Fossil footprints.
Denali National Park and Preserve
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# Fossil Footprints

Trace fossils, also called **ichnofossils**, preserve evidence of a biological activity or animal behavior, such as a dinosaur walking through mud or a small animal burrowing in the sand. This is different from a body fossil, which is a remnant of the animal itself, like a dinosaur's tooth or a snail's shell. The footprint in front of you was found in the Cantwell Formation of Denali National Park and Preserve in the summer of 2005.

Footprints can provide valuable information that is not evident from an animal's bones. Because they are records of living activity, trace fossils provide information about dinosaurs' posture, gait, foot structure, speed, and social behavior. The two footprints pictured here (at left) were discovered in 2006 on Sable Mountain. They record an individual dinosaur walking through the Cretaceous mud forming a **trackway**.

## Look closely at the dinosaur footprint…Do you see any other fossils?

On the surface of the fossil footprint in front of you are traces of other living things. These other kinds of fossils help scientists to reconstruct the environment the dinosaurs lived in.

**Leaf imprints**: At the center of the footprint, imprints of plant leaves are visible. Do you see the veins on the broadleaf plant fossil?

**Burrows**: Near the center of the footprint, you can see a round shape with a broken top. This is the mold of an ancient critter's burrow; it provides information about other animals and insects that lived alongside our Alaskan dinosaurs.

To date, 8 varieties of flora have been found in the Lower Cantwell Formation, as well as the casts of ancient logs as much as 6 inches in diameter! The pictures to the right illustrate some of the fossilized plant material found in the Cantwell Formation so far.
(Top to bottom: Broadleaf; fossilized wood; conifer needles)

Adapted from:

Lucas, Spencer G., 2000. Dinosaurs: The Textbook, 3rd ed. San Francisco: McGraw-Hill Higher Education, pp 278.

# How did the prints form?

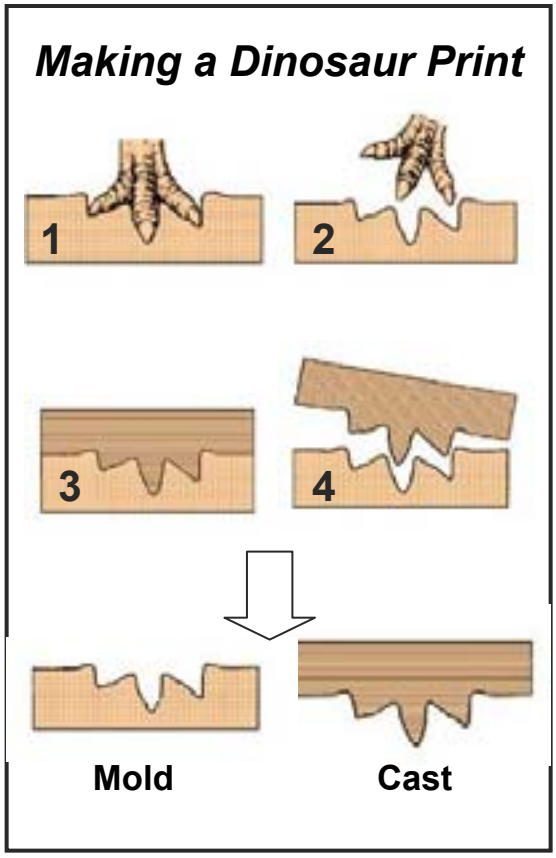
## The Cantwell Formation

The dinosaur footprints of Denali are found only in the Lower Cantwell Formation, a dark grey sedimentary sequence visible in many areas of the park, including near Igloo Creek, where the first print was found.

The Lower Cantwell formed as a terrestrial (i.e., non-marine) basin that gradually filled with sediment (such as cobbles, pebbles, sand and mud) deposited by braided streams, alluvial fans, and scattered lakes over a period of approximately 25 million years during the late Cretaceous, from approximately 80 to 65 million years ago.

The Lower Cantwell is composed of alternating beds of **shale (fine-grained), sandstone (medium-grained),** and **conglomerate (coarse-grained)**, reflecting changing conditions during deposition-- the more turbulent the water flowing in the ancient environment, the larger the sediment it could move and deposit. These beds form distinct layers in the rock, as shown in the picture at right.

## Why are the footprints raised, not indented in the rock?




Adapted from Thulborn, Tony, 1990. Dinosaur tracks. Chapman and Hall.

Dinosaur footprints and other trace fossils may be preserved as either 'molds' or 'casts.' The majority of the dinosaur footprints found in Denali are casts.

A **mold** is the depression your foot would make if you were walking along the beach– a traditional footprint. A **cast** results when the mold of a footprint is filled with sediment, forming a replica of the sole of the foot that made the print.

Denali's dinosaur footprints are usually found at the boundary between different grain sizes, such as between a conglomerate bed and a sandstone bed. The break in grain size makes a natural place for water to infiltrate and preferentially weather the weaker bed away, exposing either the mold or the cast of the footprint. In Denali, the molds have been weathered away to reveal the cast--much like a sculptor would remove his plaster mold to reveal the bronze statue inside.

# Denali's Dinosaurs

The prints on display in the Murie Science and Learning Center were made by **theropods.** Theropods were a diverse group of carnivorous (meat-eating), bipedal (upright-walking) dinosaurs that lived from the Late Triassic (about 200 million years ago) until the end of the Cretaceous (65 million years ago).

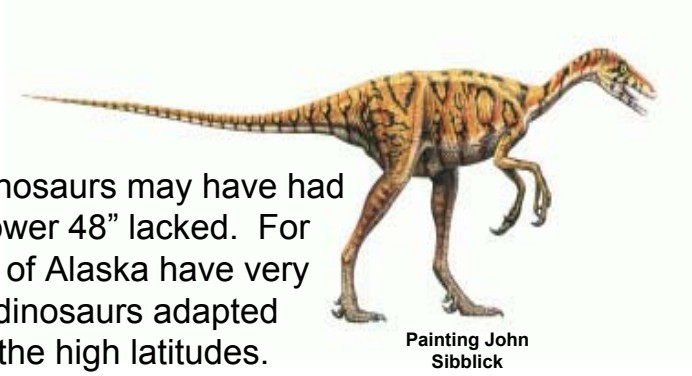
The smallest theropods were about the size of chickens, while the largest known is the gigantic *Tyrannosaurus Rex.* The track on the left was discovered on Sable Mountain in 2006, and has been interpreted as a tyrannosaurid due to its very large size (approximately 20 cm). The prints displayed here were probably made by medium-sized theropods (such as *Troodon*), measuring about 10 feet long and 100 to 200 lbs, as interpreted from the size of the footprints.

Theropods had a number of adaptations that made them fierce and effective predators. They had the largest brains of any known dinosaur group and probably had sophisticated behavior patterns, much like their distant descendents, birds. Hollow bones enhanced their great speed and agility (just like birds!).

Theropods were excellent hunters and were the predators of hadrosaurs, which were also abundant in Denali. **Hadrosaurs** are herbivorous dinosaurs (plant-eaters) who probably fed on various types of broadleaf plants that are preserved as leaf impressions alongside the footprints. Hadroaurs' mouths are broad and flat, resembling a duck's bill. Unlike ducks, however, hadrosaurs had hundreds of teeth for grinding up tough plant leafs.

## Arctic Dinosaurs

Many newly discovered fossil-bearing rocks found throughout Alaska suggests that some dinosaurs remained in here throughout the year and did not migrate during the darker, winter months. Arctic dinosaurs may have had special adaptations that their cousins from the "Lower 48" lacked. For instance, *Troodon* skulls found on the North Slope of Alaska have very large eye sockets. Perhaps Arctic and sub-Arctic dinosaurs adapted larger eyes to compensate for lower light levels in the high latitudes.



**Painting John Sibblick**

Dinosaur findings of the Alaskan interior have contributed to our understanding and interpretations of past life on earth. One thing we know for sure, given the vast amount of dinosaur fossils found throughout Alaska, dinosaurs were *thriving* here; they were a major part of an ancient Alaskan ecosystem (which included plants, insects, birds and fish) that scientists are only just beginning to understand and appreciate.

**Adapted from:**

**Fiorillo, Anthony R., 2004. The dinosaurs of Arctic Alaska. *Scientific American*, December 2004. www. sciam.com.**

**Scothmoor, Judith G., Brent H. Breithaupt, Dale A. Spinger, and Anthony R. Florrilo, 2002. Dinosaurs: The science behind the stories. Alexandria, Virginia: American Geological Institue. Pp 186.**