Remediation of arsenic contaminated soil using soil washing with an acidic and reducing solution

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Soil contamination with arsenic (As) is a serious environmental concern due to its highly toxicity and carcinogenic properity. Iron oxides are known a most important factor for the controlling As concentration in soil pore water. They absorb large amout of As and coprecipitate with As. We tried to develop a new washing method of As contaminated soil by the dissolution of iron oxide and desorption of As employing pH and redox potential adjustment. An As contaminated soil sample was collected at a rice paddy field near a copper smelter, Korea. The As concentration of the soil sample was determined with an aqua-regia extraction method. Washing solutions were prepared to be 0.001 – 0.1N HCl and 0 - 3 % Na-dithionite. The soil and washing solution were mixed at 1:4 ratio and the mixtures were reacted for 15, 30, 45 and 60 minutes. After the reaction, the soil and washing solution were separated with a centrifugation. The pH, Eh, and the concentrations of As, Fe and Mn of the washing solution were determined and the As concentration of the washed soil sample was also determined. The separated washing solution was treated with H_2O_2, $CaCl_2.2H_2O$ and cationic organic polymer to remove As.

The soil washing with the 0.01N HCl 3% Na-dithionite solution for 30 minutes was the most effective in the As removal from the soil reducing As concentration from 43 mg/kg to 18 mg/kg. The As concentration of the washing solution was reduce from 19.2 mg/L to 0.76 mg/L after the waste water treatment.

The stability of amino acids under redox-constrained hydrothermal conditions

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With the discovery of an extensive biosphere near deep-sea hydrothermal vents, the stability of amino acids at elevated temperatures and pressures is of great interest for the cycling of C and N within the crust and the overlying oceanic water column. Previous studies provide strong evidence that the decomposition properties of amino acids are very sensitive to parameters such as temperature, and catalytic reactor surfaces. However, despite the clear relevance, the redox state of the system has rarely been controlled in such studies. Here hydrothermal experiments were conducted to investigate the influence of redox conditions on the stability of glutamic acid at pressures and temperatures reflecting near-seafloor hydrothermal environments (100–250 °C, 136 bar). Reactions were conducted for 3 to 35 min. in a titanium flow-through cell. The oxidation state was controlled by equilibrating ~ 22 mmolal of H_2 (aq) with a glutamic acid solution with pH adjusted to ~10 at 25 °C. The products were identified and analyzed using gas chromatography and ionic chromatography with conductivity and electrochemical detectors. Results indicate that the reaction kinetics of glutamic acid under hydrothermal conditions is associated with conversion to the cyclic pyroglutamate via a dehydration reaction. Other products of glutamic acid included CO_2 (aq) and H_2 (aq). At temperatures above 200 °C formate was also observed, possibly produced via a decarboxylation and reduction. The conversion rate of glutamic acid to pyroglutamic acid, however, does not appear to be affected by the redox state of the system. The decomposition of glutamic acid is observed to obey first-order kinetics. From the temperature-dependent decay rate expressed by the Arrhenius equation, we obtained an activation energy of 39.6 kJ/mol with a pre-exponential factor as 74 sec^{-1}, whereas previous study estimated the activation energy of 152 kJ/mol with a pre-exponential factor as 10^{13} sec^{-1} using Pyrex glass and longer reaction times up to 15 hrs at 252 ºC [1].

[1] Povoledo & Vallentyne (1963) *Geochimica et Cosmochimica Acta* **28**, 731–734.