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Project PORO-CLIM initial results: Towards a new oceanic crustal record of magma productivity throughout initiation of the North Atlantic Igneous Province

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In May 2021 project PORO-CLIM acquired a new geophysical dataset across the little studied Porcupine and Rockall Plateau passive margins in the Northeastern Atlantic. The project aims to study the initiation of the North Atlantic Igneous Province (NAIP) and test its relationship with the Palaeocene-Eocene Thermal Maximum (PETM) global climate change event. Profile 1, a 400 km long deep seismic (MCS and OBS) profile, contains a continuous latest-Cretaceous to early-Eocene oceanic crustal thickness record that spans the entire emplacement of the NAIP. Oceanic crustal thickness can be directly interpreted as a record of magma productivity and hence mantle temperature. As such Profile 1 encodes the first continuous, sub-million year record of the entire waxing and waning cycle of mantle temperature during the initiation of any of the world's Large Igneous Provinces.

Thermogenic methane produced by shallow igneous sills within the NAIP sill province and released to the atmosphere through hydrothermal vent systems, together with the carbon dioxide released from the magma itself, are the most likely carbon sources for the PETM [1]. Profile 1 is the first whole crustal seismic record across Eriador Ridge, thought to be the thick oceanic crustal trace of the pulse of anomalously hot mantle which drove the pulse of melting which led to NAIP sill province emplacement. Thus the magma productivity record derived from Profile 1 will ultimately help constrain the rate of NAIP thermogenic carbon emissions, further testing the link between NAIP sills and the PETM. This presentation will outline the initial findings from seismic data analysis, including a preliminary magma production record spanning NAIP initiation and the relationship between magma productivity and the PETM. Initial analysis of relative changes in crustal thickness across the record suggest that long-term (>5 My) magma productivity increased from late Cretaceous to early Eocene time, whilst short term (<5 My) magma productivity became more pulsed. The new dataset also shows Eriador Ridge contains a previously unknown double peak in magma productivity. These peaks may potentially be the result of two distinct pulses of anomalously hot mantle, separated by c. 1 Myr, which could imply multiple bursts of gas release from the NAIP around the Palaeocene-Eocene boundary.

[1] Jones, S.M., Hoggett, M., Greene, S.E. and Jones, T.D. Large Igneous Province thermogenic

greenhouse gas flux could have initiated Paleocene-Eocene Thermal Maximum climate change. *Nat. Commun*. 10, 5547 (2019).