

## Isotopic and elemental geochemistry of the Han River, Korea : implications for water-rock interaction

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The aim of this study is to investigate the geochemical processes and factors controlling chemical nature of the Han River, South Korea. The Han River is the largest river in South Korea and supports a variety of human activities, including water supply for a metropolitan city, Seoul. It consists of two major rivers (the North and South Han Rivers) and many tributaries. The North Han River drains a basin consisting of the Precambrian gneissic basements and Mesozoic granites, whereas the South Han River drains a basin consisting of the Paleozoic sedimentary rocks (mostly carbonates) and Mesozoic granites.

Compared to the South Han River, the North Han River was much lower in TDS, DIC, major ions and Sr contents, but much higher in  $\delta^{34}\text{S}_{\text{SO}_4}$  and  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios. This indicates that the chemical and isotopic compositions of the Han River waters are strongly controlled by the geology of their drainage basins. The Han River waters show seasonal variations in the major ions and stable isotopes except for  $^{87}\text{Sr}/^{86}\text{Sr}$  ratio. The seasonal variation of  $\delta^{13}\text{C}_{\text{DIC}}$  values, ranging from -14.4 to -4.9‰, suggests that these values are influenced by relative contributions from groundwater, biogenic  $\text{CO}_2$  and atmospheric  $\text{CO}_2$ . The  $\delta^{34}\text{S}_{\text{SO}_4}$  values of the North Han River ( $7.0 \pm 1.5\text{‰}$ ) were higher than those of the South Han River ( $3.5 \pm 1.0\text{‰}$ ). This means that in the North Han River, dissolved  $\text{SO}_4$  were derived from oxidation of sulfide minerals in silicate rocks or deposition from atmosphere, whereas in the South Han River, from the oxidation of sulfide minerals in the abandoned poly-metallic deposits distributed over the upstream. The  $\delta^{18}\text{O}$  and  $\delta\text{D}$  values during the wet season were higher than those measured during the dry season, indicating intense evaporation in large dams.

## Sorption of naphthalene by organo-clays

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### 1:1 Clays and HDTMA Surface Coverage

Hexadecyltrimethylammonium (HDTMA) interaction with kaolinite and halloysite showed that adsorbed surfactant configurations were controlled by the clay surface structure and morphology. While the stabilized bilayer-like HDTMA structure was formed on kaolinite, an agglomerated (less-stabilized) surfactant structure was formed on halloysite. The sorption characteristics of naphthalene by HDTMA-kaolinite and -halloysite are shown in the figures below.

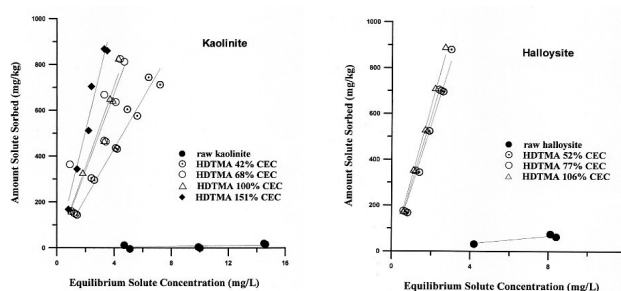


Figure 1: Sorption of naphthalene by kaolinite and halloysite.

### Discussion and results

Naphthalene was partitioned into the organic phase created by the surfactant tail groups of the organo-clays. Sorption of naphthalene by HDTMA-clays at different surfactant surface coverage revealed that the naphthalene distribution coefficient ( $K_d$ ) values were primarily affected by the amount of surfactant in the organo-clays. Sorption of naphthalene, however, was particularly dependent on the bound surfactant molecular configurations that occurred with both kaolinite and halloysite. The  $K_d$  values of naphthalene sorption on HDTMA-halloysite were generally higher than those of HDTMA-kaolinite. However, the  $K_{oc}$  value (the organic carbon-based partition coefficient) of halloysite was lower than that of kaolinite at higher HDTMA loadings. Consequently, clay structural and morphological characteristics may have a considerable impact on the surfactant configurations (e.g., stabilized vs. less-stabilized) responsible for partitioning hydrophobic organic contaminants (HOCs) such as naphthalene.

### References

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