Biosorption of heavy metals from aqueous solutions by using dead biomass of *Ralstonia* sp., bacterial strain isolated from soil

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Biosorption of Cd, Cu and Pb from aqueous solutions has been investigated in batch experiments. Dead biomass of *Ralstonia* sp. was isolated from the oil-contaminated soil at a military site in Korea. Batch experiments were performed to determine the optimum conditions of the sorption of biosorbent (dead biomass of *Ralstonia* sp.) such as pH, contact time and the various concentrations of biosorbent and metal ions in solution. The initial concentration of Cd, Cu and Pb in the synthetic aqueous solution was titrated as 5 mg/L, except the experiment for the effect of various concentrations of metals in solution on the biosorption. All examined bio-strains were sterilized by autoclaving at 121°C to get the non-living biomass. The dead biomass was added to the synthetic aqueous solution of Cd, Cu and Pb. The mixture was shaken on a rotating shaker at 130 rpm for 120 minutes (30°C) and was seperated by centrifugation at 17000 rpm for 10 minutes. The supernatant liquid was analyzed on ICP/OES for residual metal concentrations in solution. The removal efficiency for heavy metals generally increased as amounts of biosorbent increased in solution. More than 96 % of initial metal ions in solution was removed with 0.5 g of dead-biosorbent for Cd and Pb. More than 70 % of Cu was removed by using 1 g of biosorbent. At pH 1 of solution, the removal capacities of Cd, Cu and Pb were very low. However, the optimum biosorption capacity was 79 % and 98 % at pH 4 for Cu and Pb, respectively. The removal efficiency for metal ions reached about 77 % within 10 minutes of reaction time and stably maintained as the time increased. From the results of the experiment for the effect of initial metal concentration in solution on the sorption, the removal efficiencies were very high at the range of 0.05 ~ 5 mg/L. The experimental biosorption data was fitted to Freundlich isotherm model to understand the sorption mechanism. Freundlich sorption coefficient of heavy metals for biosorbent ranged from 121 to 221, suggesting that the dead biomass of *Ralstonia* sp. is a suitable biosorbent for the removal of heavy metals from aqueous solutions.

Geochemical Significance of ^{14}C and $^{87}Sr/^{86}Sr$ isotopic data of high-temperature deep groundwater at the southeastern part of Korea

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In this study, $^{87}Sr/^{86}Sr$ and ^{14}C isotope compositions were used in order to clarify the heat source and age of groundwater cycle of the high temperature deep groundwater (hot springs) at the southeastern part (Pohang and Dongrae) in the South Korea.

The two hot springs in this study are located at the Cretaceous granite area, and are mainly of Na-Cl(-SO_4) type. In Sr isotope ratios, $^{87}Sr/^{86}Sr$ ratio of the hot springs range 0.700 to 0.710. The $^{87}Sr/^{86}Sr$ ratio of each the hot spring is constant for six years. The correspondence between the $^{87}Sr/^{86}Sr$ ratio of the hot spring and the initial $^{87}Sr/^{86}Sr$ ratio of the hot spring-bearing granite indicates that the high temperature hot springs in South Korea may be derived from the heat source related with the Mesozoic granite though it is difficult to think that the Mesozoic granite itself is the heat source of the hot spring. Environmental isotope results such as δD and $\delta^{18}O$ reveal that groundwater aquifer was filled with meteoric water. However, ^{14}C age of high temperature deep groundwaters indicate that they are paleo-groundwaters ranging between 1,271 and 36,863 years.

Our $^{87}Sr/^{86}Sr$ and ^{14}C isotope results suggest that the circulation between thermal water and current meteoric water including groundwater, surface water and rainwater at the southeastern part in the South Korea should be very slow. Therefore, it may be concluded that the high temperature deep groundwater at the southeastern part in South Korea might be derived from paleo-groundwater reservoir with high temperature rather than the thermal waters derived from circulation of current meteoric water.