Soil study lends clues to ancient climate

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Credit: Matt Joeckel

Research led by the University of Nebraska-Lincoln's Matt Joeckel of the Conservation and Survey Division, Nebraska's geological survey, is furthering understanding of environmental conditions on land during the

age of dinosaurs.

In a new study published in the November edition of *Sedimentary Geology*, Joeckel outlines the findings of a multi-year project that mapped ancient soils of the Yellow Cat Member, one of five subdivisions of the Cedar Mountain Formation in central Utah's San Rafael Desert.

The research on ancient soils showed that about 125 million years ago, Yellow Cat soils developed in sediments on ancient floodplains. The sediments were deposited on the floodplains and subjected to soil-forming processes over tens of thousands of years. Once formed, the soils were buried again by incremental layers of sediment and the process started again.

"We see evidence for at least seven major episodes of floodplain sediment deposition and soil development," Joeckel said. "The ancient soils that formed are all but identical to the modern soils known as Vertisols, formed where seasonal rainfall occurs."

The Yellow Cat soils had claylike characteristics where they would swell when wet and contract during dry periods. Cracks, some as deep at 1.5 meters, which later filled with other sediments, also were recorded.

"The ancient soils—or paleosols—suggest that rainfall was strongly seasonal, if not monsoonal, and that there were also some very dry periods," Joeckel said.

"We can learn a lot about ancient climate from the soil. We know this area was not forested, but we also know it wasn't grasslands or prairie. It appeared to be open floodplains that periodically turned into shallow lakes."

The study probed sediments that formed during the Barremian age of the Cretaceous period, between 129 million and 125 million years ago.

Though researchers have known for years fossils of dinosaur bones are sandwiched among the sedimentary layers, Joeckel and research partners Greg Ludvigson of the Kansas Geological Survey and State Paleontologist Jim Kirkland of the Utah Geological Survey also found features in the sediments that appear to be dinosaur tracks.

"It is no exaggeration that dinosaurs walked on these ancient soils," Joeckel said.

Dinosaur bones and tracks can be found nearby. The remains of Utahraptor, a bipedal, predatory dinosaur like the "raptors" depicted in the 2015 movie "Jurassic World," are found in the Yellow Cat Member.

The work is part of a long-term research program involving personnel from three state geological surveys and universities in the United States and Europe. Joeckel and colleagues have already published on the stable-isotope geochemistry of the Cedar Mountain Formation and its relationship to global change in an ancient "greenhouse" world.

The research team began the Yellow Cat Member study in 2008 as part of a larger effort to study ancient climates and other aspects recorded in the sediments of the Cedar Mountain Formation. By mapping, studying and testing samples from the formations, researchers aim to learn about the climate of the past. The work also will lead to an improved understanding of the mechanisms and consequences of future climate change on Earth.

More information: R.M. Joeckel et al. Lower Cretaceous paleo-Vertisols and sedimentary interrelationships in stacked alluvial sequences, Utah, USA, *Sedimentary Geology* (2017). DOI:

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