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Late Mesozoic- Cenozoic plate boundaries in the North Atlantic – Arctic: Quantitative reconstructions using Hellinger criterion in GPlates

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Cretaceous extension that resulted in the formation of several sedimentary basins along the North American and western and southwestern Greenland margin was followed by seafloor spreading in the Labrador Sea and Baffin Bay. Controversy regarding the timing of the oldest oceanic crust in these basins spanned more than 25 years and it is still not resolved due to the complexity of the margins and non-uniqueness of potential field data interpretation. Here we revisit the geophysical data (in particular the magnetic and gravity data) available for the Labrador Sea and Baffin Bay in order to identify the age of oceanic crust and infer new parameters that can be used for quantitative kinematic reconstructions. We identify chrons 20 to 29 for the central part of the basin. For the crust formed near the extinct spreading ridge we have modelled chrons 19 to 15 assuming an ultraslow spreading rate. Oceanic crust older than chron 29 is uncertain and may be part of a transitional crust that possibly contains other type of crust or exhumed mantle. The new magnetic anomaly identifications were inverted using the Hellinger (1981) criterion of fit. In this method the magnetic data are regarded as points on two conjugate isochrons consisting of great circle segments. This method has been extensively used for kinematic reconstructions since Royer and Chang (1991) first implemented it for quantitative plate tectonics, and is now available as a new interactive tool in the open-source software GPlates (www.gplates.org).

The GPlates Hellinger tool lets the user interactively generate a best-fit rotation pole to a series of segmented magnetic picks. The fitting and determination of uncertainties are based on the FORTRAN program hellinger1 (Chang, 1988; Hellinger, 1981; Hanna and Chang, 1990); Royer and Chang, 1991). Input data can be viewed and adjusted both tabularly and graphically, and the best fit can be viewed and tested on the GPlates globe.

The new set of rotations and their uncertainties are combined with a regional model and used to infer the plate boundaries during the formation of Labrador Sea and Baffin Bay. Challenges for establishing the continuation of these plate boundaries the Arctic domain are also discussed.

References

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