



## **Nature and History of Cenozoic Polar Ice Covers: The Case of the Greenland Ice Sheet**

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The nature of the modern climate System is characterized by steep temperature gradients between the tropical and polar climatic zones and finds its most spectacular expression in the formation of ice caps in high Northern and Southern latitudes. While polar regions of Planet Earth have been glaciated repeatedly in the long course of their geological history, the Cenozoic transition from a „greenhouse“ to an „icehouse“ has in fact produced a unique climatic scenario with bipolar glaciation, different from all previous glacial events. The Greenland ice sheet is a remainder of the Northern Hemisphere last glacial maximum ice sheets and represents hence a spectacular anomaly.

Geological records from Tertiary and Quaternary terrestrial and oceanic sections have documented the presence of ice caps and sea ice covers both on the Southern as well on the Northern hemisphere since Eocene times, approx. 45 Mio. years ago. While this was well known in the case of Antarctica already for some time, previous ideas about the origin of Northern hemisphere glaciation during Pliocene times (approx. 2-3 Mio. years ago) have been superceded by the dramatic findings of coarse, terrigenous ice rafted detritus in Eocene sediments from Lomonosov Ridge (close to the North Pole) apparently slightly older than the oldest Antarctic records of ice rafting. The histories of the onset of Cenozoic glaciation in high Northern and Southern latitudes remain enigmatic and are presently subjects of international geological drilling projects, with prospects to reveal some of their secrets over the coming decades.

By virtue of the physical properties of ice and the processes controlling the dynamics of the turn-over of the ice-sheets only young records of glacial ice caps on Antarctica and on Greenland have been preserved, on Greenland with ice probably not older than a few hundred thousand years, on Antarctica potentially as old as 1.5-2 Mio. years. Deep-sea cores with their records of ice-rafting from off NE Greenland, Fram Strait and to the South of Greenland suggest the more or less continuous existence of the Greenland ice sheet for the past 18 Mio. years, if not more, a phantastic supplement of the Northern hemisphere glaciation deduced from the ice cores.

The dramatic decrease of extent and thickness of the Arctic sea ice cover of the past decades has aroused much public and political interest because of the potentially dramatic consequences for the exploitation of living and non-living resources as well as the socio-economic, technical and commercial systems developed in the Arctic seas and in the permafrost-infested adjacent land areas.

The fate of the Greenland ice sheet with its impact on global sea level changes is one of the central unresolved problems. We urgently need novel marine research platforms which allow for an all-season presence of research and monitoring programs as well of scientific drilling programs in the Arctic Ocean.