

Effects of rock-derived microorganisms on fluorescent tracer solutions

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Fluorescent dyes have been recognized as a useful conservative tracer for tracing water flow and have been used in various studies. In our previous study, the authors showed that there are cases where fluorescent dyes cannot act as conservative tracers because of the interaction with microorganisms present in groundwater [1].

In the "tracer experiment", a tracer solution is injected into natural fractures and information about water flow in the fracture is estimated from the behavior of the tracers. In the tracer experiment conducted in the fracture in the Koetoi Formation in Horonobe area of Hokkaido (northernmost part of Japan), it was expected that the effect of microbes on the fluorescent dyes would not be significant because the natural groundwater was replaced by an artificial solution (simulated groundwater) before the experiment. However, some fluorescent dyes showed non-conservative (unnatural) behavior in some time slots of the experiment [2].

Therefore, in order to know whether fluorescent dyes act as conservative tracers, it is important to understand the effect of microorganisms present on/in rocks on fluorescent dyes in solution. In this study, we used fluorescence microscopy and viability PCR to examine the characteristics (abundance, Live/Dead ratio, and genetic information) of microorganisms in solution released from rocks in the Koetoi Formation. Based on the characteristics of microorganisms and the results of contact tests between the rocks and fluorescent dye solutions, we discussed the possibility that microorganisms in the rocks could be released into the solution and then affect the fluorescent dye. The results of this research will provide points to consider when evaluating water flow using fluorescent dye solutions.

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[1] Sugiyama et al., *Heliyon*, 10(2024), e27397.

[2] Nohara et al., *Proceedings of the Japan Society of Groundwater Hydrology* (2024) (in Japanese).