International Session (Oral) | Symbol A (Atmospheric, Ocean, and Environmental Sciences) | A-GE Geological & Soil Environment

[A-GE03_30AM2]Subsurface Mass Transport and Environmental Assessment

Convener:*Yasushi Mori(Graduate School of Environmental and Life Science, Okayama University), Hirotaka Saito(Department of Ecoregion Science, Tokyo University of Agriculture and Technology), Ken Kawamoto(Graduate School of Science and Engineering, Saitama University), Shoichiro Hamamoto(Department of Biological and Environmental Engineering, The University of Tokyo), Ming Zhang(Institute for Geo-Resources and Environment, National Institute of Advanced Industrial Science and Technology), Chair:Yasushi Mori(Graduate School of Environmental and Life Science, Okayama University), Ming Zhang(Institute for Geo-Resources and Environment, National Institute of Advanced Industrial Science and Technology)

Wed. Apr 30, 2014 11:00 AM - 12:44 PM 213 (2F)

This session covers the topics on mass transport, waterand energy cycles in geoenvironment. Subjects related to laboratoryand field measurements, theoretical analysis, and numerical modelingwill be discussed. Presentations on geo-pollution, remediation,geological disposal of hazardous wastes, ground source heatutilization, mass transport in vadose zone, soil-water monitoring, andenvironmental assessment are encouraged.

12:20 PM - 12:35 PM

[AGE03-P02_PG]Effects of in-situ, long-term thermal loading on groundwater quality in marine sediments of Arakawa Lowland, Japan

3-min talk in an oral session

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Keywords:subsurface temperature, thermal pollution, long-term thermal loading, GSHP, marine sediment, groundwater quality

Subsurface temperature increase ("subsurface warming") has been documented below many large cities worldwide. The observed subsurface temperature increase has shown close relations with surface warming effects due to global warming and urbanization. Recently, ground source heat pump (GSHP) systems have become popular as a renewable energy technology for space cooling and heating. Operation of GSHP systems for space cooling discharges waste heat into the subsurface environment and, thus, induces additional subsurface temperature increase. However, any potentially negative impacts of GSHP-induced temperature increase on the subsurface environment have not been studied in detail. The objective of this study was therefore to investigate the effects of in-situ, long-term thermal loading on groundwater quality.A GSHP system was installed in a 50-m deep borehole with a corresponding 50-m long U-tube heat exchanger at the campus of Saitama University in the Arakawa Lowland, Japan. Four groundwater monitoring wells were installed in a marine sand sediment aquifer (around 17-m depth) at 1-m (W1), 2-m (W2), 5-m (W5), and 10-m (W10) distance from the U-tube. At each monitoring well, temperature detectors were placed in 10 depths at approximately 5-m interval, and the subsurface temperature was monitored before and during thermal loading. For the thermal loading, approximately 40℃ water was circulated inside the U-tube heat exchanger for 13 months, and groundwater was

frequently sampled from all four monitoring wells every 1 to 2 weeks. A wide spectrum of chemical properties (including pH, EC, DO, ORP "oxidation-reduction potential", dissolved gases, dissolved organic carbon, inorganic ions, and trace elements) were measured to characterize groundwater quality.The subsurface temperature at the nearest monitoring well (W1) increased gradually with approximately 8℃ from 17℃ (baseline) to 25℃ during 13 months of thermal loading. In contrast, at the farthest monitoring well (W10), there was no significant change in subsurface temperature, and W10 was therefore selected as a reference (non-temperature affected) monitoring well. A number of chemical components in the groundwater, including boron and potassium, increased markedly at W1 compared to W10. Since marine sediments typically contain high concentrations of chemical components including boron and potassium, the observed increase in groundwater concentration is likely due to thermally-induced dissolution and/or desorption from the marine sediment. The possible mechanisms behind the observed concentration increases will be discussed.