Proc. NIPR Symp. Polar Meteorol. Glaciol., 7, 113, 1993

A LABORATORY EXPERIMENT ON MELTING OF PRESSURE RIDGE KEELS IN THE SUMMER ARCTIC (ABSTRACT)

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In a laboratory study we consider a phenomenon which occurs in the summer Arctic; namely, the melting of the pressure ridge keels in salt-stratified water at uniform temperatures.

The experiments took place in a glass tank that measured 0.60 m long, 0.30 m wide, and 0.45 m deep, which was filled to a depth of 0.25 m with water linearly stratified with salt (salinity at the surface 3%, and salinity gradients: 1.6, 2.6, 3.8%/m), at uniform temperatures: +10.5, +8.7, +4.4, −0.5, −1.5°C. A block of bubble-free ice (0.10 m long, 0.10 m wide, and 0.04 m thick), which had initial temperature about 0°C, was submerged in the center of the tank, and extended 0.03 m below the water surface. Temperature of the ice block, temperature and salinity of water were measured during the experiments. In order to visualize the flow, the Schlieren optical system was used.

Our results show that the heat transfer to the ice takes place in four regions. Just next to the ice, there is a conductive boundary layer. Next to this layer, there is a convective layer with the flow pattern as follows: beneath the ice, the water moves downward until it reaches the level where its density equals that of the far-field water; on that level, the water starts to move horizontally; then it turns back, and moves upward to the ice. Below this convective layer, there is a double-diffusive regime. A massive water layer beneath the double-diffusive regime was maintained as a conductive region throughout the experiments.

(Received December 3, 1992)