Long-term monitoring of borehole and soil temperatures in the Kamchatka Peninsula

Makoto Yamano[1], Hideki Hamamoto[1], Yasukuni Okubo[2], Akinobu Miyakoshi[3]

[1] ERI, Univ. Tokyo, [2] AIST, [3] Sci and Tech, Chiba Univ

In 2000 to 2002, detailed temperature measurements were conducted in boreholes in the Kamchatka Peninsula, as part of an international cooperation research project for reconstruction of the ground surface temperature history (Research Group on Paleoclimate Reconstruction Studies in Kamchatka, this session). Measurements were repeated in eight wells at intervals of a few months to one year. The temperature profiles appeared to be quite stable in most of them, though significant temporal variations (by up to about 0.25 K) were observed in two wells. We made long-term monitoring of temperatures at one or two depths in four wells, two stable ones (Malki-2 and Malki-19) and two unstable ones (E-1 and UZ), using commercial water temperature recorders with a resolution of 0.001 K. The objectives of the monitoring experiments are 1) to investigate the nature of the temporal variations in the unstable wells, 2) to detect possible small-amplitude variations in the stable wells, 3) to monitor propagation of the ground surface temperature changes into the subsurface. Five instruments were deployed in 2001 and recovered in 2002 and we could successfully obtain temperature records for 168 to 330 days in three wells.

In Malki-19, temperatures 25 m and 40 m below the surface were recorded for eleven months. The temperature at 40 m showed small variations (by about 0.01 K) in the initial four months and thereafter it had been almost constant (within 0.002 K). On the other hand, the temperature at 25 m gradually decreased from September to April and then rapidly increased in May (about 0.05 K in 20 days). This temperature rise is too sharp to result from thermal diffusion of the ground surface temperature change and thought to be due to some groundwater flow, possibly related to snow melting. We re-deployed temperature recorders in this well at two intermediate depths, 30 m and 35 m, in August, 2002 and will recover them after another one-year monitoring. We also monitored soil temperatures 50 cm and 100 cm below the ground surface in the close vicinities of Malki-12 and Malki-19 with a resolution of 0.1 K for the same 11-month period. Analyses of these soil temperature data revealed that heat transfer between 50 cm and 100cm was almost purely conductive at Malki-12, while it had some non-conductive component from February to May at Malki-19, which may be attributed to freezing and melting of water contained in the soil around 50 cm.

In the two unstable wells (E-1 and UZ), significant temporal variations were recorded at 325 m in E-1 and at 108 m in UZ. The temperature variations at these points are similar to each other, oscillating with periods of several hours and amplitudes of 0.02 to 0.03 K. They are probably due to water convection inside the wells.