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Using plate tectonics to understand the misunderstood Eocene source rock and climate change mechanism

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Summary

The late Paleocene and early Eocene (47.8 to 59.2 Ma) is of interest as it provides an analogue to understand impacts of modern climate warming, particularly at high latitudes. As such, there is a lot of literature from this time period in relation to ocean circulation, climate change and source rock potential.

The remains of the freshwater fern *Azolla*, have been found in Eocene sediments in the modern central Arctic Ocean. The high concentrations of this fern were thought to have significantly contributed to hydrocarbon resources associated with the Eocene, but most notably they were accredited with reversing the global warming associated with the Paleocene/Eocene Thermal Maximum (PETM).

Here we use new plate tectonic models to argue that the famous Paleocene and early Eocene records from the Lomonosov Ridge do not record conditions representative of the entire Arctic Ocean basin. The Lomonosov Ridge, which during the Eocene was a continental fragment barely rifted from Eurasia, separating the smaller Eurasian Basin from the much larger Amerasian Basin to the west. As such, the Lomonosov Ridge does not necessarily record environmental conditions of the broader Arctic Ocean. We tested the hypothesis of freshwater caps by examining sediment records from the western Amerasian Basin. Here we show that in the larger Amerasian Basin the *Azolla* event is associated with marine microfauna along with allochthonous (terrestrially sourced) organic matter. We propose that *Azolla* events are related to an increased hydrologic cycle washing terrestrially sourced *Azolla*, and other organics, into the Arctic Ocean. If freshwater caps did occur, then they were at best restricted to the small Eurasian Basin and would have had a limited impact on Eocene global climate, contrary to current models.

Novel/Additive Information

We show that the volumes of *Azolla* associated with the Arctic *Azolla* Event could not of contributed to hydrocarbon potential on the Beaufort-Mackenzie side of the Arctic ocean and that the mats did not capture enough CO^2 to influence global warming.

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