IS THE INITIATION OF GLACIATION ON ANTARCTICA RELATED TO A CHANGE IN THE STRUCTURE OF THE OCEAN?

William W. Hay
2045 Windcliff Dr., Estes Park, CO 80517, USA (whay@gmx.de)

Today the ocean is characterized by pools of warm tropical-subtropical water bounded poleward and at depth by cold water. In the tropics and subtropics the warm waters are bounded at depth by the thermocline, which outcrops on the ocean surface between the subtropical and polar frontal systems that form the poleward boundary. It is along and between the frontal systems that the thermocline waters enter the ocean interior. These frontal systems from beneath the maxima of the zonal component of the westerly winds. Today the location of the westerly winds is stabilized by the persistent high pressure systems at the polar regions produced by the ice cover of the Antarctic and sea-ice cover of the Arctic.

Evidence from the paleobiogeographic distribution of plankton fossils indicates that during the Eocene and earlier times the subtropical and polar frontal systems were not persistent features. Recent climate model experiments show that without perennial ice cover in the polar regions a seasonal alternation between high and low atmospheric pressure systems can occur. These seasonal alternation would force major changes in the location and strength of the westerly winds, preventing the development of the well-defined frontal systems that characterize the earth today. Without the subtropical and polar frontal systems the thermocline would be less well developed and the pycnocline might even be dominated by salinity differences.

Evidence from ocean drilling suggests that the glaciation of East Antarctica began at the Eocene-Oligocene boundary, but took time to spread over the entire continent. The presence of calcareous nannoplankton in the Arctic basin during the Eocene and earlier, and their absence in Oligocene and younger strata suggest that the ice cover of the Arctic Ocean also developed at the Eocene-Oligocene boundary. Both of these events appear to be related to the development of the modern oceanic structure, but it
remains uncertain whether the ocean changed in response to the development of ice covered polar regions or vice versa.