Determining the dissolution capacity and structure at the molecular level of fishbone-derived pyromorphite formed to stabilize lead (Pb)

SAENGDAO KHAOKAEW[1] & GAUTIER LANDROT[2]*

[1]Soil Science Department, Kasetsart University, 50 Ngam Wong Wan Road, Lat Yao Chatuckak, Bangkok, Thailand (agrsdk@ku.ac.th)

[2]Synchrotron SOLEIL, L'Orme des Merisiers, Saint-Aubin, BP 48 91192, Gif-sur-Yvette, France (*correspondence : gautier.landrot@synchrotron-soleil.fr)

Fishbones can be applied to lead-polluted soils as a source of phosphorus (P), which can precipitate with lead (Pb) to form pyromorphite ($Pb_5(PO_4)_3Cl$) [1]. This mineral phase, although considered as very stable, can be dissolved by oxalic or humic acids [2-3]. The capacities of these acids to dissolve pyromorphites that contain calcium (Ca) substituting for Pb in the mineral structure has never been studied, although high Ca/Pb mol ratio (e.g. 31 % [4]) can occur in pyromorphites naturally present in soil. Since fishbones are principally made of hydroxyapatite ($Ca_5(PO_4)_3Cl$), pyromorphite that forms after fishbones applications to Pb-contaminated sites may contain some amount of Ca substituting for Pb in the mineral structure. This study aimed to determine the difference in chemical structure and dissolution capacities by oxalic or humic acids between a Ca-free pyromorphite and a pyromorphite containing P and Ca released from fishbones.

A Ca-bearing pyromorphite formed on the surface of a dialysis bag filled with fishbones and dipped into a Pb^{2+} solution. Results indicated that more Pb was released by oxalic or humic acids from this pyromorphite than the amount of Pb released from a Ca-free pyromorphite. The chemical structure of this pyromorphite was constrained by XAFS, Raman and FTIR. This study provided important information on the chemical properties of pyromorphite that may form subsequently to fishbone application to Pb-contaminated soils.

[1] Admassu & Breese (1999) *J. Hazard. Mat.* **B69**, 187-196. [2] Debela *et al.* (2010) *Chemosphere* **80**, 450-456. [3] Bolan *et al.* (2014) *J. Hazard. Mat.* **266**, 141-166. [4] Cotter-Howells (1996) *Environ. Pollut.* **93**(1), 9-16.