

First observation of a silicic acid- organic compound complex under neutral condition: Silicic acid – Tiron complex

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Silicon (Si) is one of the most common elements constructing the Earth's crust and much of it is present in different kinds of silica minerals (SiO₂). Information on the mobility and transport of Si from minerals to water as silicic acid (Si(OH)₄) is important to estimate the chemical weathering of rocks. The dissolution of silica has been investigated vigorously in inorganic salt solution included in natural waters. On the other hand, a lot of organic compounds (from simple organic compounds with low molecular weight to polymer with high molecular weight) are also present in natural waters. Only a few investigations have been conducted on the effect of organic compounds on the dissolution of silica. In addition, the interaction between silicic acid and organic compounds has still been uncertain. In an oil field, the groundwater with higher Si concentration than the solubility of quartz was found and the Si concentration increased with increasing the total organic carbon in the groundwater, suggesting that organic compounds may accelerate the dissolution of quartz. A phenolic hydroxyl group and a carboxyl group are often contained in main functional groups in natural organic compounds such as humic acid.

In order to search functional groups that can strongly interact with silicic acid, in this study, we investigated the effect of tiron with two hydroxyl groups on the dissolution of amorphous silica in neutral aqueous solution. In conclusion, tiron accelerated the dissolution due to formation of silicic acid-tiron complex. The solubility of amorphous silica increased with increase the concentration of tiron. The complex was stable over wide range of pH. Moreover, we detected directly the silicic acid –Tiron complex by ²⁹Si NMR technique.

Sorption of Uranium onto laumontite, a fracture-filling mineral of granite

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A batch sorption experiment has been conducted in a glove-box in order to investigate the uranium sorption properties of a natural fracture-filling mineral of granite, which was identified to be laumontite, a kind of natural zeolite, by using XRD and SEM. The used granite and groundwater were taken from KURT (KAERI Underground Research Tunnel), located within the KAERI research area, Yuseong, Daejeon, Korea.

The result of the uranium sorption onto laumontite both in the synthetic and natural groundwaters revealed a low distribution coefficient (K_d) as shown in Fig. 1. This low K_d value can be explained from the fact that uranium will exist as anionic complexes such as uranyl hydroxides (UO₂(OH)₄²⁻ and UO₂(OH)₆⁴⁻) or uranyl carbonates (UO₂(CO₃)₂²⁻ and UO₂(CO₃)₃⁴⁻) in the given groundwater condition [1].

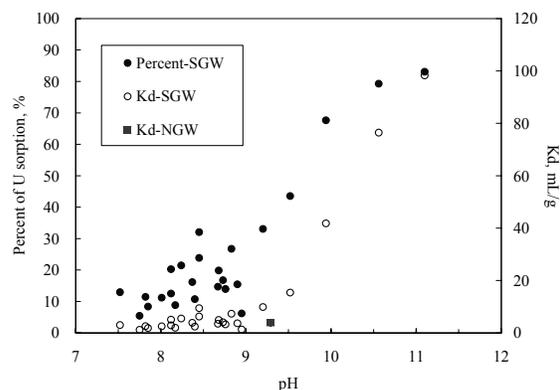


Figure 1: Result of the uranium sorption onto laumontite as a function of the pH (SGW: synthetic groundwater; NGW: a natural groundwater sampled from KURT).

The low K_d of uranium was also directly explained by the result of the X-ray image mapping for the granite with the natural fracture filled with laumontite, which showed a lower content of uranium over the fracture region. This result agrees with the result of the sorption experiment. The result was also confirmed by the CEC (5 mmol/100g) and BET (2.63 m²/g) measurements for the laumontite.

[1] D. K. Keum *et al.* (2002) *J. Korean Nucl. Soc.* **34**, 517.