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GEOCHRONOLOGY, GEOCHEMISTRY AND EXTENT OF THE 1998 MA MINTO-POVUNGNITUK LIP

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A recent U-Pb baddeleyite age of 1998 ± 6 Ma has been obtained for the main flood basalt sequence (Beauparlant Formation) of the Povungnituk Group of the Cape Smith belt, on the northern Superior craton, North America.

This age has regional significance because it matches the previously obtained 1998 ± 2 Ma age for the Watts Group (Purtuniq) ophiolite of the northern Cape Smith Belt and the 1998 ± 2 Ma U-Pb age of the Minto dykes intruding the Superior craton to the south.

Additional units can be linked to the dated units of the LIP. The Eskimo Formation (Belcher Islands) has been paleomagnetically linked to the Minto dykes and the lower lavas of the Roberts Lake Syncline (northeastern Superior craton) have been geochemically linked to the Povungnituk Group. Together these coeval units suggest widespread, short duration, large igneous province (LIP) magmatism that covered an area of >400,000 km^2 and has been termed the Minto-Povungnituk LIP (Figure 1).

Geochemical comparison between the units that erupted on, or have been transported onto, the northern margin of the Superior craton with the units within the craton to the south allows the Minto-Povungnituk LIP to be divided into two spatially separate geochemical domains with different mantle source characteristics. The northern domain, comprising the Povungnituk Group, Roberts Lake Syncline and Watts Group, shows mixing between a depleted mantle source and a more enriched mantle plume-sourced melt. The southern domain comprising the Minto dykes and the paleomagnetically linked Eskimo Formation shows signs of an even more enriched source, while these magmas also show the effect of crustal contamination.

Two distinct source mechanisms can be responsible for the observed geochemical differences between the two domains. First, a difference in lithospheric sources, where melting of different portions of Superior craton lithosphere caused the different melt signatures in the interior of the craton. In this case magmatism in the two domains is only related by having the same heat source (e.g., a mantle plume) interpreted to be located on the northwestern side of the northern Superior craton. Second, two distinct deep mantle sources that remained separated within the ascending plume. This is analogous to some current hotspots interpreted to sample both large low shear velocity provinces (LLSVPs) and adjacent ambient deep mantle. This latter interpretation would allow for the use of bilateral chemistry in LIPs as a potential tool for the recognition and mapping of the LLSVP boundaries throughout Earth's history.

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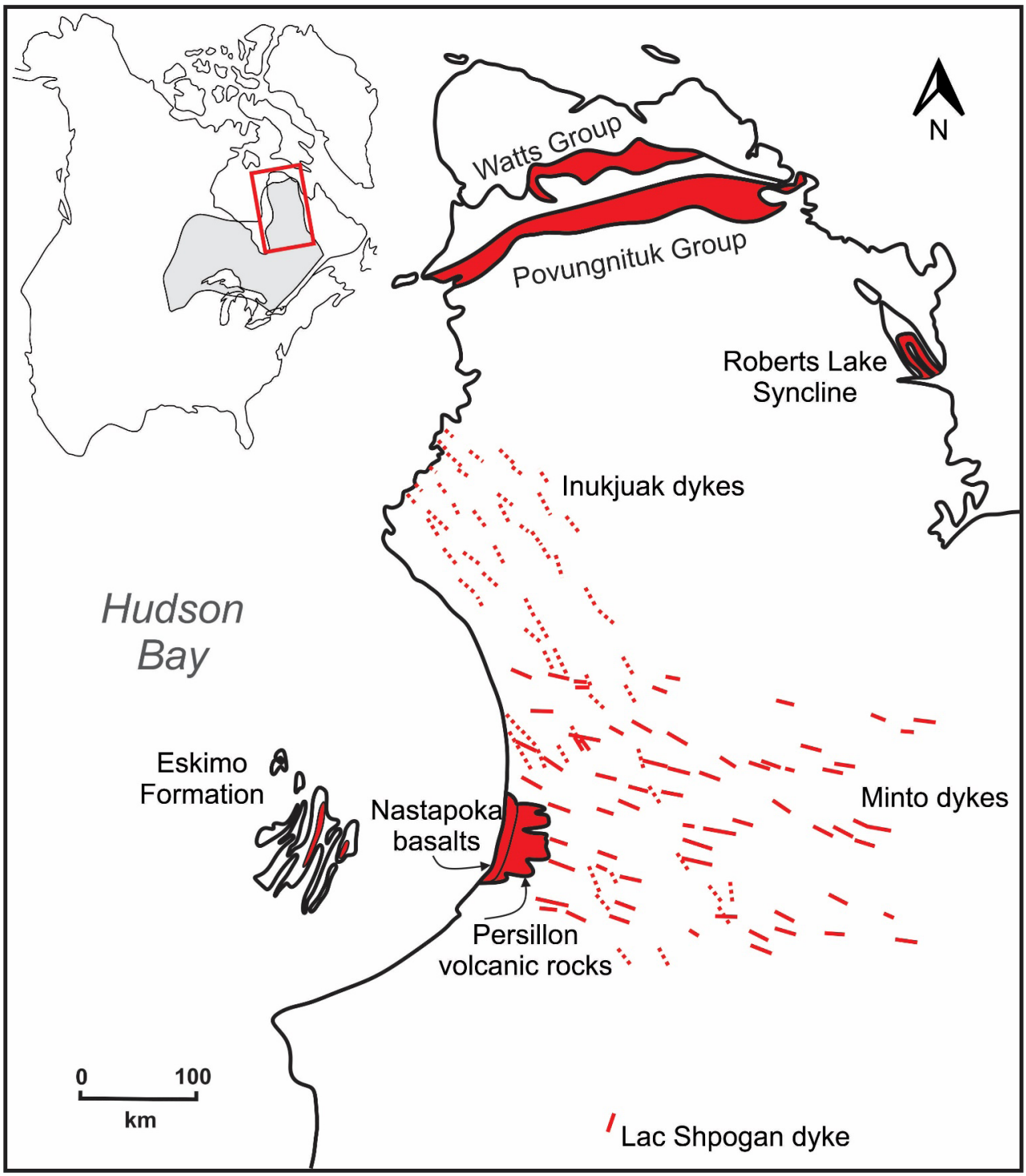

Figure 1. Map showing coeval magmatic units of the ca. 1998 Ma Minto-Povungnituk large igneous province. Inspired by Chandler (1984); Buchan et al. (1998); St. Onge et al. (2004); Clark and Wares (2006); Baragar (2007); Maurice et al. (2009).