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Future scientific drilling in the Arctic Ocean: Key objectives, areas, and strategies

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In spite of the critical role of the Arctic Ocean in climate evolution, our understanding of the short- and long-term paleoceanographic and paleoclimatic history through late Mesozoic-Cenozoic times, as well as its plate-tectonic evolution, remains behind that from the other world's oceans. This lack of knowledge is mainly caused by the major technological/logistic problems in reaching this permanently ice-covered region with normal research vessels and in retrieving long and undisturbed sediment cores.

With the Arctic Coring Expedition – ACEX (or IODP Expedition 302), the first Mission Specific Platform (MSP) expedition within IODP, a new era in Arctic research began (Backman, Moran, Mayer, McInroy et al., 2006). ACEX proved that, with an intensive ice-management strategy, successful scientific drilling in the permanently ice-covered central Arctic Ocean is possible. ACEX is certainly a milestone in Arctic Ocean research, but – of course – further drilling activities are needed in this poorly studied ocean. Furthermore, despite the success of ACEX fundamental questions related to the long- and short-term climate history of the Arctic Ocean during Mesozoic-Cenozoic times remain unanswered. This is partly due to poor core recovery during ACEX and, especially, because of a major mid-Cenozoic hiatus in this single record. Since ACEX, a series of workshops were held to develop a scientific drilling strategy for investigating the tectonic and paleoceanographic history of the Arctic Ocean and its role in influencing the global climate system:

- „Arctic Ocean History: From Speculation to Reality" (Bremerhaven/Germany, November 2008);
- "Overcoming barriers to Arctic Ocean scientific drilling: the site survey challenge" (Copenhagen/Denmark, November 2011);
- Circum-Arctic shelf/upper continental slope scientific drilling workshop on "Catching Climate Change in Progress" (San Francisco/USA, December 2011);
- "Coordinated Scientific Drilling in the Beaufort Sea: Addressing Past, Present and Future Changes in Arctic Terrestrial and Marine Systems" (Kananaskis, Alberta/Canada, February 2012).

During these workshops, key areas and key scientific themes as well as drilling and site-survey strategies were discussed. Major scientific themes for future Arctic drilling will include:

- The Arctic Ocean during the transition from greenhouse to icehouse conditions and millennial scale climate changes;
- Physical and chemical changes of the evolving Polar Ocean and Arctic gateways;
- Impact of Pleistocene/Holocene warming and sea-level rise on upper continental slope and shelf gas hydrates and on shelf permafrost;
- Land-ocean interactions;
- Tectonic evolution and birth of the Arctic Ocean basin: Arctic ridges, sea floor spreading and global lithosphere processes.

When thinking about future Arctic drilling, it should be clearly emphasized that for the precise planning of future Arctic Ocean drilling campaigns, including site selection, evaluation of proposed drill sites for safety and environmental protection, etc., comprehensive site survey data are needed first. This means that the development of a detailed site survey strategy is a major challenge for the coming years.

Here, an overview of perspectives and plans for future Arctic Ocean drilling will be presented.

References

Backman, J., Moran, K., Mayer, L.A., McInroy, D.B., and the Expedition 302 Scientists, 2006. Proc. IODP 302; doi:10.2204/iodp.proc.302.2006.