Geologic control of groundwater contamination in a basaltic aquifer beneath an agricultural field, South Korea

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Hydrochemistry data of groundwater were collected in the Gosan area, southwestern coastal part of Jeju Island, South Korea. In the western part of the study area, an impermeable clay-rich layer (Gosan Formation) locally overlies the basaltic aquifer. The Robust PCA method (ROBPCA) was used to investigate hydrochemical characteristics. The results show that principal component 1 effectively distinguishes the groundwater samples recording varying degrees of agricultural contamination. Groundwater samples whose chemistry is controlled by agricultural contamination are restricted to the eastern part of the study area, while uncontaminated water is predominantly obtained in the western part where the Gosan Formation occurs. Groundwater samples from wells near the edge of the Gosan Formation show a seasonal fluctuation of water quality (i.e., from uncontamination in a dry season to agricultural contamination in a wet season). This study suggests that groundwater below the marginal part of an impermeable layer is seasonally contaminated by a temporal extension of the pollution front during the wet season, even though the impermeable layer plays a role as a natural barrier to protect groundwater from the infiltration of surface contaminants.

PANGA: A new tool for the evaluation of noble gas data

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In recent years, several new models for the description of dissolved noble gases in groundwater have been developed, because the more traditional models did not yield good results for certain data sets [1]. The oxygen depletion model was proposed in response to the observation that the classical models yielded too low temperatures for some aquifers [2]. To overcome specific problems related with unrealistically high temperature estimates of the closed-system equilibration model, a Monte Carlo-based evaluation method was developed [3].

In order to adapt and simplify the evaluation process, we created *PANGA*, a new software for the analysis of noble gas data sets. Its basic features are comparable to *Noble* [4], but it also includes more recent excess air models and provides additional features like fast Monte Carlo fitting (up to several 100,000 fits per minute) and the subsequent depiction and evaluation of the results in one- and two-dimensional histograms as well as the possibility to interactively explore the χ^2 space of noble gas fits, enabling the user to identify problems like local minima in the χ^2 surface.

Comparison tests have shown that *PANGA* is able to reproduce *Noble's* results very well. The analysis of several data sets showed that Monte Carlo results, especially parameter uncertainties, differ considerably from the original fit results in a number of cases. Therefore, it is recommended to perform Monte Carlo evaluations in all cases, especially if any kind of problematic behavior occurs, like parameters approaching physical boundaries or unrealistically high temperature estimates or uncertainties.

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