Formation mechanisms of trace metal-bearing sulfide minerals in acidic and saline environments

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Sulfide minerals play a central role in the cycling of trace elements in low temperature environments. They are thus used as paleotracers in the sedimentary record, and are also viewed as efficient toxic metal scavengers in contaminated environments. Among research questions still open in these fields, a major challenge concerns the understanding of the molecular scale mechanisms underlying their biotic and abiotic formation pathways, especially in acidic and saline environments.

In order to progress in this research, we have combined synchrotron-based x-ray spectroscopy and electron microscopy analyses to elucidate some key steps of pyrite nucleation at ambient temperature [1] and to unravel the mechanisms of trace elements incorporation in this mineral, especially nickel [1] and arsenic [2]. We have also investigated the mechanisms of nickel sequestration in biogenic iron sulfides produced by sulfate reducing bacteria [3]. These findings yield useful bases to interpret the formation and long-term evolution of metal-bearing pyrite in saline environments as mangroves [4,5]. Finally, we will demonstrate that arsenic sulfides formation by acidophilic sulfate reducers appears as a promising water treatment process in heavily contaminated acid mine drainage [6].

[1] Morin et al. *Geochem. Persp. Let.* **2017**, 5, 6-11; [2] Le Pape et al. *Environ. Sci. Technol.* **2017**, 51, 150-158; [3] Ikogou et al. *Appl. Geochem.* **2017** 80, 143-154; [4] Noël et al., *Geochim. Cosmochim. Acta* **2015**, 69, 82-98; [5] Noël et al. *ACS Earth Space Chem.* doi: 10.1021/acsearthspacechem.7b00005 ; [6] Le Pape et al. *J. Hazard. Mater.* **2017**, 321, 764-772.