

Sauropod Tracks or Mud Bubble Fountains?—High Resolution Photogrammetry Provides Insights into Formation of Enigmatic Sedimentary Structures

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The Kayenta Formation (~184 Ma) outcrops on the Colorado Plateau in Arizona preserves an exceptional array of theropod trace fossils in fluvial-lacustrine strata. The famous “Tuba City” or Moenave tracksite lies in close geographic association with perplexing sedimentary structures bearing a superficial resemblance to sauropod tracks—based on size and relative regularity of shapes. ¹ The bed sits in an apparent transgressive-regressive cycle with the structure bearing sandstones being part of the lacustrine transgressive sequence. Yet, numerous problems concerning the morphology and origin of the structures remain, including: (1) the structures resemble indentations around which a rim is inverted like a meteor impact apron; (2) sedimentary characters suggest repeated events rather than single mechanical stress; and (3) they lack finer anatomical points, bearing no claw marks or indentations suggesting differentiated digits. To address this issue, we compared high-resolution photogrammetric models of rim structures with both sauropod and elephant footprints, providing both a modern and paleo-analog. New quantitative measurements suggest they differ in rim morphology and viable emplacement strategy from that would be expected of tracks. Instead, we hypothesize that the structures represent large mud bubble traces. These formed through upwelling gas and mud forming bubbles that burst, creating the rimmed, ropey texture of the outermost layers and establishing the dynamic structure necessary to preserve a sharp vertical orientation of the innermost layer. Methane from underlying lacustrine strata provide a possible source of the gas. Future tests of this hypothesis include observing modern example and the experimental formation of mud bubbles—all of which can help provide a potential high-resolution snapshot of the area's surface and diagenetic climate at the time of formation.

¹Olsen et al., 2019, Fieldtrip for the for the ICDP-EarthRates CPCP2/EMCT Workshop

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