Geophysical Research Abstracts, Vol. 8, 06052, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06052

Gases and gas hydrates in subglacial Lake Vostok: an experimental constraint from gas-content measurements in accretion ice

V. Lipenkov (1,2), D. Raynaud (2) and T. Ikeda-Fukazawa (3)

(1) Arctic and Antarctic Research Institute, St. Petersburg, Russia, (2) Laboratoire de Glaciologie et Géophysique de l'Environnement, CNRS and University Joseph Fourier, Saint-Martin-d'Hères, France, (3) PRESTO, Japan Science and Technology Agency, Institute of Statistical Mathematics, Tokyo, Japan (lipenkov@aari.nw.ru)

When considering the gas budget of a subglacial lake featured by bottom ice melting on one side and ice accretion on the other, one usually accepts that the gas composition and the total gas content of sub-ice water are mostly controlled by the ice-water exchange between the lake and the overlying ice sheet. This implies accumulation of N_2, O_2 and other atmospheric gases in the lake. Earlier theoretical works by Lipenkov & Istomin (2001) and McKay and others (2003) have shown that about 30 water renewals are required to reach the upper bounds of concentrations of nitrogen and oxygen dissolved in lake water (i.e., 2.4-3.1 g N_2/l and 0.8-1.3 g O_2/l), which correspond to equilibrium between gases in solution and those in a hydrate phase. Assuming a long-lasting steady state of the lake, it has been concluded that the hydrate growth and the high oxygen concentration (50 times more than in air-equilibrated water) are likely characteristics of Lake Vostok.

To check the theoretical inferences we have performed accurate measurements of total gas content along the Vostok accretion ice core using an experimental setup capable of measuring very small concentrations of gases in ice, such as those expected for equilibrium between ice and air-saturated water. Our results suggest that the actual concentration of gases dissolved in the upper lake layer (from which accretion ice 2 has formed) is about one order of magnitude lower than predicted for saturation level. We therefore conclude that formation of gas hydrate is impossible in this part of the lake. The new data provide a useful experimental constraint for understanding the gas

distribution in Lake Vostok, as affected by circulation and mixing of water beneath the ice sheet.