Isotopic tracing of the origin and transport of perchlorate

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Perchlorate (ClO_4^-) is ubiquitous in the environment. It has both natural and synthetic (anthropogenic) sources. The isotopic compositions of oxygen (^{18}O:^{17}O:^{16}O) and chlorine (^{37}Cl:^{36}Cl:^{35}Cl) in representative samples of natural and synthetic perchlorate have been characterized [1, 2]. Natural ClO_4^- is formed mainly in the stratosphere as a product of reaction of atmospheric Cl species with ozone. Highest known natural ClO_4^- abundances (0.1-0.2 wt%) are in the nitrate salt-rich caliche soils of the hyperarid Atacama Desert, Chile, but there are measurable background concentrations in nearly all soils, as well as surface waters and groundwaters. Synthetic ClO_4^- is formed mainly by electrolytic oxidation of NaCl brine. Stable isotopic compositions of O and Cl provide a means by which to distinguish the origin of three principal sources of ClO_4^- found in the environment of the SW USA (synthetic, indigenous natural, and Atacama natural from application of imported Chilean nitrate-salt fertilizer). Microbial reduction of ClO_4^- is associated with a systematic isotope effect [3, 4], that may create some ambiguity in source identification, but which the characteristic ^{36}Cl enrichment in indigenous natural ClO_4^- helps to resolve [2]. Isotopic tracing of ClO_4^- has been applied in several groundwater basin studies.

Research supported by DOD/ESTCP & DOD/SERDP.

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The aquatic chemistry of Lake Matano, Indonesia

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Lake Matano is situated in the heart of a region targeted for biological conservation based on a two-fold criterion of rapid habitat loss and high levels of species endemism. It is the 8th deepest lake on Earth and an important freshwater resource for south-east Asia. Though it parallels the surrounding terrestrial ecosystem with high levels of endemism, its productivity is abnormally low and comparable to ultra-oligotrophic high-arctic lakes. Here we examine the controls on the chemical composition of Lake Matano, in an effort to determine the role of its unique chemistry in maintaining both low productivity and high endemism.

The major ion composition is dominated by weathering of ultramafic rocks and is demonstrated by very high Mg contents and the Na/(Na+Ca) composition. Most elements (with the exception of Mg, Si and HCO3) are depleted in comparison to average global river water. Lateritic soils in the drainage basin supply abundant particulate Fe-(oxy)hydroxides to the lake. A large flux of Fe (II) and Mn (II) to the persistently stratified, anoxic bottom waters is likely due to reductive dissolution in the underlying sediment. This process may also be responsible for higher concentrations of most major ions in the anoxic waters, which imparts additional stability to the water column.