

Arsenic sequestration and oxidation at the surface of Fe(II)-containing iron (hydr)oxide nanoparticles

G. MORIN¹, G. ONA-NGUEMA¹, Y. WANG¹, F. JUILLOT¹, N. MENGUY¹, G. CALAS¹ AND G.E. BROWN JR.²

¹Institut de Minéralogie et de Physique des Milieux Condensés (IMPMC), Université Paris 6, Université Paris 7, IGP, CNRS, 140, rue de Lourmel, 75015 Paris, France (guillaume.morin@impmc.jussieu.fr)

²Surface & Aqueous Geochemistry Group, Department of Geological and Environmental Sciences, Stanford University, Stanford, CA 94305-2115, USA (gordon.brown@stanford.edu)

Sorption and desorption processes onto (biogenic) iron oxides control the mobility of arsenic in soils and aquatic ecosystems. Recent investigations of arsenic-iron-bacteria systems under anoxic conditions have revealed that As (III), the more toxic form of arsenic, sorbs efficiently onto nano-magnetite [1, 2] and, to a lesser extent on the surface of green-rust, an Fe (II, III) hydroxide [3]. Using X-ray absorption spectroscopy and high resolution transmission electron microscopy, we have shown that these sorption reactions proceed via the formation of monomeric and polymeric surface complexes, as well as surface precipitates, depending on arsenic surface coverage and on the nature and solubility of the substrate [1-4].

More recently, we have investigated the sorption of As (III) onto Fe (II, III) hydr (oxides) under controlled oxygenated conditions and have found that As (III) can be readily oxidized to the less toxic form As (V). Comparison with other systems with and without Fe (II) suggests that this oxidation process is related to Fenton-like reactions in the presence of Fe (II) and oxygen [5]. These results are relevant to the behavior of arsenic at redox boundaries in natural systems such as soils and sediments, and they provide new strategies for using Fe (II)-bearing iron oxide nanoparticles, such as nano-magnetite, in water-treatment processes.

[1] Wang *et al.* *GCA* 2008, **72**, 2573–2586. [2] Morin *et al.* *Langmuir* 2009, **25**, 9119–9128 [3] Wang *et al.* *ES&T* 2010, **44**, 109–115. [4] Ona-Nguema *et al.* *GCA* 2009, **73**, 1359–1381. [5] Ona-Nguema *et al.* *ES&T submitted*

Removal of borate with magnesium oxides prepared at different temperatures

S. MORIYAMA*, K. SASAKI, H. YOSHIZAKA AND T. HIRAJIMA

Department of Earth Resource Engineering, Kyushu University, Motoka 744 Fukuoka, Japan (*correspondence: s-moriyama09@mine.kyushu-u.ac.jp)

Magnesium Oxide (MgO) has been selected to a potential material for removal of borate in aqueous system effectively [1]. MgO is known with high reactivity with H₂O, one of solid bases and has high isoelectric point. In the present study, magnesium oxides-rich phases were produced by calcination of MgCO₃ at 600°C, 800°C, 1000°C, and 1100°C for 1 h. Their XRD patterns showed that products include MgO as the dominant phase. The specific surface area was the largest with the product at 800°C. Sorption isotherm of borate showed that the greater sorbent was obtained higher calcination temperatures, independent of specific surface area. TEM images showed that crystal growth of MgO was advanced at higher calcination temperatures compared to low calcination temperatures, and the CO₂-TPD revealed that higher calcination temperatures provide greater basicity per unit surface area in a range of 800-1000°C.

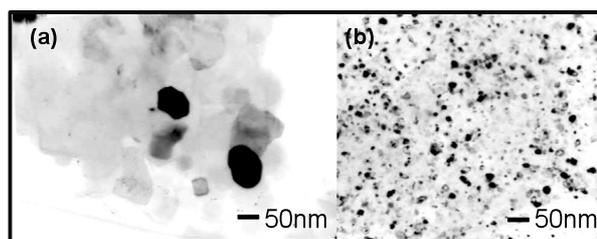


Figure 1: TEM images of calcined products at (a) 1100°C (b) 800°C of MgO-rich phases. The horizontal bars indicate 50 nm.

Borate ions are removed by sorption on positively charged sites on MgO as well as coprecipitation with Mg(OH)₂. The sorption experiments indicate that the greater densities of basicity with higher calcination temperatures are more favorable to advance the process which a molecular form of boric acid accesses to the protonated surface of MgO ($\equiv\text{MgOH}_2^+$). It is considered that basicity and crystallinity of the calcined MgO effect on the sorption efficiency of borate on MgO.

[1] Sasaki *et al.* (2009) *Proc. 4th Boron Sym.*, pp.455-461.