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Tectonic Evolution of the Circum-Arctic

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The Eocene to recent opening along the modern Gakkel spreading ridge is fairly well understood, but there is little consensus on Arctic reconstructions for Cretaceous and older events. Most workers agree that the Canada Basin opened (at least in part) as the result of rifting initiated c. 135 Ma; this age is inferred from pre- to syn-rift sedimentation on the conjugate margins, now the margins of Arctic Alaska and Arctic Canada (Houseknecht and Connors 2016; Hutchinson et al. 2023), and is supported by a shared syn-rift depositional history (Hutchinson et al. 2023). However, 1) the actual age of Canada Basin seafloor remains unknown, i.e. the age of sea-floor spreading after the on-set of rifting, and 2) as ages for the High Arctic large igneous province (HALIP) become more refined, the relationship between Canada Basin opening and the HALIP becomes central to basin opening scenarios (Dockman et al. 2018). Both of these issues are further complicated by the disparate geological timescales in common use today (Malinverno et al. 2012; Ogg 2020).

Gravity and magnetic (aeromagnetic and ship-bourn) data record what is interpreted as a fossil spreading ridge in the Canada Basin with inferred ages of 142 Ma (maximum) to 120 Ma (minimum) (Grantz et al. 2011; Chian et al. 2016; Døssing et al. 2020). This time frame overlaps with the Cretaceous Normal Superchron, thus restricting magnetic reversals in the Canada Basin to pre- or post-date the long Creataceous quiet period. Differences between magnetic anomaly timescales allow Canada Basin magnetic anomalies to be pre-120 Ma or post-83 Ma (Malinverno et al. 2012) or pre-130 Ma or post-124 Ma (Ogg 2020). Recent age data from the High-Arctic Large Igneous Province (HALIP) apparently record three main pulses of magmatism at c. 125 Ma, 95 Ma, and 80 Ma which lies within this critical window of time, and is used to invoke extension-drives-plume magmatism (Hadlari 2024), rather than the conventional view that plumes facilitate extension. Clearly, more work remains to be done in order to resolve some of these argue that the HALIP post-dates extension. Without agreement on the magnetic polarity timescale, the timing of tectonic events remain problematic.

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