Coupling micro-Raman and micro-scanning X-ray diffraction to characterize heterogeneous material

A. COURTIN-NOMADE[1]*, M. VANAECKER[1], M. KUNZ[2] AND N. TAMURA[2]

[1]University of Limoges, FST, 123, avenue A.Thomas, 87060 Limoges cedex, France (*correspondence: alexandra.courtin@unilim.fr, maxime.vanaecker@unilim.fr)

[2]Advanced Light Source, Lawrence Berkeley National Lab, 1 Cyclotron Rd, Berkeley, CA 94720, USA (MKunz@lbl.gov, NTamura@lbl.gov)

A large, formerly mined sulfide deposit, in which the association of pyrite, chalcopyrite, sphalerite and ± galena dominated, has been weathered under supergene conditions, leading to the formation of highly heterogeneous secondary phases, intimately mixed at a scale ranging from 10 to 50 µm. Due to their small size, those minor phases have been identified using synchrotron-based micro-Scanning X-Ray Diffraction (µSXRD) coupled to conventional micro-Raman acquisitions. The authigenic metal-bearing phases have been identified as sulfosalts such as famatinite (Cu_3SbS_4 - F) or covellite (CuS), sulfates (e.g. anglesite $PbSO_4$ - A) and iron (oxy-)hydroxides (e.g. lepidocrocite - L and hematite - H).

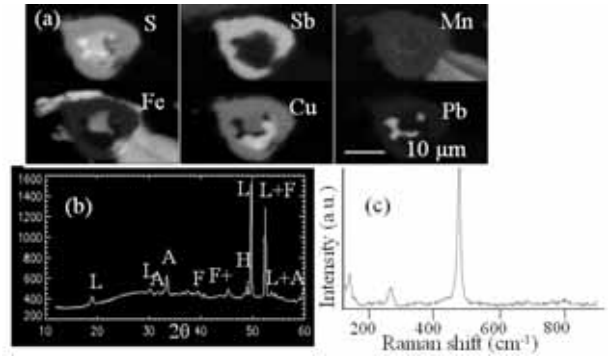

Figure 1: (a) SEM elemental map showing the various metal-bearing carriers associated within a 20µm large phase; (b) micro-X-Ray diffraction pattern obtained on the whole phase; (c) micro-Raman spectrum of the bright Cu phase evidenced covellite.

Micron-scale resolved techniques enable to decipher the relationships between the various mineral phases and identification of the carriers of potentially toxic metals such as Cu or Pb are of primary concern to forecast how the environment of the mining district is affected.

Assessment of the long term stability of paper sludge covers over mine tailings using solid state NMR

C. COUSINS* AND G. SPIERS

Centre for Environmental Monitoring, MIRARCO, Laurentian University, Sudbury, Ontario, CANADA, P3E 2C6 (*correspondence: ccousins@mirarco.org)

The applicability of using paper sludge as an organic cover for mine wastes to prevent the oxidation of sulfide minerals by creating an anaerobic barrier is currently being investigated the mining industry. Additionally, paper sludge covers sequester carbon and may be useful to produce biofuel feedstocks [1, 2]. However, the degradation of these paper sludge amendments must be examined to enable prediction of their potential for long-term mine drainage prevention.

Paper sludge amendments were applied over a six year period to mine tailings or waste rock from historic gold mine operations now belonging to the Porcupine Joint Venture (PJV) of Goldcorp Inc. Samples were collected from four different PJV properties, each a site of a historical gold mine operation.

As raw paper sludge is primarily composed of lignin, hemicellulose, and cellulose [3], the speciation of the organic matter will be used to determine the degradation of the paper sludge and to predict the amendment's long-term stability.

Speciation of the organic carbon will be determined using cross-polarized/magic angle spinning solid-state NMR, as previous work has shown that cellulose, hemi-cellulose, and lignin [4, 5] all have distinct chemical shifts, enabling their identification. Organic carbon speciation analysis from the NMR spectra will also be compared with FTIR data [6, 7].

Other spectroscopic techniques, including CNS combustion, ICP-AES, and ICP-MS, will be used to characterize the long-term suitability of paper sludge amendments for reclamation of gold waste materials in Northern Ontario, Canada.

[1] Beachamp *et al*. (2002) *Chemosphere* **46**, 887-895. [2] Phillips *et al.* (1997) *Bioresource Techn.* **60**, 73-80. [3] Albrecht *et al.* (Online ahead of print) *European Journal of Soil Science* doi, 10.1111/j.1365-2389.2007.00993.x. [4] Kono *et al.* (2002) *J.Am.Chem.Soc.* **124**, 7506-7511. [5] Haw & Maciel (1984) *Anal. Chem.* **56**, 1323-1329 [6] Fackler *et al*. (2007) *FEMS Microbiol Lett* **271**, 162-169. [7] Zhbankov *et al.* (1966) *J Appl Spectrosc USSR*+ **4**, 442-445.