

## **Paleoenvironmental Associations of Trace Fossils in the Upper Devonian Catskill Formation of North-Central Pennsylvania, USA**

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The distribution and tiering of continental trace fossils preserves the behavioral responses of ancient organisms to such environmental parameters as soil moisture, soil oxygenation, and height of the paleo-water table. These parameters in alluvial settings are dependent upon proximity to a fluvial channel and to climate, which controls the groundwater profile. The Upper Devonian Catskill Formation (CF) in north-central Pennsylvania comprises a thick succession of fluvial channel sandstones and overbank deposits that were pedogenically modified to varying degrees. Overbank deposits are characterized by purple and red laminated mudstones, sandstone-siltstone interbeds and well-churned paleovertisols. These strata contain a suite of ~7 ichnotaxa representing behaviors of organisms that inhabited channel and floodplain environments. Poorly developed floodplain paleosols and pedogenically modified channels are characterized by 1-5-mm-thick, brown, clay-filled rhizoliths, rare 1-3 cm diameter brown clay-filled and drab rhizoliths, small backfilled burrows assigned to *Naktodemasis*, *Beaconites*, lungfish burrows, *Diplichnites* trackways, and in-place stump casts. Burrows and rhizoliths are usually preserved in full relief. Nonpedogenically modified channels are characterized by bivalve burrows preserved in convex hyporelief and 1-3-mm-thick clay or sand-filled rhizoliths along bar tops. Ichnoassemblages in well-developed floodplain paleovertisols are similar to those of poorly developed paleosols, but they contain abundant drab rhizoliths >1cm in diameter and rare, passively infilled vertical burrows of unknown ichnotaxonomic affinity. Backfilled burrows are often absent from these units, resulting from thorough churning of the sediment by bioturbation and shrink-swell of clays. Small, backfilled burrows and *Beaconites* always co-occur with rhizoliths, indicating that they were constructed during periods of subaerial exposure of alluvial sediments. Lungfish burrows nearly always co-occur with and are crosscut by rhizoliths and commonly contain caliche, indicating that they were pedogenically modified during seasonal low water table levels. CF traces appear to be weakly to moderately tiered, consistent with tiering in other seasonally wet-dry alluvial settings. The distribution of CF traces indicates the specific preferences for moisture and medium consistency by organisms in alluvial settings, and that they were part of the pedogenic process in the Late Devonian.