

## **SESSION: Global Perspectives on Mesozoic Lacustrine Ecosystems**

### **A WINDOW TO THE EARLY CRETACEOUS NORTH AMERICAN CLIMATE AND ENVIRONMENT: THE 'LAKE CARPENTER' LACUSTRINE STRATA OF THE CEDAR MOUNTAIN FORMATION**

Marina B. Suarez<sup>1</sup>, Aisha Al-Suwaidi<sup>2</sup>, James I. Kirkland<sup>3</sup>, Kathryn Snell<sup>4</sup>, Andreas Möller<sup>1</sup>, Noah McLean<sup>1</sup>, Celina A. Suarez<sup>5</sup>, Elizabeth Montgomery<sup>6</sup>, Marquise Paige<sup>7</sup>

<sup>1</sup>Department of Geology, The University of Kansas, 1414 Naismith Dr. Lawrence, Kansas, 66045, United States of America; [mb.suarez@ku.edu](mailto:mb.suarez@ku.edu)

<sup>2</sup>Earth Science Department, Khalifa University, PO Box 127788, Abu Dhabi, United Arab Emirates; [aisha.alsuwaidi@ku.ac.ae](mailto:aisha.alsuwaidi@ku.ac.ae)

<sup>3</sup>Utah Geological Survey, Utah Department of Natural Resources, Salt Lake City, Utah 84114-6100, United States of America; [jameskirkland@utah.gov](mailto:jameskirkland@utah.gov)

<sup>4</sup>Department of Geological Sciences, The University of Colorado, UCB 399, Boulder, CO 80309, United States of America; [Kathryn.snell@colorado.edu](mailto:Kathryn.snell@colorado.edu)

<sup>5</sup>Department of Geosciences, The University of Arkansas, 340 N. Campus Dr. Fayetteville, Arkansas 72701, United States of America; [casuarez@uark.edu](mailto:casuarez@uark.edu)

<sup>6</sup>Palo Alto College, 1400 V. Villaret Blvd, San Antonio, Texas 78224, United States of America; [calger@alamo.edu](mailto:calger@alamo.edu)

<sup>7</sup>Department of Geological Sciences, The University of Texas at San Antonio, One UTSA Circle, San Antonio, TX 78249; [mpaige27@gmail.com](mailto:mpaige27@gmail.com)

The Cedar Mountain Formation is thought to span a significant portion of the lower Cretaceous and the base of the upper Cretaceous (Valanginian to Cenomanian). As such, the Cedar Mountain Formation is important for understanding the transition of terrestrial ecosystems from those characterized by pre-angiosperm ecosystems of the Jurassic to the angiosperm-dominated ecosystems that characterized the height of dinosaur diversity in the later part of the Cretaceous. Lacustrine strata offer unique opportunities to shed light on environmental and climate conditions of the past. This study presents results from a multi-proxy study of lacustrine strata in the Cedar Mountain Formation termed "Lake Carpenter." The sequence of strata is about ~30 m thick and located near Arches National Park. The lower ~7 m is characterized by dark organic-rich mudstones, shales, and tan limestones and dolostone. The middle portion between about 7 and 25m consists of more massive carbonate-rich strata with abundant aquatic fossils including ostracodes, charophytes, and fish scales. The upper portion to about 30 m consists of green to tan mudstones with carbonate nodules and increases in siliciclastic content. Carbonate mineralogies include calcite, high-magnesium calcite, and dolomite (including dolomicrites) based on XRD analyses.

To put the lacustrine sequence into stratigraphic context, bulk organic C isotope values were utilized to construct a chemostratigraphic record. The carbon isotope values range from -32.3‰ to -21.1‰ vs. VPDB. Zircons from four suspected volcanic ash layers were analyzed for U-Pb using LA-ICP-MS. One of these produced concordant Cretaceous dates. The youngest zircons from this sample was analyzed using CA-ID-TIMS and produced a date of  $115.65 \pm 0.18$  Ma. Based on the chemostratigraphic record and the U-Pb date, the deposition of the lacustrine sequence occurs in the mid to late Aptian and spans a time that is thought to have coincided with a cold snap based on marine records.

Carbonate analyses of the carbonates within the lacustrine sequence ranges from -9.2‰ to +5.4‰ vs. VPDB for carbon and -9.3 to -0.3‰ vs. VPDB for oxygen. Overall, carbonate isotope data is positively covariant and along with the mineralogy, seems to suggest that the lake was a closed-basin, alkaline lake and would have likely experience significant evaporation. To investigate paleotemperature, selected samples were analyzed for clumped isotope values ( $\Delta_{47}$ ) to determine temperature of formation. Preliminary temperature estimates of calcite formation range from 27°C to 41°C. Estimates for dolomite range from 19°C to 21°C. Lacustrine carbonate formation typically is biased toward spring and summer and as such some of these temperatures (particularly the values for dolomites) seem slightly lower than expected for a greenhouse climate but may be consistent with a “cold-snap” during the late Aptian. Palustrine carbonates from the type section of the Ruby Ranch Member range 19.8°C to 44.5°C (Suarez et al. 2021) and suggests the lacustrine strata records a similar range in temperatures during the Aptian Stage in this part of North America.

#### REFERENCES CITED:

Suarez, MB, Knight, J, Snell, KE, Ludvigson, GA, Kirkland, JI, Murphy, L 2020. Multiproxy paleoclimate estimates of the continental Cretaceous Ruby Ranch Member of the Cedar Mountain Formation. In: Bojar, A-V, Pelc., A, Lecuyer, C, editors. Stable Isotopes Studies of Water Cycle and Terrestrial Environments. Geol Soc, London, Spec Pub, 507: <https://doi.org/10.1144/SP507-2020-85>

KEYWORDS: Early Cretaceous, lacustrine, stable isotopes, paleoclimate

Presentation Mode: Invited Speaker