H213-P014 **Room: Poster Session Hall** **Time: May 23**

Spatial separation of groundwater flow paths from a multi-flow system using stable isotopes of oxygen and hydrogen as tracers

Shinji Nakaya[1]; Kenji Uesugi[2]; Hiroyuki Komiya[3]; Harue Masuda[4]; Minoru Kusakabe[2]

[1] Civil Eng., Shinshu Univ.; [2] none; [3] Drico LTD.; [4] Dept. Geosci., Osaka City Univ.

Understanding groundwater recharge patterns and basin-scale flow paths is important for environmental conservation and the management of water resources in urban areas. In a basin-scale area, especially one surrounded by mountain ranges, a wide range of recharge waters arise from potential recharge areas such as mountains and plateaus through different aquifers. The principal chemical constituents of groundwater can be used to characterize the water quality of different aquifers. Principal component analyses (PCA) have been employed to trace the origin of the groundwater and calculate the mixing portions and mass balances from ambiguous groundwater composition data [e.g., Laaksoharju et al., 1999]. These PCAs make it possible to evaluate the spatial and temporal variations in the principal physicochemical processes implicated in groundwater quality [e.g., Sanchez-Martos et al., 2001].

Previous researchers have investigated the stable isotopic ratios of oxygen and hydrogen to study groundwater recharge and flow because these stable isotopes of oxygen and hydrogen have the potential to trace both source and flow paths in groundwater systems [e.g., Craig, 1961; Mizutani and Oda, 1983; Mizota and Kusakabe, 1994; Mizutani and Satake, 1997; Adams et al., 2001; Mizutani et al., 2001; Weyhenmeyer et al., 2002; Lui et al., 2004; Wilcox et al., 2004]. However, few studies have addressed the potential contribution of isotopic ratios of oxygen and hydrogen data to the separation of groundwater flow paths from a multi-flow system at the basin scale. Most previous research, in which hydrologic and physical approaches were employed to measure parameters such as potential head, flow velocity, and geophysical techniques, have been found to be ill suited to the estimation of the spatial distribution of isotopic ratios of oxygen and hydrogen data to identify groundwater flow paths. The spatial estimation method, however, does not provide for the objective diagnosis of spatial separation of flow paths. Improvements could be made in the flow path separation methodology, considering that groundwater mixing obscures the spatial separations of the sources and flow paths from the spatial distribution of both stable isotopes in a multi-flow system. In addition, it is difficult to separate the flow paths spatially using hydrologic and physical approaches. However, determining specific groundwater flow paths in groundwater systems allows the investigation of hydrologically important problems such as water resources management, environmental conservation, and the mechanism of pollution.

Stable isotopes of oxygen and hydrogen have the potential to serve as tracers for both source and flow paths in a groundwater system. The ratios of stable isotopes of oxygen and hydrogen can be used as natural tracer parameters to separate multi-flow groundwater paths by applying a simple inversion analysis method to determine the differences between observed and calculated isotopic ratios of oxygen and hydrogen data in a simple mixing model. The model presented here assumes that the distribution of natural tracers in the steady state is governed by simple mixing between flow paths with a normal distribution of flow-rate. When the inversion analysis and simple mixing model were applied to the multi-flow system of the Matsumoto Basin, which is surrounded by Japanese alpine ranges, the end-members of the relationship between observed isotopic ratios of oxygen and hydrogen could be separated spatially into specific groundwater flow paths in the multi-flow system of shallow and deep groundwater flow paths.