Evolution of the Green River Formation, Piceance Creek Basin – Implications for Eocene lake history, Colorado, Utah, and Wyoming

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The Piceance Creek Basin (PCB) in Colorado formed during the Laramide orogeny, and comprised a foreland lake basin during the early to middle Eocene. Deposition in the basin is described based on small-scale (1 to 10's of meters in thickness), mid-scale (10's to 100's of meters in thickness), and large-scale (100's of meters in thickness) depositional complexes. On the small-scale, changes in the lithofacies and kerogen richness in mudstone is controlled by variations in runoff and vegetation. These complexes are interpreted to be climatically driven, and occur as small-scale cycles that bundle into small-scale depositional cycles. Correlating these cycles to published age determinations, we interpret them to represent 400 ka eccentricity cycles, bounded by sequence boundaries. Published hypothermal events correlate with five of these sequence boundaries. In the mid-scale, six Lake Stages are separated based on the changes in the depositional trends and are defined as: S1 - Fresh Lake, S2 - Transitional Lake, S3 - Rapidly Fluctuating Lake, S4 - Rising Lake, S5 - High Lake, and S6 - Closing Lake. Lake Stages are controlled by the combination of climate and tectonics, and are used to correlate the marginal lake deposits with the deeper profundal deposits. Similarly, Lake Stages are used to correlate the PCB with neighboring basins in Utah and Wyoming. Due to the different morphological and hydrological systems between these basins, there are some uncertainties in correlating the lower part of lake deposits formed during S1 and S2. However, the strong climate signal during S3 that formed during the peak of the Eocene climate optimum, is clearly recognizable in all three lakes and makes a good correlative unit. The ensuing development of lake systems, an increase of the water depth and deeper water facies associations in lake sections during S4 and S5 also occurs in all three lakes. The closing of the lake (S6) occurred at different times in the different basins, and does not form a time-correlative boundary. In the large-scale, based on the evolution of the Lake Stages, we suggest that during S1, the deposition in all three basins was tectonically controlled. Climate controls dominated during S2 and S3, and peaked during the S3. S4 to S6 show both tectonic and climatic influences.