

A Holocene cryptotephra record from the Chukchi margin: the first tephrostratigraphic study in the Arctic Ocean

Vera Ponomareva¹, Leonid Polyak², Maxim Portnyagin³, Peter Abbott⁴, Siwan Davies⁴

¹Institute of Volcanology and Seismology, Russia; ²Byrd Polar Research Center, Ohio State University, USA; ³Helmholtz Centre for Ocean Research Kiel (GEOMAR), Germany;

⁴Department of Geography, Swansea University, UK

Developing geochronology for sediments in the Arctic Ocean and its continental margins is an important but challenging task complicated by multiple problems. In particular, the Chukchi/Beaufort margin, a critical area for reconstructing paleoceanographic conditions in the Pacific sector of the Arctic, features widespread dissolution of calcareous material, which limits possibilities for radiocarbon chronology. In order to evaluate the untapped potential of tephrochronology for constraining the age of these sediments, we investigated a sediment core from the eastern Chukchi Sea margin for cryptotephra. The core was collected in the area of sediment focusing on the upper slope (Darby et al., 2009). Samples were taken from the upper sedimentary unit composed of homogenous, fine-grained mud inferred to represent marine environmental conditions of the last 8-9 ka. Based on this age estimate, the initial set of 36 samples has an average resolution of ~250 years. Freeze-dried samples (0.5 g) were treated with HCl, wet-sieved to obtain a 80-25- μm fraction, treated with 1% NaOH to disaggregate clay clumps, and separated at specific density between 2.3 and 2.5 g/cm³. Residues in all samples featured abundant shards of colorless volcanic glass with an admixture of brown shards in the lower part of the unit. Three apparent tephra peaks were identified in the upper part of the record. The electron microprobe analysis of individual shards from these peaks showed nearly identical chemical compositions indicative of the late-Holocene tephtras of the Aniakchak volcano in southwestern Alaska (e.g., Kaufman et al., 2012). The glasses analyzed exhibit a continuous composition range from 55 to 77 wt% SiO₂ overlapping with two major populations of Aniakchak glasses (andesitic and dacitic) and also including some intermediate compositions. We infer that the three tephra peaks identified correspond to the three prominent tephra layers investigated in lake deposits between Aniakchak and the core site and dated to ~0.4, 3.1, and 3.7 ka (Kaufman et al., 2012). Further detailed study of tephra distribution in the Chukchi margin cores is underway. Identification of distinct tephra peaks with the composition traceable to specific known eruptions provides a powerful, independent chronological tool, much needed for Arctic paleoceanography. The consistent presence of cryptotephra in the analyzed samples suggests its wide occurrence in at least the Chukchi margin sediments; studies from other Arctic shelves and basins are needed to understand the geographic pattern of tephra distribution in seafloor sediments from this part of the world.

Darby, D.A., Ortiz, J. Polyak, L., et al., 2009. The role of currents and sea ice in both slowly deposited central Arctic and rapidly deposited Chukchi-Alaskan margin sediments. *Global Planet. Change* 68, 58-72.

Kaufman, D.S., Jensen, B.J.L., Reyes, A.V., et al., 2012. Late Quaternary tephrostratigraphy, Ahklun Mountains, SW Alaska. *J. Quatern. Sci.* 27, 344–359.