Application of U isotopes as tracers of water-rock interaction in the Han River Basin, Korea

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In order to investigate the temporal and spatial variability of water chemistry, major ions, and Sr and U isotopes were analyzed in the dissolved load of water samples collected from two major tributaries (the North and the South Han River) of the Han River, Korea. The Han River basin was primarily selected as a study site because its two major tributaries have distinct geological characteristics in their drainage areas: It drains Precambrian gneisses and Mesozoic granites, whereas the South Han River drains Paleozoic carbonates and clastic sedimentary rocks.

Total cation charge (TZ^+) of the North Han River draining the silicate terrains were similar with the global river average (TZ^+ = 0.725 meq/l: Meybeck, 1988), whereas TZ^+ of the South Han River draining karst terrains were nearly three times higher than the global river average. Sr isotopic compositions in the North Han River were more radiogenic than the South Han River.

Recent researches have indicated that U isotopes could be used as tracers investigating water-rock interaction during weathering processes and groundwater inputs to river waters. U was separated using a TRU-spec extraction chromatography method and then analyzed by a MC-ICP-MS in Korea Basic Science Institute. All values of ($^{234}U/^{238}U$) ratios were above 1 (= secular equilibrium). ($^{234}U/^{238}U$) ratios in the North Han River were nearly secular equilibrium (1.02 ~ 1.06), whereas those in the South Han River were much higher (1.14 ~ 1.22). This indicates that basin geology strongly affects ($^{234}U/^{238}U$) ratios of river waters. Small ^{234}U-^{238}U fractionations in the North Han River can be attributed to surface weathering of the bedrock. However, relatively higher ^{234}U- ^{238}U fractionations in the South Han River are thought to result from groundwater input and much intensive water-rock interaction with carbonates relative to the silicates in the North Han River basin. Furthermore, ($^{234}U/^{238}U$) ratios showed a seasonal variation: higher ratios during spring and lower ratios during summer. This study shows that U isotopes can be used as a good tracer to investigate weathering processes.

References

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