

Uranium minerals in black shale, South Korea

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Uranium (U) in black shale, South Korea has been the subject of interest because of its potential roles in energy and mining industries. Previous reports found that black shale in Korea is highly metalliferous with lead, uranium, and vanadium, but also that uranium content increases with increasing total carbon content in the black shale. Yet, identification and understanding of minerals for uranium and other elements in the black shale is still not clearly addressed. In the present study, U-containing minerals in the black shale is characterized by combination of geochemical composition analysis and electron probe microanalyzer (EPMA) analysis.

Results show that uranium content is moderately proportional to the content of total organic carbon (TOC) in the black shale. XRF analysis shows that Al, Mg, Ba, and K are major elements with trace elements such as Zn, P, S, and Ti. Total uranium concentration is up to 0.13 wt. %, whereas total concentration of V and Ba are 0.17-1.6 wt. %, and 2.0-5.0 wt. %, respectively. Using EPMA, it is found that two different element series of U-P-Cu and U-V-Ba are found in U-containing minerals. Ratio of the series for U : V : Ba and U : P : Cu are 2 : 2 : 1 and 4 : 4 : 1, respectively. These results indicate that the U-containing minerals are francevillite ((Ba, Pb)(UO₂)(V₂O₈)(H₂O)) and torbernite (Cu (UO₂)₂ (PO₄)₂ (H₂O)₈) in the black shale. These findings are not consistent with previous reports showing that uraninite is a main mineral in U-containing minerals at a different area of the black shale, Korea. Upon our results, it is worthy to note that formation of uranium minerals are sensitively affected by geochemical environments and tectonic movements in the black shale, South Korea.

Uptake and retention of mercury by hydroxylapatite

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Mercury (Hg) is well known as a toxic element for humans and ecosystems. Partitioning of the mercury to minerals and organics has been known to influence the fate and transport of mercury species in natural ecosystems. Despite the importance of mercury interaction with minerals, sorption mechanisms and modes are not still clearly understood. Systematic characterization of mercury uptake by hydroxylapatite (HAP, [Ca₅ (PO₄)₃OH]) is little addressed over a wide range of physicochemical conditions.

Mercury sorption on HAP shows that the initial uptake of mercury by HAP sharply increases, levels off, and then followed by little changes as a function of concentration at pH 7.0 and 9.0, showing a typical pattern of Langmuir sorption. No obvious differences are found in the sorption pattern at the two pHs. Compared to that of the sorption at pH 7.0, however, the sorption of mercury on HAP decreases by a factor of 4 at pH 9.0. In addition, the mercury uptake by HAP decreases with increasing ionic strength of the solution. From $I = 0.01$ M to $I = 0.1$ M, total amount of the sorption decreases around by a factor of 2. During the duration of the kinetic experiments, the initial uptake and retention of mercury by HAP is rapid and ~85% of Hg is sorbed on the HAP within 30 mins, suggesting that adsorption plays a key role in the initial uptake of mercury at the HAP-water interface. Results reveal that different physicochemical conditions such as pH and I influence the mercury uptake by HAP sensitively.