Early Eocene Gateways

2 September 2020

Tasman Gateway

Henk is the best person to ask about the Tasman Gateway given he has published numerous papers on this subject. Tectonically, the Tasmania-Victoria Land opening is a strike-slip system tied in with the opening of Antarctica-Australia and the Tasman Sea. Most models have some motion starting in the Paleocene(?) but there is no evidence of a deep-water connection until at least the **Oligocene** (Bijl *et al.*, 2013; Brown, Gaina and Müller, 2006; Stickley *et al.*, 2004)

The Drake Passage and the Scotia Sea

The history of the Drake Passage gateway is complex and I can best direct you to the extensive literature (Dalziel, 2014; Eagles, Livermore and Morris, 2006; Maldonado *et al.*, 2007; Maldonado *et al.*, 2014). Most of this suggests an **Oligocene** age for deep-water connectivity.

But, the exact geometry of the Early Eocene paleogeography and opening history between South America and the Antarctic Peninsula in the Late Cretaceous – early Cenozoic remain unclear. There was a continuous arc along the Pacific margin, but the passing of the Scotia Sea plate through this area has resulted in major deformation of southern Patagonia and the northern part of the Antarctic Peninsula.

Arctic Deep-Water Connections

North Atlantic

There is a substantial literature on the breakdown of the North Atlantic gateways, much of it written in the 1980s and which I can send you. In short, the Scotland-Faroes-Iceland-Greenland land-bridge breaks down in the **Paleocene** and there is a deep-water connection (probably around the Faroes) by the **Early Eocene**. However, there is no evidence of a deep-water connection to the Arctic until the **Oligocene** at the earliest when Svalbard moves away from Greenland (another strike-slip system). Indeed Dore et al suggest that the Fram Strait was not fully available for deep-water flow until **c.17.5 Ma** (Doré *et al.*, 2015).

The Barents Sea is an epicontinental sea formed on continental crust. Today it is on average only c.200m deep and so not a conduit for deep-water circulation.

Nares Strait

The Nares Strait between Ellesmere Island and Greenland is today c.600m deep and very narrow. Its history is unclear though Tessensohn et al (2006) suggest a **Late Cretaceous – Paleocene** age of movement. But I think this depends on your plate model!

Bering Strait

I am not aware of any indication that the Bering Strait is younger than **Late Miocene** (Marincovich and Gladenkov, 2001).

The Bering Sea is likely a trapped piece of the proto-Pacific and bounded to the south by the Aleutian Arc. The age of this arc is somewhat problematic. It may have been in place in the **Early Eocene**, though other work suggests a **Late Eocene-Oligocene** age for magmatism (Jicha *et al.*, 2006).

West Siberia Seaway

The West Siberian Seaway is not deep-water *per se*, and like the Barents Sea lay on continental crust, with only a narrow, intermittent connection to Tethys through the Turgai Strait.

Western Interior Seaway

In North America, the Western Interior Seaway connection had already disappeared by the Early Eocene.

Paul Markwick

p.j.markwick@leeds.ac.uk
paul.markwick@knowing.earth

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