Evaluation of anthropogenic contamination of bedrock groundwater using hydrochemical data: An example from suburban areas in Korea

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A better evaluation of the relative contribution from natural versus anthropogenic sources to the observed groundwater quality is highly needed for better groundwater management. In this work, we evaluated hydrochemical data of 102 bedrock groundwater samples from two suburban areas using multivariate statistical techniques, in order to distinguish between anthropogenic contamination and natural process. The hydrochemistry of groundwater changed gradually from Ca-Na-HCO_3 to Ca-HCO_3-Cl type, concomitantly with the general increase of nitrate. The estimation of the distribution using the non-parametric kernel algorithm showed the bimodality for F and NO_3. The collected samples could be divided into natural versus anthropogenic groups via multivariate hierarchical, k-means, and fuzzy c-means clustering methods. The results from those multivariate clustering showed a drawback in terms of definite classification. On the other hand, the model-based clustering with a mixture model was a preferred method for identifying the two groups. Careful examination of hydrochemistry data for the two clustered groups suggests that the formation of Ca-Na-HCO_3 type groundwater is mainly controlled by plagioclase hydrolysis accompanying subordinate cation exchange (between Ca and Na) and calcite precipitation, while Ca-HCO_3-Cl type groundwater with noticeable NO_3 reflects varying degrees of anthropogenic contamination by agrochemicals and sewage/manure. This study provides an example of the successful application of the model-based clustering with mixture model to the regional groundwater quality evaluation.

Preliminary results of a recent expedition to the Australian-Antartic Ridge

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The Australian-Antarctic Ridge (AAR) is the largest unexplored expanse of the global mid-ocean ridge system. In early 2011, the Korea Polar Research Institute conducted a short survey of two segments at 160°E (K1) and 152.5°E (K2) using the icebreaker Araon. As a result, we have a multi-beam map and 16 rock core samples from the two segments. Also, we found strong signals of hydrothermal venting using MAPR (Miniature Autonomous Plume Recorder) profiles from the ridge. The AAR is intermediate spreading ridge and its axial depth is relatively shallow (~2100m). The axial morphology varies from an axial high to well-developed rift valley in the K1 segment, suggesting magma supply has varied on short spatial scales. The K1 western end abuts a transform with a strike towards the Balleny Islands, providing a possible source of excess magma supply and the shallow axial depth. MgO varies from 1.72 to 7.63 wt.%, mostly between 6~7wt.%. Fe-Ti basalt and dacite are at the western end of the K1 segment where magma supply appears most robust. The K2 segment samples are more primitive, and include E-MORB with 0.65% K_2O. Na_8 (2.5) is lower than the EPR but slightly high in the context of the global correlation with axial depth. It falls on trend with the slightly higher Na of Indian Ocean ridges. Trace elements and isotopes will be analyzed to characterize the mantle source. It appears that hydrothermal vents are distributed in the central part of the K1 segment. In the K2 segment, hydrothermal vent signals were mainly found in the western part of the segment.