Establishing a Pan-Arctic Pleistocene Stratigraphy and a Comprehensive Paleoclimate Record for the Arctic Ocean

The Arctic is the least known of the world's oceans but as new technologies provide access to this ice-covered region, we are on the threshold of a revolution in our fundamental understanding of the geology and geophysics of the Arctic Ocean. Given the logistical challenges, seismic-reflection and -refraction data are scarce in the central Arctic Ocean and large areas are virtually unsampled by piston or gravity corers. Even more critical, is the total lack of high-resolution sediment records from this ocean (sedimentation rates greater than 10-20 cm/kyr). Recent findings suggest that we have been looking in the wrong places for such records and that the continental slopes and perhaps drift deposits on the flanks of the mid-ocean ridges might hold such records that could lead to a millennial-scale paleoclimatic history for this polar ocean. Despite this lack of data, it is becoming increasingly clear that the Arctic Ocean plays a critical role in the global climate and tectonic history. It is a source for deep-water formation that drives the global thermohaline circulation and, thus, the heat transfer from lower to higher latitudes. The perennial sea ice cover is currently affecting the Earth's albedo, but its history remains unknown. The tectonic evolution controls the physiography of the Arctic Ocean basin, which in turn largely influence where and how the currents flow.

Thus we suggest a coordinated Marine Geological and Geophysical (MGG) program that has specific detailed objectives, but with the common goal of Linking Eurasian and Amerasian records to constrain the paleoenvironmental and tectonic evolution of the Arctic Ocean. We envision several ice-breaker cruises to the Arctic Ocean over the duration of the IPY with the primary goal of obtaining seismic and other acoustic data that will be key in understanding the sedimentology of the Arctic sea floor and guide coring activities. These cores will then be dated with a variety of standard and newly evolving technologies (radiocarbon, Pb-210, optically stimulated luminescence, paleomagnetic intensity variations, etc.). One of the critical needs is to establish a paleoclimatic history of the Pleistocene and older sediments in the Arctic Ocean that can address the following questions:

- How did changes in the influx of warm, North Atlantic Intermediate Water into the central and western Arctic change relative to surface conditions (SST, ice cover, circulation, and other oceanic parameters)?
- What was the impact of the opening of the Bering Straits on the Arctic Ocean?
- Did ice shelves exist in this area during earlier glacial stages that could help explain the origin of plough marks on the sea floor of the Chukchi Borderland to the north?
- Did sea surface temperatures in August fluctuate during the Holocene and previous interglacial intervals? If so, are these fluctuations in phase with those of the North Atlantic/Greenland Ice Sheet climate events such as Dansgaard/Oescheger cycles?
- Did the net drift of ice in the Arctic change over century to millennial time scales that mimic decadal-scale Arctic Oscillation circulation changes in the

last half-century?

- When did ice groundings on the Lomonosov Ridge and Chukchi Borderlands occur in the past and were they synchronous?
- When did the perennial sea ice first appear in the Arctic?
- What role does the Arctic Ocean play in global climate?

An international effort will be required to analyze the many sediment records obtained during the several coring expeditions to the Arctic. This team of paleoceanographers will apply both standard and novel techniques to determine climate proxies that can lead to a comprehensive understanding of the role of the Arctic in global climate change.

Potential Collaborators:
Dennis A. Darby, Old Dominion University
Martin Jakobsson, University of New Hampshire and University of Stockholm
Leonid Polyak, Ohio State University
Margo Edwards, University of Hawaii
Glenn Berger, Desert Research Institute, University of Nevada
Anne deVernal, GEOTOP, Universiti of Quebec at Montreal
Claude Hillaire-Marcel, GEOTOP, Universiti of Quebec at Montreal
Stephanie Brachfeld, Montclair State University
Jens Bischof, Old Dominion University
Greg Cutter, Old Dominion University
James V. Gardner, University of New Hampshire
Larry A. Mayer, University of New Hampshire
Andrew A. Armstrong, University of New Hampshire