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JURASSIC DINOSAUR TRACKSITES FROM THE AMERICAN WEST

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Abstract—Middle Jurassic dinosaur megatracksites are rare in the Western Interior of the United States. This paper reports two previously unknown localities from the Bighorn Basin of northern Wyoming that constitutes the two most extensive Middle Jurassic tetrapod tracksites currently known in North America (Fig. 1). Track bearing horizons outcrop on Bureau of Land Management, National Park, and private lands throughout the basin. These trace fossils occur in carbonate units once thought to be totally marine in origin. The youngest (stratigraphically highest) of these occurs along a single horizon at or near the top of the "basal member" of the "lower" Sundance Formation (mid-Bathonian in age, ~167 ma) (Kvale, et al.,2001, Kvale, et al., 2001, Mickelson, et al., 2005). This discovery necessitates a major change in the paleogeographic reconstructions for Wyoming for this period. The older (stratigraphically lower) tracksites occur at multiple horizons within a 1 m interval (uppermost Bajocian in age, ~170 Ma) in the middle part of the Gypsum Spring Formation (Fig. 2) (Kvale, et al.,2001, Kvale, et al., 2001, Mickelson, et al., 2005).

Terrestrial tracks are tridactyl and attributed to small- to medium-size bipedal dinosaurs. At least some of these prints can be attributed to theropods. The Sundance tracks are represented primarily by digit impressions (Fig. 3), whereas both digit and heel impressions are preserved in some of the Gypsum Spring footprints (Fig. 4). Swim tracks of crocodile (Fig. 5) and possibly bipedal dinosaurs (Figs. 6A-B) are also present in the Gypsum Spring Formation.

Numerous similar trackways in the Sundance (Fig. 7) that trend in the same south-southwesterly direction may indicate gregarious animal behavior, the presence of a physically constrained path-way (e.g. along a tidal flat), subject to repetitive visitation by a small number of individuals. The northwest-southeast trending orientations of ripple crests on the Sundance surface in the Bighorn Basin trend have a slight asymmetry to the northeast. This indicates that open water conditions existed to the southwest. As such, the south-southwesterly trend of the majority of the trackways in the Bighorn Basin indicates that the animals were moving towards the local shoreline and not parallel to it. This implies that the pathways may not have been constrained physically. If the animals were moving towards the water this suggests, but certainly does not confirm, that these animals may have been swimmers or waders (Kvale, et al.,2001, Kvale, et al., 2001, Mickelson, et al., 2005). Moreover, one may infer that fish may have been a major food source for these opportunistic animals along the Sundance Sea shoreline (Kvale, et al., 2001, Kvale, et al., 2001, Kirkland, et al., 2005, Mickelson, et al., 2005).

Similarities between the two megatracksites include their formation and preservation in upper intertidal to supratidal sediments deposited under at least seasonally arid conditions. Microbial mat growth and salt crystals forming on the ancient tidal flats apparently initiated the preservation of these prints (Fig. 7). Penecontemporaneous microbial mats and the formation of salt crystals also prevented the initial reworking of the track-bearing surface by wind- or water driven currents (Kvale, et al., 2001).

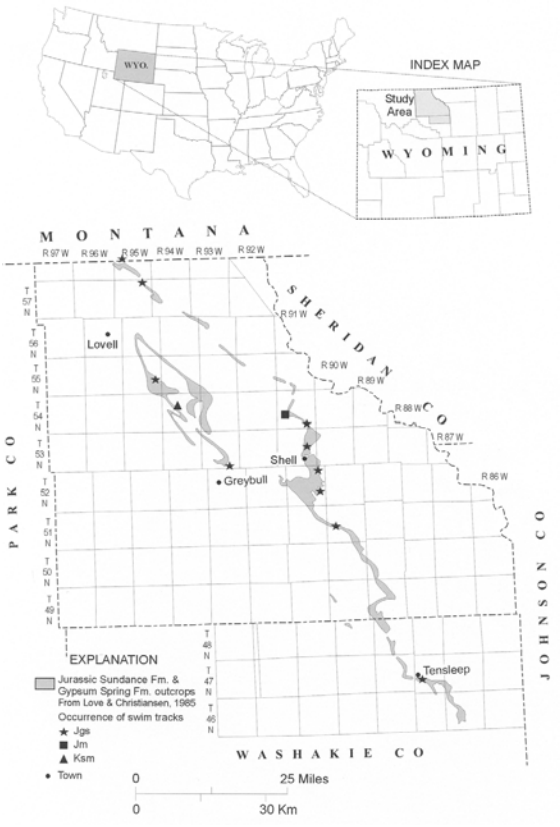

FIGURE 1. Map of the northeastern part of the Bighorn Basin, northern Wyoming, showing the distribution of the Sundance and Gypsum Spring formations with exposed track surafces.

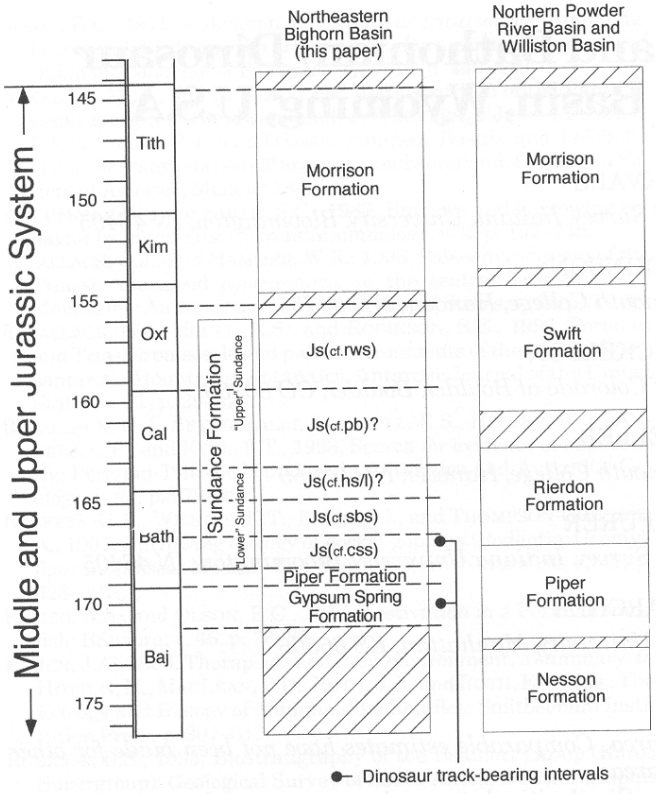

FIGURE 2. Generalized Jurassic stratigraphy of the northeastern Bighorn Basin and adjoining areas, Wyoming and Montana.

FIGURE 3. Sundance Formation tracks. Preserved as a concave epirelief impression, this track is one of several hundred. The majority of the Sundance tracks have no functional heel preserved.

FIGURE 4. Gypsum Spring Formation tracks. The footprint, preserved as a cast from a single block of calcareous sandstone, is that of a small gracile-like dinosaur similar morphologically to Grallator tracks. This track differs from the vast majority of Sundance tracks in that it preserves a heel-like impression.

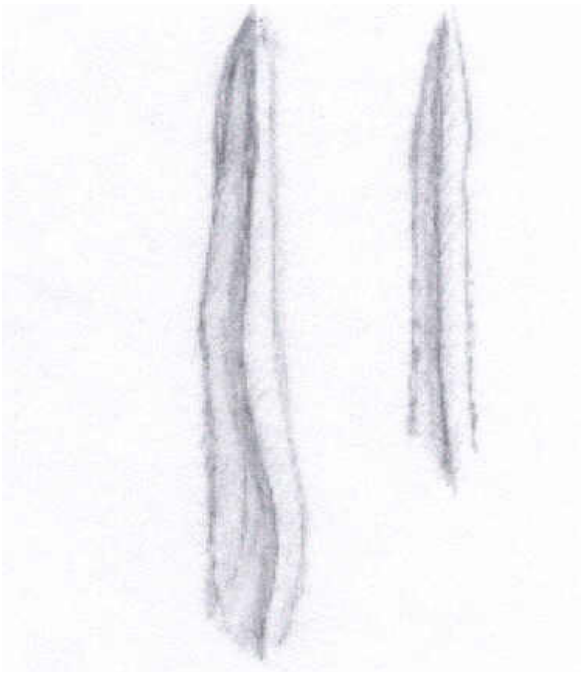

FIGURE 5. Illustration of a possible swim track of a bipedal dinosaur. The traces are mostly paired and sometimes single and rarely in threes, linear, grooves. The outer grooves are sub-equal in length, relative to the center groove when all three digits are preserved.

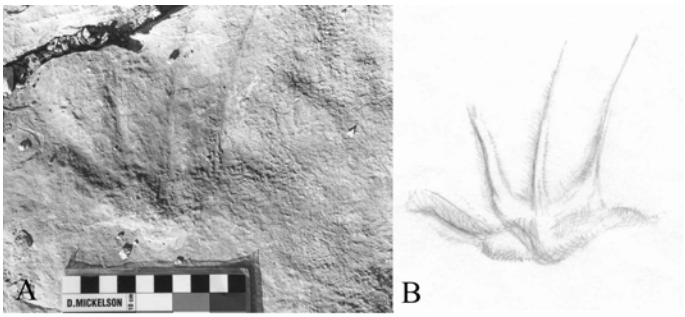

FIGURE 6. **A**, Photo and **B**, companion illustration of a crocodile pes track. Preserved are all 5 digits. Crocodiles have 4 digits on their manus and 5 digits on their pes.

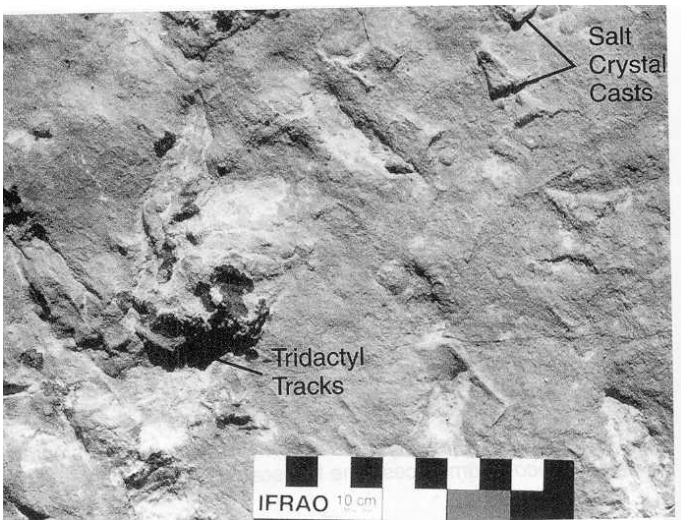

FIGURE 7. Salt crystal casts to the right of a tridactyl dinosaur footprint.

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