Estimating the role of competing ions on the arsenic mobilization processes in the aquifers of Bengal basin by surface complexation modeling

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This study investigates the relative roles of the different competing ions on the arsenic (As) mobilization in the sedimentary aquifers of Bengal basin by surface complexation modeling of the temporal varaibility of As in shallow (<50 m) groundwater. Two sets of piezometers ($2 \times 5 = 10$), installed at the two sites with relatively contrasting dissolved As concentration in groundwater, were monitored bi-weekly for As and other hydrogeochemical parameters over a period of 20 months. The estimation of the standard deviation (SD) for As(III) reflects strong temporal variation (SD ≥ 10 μg/L) in all the piezometers of two sites over the monitoring period. Particularly, the variation is more prominent in the shallowest part of the aquifer, where the site specific cyclic trends are evident. While, As(V) shows significant temporal variation in the piezometers of high As site only and no specific trend is reflected in the variation.

Two different surface complexation models (SCMs), developed for ferrihydrite and goethite have been explored to account for the observed temporal variation in As(III) and As(V) concentrations. The SCM for ferrihydrite has provided the better estimation for both As(III) and As(V) variations. Among the different competing ions, PO_4^{3-} appears as the major competitor of As(III) and As(V) adsorption onto ferrihydrite and the competition ability decreases in the order $PO_4^{3-} >> Fe(II) > H_4SiO_4 = HCO_3^-$. It is further revealed that a small decrease in pH significantly increases the concentration of As(III) and decreases the As(V) concentration and vice versa. The present study suggests that the reductive dissolution of Fe oxyhydroxides alone cannot explain the observed high As concentration in groundwater of the sedimentary aquifers. Perhaps, the reductive dissolution of Fe oxyhydroxides followed by competitive sorption reactions with the aquifer sediment is the processes conducive for As enrichment in the groundwater of Bengal basin.

Neoproterozoic late to post-collisional, quartz-bearing ultrapotassic syenites from southernmost Brazil

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Continental collision is registered in southernmost Brazil at ca. 650 Ma by tectonic interleaving of paragneisses and orthogneisses of different ages under granulite facies metamorphic conditions. Megacrystic and fine-grained syenites are intrusive subparallel to the main gneissic banding and have locally undergone subsolidus deformation at around 700 °C. The syenites contain slighly perthitic K-feldspar and variable proportions of pyroxene, amphibole and red biotite, with small amounts of plagioclase and quartz. Their crystallization age is 642 ± 10 Ma (U-Pb zircon LA-MC-ICP-MS), determined in least deformed variety. Their main geochemical features (SiO_2 58-62 wt%) are high HFSE, REE, Rb, Sr, and Ba contents, as well as K_2O/Na_2O ratios (4-10), typical of ultrapotassic rocks. The trace-element patterns suggest that they are derived from OIB-type sources. Their initial $^{87}Sr/^{86}Sr$ ratios vary from 0.719 to 0.729, and $^{143}Nd/^{144}Nd$ ratios from 0.5116 to 0.5118. Similar values for both isotope ratios have been reported for post-collisional ultrapotassic magmatism in southwest Tibet. Melting of phlogopitic, Rb-enriched mantle sources may account for the extremely high $Sr_{(i)}$ values found in the studied syenites. The ultrapotassic character, trace-element and isotope patterns are consistent with sources previously affected by subduction, and are therefore compatible with structural data indicative of post-collisional setting.