at least nine tracksites, all in the Cedar Mountain Formation. Collectively these tracksites are evidence of a diverse dinosaurian fauna, including the major dinosaur groups: theropods, sauropods, ornithopods, thyreophorans and birds (Lockley *et al.*, 1999, 2004, 2012, 2014a, b, 2015; Wright, *et al*., 2006). In 2008, a team from the Dinosaur Institute of the Natural History Museum of Los Angeles County (Thornbury Dinosaur Expedition) discovered a diverse dinosaurian ichnofauna at a construction site in the Burro Canyon Formation, near Blanding in south-eastern Utah (Fig. 1). Until then, the Burro Canyon Formation had yielded just a handful of fossils and with the exception of a single find close to the top of the formation near Moab (Kirkland *et al*., 1997; Taylor *et al*., 2011), no remains of dinosaurs.

The aim of this study is to describe the first record of dinosaur tracks from the lower part of the Lower Cretaceous Burro Canyon Formation from a new site dubbed the White Mesa Tracksite, due to its proximity to the small town of

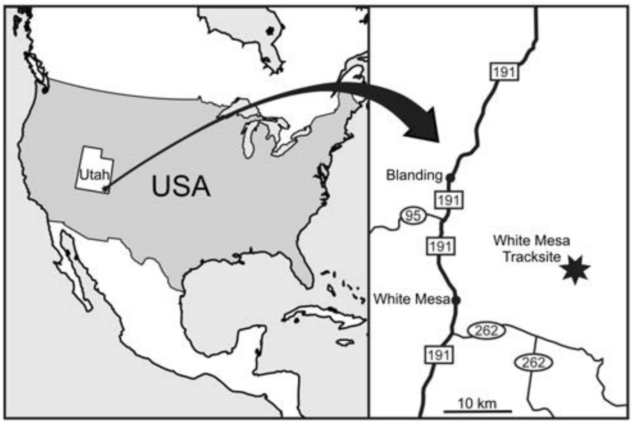

Fig. 1. The new White Mesa Tracksite (LACM 7710) in the Burro Canyon Formation is located in the southeastern corner of Utah, near the towns of Blanding and White Mesa.

White Mesa, San Juan County. Bureau of Land Management regulations does not permit publication of precise site location, but the location data can be obtained from the Natural History Museum of Los Angeles County, site number LACM 7711. All tracks reported in the present study were collected from lands administered by the US Bureau of Land Management and are now part of the collection of the Natural History Museum of Los Angeles County (LACM 154070–154075, 154078, 154079, 154081–154084, 154086–154088 and 154322); two large sauropod pes casts were left in the field due to their size, weight and inaccessibility.

GEOLOGICAL SETTING

The White Mesa Tracksite is located in the lower part of the Lower Cretaceous Burro Canyon Formation, to the east of White Mesa and Blanding, Utah (Fig. 1). The tracks are in a laterally extensive, relatively flat-bedded sandstone bed that lies at the top of a gravelly, trough cross-bedded sandstone 3–7 m thick that was deposited as the first unit above the unconformity at the top of the Upper Jurassic Morrison Formation (Fig. 2A, B). This occurrence, at the top of a fining-upward sequence, represents the typical context for a track assemblage as it indicates that tracks were made during a hiatus following a depositional event.

The Burro Canyon Formation was first described near Slick Rock in west-central Colorado by Stokes and Phoenix (1948). It is a fluvial unit that consists of pebbly channel sandstones and green floodplain mudstones. Stokes (1949, 1952) also described the contiguous Cedar Mountain Formation in east-central Utah (Kirkland *et al*., 1997, 1999; Kirkland and Madsen, 2007). These formations are distinguished on the basis of thickness, pebble size, and palaeocurrents (Craig, 1981). According to Craig (1981), both units were deposited atop the Upper Jurassic Morrison Formation and formed a broad alluvial plain, with rivers flowing from highlands to the south, depositing the sediments of the Burro Canyon Formation, while those flowing to the west deposited the material of the Cedar Mountain Formation. The southwest-flowing (modern) Colorado River has served as the arbitrary boundary between the Cedar Mountain (northwest) and Burro Canyon (southeast) Formations (Craig, 1981). The Burro Canyon Formation is not present south of the San Juan River in southern Utah (Fig. 2C).

Stratigraphic data on the Burro Canyon Formation in the Blanding region is almost completely lacking, as very little research has been done. Although not followed by subsequent researchers, Young (1960, fig. 12) combined the Burro Canyon Formation with the previously named Cedar Mountain Formation. His section 76 was measured in section 12, T. 37 S., R. 22 E. about 5 km (3 miles) south of Blanding and consisted of three sandstone units totalling about 30 m thick with his middle sandstone (Young, 1960, fig. 12) correlated to the Poison Strip Sandstone Member of the Cedar Mountain Formation in the Arches National Park region (Kirkland, 1997, 1999). A more detailed stratigraphic section of comparable thickness consisting mostly of sandstone was described by Kirby (2008) from a site about 5 km (3 miles) northwest of Blanding (Fig. 2A).

The basal unit of the Burro Canyon Formation is a trough cross-bedded conglomeratic sandstone that varies from about 1 m thick on the north end of the observed outcrop to more than 6 m thick about 100 m to the north. It overlies the Morrison Formation unconformably. The tracksite is in a wavy to flat-bedded medium-grained sandstone 1–2 m thick that forms the top of the exposed Burro Canyon Formation at the tracksite locality (Fig. 2D). These sandstones apparently represent the lower Cedar Mountain Sandstone of Young (1960). A sample of the track-bearing sandstone was sampled for detrital zircons to provide an estimate of the site's maximum age (Dickenson and Gehrels, 2008, 2010). The sample was processed by Apatite to Zircon, Inc. in Viola, Idaho. The two youngest zircon U-Pb dates were 130.17 Ma and 131.03 Ma with five additional young zircons ranging in age from 139.57–137.68 Ma (the complete set of data is on file with the Utah Geological Survey). These ages are surprisingly old as the oldest maximum ages published for Cedar Mountain Formation sandstones from the upper Yellow Cat Member have been about 124 Ma (Greenhalgh *et al.*, 2006; Greenhalgh and Britt, 2007; Britt *et al.,* 2009). However, short episodes of volcanic activity have been documented at 131 Ma and 139 Ma by Hunt *et al.*, (2011). A recent study has dated the base of the Yellow Cat Member to 139.7 Ma, and the top of the Member to 137.2 Ma, pushing the date even further back and narrowing the depositional gap to the Morrosin Formation (Hendrix, 2015). The zircon data from the tracksite sandstone are interpreted as representing a population of zircons postdating 130 Ma and predating 124 Ma and thus represents a Barremian age for the lower sandstone of the Burro Canyon Formation in the Blanding area (Ogg and Hinnov, 2012).

With the exception of a dinosaur site high in the Burro Canyon Formation, in strata equivalent to the Aptian-Albian Ruby Ranch Member of the Cedar Mountain Formation at Hotel Mesa on the east side of the Colorado River northeast of Moab, Utah, near Dewey Bridge (Kirkland *et al*., 1997; Taylor *et al*., 2011), no fossils had been previously reported from this formation in Utah. All other reports of Burro Canyon fossils have been in western Colorado and consist of

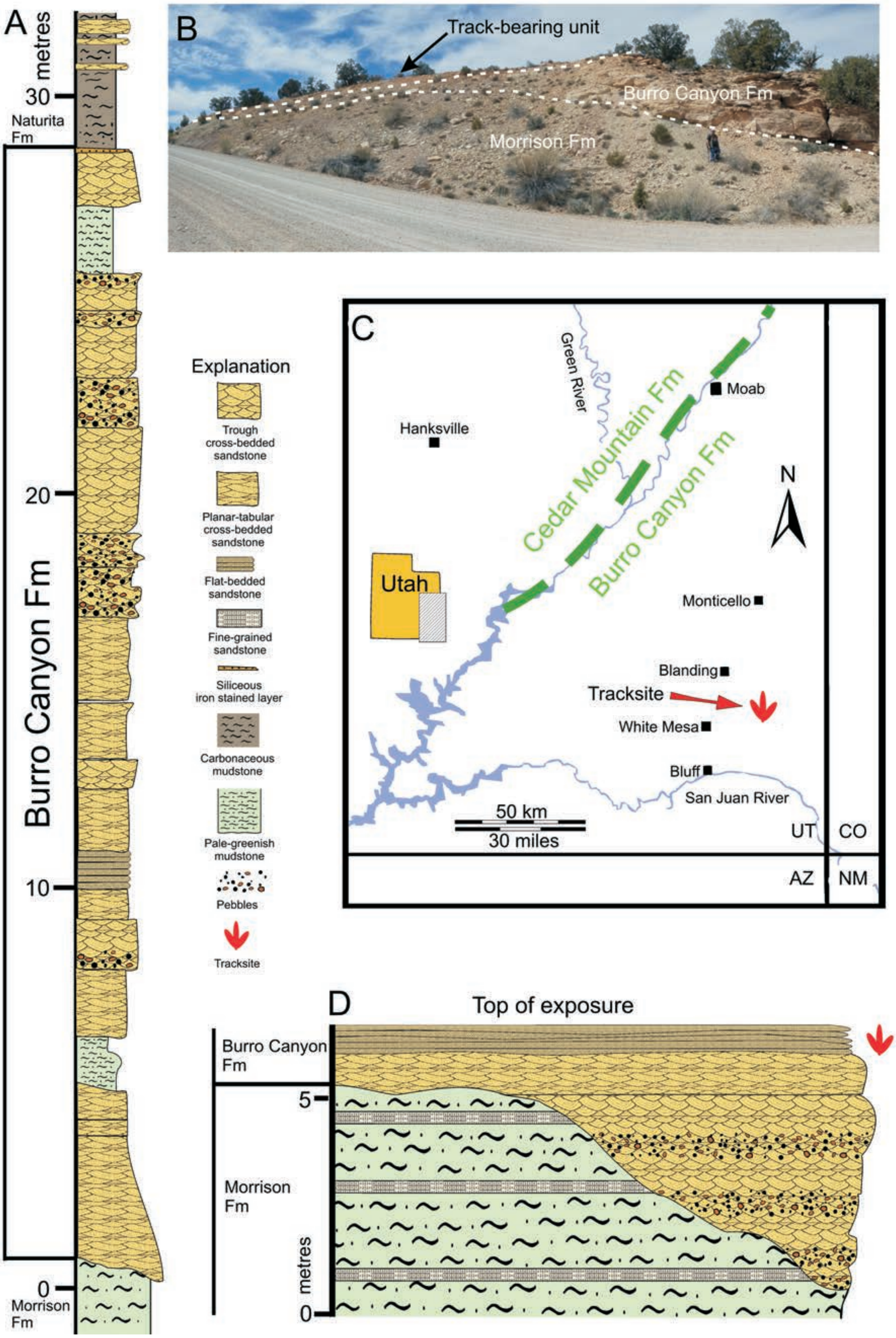

Fig. 2. Stratigraphy and location. **A.** Stratigraphic section of the Burro Canyon Formation northwest of Blanding Utah. Use of "Naturita" following Young (1960) and Carpenter (2014), Data from Kirby (2008). **B.** Outcrop viewed from the northeast showing distribution of major lithostratigraphic units. **C.** Map of south-eastern Utah with geographic relationships of the Cedar Mountain and Burro Canyon formations indicated. **D.** Stratigraphic relationships of major lithostratigraphic units in B, and location of the tracksite indicated by footprint silhouette.

Table 1

Measurements of the described tracks

Identification	Figure	LACM Nr.	Length	Width	L/W	Div°. II-IV
Theropod	3A	154082	57	50	1.14	53
Theropod	3B	154073	43	36	1.19	30
Theropod	3C	154022	52	31	1.68	32
Theropod	3D	154071	27	19	1.42	-
Theropod	3E	154078	19	16	1.19	51
Theropod	3F	154081	29	20	1.42	46
Sauropod manus	4A	154083	29	51	0.57	-
Sauropod manus	4B	154075	39	49	0.80	-
Sauropod manus	4C	154074	33	42	0.79	-
Sauropod manus	4D	154088	14	22	0.64	-
Sauropod pes	4E	154087	36	28	1.29	-
Sauropod pes	4F	-	65	51	1.27	-
Sauropod pes	4G	-	76	49	1.55	-
Ornithopod	5A	154079	37	34	1.09	70
Ornithopod	5B	154086	32	30	1.07	68
Ornithopod	5C	154070	18	19	0.95	73
Thyreophor	6	154084	32	23	1.39	-

rare compressed plant fossils, ganoid fish scales, freshwater molluscs, and ostracods (Stokes, 1952; Simmons, 1957; Young, 1960).

TRACKS FROM THE WHITE MESA TRACKSITE

All tracks from the White Mesa assemblage were found at a construction site where the trackbearing layer of sediments had been broken up and bulldozed, and thus their individual associations could not be mapped. All tracks are preserved as natural casts, and as such their mode of preservation is different from tracks found at the Mill Canyon Dinosaur Tracksite north of Moab, which is the largest and most diverse assemblage presently known from the Cedar Mountain Formation (Lockley *et al*. 2012, 2014a). As shown in Figures 3–6 and Table 1, 17 identifiable individual tracks have been illustrated. Six represent theropods, seven sauropods, three ornithopods and one thyreophoran. This distribution can be taken as a crude proxy census of the dinosaur diversity represented in this ichnoassemblage.

Theropod tracks

Description: Six mesaxonic tracks (5 tridactyl and 1 didactyl) – with long slender digit impressions, were collected. The tracks range in length from 19 to 57 cm; all of them are longer than they are wide, width a length/width ration from 1.14–1.68 (Table 1) and some show evidence of laterally compressed claws (Fig. 3). The divarication angle between digits II and IV in the specimens are low from 30–53°(Table 1). Track D, is apparently didactyl, as the cast is complete without any evidence of a broken, or missing digit (Fig. 3D). The metatarso-phalangeal region – the “heel” of the tracks – is asymmetrically developed , with the pads of digit IV protruding further backward than digit II. Where preserved, the impressions of claws are short and triangular, and the claw of digit III is off-set towards one side (Fig. 3B). One track has a peculiar lateral swelling in the mid-distal part of digit III, which doubles the width of the digit impression (Fig. 3C).

Discussion: Tracks of theropod dinosaurs are characterized by being functionally tridactyl, longer than wide, with long, narrow, often tapering digits usually ending in long, sharp claw impressions. The “heel” of the tracks, or to say it more formally, the area of the metatarsal-phalangeal joint, is asymmetrically developed, as the impression of digit IV extends further backward than the impressions of digits II and III (Moratalla *et al.,* 1988; Thulborn, 1990; Lockley, 1991; Castanera *et al.,* 2013). The divarication angle between digits II and IV characteristically is 50–60°, but can be as low as 30° and up to 75° (Thulborn, 1990). Theropod trackways are typically narrow-gauged, with high pace angulations, approaching 180° and a tendency for the feet to show little discernible inward rotation (Moratalla *et al.,* 1988; Thulborn, 1990; Lockley, 1991). The tracks from the White Mesa assemblage are all tridactyl, mesaxonic, longer than wide, with long slender digit impressions terminating in claws, and a low divarication angle between 30–53°, and an asymmetrically developed metatarsal-phalangeal joint. This helps confidently identify the tracks as theropodan. The largest and best-preserved track assemblage (Fig. 3A) resembles the largest morphotype found from the contemporary Mill Canyon Dinosaur Tracksite (Lockley *et al*., 2014a, b), which has been assigned to the ichnogenus *Irenesauripus*. The other tridactyl tracks are variable in shape, in part due to preservational factors, and are not assigned to any specific ichnotaxon.

In contrast to the typical tridactyl morphology of most theropod tracks, dromaeosaurian tracks have been shown to be functionally didactyl, as reviewed by Lockley *et al. (in press*). One apparently complete and deeply impressed didactyl track could, very tentatively, be attributed to a dromaeosaurid (Fig. 3D). Although possible dromaeosaurid tracks were reported from isolated impressions at the Arches National Monument site (Lockley *et al*., 2004), the only convincing examples of dromaeosaurid tracks (ichnogenus *Dromaeosauripus*) preserved as clear trackways come from the Mill Canyon Dinosaur Tracksite (Lockley *et al*., 2014a, b). These tracks are very slender with diagnostic digital pad traces for digits III and IV and other diagnostic features such as the proximal trace of digit II without any corresponding distal trace. Although we consider the apparently didactyl cast illustrated here – difficult to identify with confidence, the only confirmed didactyl theropod (dromaeosaurid) tracks from North America currently know are from this time interval.

The lateral swelling in the mid-distal part of one of the theropod tracks (Fig. 3C) could indicate a pathological condition. Injuries to the digits are known from a few occurrences of theropod tracks where the tracks bear direct evidence of limping gaits and displaced, or even missing, digit

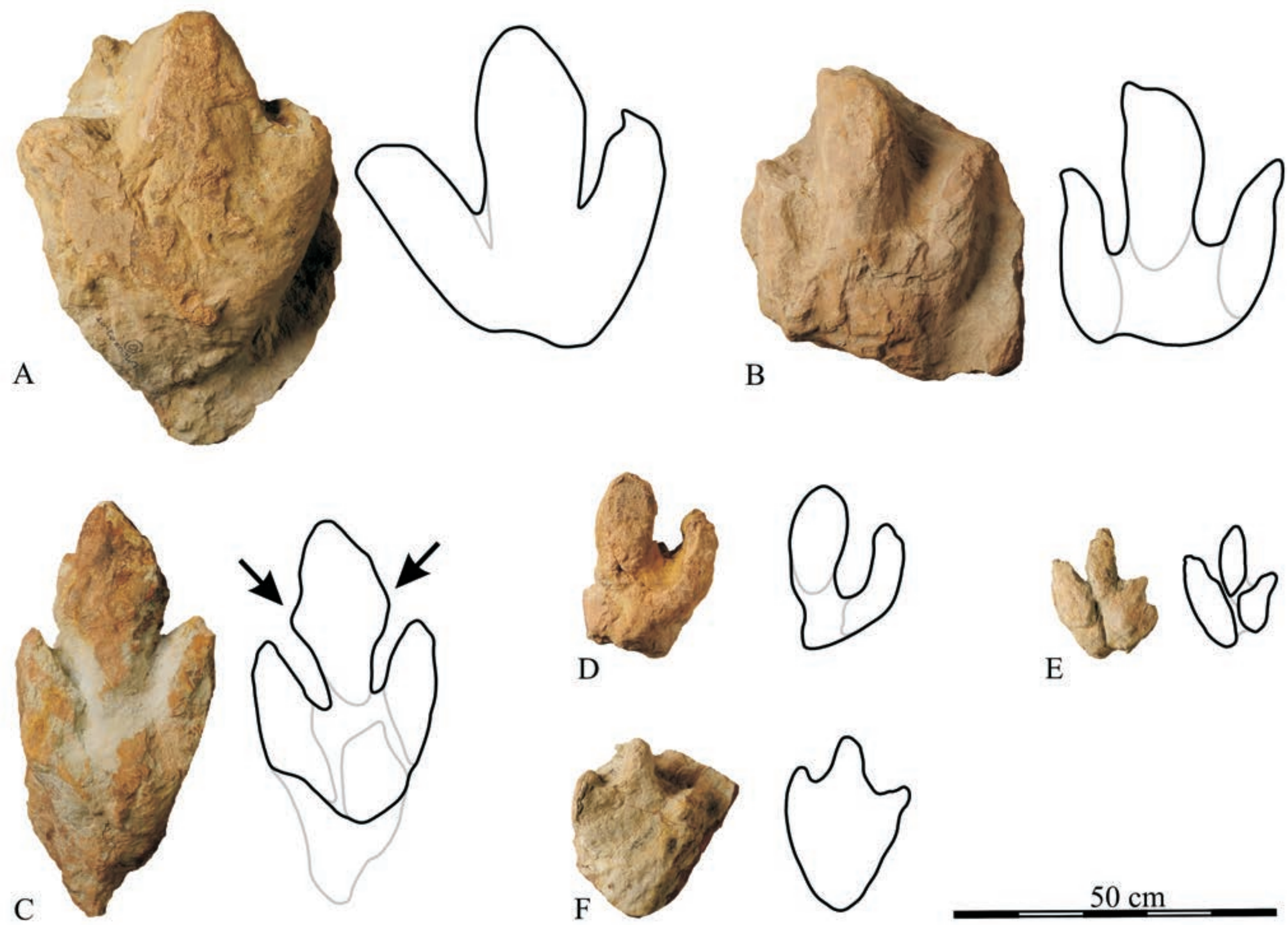

Fig. 3. Theropod tracks from the White Mesa Tracksite exhibit large morphological variation, suggesting s different trackmakers. **A.** Large track with broad digits (LACM-154082). **B.** Large track with relatively slender and parallel digits (LACM-154073). **C.** Large track with interpreted pathological swelling on digit III, indicated by arrows (LACM-154322). **D.** Didactyl track of possible dromaeosaurid affinity (LACM-154071). **E.** Small track with clear divisions between the individual digits (LACM-154078). **F.** Small track with relatively short digits (LACM-154081). All specimens are reproduced to same scale.

impressions (e.g., Ishigaki, 1986; Lockley, 1991; Lockley *et al*., 1994; McCrea *et al*., 2015). A well-preserved skeleton of a sub-adult *Allosaurus fragilis* Marsh from the Upper Jurassic Morrison Formation of Wyoming shows a pathology in the pedal phalanx III-1 that has caused exosteal growth and inflammation of the phalanx to such a degree that it must have enlarged the diameter of the digit to the point of rubbing against digits II and IV (Hannah, 2002). With the swelling caused by the inflammation of the soft tissue, it is likely that the animal would have produced a track similar to the one found in the Burro Canyon Formation (Fig. 3C). Thus we carefully interpret the lateral widening of the digit impression as the result of a trauma of the digit III. However, as the track was found isolated and not as part of a trackway, the possibility that it represents a local preservational phenomenon cannot be excluded.

Sauropod tracks

Description: Seven sauropod tracks were recorded: four manus and three pes print casts (Fig. 4). The manus casts differ morphologically from each other in that they range from wide and banana-shaped with a concave posterior (Fig. 4A) to elongate crescent-shaped also with a concave posterior (Fig. 4B), and to more hoof-shaped or semicircular (Fig. 4C, D). All show evidence of a short, triangular, inward-facing pollex claw. The manus tracks are up to 51 cm wide and are all significantly wider than long (Table 1).

The pes casts are variable in shape, from elongated bean-shaped (Fig. 4G) to more rounded and subcircular (Fig. 4F), to sub-triangular in shape (Fig. 4E). The two largest casts show the diagnostic pentadactyl configuration with the traces of digit I–III claws recognizable, though somewhat eroded (Fig. 4F,G).

Discussion: Sauropods show a strong degree of heteropody between their pes and manus tracks. The pes track is elongated, entaxonic, and can display from three to five short outward-rotated digit impressions. The manus track is crescent shaped, normally without indications of free digits, except for, in some genera, a prominent inward-directed pollex claw (Thulborn, 1990; Lockley, 1991; Lockley *et al.,* 1994b; Wright, 2005). The manus-pes size ratio varies from 1:2 (Santos *et al.,* 1994) up to 1:5 (Lockley *et al.,* 1994b), and sauropod trackways can be broadly divided into wide-

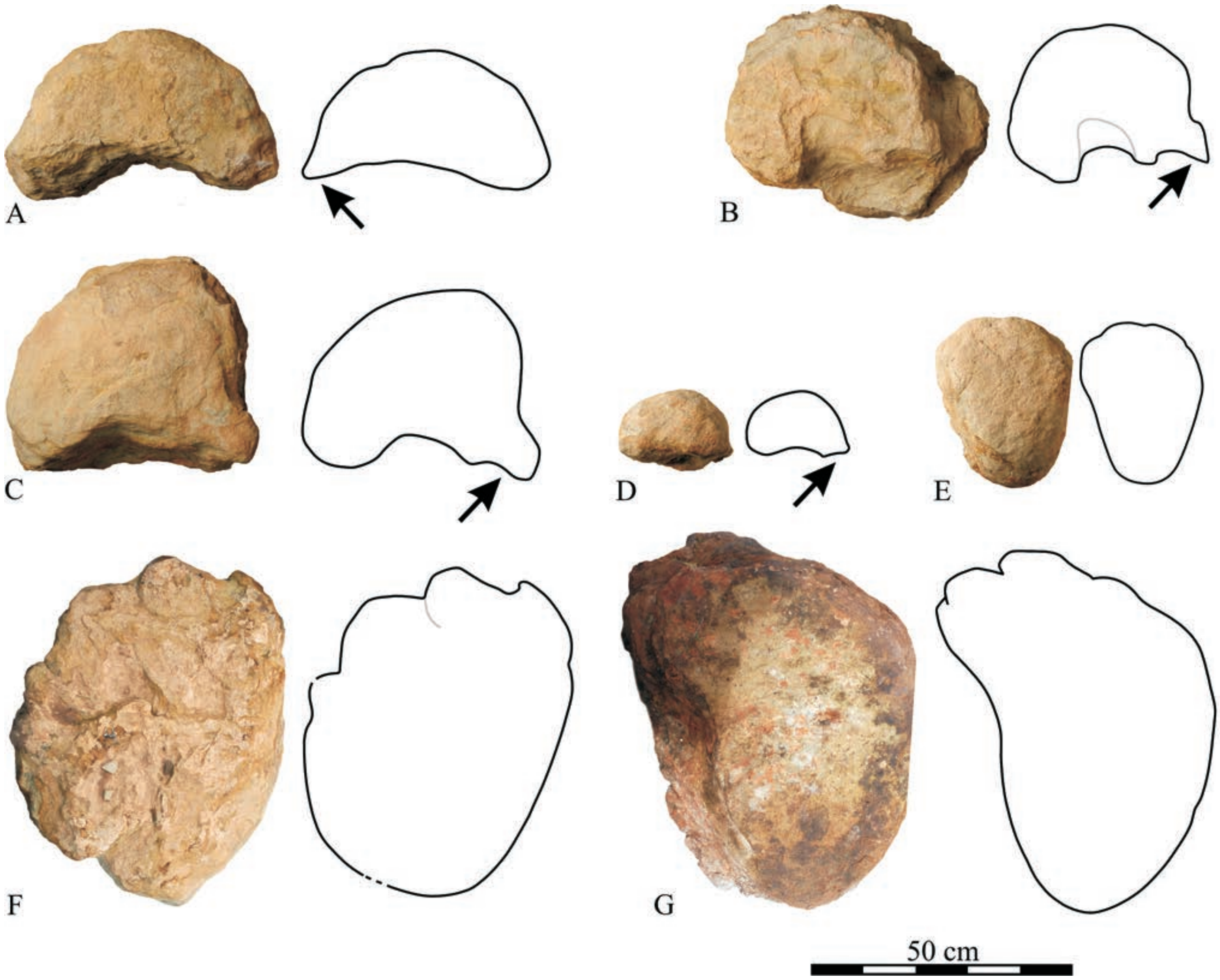

Fig. 4. Casts of sauropod manus prints (A–D) consisting of three distinct morphologies. **A.** Narrow, banana-shaped (LACM-154083). **B.** Crescent-shaped (LACM-154075). **C.** Large hoof-shaped (LACM-154074). **D.** Small hoof-shaped (LACM-154088). All manus casts show evidence of a short, inward-facing pollex claw (arrows). Pes casts ranging from 32 cm to 72 cm in length (E–G). **E.** Small sauropod pes cast with weak indications of digit impressions (LACM-154087). **F.** Large sub-circular pes cast with clear evidence of short outward-rotated digits. **G.** Large bean-shaped pes cast with indications of short, blunt digits. All specimens are reproduced to same scale

and narrow-gauge trackways (Lockley *et al.,* 1994b). The White Mesa specimens are all interpreted as manus and pes casts of different sizes and perhaps taxa of sauropod trackmakers, although the possibility exists that the small specimens might originate from non-sauropod trackmakers.

Ornithopod tracks

Description: Ornithopod tracks were found with lengths from 18 to 37 cm and they are characterized by being about as wide as long, having short, broad digits with blunt digit terminations. The divarication angle between digits II and IV are high from 68°–73° (Table 1). The "heel" area is symmetrically rounded. All the collected ornithopod casts were somewhat eroded, and do not reveal much anatomical details of the feet of the trackmakers (Fig. 5).

Discussion: Ornithopod tracks are tridactyl, mesaxonic and generally as wide or wider than they are long, the digits are short and rounded and, when present, the imprints of the claws or unguals are blunt and rounded. The "heel" of the tracks is symmetrically tapered to rounded, or sometimes with a bilobed morphology, and the divarication angles between digits II and IV are normally in excess of 60°. The trackways are wider than those of theropods, with lower pace angulations, and the feet often show an inward rotation (Moratalla *et al.,* 1988; Thulborn, 1990; Lockley, 1991).

The White Mesa specimens, with their high divarication angle, short, blunt digits, and general dimensions with a length/width relation close to 1 (Table 1), fall well within the morphospace that characterize ornithopod tracks (e.g., Moratalla *et al.,* 1988; Thulborn, 1990; Lockley, 1991, Castanera *et al*., 2013). The medium- and largest-sized casts are morphologically similar to the ornithopod tracks from the Mill Canyon Dinosaur Tracksite, although the latter are preserved as impressions, not casts. They represent small to medium-sized animals.

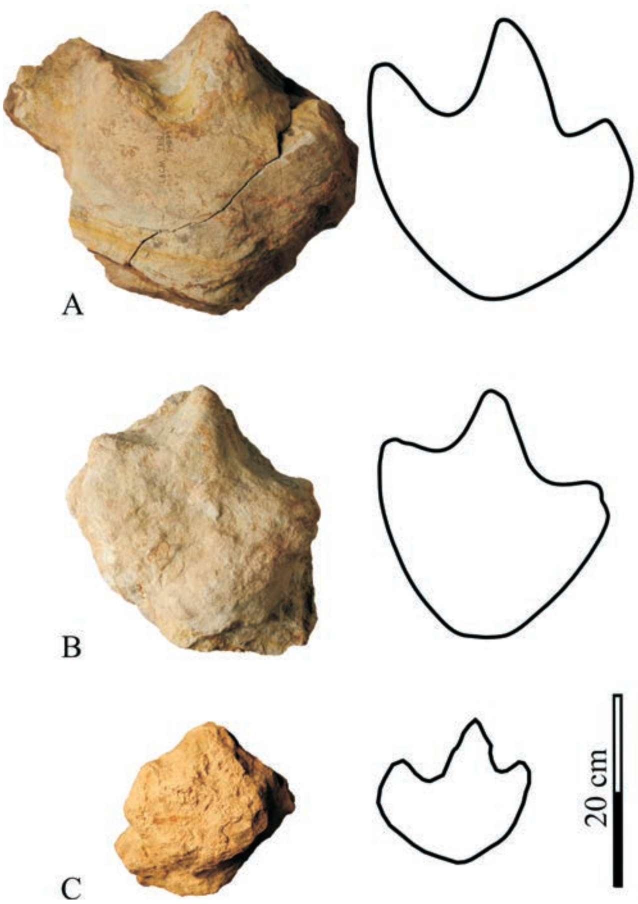

Fig. 5. Three natural casts of ornithopod tracks. Despite their different sizes, their overall dimensions are very similar. **A.** LACM-154079. **B.** LACM-154086. **C.** LACM-154070. All specimens reproduced to same scale.

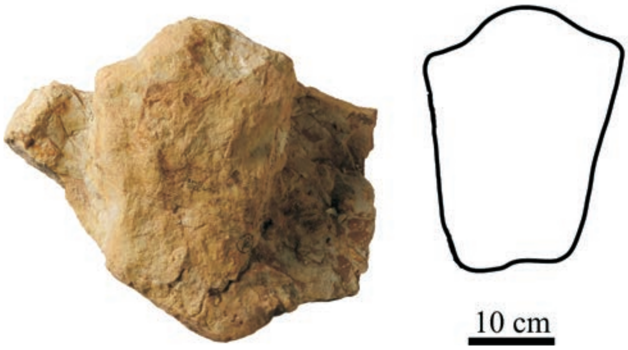

Fig. 6. Possible thyreophoran track cf. *Deltapodus* (LACM-154084) with highlighted outline showing the characteristic delta shape with short, blunt digits.

? Thyreophoran track

Description: Only a single presumed thyreophorean track was found at the White Mesa Tracksite. It is a natural cast of elongate track with evidence of three short, blunt digits (Fig. 6). The cast is mesaxonic, sub-triangular in shape, being widest across the digit impressions and tapering towards the "heel". The specimen measures 32 cm in length and is 23 cm across the widest point. The distal parts of the digits are impressed to a depth of 13 cm and the cast gradually shallows to 6 cm at the heel area.

Discussion: Thyreophorean and especially stegosaur tracks are poorly known in the fossil record, and some confusion exists about the identification of stegosaur tracks (Thulborn, 1990; Whyte and Romano, 1994, 2001; Lockley and Hunt, 1998; Long, 1998; Gierlinski and Sabath, 2002, 2008; Lires *et al*., 2002; García-Ramos *et al*., 2006, 2008; Whyte *et al.,* 2007; Lockley *et al.,* 2008; Milàn and Chiappe, 2009; Mateus *et al.,* 2011; Xing *et al*., 2013). The tracks named as *Deltapodus brodricki* (Whyte and Romano, 1994, 2001) however, are a close fit for the flesh-out morphology of the stegosaur pedal skeleton. *Deltapodus* is characterized by entaxonic, crescent shaped manus impression that is approximately twice as wide as long, and may have the impression of an inward directed pollex claw. The pes of *Deltapodus* is generally triangular to sub-triangular in outline, tridactyl and mesaxonic, with impressions of short, bluntly rounded digits and a maximum width across the base of the digit impressions (Whyte and Romano, 1994). Other tracks attributed to thyreophoreans have longer digits on the pes, are tetradactyl, and have pentadactyl manus prints and include the ichnogenera *Stegopodus* and *Tetrapodosaurus* which appears to be less common globally than *Deltapodus* (Lockley and Hunt, 1998; Milàn and Chiappe, 2009; Cobos *et al.,* 2010). Based on the morphology of the cast, we tentatively interpret the White Mesa specimen as a *Deltapodus* pes cast.

DISCUSSION

Stratigraphy and sedimentology

The sedimentological context of the tracks, at the top of the first major depositional unit of the Burro Canyon Formation, indicates that they were formed after the first influx of Burro Canyon sediments: i.e., at the top of a fining-upward sequence; they represent the first hiatus in deposition. This is a common sedimentological context for track preservation. As noted below, although the stratigraphy of this region is poorly known, with the Burro Canyon Formation being a generalized name for the corresponding lithostratigraphic unit south and east of the Colorado River, and the Cedar Mountain Formation being the name used for partially equivalent units to the north and west, it is possible to infer the relationship of this unit to units in the better known Cedar Mountain Formation, and to compare the ichnofaunas from the two areas.

Fauna composition

The described track fauna indicates a diverse dinosaurian fauna, comprising theropods, sauropods, ornithopods, and possibly thyreophorans. The theropod tracks vary in size from small (19 cm) to very large (57 cm), and a possible didactyl track from a large dromaeosaurid (Fig. 3D) is also present. Sauropods are represented by tracks with pes lengths of 36–72 cm, and three distinct shapes of manus

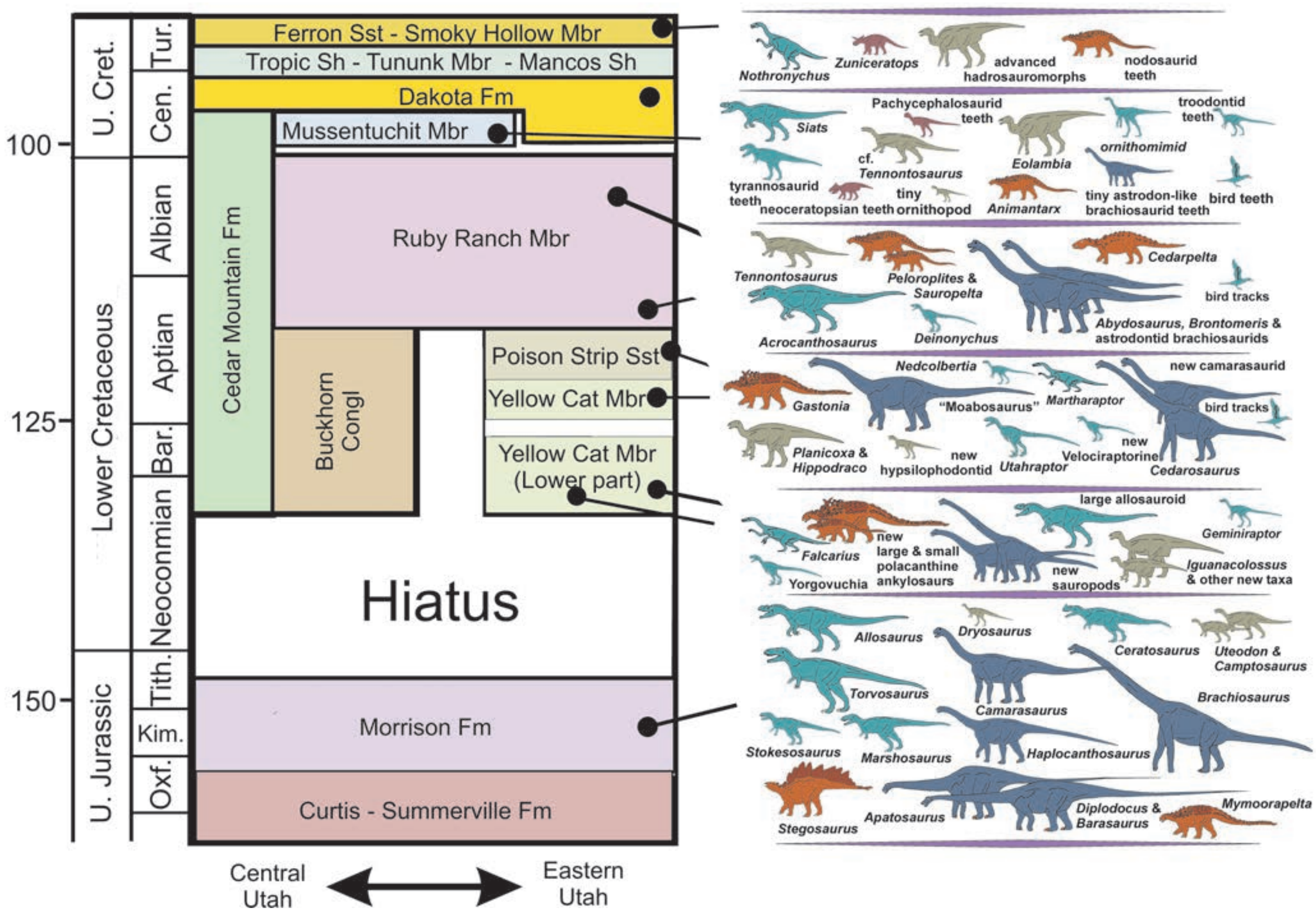

Fig. 7. The currently known, mid-Mesozoic dinosaur faunas of Utah. The tracks from the White Mesa Tracksite correspond in age and composition to the fauna known from the Yellow Cat Member of the Cedar Mountain Formation. Modified from Kirkland and Farlow (2012).

tracks (Fig. 4). Ornithopod tracks from 18– 37 cm in length indicate small to medium-sizes animals (Fig. 5). The theropod, sauropod and ornithopod tracks all indicate considerable variability in the size of the animals representing these three groups. The differential size and morphology of the theropod and sauropod casts could indicate different track-making taxa, different sizes (or age groups) of single taxa, or a combination of both size and different track-maker taxonomies.

Collectively the ichnofauna from the Burro Canyon Formation indicates a diverse fauna in which the major dinosaurian groups were represented by several animals of variable size and significant taxonomic diversity.

The contemporary Cedar Mountain Formation in the vicinity of Arches National Park (125 km north of our study site) has produced abundant Lower Cretaceous vertebrates in recent years from several stratigraphic intervals spanning the Barremian to the Albian (Kirkland *et al*, 1997, 1999; Kirkland and Madsen, 2007; Britt *et al*., 2009, Sprinkel *et al*., 2012). Aubrey (1996, 1998) has argued that the lowermost, sandstone-dominated portion of the Burro Canyon Formation in Colorado contains no Lower Cretaceous fossils and intertongues with smectitic muds of the Brushy Basin Member of the Morrison Formation, and concludes that these rocks should be placed within the Morrison Formation. This author (Aubrey, 1998; Ayers, 2004) has used a prominent calcrete to separate the Lower Cretaceous from the underlying Jurassic, but across central Utah a diverse dinosaur fauna has been recovered well below the calcrete (McDonald *et al*., 2010; Senter *et al*., 2010, 2012; Kirkland *et al*., 2012) and the Jurassic-Cretaceous boundary is defined on the presence of gravel-sized (~ 1 cm) pebbles as an important component of the strata, where a laterally extensive basal conglomerate is absent (Kirkland and Madsen, 2007; Hunt *et al*, 2011; Sprinkle *et al.*, 2012).

Given the Barremian age of the White Mesa Tracksite, and its potential correlation with the lower part of the Yellow Cat Member of the Cedar Mountain Formation, it is possible to restrict the dinosaur groups represented by the tracks at this locality to taxonomic groups known from skeletal remains in the Barremian "lower" Yellow Cat Member of central Utah. These dinosaurs include the dromaeosaurids *Utahraptor ostrommaysorum* and *Yorgovuchia doellingi*, the troodontid *Geminirator suarezarum*, the therizinosauroids *Falcarius utahensis* and *Martharaptor greenriverensis,* a large allosauroid, basal macronarian and titansauriform sauropods, polacanthid ankylosaurs, and primitive iguanodonts such as *Iguanacolosus fortis* and *Hippodraco scutodens* (Kirkland *et al*., 2005, 2012; McDonald *et al*., 2010; Senter *et al*., 2010, 2012).

CONCLUSIONS

The new ichnoassemblage reported from the White Mesa Tracksite comprises the first described dinosaur tracks from the Lower Cretaceous Burro Canyon Formation. This ichnofauna is composed of different-sized tracks belonging to theropods, sauropods, ornithopods, and possible thyreophorans. The age of the track-bearing layer is interpreted to be Barremian (Lower Cretaceous), based on zircon U-Pb geochronology. This layer is thus interpreted as contemporary with the Yellow Cat Member of the Cedar Mountain Formation. One large theropod track with a peculiar lateral swelling in the middle part of digit III is interpreted as evidence of a possible pathological condition. A track tentatively interpreted as *Deltapodus* is the second reported occurrence of the ichnogenus in the Cretaceous as all but one previous reports have been from the Middle to Late Jurassic. The new ichnoassemblage comprises a similar diversity of dinosaurs as the dinosaur fauna of the Yellow Cat Member of the Cedar Mountain Formation, thus demonstrating that the hitherto unknown dinosaur fauna of the Burro Canyon Formation in south-eastern Utah is consistent with that found in correlative units of the Cedar Mountain Formation of east-central Utah.

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