

Dearsinification of geothermal brine by anion exchange reactions with inorganic materials

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Retrieved materials from the geothermal fluid contain high As concentration . To make the retrieved materials useable, dearsinification of the geothermal fluid is necessary. Dissolved arsenic concentration in the geothermal fluid averages 14 mgL⁻¹, and also contains high amounts of dissolved Cl and SiO₂. In situ analyses and predicted aqueous speciation (REACT-Geochemist's Workbench) indicate predominance of the arsenite species H₃AsO₃(aq). Inorganic materials known to remove dissolved anionic metal species, which include a Fe-oxyhydroxysulfate, Mg-Al-hydrotalcite (HT) and an Mg-rich solid, were investigated in this study.

Two sets of sorption experiments were conducted: (1) laboratory experiments with arsenate and (2) in situ experiment with arsenite. HT removed a maximum of 33.7 mg/g when used with arsenate in laboratory experiment. However, HT was not able to remove dissolved As in the geothermal fluid due to (1) competition with Cl and (2) existence of an uncharged As.

Additions of the Fe-oxyhydroxysulfate in both experiments were accompanied by an increase in Fe³⁺ content and decrease in pH (i.e. acidic). On the other hand, addition of the Mg-rich solid in both experiments resulted to an increase in pH (i.e. alkaline) and Mg content. The addition of the inorganic materials removed dissolved As to minimum levels (less than 2 ppm) in both experiments. Dissolved As uptake during the addition of the inorganic materials involved initial partial dissolution followed by adsorption-coprecipitation reactions.

The Fe³⁺ released by the partial dissolution of the Fe-oxyhydroxysulfate resulted to the oxidation of the dissolved arsenite into arsenate. Fe-oxyhydroxysulfate is known to readily adsorb arsenate. On the other hand, the alkaline condition resulting from the addition of the Mg-rich solid is susceptible to the coprecipitation of dissolved As.