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Arctic Ocean Paleoceanography and Future IODP Drilling

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Although the Arctic Ocean is a major player in the global climate/earth system, this region is one of the last major physiographic provinces on Earth where the short- and long-term geological history is still poorly known. This lack in knowledge is mainly due to the major technological/logistical problems in operating within the permanently ice-covered Arctic region which makes it difficult to retrieve long and undisturbed sediment cores. Prior to 2004, in the central Arctic Ocean piston and gravity coring was mainly restricted to obtaining near-surface sediments, i.e. only the upper 15 m could be sampled. Thus, all studies were restricted to the late Pliocene/Quaternary time interval, with a few exceptions. These include the four short cores obtained by gravity coring from drifting ice floes over the Alpha Ridge, where older pre-Neogene organic-carbon-rich muds and laminated biosiliceous oozes were sampled. Continuous central Arctic Ocean sedimentary records, allowing a development of chronologic sequences of climate and environmental change through Cenozoic times and a comparison with global climate records, however, were missing prior to the IODP Expedition 302 (Arctic Ocean Coring Expedition – ACEX), the first scientific drilling in the central Arctic Ocean. By studying the unique ACEX sequence, a large number of scientific discoveries that describe previously unknown Arctic paleoenvironments, were obtained during the last decade (for most recent review and references see Stein et al., 2014). While these results from ACEX were unprecedented, key questions related to the climate history of the Arctic Ocean remain unanswered, in part because of poor core recovery, and in part because of the possible presence of a major mid-Cenozoic hiatus or interval of starved sedimentation within the ACEX record. In order to fill this gap in knowledge, international, multidisciplinary expeditions and projects for scientific drilling/coring in the Arctic Ocean are needed. Key areas and approaches for drilling and recovering undisturbed and complete sedimentary sequences are depth transects across the major ocean ridge systems, such as the Lomonosov Ridge. These new detailed climate records spanning time intervals from the (late Cretaceous/)Paleogene Greenhouse world to the Neogene-Quaternary Icehouse world will give new insights into our understanding of the Arctic Ocean within the global climate system and provide an opportunity to test the performance of climate models used to predict future climate change. During the Polarstern Expedition PS87 in August-September 2014, new site survey data including detailed multibeam bathymetry, multi-channel seismic and Parasound profiling as well as geological coring, were obtained on Lomonosov Ridge (Stein, 2015), being the basis for a more precise planning and update for a future IODP drilling campaign.

Reference:
Stein, R. (Ed.), 2015. Cruise Report of Polarstern Expedition PS87-2014 (Arctic Ocean/Lomonosov Ridge). Reps. Pol. Mar. Res., in press.
Stein, R. , Weller, P. , Backman, J. , Brinkhuis, H., Moran, K. , Pälike, H., 2014. Cenozoic Arctic Ocean Climate History: Some highlights from the IODP Arctic Coring Expedition (ACEX). Developments in Marine Geology 7, Elsevier Amsterdam/New York, pp. 259-293.