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**TITLE:** Creatures from the Bakken Lagoons: Palynology Confirms the Brackish Depositional Environment with Implications for Basin Evolution

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**ABSTRACT BODY:**

**Abstract Body:** The Middle Bakken Formation and correlatives in western Montana and Alberta have brackish-water lagoonal deposits of non-fossiliferous mud and silt that cover large areas of each basin and may record basin-wide events. In the Bakken of Saskatchewan and North Dakota, they occur in the upper Middle Bakken (Unit B in SK or Facies E or 4 in the U.S.) where they have been well documented with sedimentology, impoverished ichnofacies, and low abundance of marine fossils. They overlie the clean marine sands and underlie the capping marine carbonates of the Middle Bakken. A transgressive, bioclastic lag is locally present at the upper boundary.

The Sappington Formation in western Montana is temporally and stratigraphically correlative with the Bakken and contains a similar, yet thicker, brackish water lagoonal facies of non-fossiliferous mud and silt with an impoverished ichnofacies. It overlies offshore marine siltstone of the lower Middle Sappington and underlies shoreface siltstone and sandstone of the upper Middle Sappington. A transgressive crinoid limestone lag is locally present at the upper contact of these lagoonal facies.

New palynology from these strata in outcrops in Western Montana and from core in the Williston Basin of Sheridan County Montana independently confirms the restricted lagoon environment as inferred from physical attributes. Spores in these dark green non-fossiliferous shales are dominated by terrestrial species (80%) including Retispora lepidophyta with much fewer marine phytoplankton (acritarchs, prasinophytes). The high ratio of terrestrial to marine palynomorphs indicates deposition in a marginal marine environment consistent with impoverished ichnofacies and a lack of marine macrofauna.

The large areal extent of these lagoonal deposits suggests that they record fundamental basin reorganization dominated by allocyclic controls rather than local autocyclic facies controls. Tectonically driven paleohighs such as the Nesson Anticline and Swift Current Arch in the Williston Basin and the Lemhi Arch in the Sappington Basin may have formed the temporary barriers that separated these lagoons from the open ocean. The incursion of marine waters across these barriers is related to relative sea level rise and subsidence of these paleohighs, and is marked by the thin bioclastic, transgressive lag that represents a return to marine deposition. Whether lagoonal deposits in different areas are the same age remains uncertain.