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Paleomagnetic dating of Holocene western and eastern Canadian Arctic sediments: combined use of radiocarbon, paleomagnetic secular variation and global spherical harmonic model of the geomagnetic field

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Radiocarbon dating of Holocene sediments is often challenging in the Arctic due to the paucity of datable material, carbonate dissolution and an often poorly constrained reservoir correction, highlighting the need to combine 14C dating with other methods to establish robust Arctic chronologies. Here we illustrate the potential of using Holocene paleomagnetic secular variation records and a time-varying spherical harmonic model of the geomagnetic field (CALS7K.2; Korte and Constable, 2005) in conjunction with radiocarbon dating to establish or improve age models from marine sedimentary records recently recovered on board the CCGS Amundsen in the Beaufort Sea (western Canadian Arctic, core 2004-804-650PC) and Lancaster Sound (eastern Canadian Arctic, core 2004-804-009PC). For both cores, a u-channel-based paleomagnetic study reveals the presence of a strong, stable, well-defined single component magnetization (maximum angular deviation < 5°), with characteristic remanent magnetization (ChRM) inclinations varying around the expected inclination for the latitude of the sites assuming a geocentric axial dipole. For core 650PC (Beaufort Sea), an age model spanning the last ∼6 000 cal BP was established from one radiocarbon age in addition to nine paleomagnetic tie points obtained by comparing the ChRM declination profiles of core 650PC and the CALS7k.2 geomagnetic model output. In order to verify the robustness of this correlation, the ChRM inclination record of core 650PC was then compared with other western North American lacustrine and volcanic Holocene paleomagnetic secular variation records. Several common magnetic inclination features are detected among all the considered records during the last ∼6 000 cal BP, indicating the same geomagnetic origin as well as the consistency of the derived age model. Similarly, for core 009PC (Lancaster Sound), the initial age model consisting of 4 radiocarbon ages was improved by adding 4 paleomagnetic tie points derived by comparing the ChRM inclination profiles of core 009PC with the CALS7k.2 model output. The improved age model spanning the last ∼11 000 cal BP results in a striking correlation between the d18O record from the Devon Island ice cap and the sea-surface temperatures in Lancaster Sound. These results reveal the potential of using both the CALS7k.2 model output and paleomagnetic secular variation in combination with radiocarbon dating for chronostratigraphic purposes in Arctic sediments.

Korte, M., Constable, C.G., 2005. Continuous geomagnetic field models for the past 7 millennia: 2. CALS7K. Geochem. Geophys. Geosyst., 6 Q02H16, doi:10.1029/2004GC000801.