Arsenic geochemistry in a biostimulated aquifer: An aqueous speciation study

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Biostimulation has been the main focus for uranium remediation at the former uranium mill site in Rifle, CO. While this technique has been shown to decrease aqueous uranium concentrations downgradient of acetate injection wells, it has also increased arsenic concentrations from around 1 uM to 6 uM. In order to determine the effects of uranium remediation on arsenic chemistry, groundwater samples were collected and preserved for concentration and speciation analysis during the 2009 and 2011 experiments. A Dionex AS/AG-16 column was used to separate arsenic species using a sodium hydroxide gradient eluent. Inductively coupled plasma mass spectrometry was used as an arsenic specific detector and to separately measure total concentrations of arsenic, uranium and other redox sensitive elements. The highest arsenic concentrations observed at the Rifle site were found when the system was in sulfate reduction and the sulfide concentrations were highest. Prior analyses of arsenic speciation focused solely on arsenate, arsenite and methylated species, but more recent research has shown that systems with high sulfide concentrations have additional thiolated arsenic species. Thioarsenates (mono-, di-, tri- and tetra-thio), and specifically trithioarsenate, dominate the arsenic speciation when the concentrations are highest. Stopping biostimulation before sulfate reduction begins could prevent the formation of thioarsenates and high arsenic release. Other uranium remediation techniques such as bicarbonate flushing will also help with uranium remediation without creating a problem with arsenic release.