

Structure and reactivity of nanocrystalline iron oxides in the environment

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Iron (oxyhydr)oxides are widespread minerals in Earth's surface environments. They exhibit a large variety of polymorphic structures that can be used as tracers of physicochemical conditions of formation, especially redox and pH. Moreover, structural defects and inorganic and organic impurities are also potential indicators of formation pathways, either biotic or abiotic. When formed at ambient temperature, iron oxide minerals usually have sub-micron size, which enhances their surface reactivity. Although the properties and occurrences of iron oxide minerals have been studied for several decades, recent advances have been made in understanding the structures of nanocrystalline iron oxyhydroxides as well as their surface reactivity.

In the present communication, we will review recent spectroscopic investigations of ferrihydrite [1], schwertmannite [2], and nanomagnetite [3] that play a key role in iron and trace element cycling in the environment and in water treatment technologies. Local structures of these mineral phases, including the status of sorbed or coprecipitated impurities, will be discussed based on Extended X-ray Absorption Fine Structure (EXAFS) analyses. Implications for the remediation of arsenic contaminated waters in mining environments will be especially addressed. In addition, we will present specific properties of nanomagnetites for scavenging pollutants such as arsenic via precipitation, sorption, and redox reactions. Spectroscopic results will be interpreted in light of theoretical calculation for arsenic sorption onto the surface of the reference mineral, hematite.

[1] Maillot *et al.* 2011 GCA 75, 2708-2720. ; [2] Maillot *et al.* 2013 GCA 104, 310-329 ; [3] Wang *et al.* 2011 ES&T 45, 7258-7266 ; [4] Blanchard *et al.* 2012 GCA 86, 182-195

Light hydrocarbons and dissolved organic carbon in shallow aquifers of the St. Lawrence Lowlands: Concentrations and $\delta^{13}\text{C}$ signatures

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Recent field studies identified a new source of natural gas in Quebec: shale gas. These gases are mainly found in the Utica Shale and result from kerogen cracking. Gases formed from kerogen cracking are referred to as thermogenic gases and are mainly composed of methane, ethane and propane. Due to the presence of natural faults in the bedrock above the Utica Shale, these gases can migrate and contaminate the shallow aquifers that are exploited for human consumption. Contamination of the aquifers can also be caused by the migration of biogenic gases formed by methanogenic bacteria in surface wetlands and lake sediments. As part of an effort initiated by the Québec *Commission d'étude environnementale stratégique* on shale gases, the project consists in the development and implementation of the methods and the analysis of the concentration and the isotopic signature of these light hydrocarbons and dissolved organic carbon (DOC) in groundwater samples. The stable isotope analyses will help determine the origin of the gas and DOC in these samples, including the discrimination between Utica shale gas and conventional gas. Water samples have been collected from >100 wells in the St. Lawrence Lowlands (Québec, Canada).