The Tectonomagmatic Development of the Vøring Marginal High, Norwegian Sea: Core-log-seismic Integration of the IODP Expedition 396 Boreholes U1571 and 1572

Dmitry Zastrozhnov[a,b], Sverre Planke[a,b], Nina Lebedeva-Ivanova[b], John M. Millett[c], Stefan Bünz[d], Cornelia M. Binde[d], Ben Manton[b], Christian Berndt[e], Peter Betlem[a,f], David W. Jolley[g], Kasia Sliwinska[h] and Henk Brinkhuis[l,j]

[a]Department of Geosciences, University of Oslo, Oslo, Norway, zastrozhe@gmail.com; [b]Volcanic Basin Energy Research (VBER), Oslo, Norway; [c]VBER UK Ltd., Aberdeen, United Kingdom; [d]UiT The Arctic University of Norway, Tromsø, Norway; [e]GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany; [f]UNIS – The University Centre in Svalbard, Longyearbyen, Norway; [g]University of Aberdeen, Aberdeen, United Kingdom; [h]Geological Survey of Denmark (GEUS), København, Denmark; [i]Royal NIOZ, the Netherlands Institute for Sea Research, the Netherlands; [j]Utrecht University, Utrecht, the Netherlands

During the Paleogene, the northeastern Atlantic Ocean witnessed a significant episode of magmatic activity, resulting in the production of an immense 6-10 million cubic kilometers of magma. This magmatic activity was associated with the occurrence of the Paleocene-Eocene Thermal Maximum (PETM) around 56 million years ago, attributed primarily to the release of thermogenic gases. The outer margins of the northeastern Atlantic subsequently underwent the final stages of tectonic rifting, resulting in regional uplift and erosion. One of the most prominent geological features in this region is the Vøring Marginal High, characterized by substantial seaward-dipping reflectors near the COB (Continental-Ocean Boundary) and the presence of diverse volcanic facies in its eastern sector. Here, the Skoll High exhibits a thin basaltic cover and below a few hundred meters of Cenozoic sediments allowing the study of breakup-related tectonomagmatic processes through shallow drilling and high-resolution seismic acquisition. In this study, we evaluate drilling data from IODP Expedition 396, focusing on sites U1571 and U1572 on the Skoll High. We apply an integrative approach by combining core and log data with high-resolution bio- and lithostratigraphy and a range of seismic reflection data, encompassing both conventional 2D and 3D seismic datasets as well as high-resolution 2D and 3D seismic data acquired during the CAGE22-5 research cruise. We identify four distinct Cenozoic sedimentary horizons, which include the Top Basalt and Base Basalt, along with two sub-basalt horizons. Furthermore, we have conducted a comprehensive volcanic facies analysis, utilizing the principles of igneous seismic geomorphology. The Top Basalt horizon provides remarkable insights into the characteristics of the ancient volcanic surface. While the top of the basalt pile in the southeastern part of the Skoll High is faulted and eroded the Top Basalt attribute map reveals a pitted top basalt surface and with lobate structures and linear ridges towards the west. The pits are interpreted as rootless cones, which comprise volcanic craters resulting from the explosive reaction between lava flows, which flow over water-saturated sediments. The dimensions of the rootless cones are comparable with cones present in the Myvatn area of NE Iceland. The mapping of sub-basalt horizons indicates potential pre-breakup episodes of extrusive volcanism, which were previously undocumented for the Vøring Margin. High-resolution biostratigraphy data show that sediments recovered directly above the basalts contain *Azolla* spp. and associated dinocyst marker species. This discovery possibly widens the timeframe for the cessation of extensive magmatic activity in the region to the *Azolla* event, which occurred from 49 to 48 million years ago (mid-Chron 22n to mid-Chron 21r). The results of this comprehensive study shed light on the complex paleoenvironment of the Vøring Marginal High during the pre- and syn-breakup phases in the Paleogene. The findings suggest the presence of rapid uplift/subsidence events and a more prolonged period of volcanic activity in this region of the NE Atlantic than previously documented.