Geophysical Research Abstracts
Vol. 14, EGU2012-4924, 2012
EGU General Assembly 2012

Study of the water-rock interaction in Tsengwenshi groundwater system (southern Taiwan) using BCR sequential extraction procedure

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The heavy metals in groundwater seriously risk the human wealth, agriculture and the aquaculture, especially, if the water is the major source of daily use. Generally, in spite of anthropogenic source, the heavy metals in groundwater are released during water-rock interaction. However, there are many mineral phases being capable of releasing heavy metals. It would need a sequential extraction procedure to identify the source mineral phase in the aquifer. In addition, the geochemical reactions after the release of heavy metals are also important to modify the concentrations. In this study, the rare earth elements are used to be a natural tracer for this purpose. The study area, Tsengwenshi watershed in southern Taiwan, is an alluvial fan with all kinds of land uses and is notorious of arsenic contamination. The groundwaters sampled in this study show that arsenic is enriched in deep aquifer (depth>150m), which is composed of sediments deposited in the last glacial period (18 ka). Based on this conceptual model, the results of BCR sequential extraction procedure are categorized into shallow aquifer (depth<150m) and deep aquifer; and, the averages of heavy metals in two groups can be subsequently obtained to take account of extensive water-rock interaction in the groundwater system. The results show that arsenic and other heavy metals are mostly binding with Fe-Mn oxides. To compare the ratios between deep and shallow aquifers for all heavy metals, the pattern of groundwaters does not show the similar type with those of extracted phases from soils. It is believed that the released heavy metals were strongly modified by the geochemical reactions during the transportation in the groundwater system. In addition, the analysis results of the rare earth elements demonstrates that almost all groundwaters with high arsenic do not have Ce negative anomaly; and, on the contrary, those with low arsenic are generally characterized by strong negative anomaly. Generally, the Ce negative anomaly is a prominent indicator of oxidation reaction even though the groundwataers are very negative in redox state in the present. However, the relationship between Ce negative anomaly and arsenic is deserved to be evaluated in more detail.