

Invertebrate and Vertebrate Ichnofossils from the Lower Part of the Upper Cretaceous Cantwell Formation, Denali National Park and Preserve, Alaska: Insights into the Paleoenvironments, Paleohydrology, and Paleoclimate of High Latitude Continental Paleoecosystems

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The fluviially dominated lower part of the Upper Cretaceous Cantwell Formation, Denali National Park, has produced invertebrate and vertebrate ichnofossils, including insect trails and trackways, beetle and soil bug backfilled burrows, crayfish burrows, fish swimming trails, and footprints and trackways of pterosaurs, theropods, ornithopods, birds, and possible mammal burrows. Ichnofossil are paramount to understand better Late Cretaceous high latitude paleoenvironments because trace fossils serve as proxies for body fossils, paleohydrology, incipient soil development, and paleoclimate indicators. Invertebrate ichnofossils are analogous to traces produced by: (1) extant nematodes (Animalia: Nematoda) = thin-diameter *Cochlichnus* and *Unisulcus*; (2) aquatic oligochaetes (Annelida: Oligochaeta) = large-diameter *Cochlichnus*; (3) mud-loving beetles (Coleoptera: Heteroceridae) = *Steinichnus*; (4) midge fly larvae (Diptera: Chironomidae) = short U-shaped, small-diameter burrows rarely with a bottom; (5) tubificid worms (Oligochaeta: Tubificidae) = short, thin vertical burrows similar to *Trichichnus*; (6) mayflies (Insecta: Ephemeroptera) = short, U-shape, large diameter burrows similar to *Arenicolites*; (7) biting midge larvae (Diptera: Ceratopogonidae) = irregular surface trails similar to *Haplotichnus*; (8) grasshoppers or crickets (Orthoptera: Gryllidae, Acrididae) = hopping traces as cm-scale cf. *Saltator*; (9) crayfish burrows as subvertical, large diameter, 20-50 cm deep burrows = *Camborygma*; (10) clam resting burrows as large-diameter, crescent-shaped, shallow burrows = *Lockeia*; and (11) backfilled meniscate burrows and backfilled burrows produced by beetles and soil bugs = *Naktodemasis* and *Beaconites*, respectively. Most potential tracemakers are known from Cretaceous amber and compression fossils. Swimming trails produced by ray-finned and lobe-finned fishes assigned to *Undichna* occur in black siltstone and shale and interbedded sandstone-mudstone. Small mammals likely produced subhorizontal burrows 12-15 cm in diameter with longitudinal scratch marks. Bird footprints preserved as six morphotypes record various behaviors and sizes of birds. A megatracksite records hundreds of hadrosaur footprints in four different sizes, suggesting postnatal supervision and social behavior. Ichnofossils suggest that organism activity was occurred in fluvial sediments during the summer months when aquatic and terrestrial communities were much more active. The Late Cretaceous climate was similar to the present-day area of the U.S.-Canada border.