

2005 Salt Lake City Annual Meeting (October 16–19, 2005)

Paper No. 141-10

Presentation Time: 10:50 AM-11:05 AM

AQUEOUS GEOCHEMISTRY AND ENVIRONMENTAL FATE OF NATURAL PERCHLORATE

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Natural perchlorate has been recently measured in groundwaters from 2 to 4 nanomolal (nm) (0.2 to 0.4 ppb) in northern New Mexico. Liquid chromatography-mass spectrometry/mass spectrometry (EPA SW846 method 8321A), with an instrument detection limit of 0.6 nm (0.06 ppb), was used during this investigation. Perchlorate consists of four-double covalent bonds between chlorine and oxygen (tetrahedral coordination), making this highly soluble oxyanion very stable and nonreactive in aqueous environments. Formation of natural perchlorate under strongly oxidizing conditions is possible through evaporation and production of ozone during electrical storms. These processes occur in northern New Mexico and may generate low concentrations of perchlorate during early stages of the hydrological cycle. Perchlorate does not adsorb onto inorganic surfaces, including hydrous ferric oxide, smectite, and manganese oxide, characterized by net-negative surface charges under circumneutral pH conditions (6.5 to 9.0). Physical processes including mixing and dispersion control the distribution of perchlorate in groundwater. The overall reduction of perchlorate to chloride is given by the following half reaction: $\text{ClO}_4^- + 8\text{H}^+ + 8\text{e}^- = \text{Cl}^- + 4\text{H}_2\text{O}$, with an E° of 1.39 volts (V) and an Eh (pH7) of 0.98 V. This reaction has relevance to natural systems such as wetlands and other microbially-active environments with plentiful and diverse electron donors. Perchlorate is reduced to intermediate compounds (chlorate [Cl(V)] and chlorite [Cl(III)]) and eventually to chloride in anaerobic environments by serving as a terminal electron acceptor during oxidation of acetate and other forms of reactive organic carbon. Perchlorate reduction is both thermodynamically and microbially enhanced under denitrifying conditions.

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General Information for this Meeting

Session No. 141

Naturally Occurring Perchlorate (and Other Oxyanions) in the Hydrologic Cycle—Origins, Accumulation, Transformations, and Transport

Salt Palace Convention Center: 251 C

8:00 AM-12:00 PM, Tuesday, 18 October 2005

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