Geophysical Research Abstracts
Vol. 18, EGU2016-12956, 2016
EGU General Assembly 2016

The Opening of the Arctic-Atlantic Gateway: Tectonic, Oceanographic and Climatic Dynamics - an IODP Initiative

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The modern polar cryosphere reflects an extreme climate state with profound temperature gradients towards high-latitudes. It developed in association with stepwise Cenozoic cooling, beginning with ephemeral glaciations and the appearance of sea ice in the late middle Eocene. The polar ocean gateways played a pivotal role in changing the polar and global climate, along with declining greenhouse gas levels. The opening of the Drake Passage finalized the oceanographic isolation of Antarctica, some 40 Ma ago. The Arctic Ocean was an isolated basin until the early Miocene when rifting and subsequent sea-floor spreading started between Greenland and Svalbard, initiating the opening of the Fram Strait / Arctic-Atlantic Gateway (AAG). Although this gateway is known to be important in Earth's past and modern climate, little is known about its Cenozoic development. However, the opening history and AAG's consecutive widening and deepening must have had a strong impact on circulation and water mass exchange between the Arctic Ocean and the North Atlantic. To study the AAG's complete history, ocean drilling at two primary sites and one alternate site located between 73°N and 78°N in the Boreas Basin and along the East Greenland continental margin are proposed. These sites will provide unprecedented sedimentary records that will unveil (1) the history of shallow-water exchange between the Arctic Ocean and the North Atlantic, and (2) the development of the AAG to a deep-water connection and its influence on the global climate system. The specific overarching goals of our proposal are to study: (1) the influence of distinct tectonic events in the development of the AAG and the formation of deep water passage on the North Atlantic and Arctic paleoceanography, and (2) the role of the AAG in the climate transition from the Paleogene greenhouse to the Neogene icehouse for the long-term (∼50 Ma) climate history of the northern North Atlantic.
Getting a continuous record of the Cenozoic sedimentary succession that recorded the evolution of the Arctic-North Atlantic horizontal and vertical motions, and land and water connections will also help better understanding the post-breakup evolution of the NE Atlantic conjugate margins and associated sedimentary basins.