

Contents in Context

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Perchlorates in the environment – the key current issues

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The perchlorate anion has a unique and profound ability to inhibit iodine uptake by the human thyroid, with potential adverse effects on the growth and development of fetuses, infants, and children. Given its ubiquitous, modern use in 'energetic applications', it is almost certain that perchlorate contamination is much more widespread, especially in industrial nations. In this Research Front, we present a series of papers from widely different perspectives in order to provide a starting point from which the question of whether perchlorate should still qualify as an emerging contaminant of concern can be answered.

Constraints on the possible atmospheric sources of perchlorate

James M. Roberts

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Perchlorate ion is a potentially harmful trace pollutant that can interfere with the proper absorption of iodine by the thyroid gland. Natural, atmospheric chemical sources of perchlorate have been proposed based on isotopic composition of mineral deposits, ground and surface waters. Understanding this natural source is crucial to the formulation of effective mitigation and control strategies.

Perchlorate: a cause for iodine deficiency?

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Environ. Chem. 2009, 6, 7

Depending on its severity, inadequate iodine nutrition can lead from minor developmental disorders all the way to cretinism. In recent years, the omnipresence of environmental perchlorate, a potent iodine transport inhibitor, has been much in the news but the ultimate issue of iodine nutrition has largely been ignored. There is little consciousness that even many developed nations are putting future generations in peril with vulnerable populations that are barely iodine sufficient, whether or not there is any excessive perchlorate intake.

Perchlorate in the environment: the emerging emphasis on natural occurrence

David R. Parker

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Perchlorate is an emerging environmental contaminant that has a unique ability to interfere with normal iodine uptake by the human thyroid gland, and thus has the potential to adversely affect normal growth and development of infants and children. In the last decade, perchlorate's environmental behaviour has been intensely studied in the United States, but has received little attention elsewhere. Recent evidence strongly suggests that perchlorate occurs at low levels naturally, and is ubiquitously present in the human diet. An atmospheric source for this natural occurrence is strongly implicated, and the naturally occurring isotopes of oxygen and chlorine offer considerable promise for unravelling the chemical mechanisms responsible.

Perchlorate and ion chemistry of road runoff

Jennie Munster and Gilbert N. Hanson

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Recognising that road flares and air bags may contribute perchlorate to road runoff, we analysed perchlorate in runoff from two accident-prone suburban highways during a period of five rain events. This runoff reaches recharge basins where it then infiltrates into the groundwater. The concentrations of perchlorate averaged $\sim 2 \mu\text{g L}^{-1}$, high enough to be of concern if the drinking water standard for perchlorate were in the low μg levels.

Perchlorate in an urban lawn environment

Jennie Munster and Gilbert N. Hanson

Environ. Chem. 2009, 6, 36

The extent of perchlorate contamination in our environment is inadequately known. We examined perchlorate content in precipitation, soil water, soil cores and grass clippings in an urban lawn environment. Our results show that perchlorate is present in the lawn environment at concentrations that may adversely affect human health.

Fractionation of stable isotopes in perchlorate and nitrate during in situ biodegradation in a sandy aquifer

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Environ. Chem. 2009, 6, 44

Perchlorate (ClO_4^-) and nitrate (NO_3^-) are common co-contaminants in groundwater, with both natural and anthropogenic sources. Each of these compounds is biodegradable, so in situ enhanced bioremediation is one alternative for treating them in groundwater. Because bacteria typically fractionate isotopes during biodegradation, stable isotope analysis is increasingly used to distinguish this process

from transport or mixing-related decreases in contaminant concentrations. However, for this technique to be useful in the field to monitor bioremediation progress, isotope fractionation must be quantified under relevant environmental conditions. In the present study, we quantify the apparent in situ fractionation effects for stable isotopes in ClO_4^- (Cl and O) and NO_3^- (N and O) resulting from biodegradation in an aquifer.

Characteristics of perchlorate formation via photodissociation of aqueous chlorite

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Environ. Chem. 2009, 6, 53

Perchlorate, a well-known thyroid disruptor with both man-made and natural sources represents a major environmental problem in the United States but little information is available concerning the source of natural perchlorate. Previous research has demonstrated that perchlorate can be produced from exposure of some chlorine compounds to ultraviolet radiation, but no information was available how quickly or comparatively how much perchlorate was formed. The results of the present study can be used to evaluate the potential impact of ultraviolet processes on the overall occurrence of perchlorate in the environment.

Investigating biogenic heterogeneity in coastal sediments with two-dimensional measurements of iron(II) and sulfide

David Robertson, David T. Welsh and Peter R. Teasdale

Environ. Chem. 2009, 6, 60

Microbial respiration generally occurs in distinct layers within coastal sediment, producing high porewater iron or sulfide concentrations, although this layering is dramatically modified by the activities of sediment-dwelling organisms. The present study describes use of a new technique to simultaneously measure two-dimensional concentrations of porewater iron and sulfide at millimetre resolution, allowing the patchiness of patterns of microbial respiration in sediment to be clearly observed. The measurements generally supported a conceptual model predicting the effects of animal burrows and seagrass roots on the porewater iron and sulfide distributions, although the addition of organic matter provided some unexpected observations that require further investigation.

Variation of atmospheric volatile organic compounds over the Southern Indian Ocean (30–49°S)

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Environ. Chem. 2009, 6, 70

Oceans represent 70% of the blue planet, and surprisingly, ocean emission in term of volatile organic compounds is poorly understood. The potential climate impacts on a global scale of various trace organic gases have been established, and the terrestrial inputs are well studied, but little is known about which of these can be emitted from oceanic sources. In the present study, atmospheric samples were taken over the Southern Indian Ocean, while crossing some oceanic fronts and different phytoplankton species. Such a study should aid in understanding oceanic emission, especially from phytoplankton, and will help modellers to determine concentrations of organic traces in the remote marine troposphere.

Relationship between oxidative degradation of 2-mercaptobenzothiazole and physicochemical properties of manganese (hydro)oxides

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Environ. Chem. 2009, 6, 83

Manganese (hydro)oxide is one kind of the most important natural minerals that are capable of oxidising organic contaminants with a wide range of functionality. However, the oxidative reactivity of manganese (hydro)oxides for organic pollutant degradation may depend on their individual physicochemical properties. It is important to determine a relationship between their oxidative reactivity and physicochemical properties.