Coseismic fluid-rock interaction in an active fault zone estimated from Sr speciation analysis of fault gauge

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Chemical behavior of trace elements during fluid-rock interaction is generally estimated on the basis of the change in their concentration in solid or fluid phases. Changes in mineral phases associated with fluid-rock interactions are discussed based on the correlation with concentration changes of elements, but the trace element-hosting phases themselves have been identified scarcely by spectroscopic observation. This is because XRD analyses can detect only major mineral phases hosting major elements, and cannot applied to the host mineral phase estimation for trace elements.

In this presentation, we applied XAFS (X-ray Absorption Fine Structure) analysis to fault-gauge system to understand the behavior of elements related to the coseismic fluid-rock interactions. XAFS is a powerful spectroscopic tool to estimate chemical species of elements from local electron environment condition around the objective elements. The Chelungpu fault in Taiwan was selected for this purpose. The Taiwan Chelungpu-fault Drilling Project (TCDP) was undertaken after the the Chi-Chi earthquake (M7.6; 1999), and gauge samples were collected from three fault zones from 1100 m to 1300 m in depth from Hole-B core samples. Distinct changes observed in concentration for various trace elements at the center of the fault zone relative to the adjacent rocks are interpreted as a result of coseismic fluid-rock interactions at above 350 degrees centigrade [1]. For example, Sr concentration increased twice at the center of the fault zone with distinctly lowering ^{87}Sr/^{86}Sr ratio. The host mineral phase of Sr was estimated from XANES analysis of Sr, Ca, and S.

XANES spectra of Ca and S and literature data [2] suggested that potential host phase of Sr newly produced at the center of the fault zone is calcite, gypsum, and plagioclase. XANES spectra of Sr from the samples at the center of the fault zone were consistent with that of albite (sodic plagioclase) among the candidate minerals. The production of albite phase enriched in Sr indicates occurrence of high temperature fluid more than 250 degrees centigrade, which is consistent with the previous discussion [1] estimated from elemental concentration increase/decrease trends. Occurrence of such high-temperature fluids during the earthquake will play an important role to the fault weakening.

[1] Ishikawa (2008) *Nature Geosci.* **1**, 679-683. [2] You (1996) *Earth Planet. Sci. Lett.* **140**, 41-52.

Remediation of Heavy Metals in Nano-Materials

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Remediation Techniques for Heavy Metals in Soil

Zeolites act as molecular sieves by crystallising in cage and channel structures. There are three proposed mechanisms that zeolites use to immobilise heavy metals; modification of the pH of the soil, sorption of metals onto mineral surfaces, and cation exchange process[1].

The aim of this project is to determine the effectiveness of zeolite-A to act as a remediation tool for lead and arsenic in contaminated soils.

Pyrite ash is a waste product from the production of sulphuric acid characterised as mostly iron oxides and silicate *nanoparticles*. The material contains high levels of arsenic and lead up to 15,000 and 24,000 mg/kg, respectively.

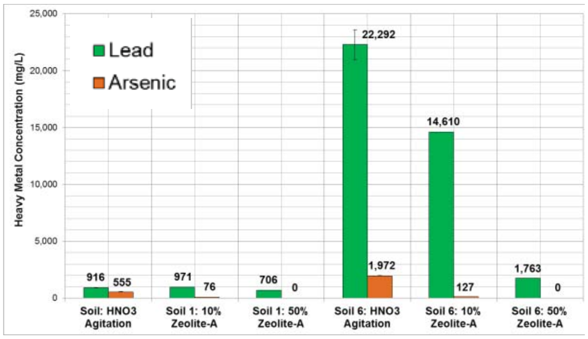

Figure 1 - Concentration of Soil Leachate following Remedial Action with Zeolite-A Additives at 10% and 50% Quantities Compared to Original Leachate Concentrations (mg/L)

Results and Conclusion

Zeolite-A has been found to give positive results as a remediation technique. Two soil samples, 1 and 6, were collected from a pyrite ash contaminated site. The particle size is around 100 nm, and the pH of the two samples are 1.8 and 5.5, respectively. It was found that zeolite-A more readily adsorbs arsenic rather than lead (see Figure 1).

A 10% weight dosage of zeolite-A successfully immobilised 86% of the arsenic in sample 1, and 93% from sample 6. A 50% dosage of zeolite-A removed 100% of the arsenic in both soil samples. Zeolite-A was found to be less efficient remediating lead, which showed using 10% zeolite-A, only 34% was removed.

Further experiments will be carried out using XRD, XRF, AAS, and SEM-EDX. We aim to fully understand the complexation and insertion mechanisms for lead and arsenic, and to determine the potential of zeolite-A as an affordable and accessible method of remediation.

[1] Shu, Shao, Li, Shao, and Du (2009) *J. Hazard. Mater.* **170**, 1-6.