Carbonate seep mounds record a Cretaceous methane generation and migration event during rifting of the Amerasia Basin

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Carbonate deposits have been found on two islands in the Arctic Archipelago over 450 km apart (two locations on Prince Patrick Island and over 100 on Ellef Ringnes Island). Stable isotope values from all locations show highly depleted $\delta^{13}C$ values, consistent with an origin through oxidation of methane seeping into the sea floor. Fossils from seep locations indicate a consistent Early Albian age (113-107 Ma), indicative of a major basin wide methane generation and migration event. Burial and thermal history model indicates thermogenic gas production from the main source rocks of the basin (Middle-Late Triassic Murray Harbour and Hoyle Bay formations) occurred ~140-60 Ma, with peak gas production rates ~113-100 Ma, consistent with timing based on paleontological control. However, stable isotope data suggest an additional contribution from biogenic sources, likely organic rich shales of Middle Jurassic to Early Cretaceous age that remained within the biogenic gas window during seep mound formation. The low thermal maturity of the basin in the Prince Patrick region also requires either long-distance migration of thermogenic gas or great biogenic contribution.

Methane seep mounds are commonly associated with normal faults and/or fractures associated with salt diapirs, suggesting that they served as primary conduits for gas migration. Timing of methane seepage is consistent with regional extension associated with rifting and opening of the Amerasia Basin. Enhanced rifting and sedimentation then combined to form maximum burial conditions for gas generation and migration.