

Evaluation of the causes of the decrease in concentration of fluorescent dyes used to trace groundwater based on batch experiments using minerals and sedimentary rocks

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Fluorescent dyes are widely used as conservative tracers for tracking water movement and contaminant transport due to their advantageous properties, including low absorption by rocks and resistance to decomposition. These dyes exhibit low background signals and detection limits, along with minimal environmental impact and toxicity. These characteristics make them valuable tools for various applications, such as distinguishing between drilling fluids and groundwater during deep underground drilling, and for use non-adsorbing tracers in tracer tests to understand solute transport boreholes. However, in actual groundwater survey sites, there have been reports of cases where the concentration of the fluorescent tracer has unintentionally decreased, resulting in it behaving as a non-conservative. This phenomenon is feared to cause over- or underestimations of parameters in flow paths and groundwater velocities. Therefore, the acquisition of scientific knowledge to understand the conditions and mechanisms that cause a decrease in the concentration of fluorescent dye and its standardization can be expected to contribute to reducing the uncertainty in groundwater flow assessment. The ultimate goal of this study is to standardize the conditions under which fluorescent dyes used in groundwater surveys can be used as non-adsorbing tracers. As first step towards achieving this goal, we will present the factors that lead to the decline in fluorescent dye concentration based on batch experiments using the rocks of the Koetoi formations in the Horonobe area of Hokkaido (northernmost part of Japan), where a decrease in uranine concentration has been confirmed. Particular attention will be paid to the effect of the pH and concentration of major ion concentration in the liquid phase on the decrease in fluorescent dye concentrations.

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