ONE Planet Doctoral Training Partnership

Natural Environment Research Council

Project title: White Sea meromictic lakes as rich archives of palaeoenvironmental change (Ref: OP2181)

Keywords: Palaeoclimate, microfossils, proxies, sea-level change

One Planet Research Theme:

Climate & Climate Change ☒ | Earth System Processes ☒ | Anthropocene ☒ | Environmental Informatics ☐

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Key Research Gaps and Questions:

- (PALAEO) STRATIFICATION: How have the presently meromictic (permanently stratified) lakes of the White Sea evolved over the Holocene?
- PALAEOCLIMATE: Ice deglaciated from this region a lot quicker than expected, and is this linked to a rapid increase in temperatures over the mid-late Holocene?
- SEA LEVEL: Models and observations of the relative sea-level history of the White Sea region need to be reconciled. The current lack of sea-level index points, particularly in the late Holocene, mean there is a real need to develop a series of observations of past sea-level change to constrain deglaciation history in a tectonically complex region.

Project Description: Not only do lakes in the White Sea region of the Russian Arctic provide ideal sites from which to generate records to constrain deglaciation and postglacial sea-level change[1], but they also represent a rare and globally unique laboratory providing insight into lake responses to climate change. Due to rapid geological uplift (at the fastest rates seen in the Russian Arctic), the lakes are at various stages of separation from the sea, driving them to sequentially shift from a partially to permanently stratified (meromictic) state[2]. In this way, a unique series of lakes exist, exhibiting a gradient of environmental conditions. As ~16% of lakes globally are expected to undergo less frequent mixing and approach meromictic states by 2100AD[3] – a regime change that will profoundly modify their role in regulating global climate – the White Sea region can be viewed as future representation of the Arctic under future climate change.

Ongoing monitoring by project partners at Lomonosov Moscow State University shows warming of these lakes has accelerated over the last decade. However, in order to assess the impacts of future climate change, we need to understand how these lakes have responded to past environmental changes over much longer geological timescales. The locality of the White Sea presents a myriad of opportunities to investigate the drivers of past and current climate change, and the effects on high Arctic lakes. In this project, you will address one or more of the key questions above depending on your area of expertise, and will be supported in the development of a multi-disciplinary research strategy, which combines proxy records from lake sediment cores and numerical modelling. You will conduct fieldwork from the White Sea Biological Research Station with support from colleagues at Lomonosov Moscow State University, and undertake a range of laboratory analyses, including diatoms, chironomids, X-ray Fluorescence scanning, and radiocarbon dating. Depending on your interests, there will be exciting opportunities to use your newly developed proxy records to inform earth systems models.

Refs: [1]Baranskaya et al. (2018) Quat. Sci. Rev. 199: 188-205; [2]Krasnova et al. (2015) EARSeL eProc. 14: 8-22; [3]Woolway & Merchant (2019) Nat. Geosci. 12: 271-6

Prerequisites: You will receive full training on field & laboratory techniques, but background in microfossil analysis would be beneficial. For more information, please contact emma.hocking@northumbria.ac.uk.

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