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Reading the Leaves: The paleoecology and paleolatitude of the Early Cretaceous (Albian) Winthrop Formation, Washington State, USA

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ABSTRACT: The abundant megafloora of the late Albian (~105 Ma) Winthrop Formation of north-central Washington State allows for the investigation of plant phylogeny, diversity, and paleoecology during the rapid diversification of the angiosperm clade, and offers independent paleolatitudinal constraints for the tectonic history of the western Cordillera of North America. With an estimated diversity of more than 150 species distributed in eight vascular and non-vascular plant classes, the Winthrop is the most diverse North American flora yet described from the Early Cretaceous. Deposited in a braided-stream setting, the richest leaf sites occur above incipient paleosols near the base of crevasse splays. Analyses of species abundance and species presence–absence matrices showed that angiosperms were taxonomically diverse in both stable and frequently disturbed environments. However, in the stable environments, angiosperms shared niche space with other plant clades that were dominant earlier in the Mesozoic, showing that the floristic composition of the flora was heterogeneous and varied with depositional environment. Additionally, consistently low leaf mass per area of Winthrop dicot leaves reinforce the hypothesis that Early Cretaceous landscapes were colonized by fast-growing, weedy angiosperms.

The tectonic setting, age, and fossil flora of the Winthrop Formation make it an excellent target to test the “Baja BC hypothesis” using paleoclimate proxies and paleobiogeographic inferences. This long-standing hypothesis postulates that Baja BC block, a large crustal element comprising western Washington State, British Columbia, and southwestern Alaska, originated at the latitude of Mexico. The debate has pitted paleomagnetic results against long-held interpretations about the tectonic evolution of western North America. Fossil leaves from the Winthrop Formation indicate that the mean annual temperature (MAT) was ~24°C during the mid-Cretaceous, suggesting a subtropical to tropical climate. Using a mid-Cretaceous North American MAT profile, this warm temperature indicates that the Winthrop Formation was deposited at a paleolatitude of ~38°N, suggesting 2,200 km of northward offset relative to stable North America.

Speaker Biography: Ian Miller is Curator of Paleontology and Director of Earth & Space Sciences at the Denver Museum of Nature & Science. He earned a Ph.D. in geology and paleobotany at Yale University in 2007 and has been at DMNS since 2007. His research focuses on fossil plants and their applications for understanding ancient ecosystems and climate. He is presently working on projects in the Colorado Rockies, the Grand Staircase Escalante National Monument in Utah, the San Juan Basin in New Mexico, and Madagascar.

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