Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

AGE04-P04 会場:コンベンションホール 時間:5 月 24 日 18:15-19:30

海成帯水層の温度変化が地下水質に与える影響
Effects of temperature change in a marine subsurface aquifer on groundwater quality

釼持 将人 [1*] ; 植木 崇 [1] ; 斎藤 健志 [1] ; 濱本 昌一郎 [2] ; 川本 健 [1] ; Moldrup Per[3] ; 小松 登志子 [1]
KENMOCHI, Masato[1*] ; UEKI, Takashi[1] ; SAITOU, Takeshi[1] ; HAMAMOTO, Shoichiro[2] ; KAWAMOTO, Ken[1] ; MOLDRUP, Per[3] ; KOMATSU, Toshiko[1]

[1] 埼玉大学大学院理工学研究科, [2] 東京大学, [3] オールボー大学
[1]Graduate School of Science and Engineering , Saitama University, [2]The University of Tokyo, [3]Aalborg university, Aalborg, Denmark

Ground Source Heat Pump (GSHP) systems are getting increasingly used worldwide. GSHP systems utilize the groundwater temperature via heat exchange for cooling or heating of buildings, and GSHP is generally recognized as a renewable and sustainable energy system. For example, applying GSHP instead of conventional heating/cooling systems makes it possible to reduce CO_2 emissions to the atmosphere, save energy, and restrain urban heat island phenomena. On the other hand, GSHP systems dispose heat or cold to the subsurface, which causes subsurface temperature change and, consequently, may cause changes in chemical composition of the groundwater (possible groundwater contamination) as well as a disturbance of the subsurface microbial ecosystem. However, the effect of temperature change on the subsurface environment is not well understood. Therefore, we conducted a long-term thermal loading and natural cooling test and investigated the temperature change effects on groundwater quality. The experimental site is located in Saitama University, Japan. The experimental system was installed with a U-tube as the heat exchanger. Four groundwater monitoring wells were installed for an upper (marine) and a lower (non-marine) aquifer at 1m (W1), 2m (W2), 5m (W5) and 10m (W10) distance from the U-tube heat exchanger. Thermal loading into the subsurface was applied for totally 13 months by circulating 40 ℃ water inside the U-tube heat exchanger. Results showed groundwater temperature at W1 increased about 8 ℃ (from 17 ℃ to 25 ℃) for the first 6 months and then stayed almost constant. In the upper aquifer, concentrations of boron, DOC, and several other chemical components increased together with the increase in subsurface temperature. In the lower aquifer, a similar effect of temperature could only be observed for one chemical while data were not sufficient for other chemical compounds. After thermal loading, the effect of natural cooling on groundwater quality was investigated for 14 months. At the end of the thermal cooling period, the subsurface temperature and the concentrations of components that had increased during thermal loading all decreased to approximately the initial values observed before heating had started. For these components, an approximate linear relationship between change in chemical concentration and change in subsurface temperature was observed.

キーワード: 地中熱利用ヒートポンプ, 熱負荷, 温度変化, 地下水質, 海成帯水層, 自然冷却
Keywords: Ground Source Heat Pum(GSHP), thermal loading, temperature change, groundwater quality, marine aquifer, natural cooling