Influence of humic and fulvic acid on arsenic transport in columns filled with ferrihydrite-coated sand

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Arsenic mobility in the environment is primarily controlled by adsorption onto minerals such as Fe, Al, and Mn oxides and clays. However, natural organic matter (NOM, humic substances (HS)) including fulvic acids (FA) and humic acids (HA) was shown in batch experiments to effectively compete with As for sorption sites at mineral surfaces potentially increasing As mobility. Additionally, HS have the potential to form complexes with As either binding to the mineral surface as surface complexes or possible increasing their mobility as dissolved complexes.

In this study, we carried out breakthrough and desorption experiments with columns filled with ferrihydrite (FH)-coated sand to answer the following questions:

1. Is As (III) transported faster or slower than As (V) in column systems filled with FH-coated sand?
2. Are As (III) and As (V) transported faster or slower in the presence of HS compared to HS-free systems?
3. Is transport of As (III) and As (V) faster when fulvic acids are present compared to humic acids?

Arsenic only, As/FA, and As/HA solutions were injected into the columns separately and breakthrough curves of As, Fe and OM were followed in each setup for the breakthrough experiments. In desorption experiments, As (III) and As (V) were presorbed to FH-coated sand and desorbed by HA, FA or background electrolyte solution (NaCl) without HA/FA in independent setups. Samples from the eluate were collected and analyzed for As, Fe and DOC.

First, we found that As (III) was more mobile than As (V). Second, As transport in both breakthrough and desorption experiments was faster in the presence of humic and fulvic acids, suggesting that HA and FA competed with As for sorption sites in the FH-coated sand. Third, FA, due to their smaller molecular size, was more effective in mobilizing As than HA. The presence of HA and FA in As-contaminated environments and their shown effects on As transport suggests that HA and FA have the potential to influence As transport in As-contaminated aquifers.

Role of stable isotopes in management of coalbed natural gas co-produced water

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The Powder River Basin located in western Wyoming is an area of accelerating coalbed natural gas (CBNG) production. The major challenge associated with expansion of these CBNG operations is how to manage the huge amounts of co-produced water which is pumped out of the coal seams to facilitate production of the gas. Depending on the quality of this co-produced water several management options are currently available. The higher quality water can be used to supplement area water supplies. However, if the water does not meet federal and state standards for beneficial use and the cost of treatment is uneconomical it can be re-injected into subsurface formations or disposed of into ponds and surface drainages where it will infiltrate into the shallow ground water. To devise effective management and monitoring practices there is need to develop a tool that can monitor the fate of CBNG co-produced water.

This study examines the potential of using stable carbon isotope signature of dissolved inorganic carbon ($\delta^{13}C_{DIC}$) as natural tracer of CBNG co-produced water. In the study area, the CBNG co-produced waters have positive $\delta^{13}C_{DIC}$ values in range of +10‰ to +21‰ V-PDB, distinct from the ambient regional surface and groundwaters, with $\delta^{13}C_{DIC}$ values ranging from -10‰ to -15‰ V-PDB. Our initial results demonstrate that these contrasting $\delta^{13}C_{DIC}$ signatures can be used to track the fate of CBNG co-produced waters. The $\delta^{13}C_{DIC}$ signatures in conjunction with other geochemical proxies can also help in assessing changes in ambient surface/ ground water quality due to CBNG co-produced water contribution.