Biomineralization of electroactive Mn-oxides by the Mn(II) oxidizer *Pseudomonas putida* strain MnB1.

Laura Galezowski[1], Jennyfer Miot[1], Nadir Recham[2,3], Fériel Skouri-Panet[1], Dominique Larcher[2,3], François Guyot[1]

[1] Institut de Minéralogie, Physique des Matériaux et Cosmochimie, Sorbonne Université, Muséum National d'Histoire Naturelle, CNRS UMR 7590, 4 Place Jussieu, 75252 Paris Cedex 05, France

[2] Laboratoire de Réactivité et Chimie des Solides, CNRS UMR 7314, Université de Picardie Jules Verne, 33 rue Saint Leu, 80039 Amiens Cedex, France

[3] Réseau sur le Stockage Electrochimique de l'Energie (RS2E), FR CNRS 3459, France

Microbial metabolisms play an important role in the redox cycling of manganese and some other elements in the environment. Mn(II) oxidation is promoted by a diversity of Mn(II)-oxidizing organisms which lead to the biomineralization of manganese oxides. Furthermore, some abiotic Mn-oxides, generally synthesized at high temperatures, are reported to have the ability to reversibly host cations (in particular alkali?) or water molecules within their structure. These properties are exploited in electrochemical energy storage devices, using abiotic Mn-oxides as electrode materials (e.g. alkaline Zn/MnO_2 or Li/MnO_2 cells). In contrast, electroactivity of Mn-biominerals has been poorly studied yet. Here, we evaluated the mechanisms of Mn biomineralization (including kinetics of Mn(II) oxidation) by the Mn(II)-oxidizer *Pseudomonas putida* strain MnB1. Manganese speciation, biominerals crystallinity and texture as well as organic matter content were determined by a combination of X-ray absorption spectroscopies, electron microscopies and thermogravimetric analyses coupled to mass spectrometry. Electrochemical activity of the biominerals was evaluated in battery configuration vs. metallic Li or Na, and showed very appealing properties (voltage, capacity, reversibility, power capability…). In comparison with abiotic manganese oxides, biomineralized manganese oxides were shown to exhibit textures that likely enhanced ionic conduction. Thus, our study sheds light on the reactivity of these electroactive Mn-biominerals that are widespread in the environment. In addition, these results open an alternative route for the synthesis of performant electrode materials under environmental friendly conditions.