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Probable occurrence of green rust mineral in the Sinnamary river (French Guiana), a potential attenuator of mercury contamination

F. Jorand (1), F. Landry (1), and J. Ghanbaja (2)

(1) LCPME UMR 7564 CNRS – UHP, Nancy University, 405 rue de Vandœuvre, 54600 Villers-les-Nancy, France, (2) Service commun de microscopie électronique, Faculté des Sciences, Nancy University, BP 239, F-54506 Vandoeuvre Cedex, France. (jorand@lcpme.cnrs-nancy.fr / , Fax: + 33 3 83 275 444 / Phone: + 33 3 83 685 248).

The Petit-Saut hydroelectric reservoir on the Sinnamary river in French Guiana, impounded in 1994, has flooded more than 360 km^2 of equatorial rain forest. The anaerobic degradation of submerged organic matter rapidly induced a strong decrease of the redox potential along the water column of the lake. In addition, the widespread erosion of soils naturally rich in mercury and the local input of elemental Hg° from gold mining activities had significantly contaminated the river with mercury. Finally, the huge amount of Fe^{II} transported from the reservoir is strongly oxidized in Fe^{III} passed the dam and large red-brown flocs can be seen for several dozen of kms downstream of the barrage where 1 cm thick biofilms can be seen on any surfaces. The analysis of these flocs or biofilms revealed the presence of a large amount of bacteria and other microorganisms having a significant iron reducing activity. Since the Fe^{III} content of these biofilms was as high as 30 % of the dry matter content, it represents a significant source of electron acceptor for the bacterial anaerobic respiration. The reduction of Fe^{III} is susceptible to give highly reactive ferrous minerals, like green rust, a mixed Fe^{II}-Fe^{III} mineral, which can react towards Hg^{II} producing the volatile Hg° (see Estrade *et al.*, EGU 2008). In this context, we wondered if the amorphous Fe^{III} constituting these flocs could be transformed by bacteria into GR minerals. A several week incubations of amorphous Fe^{III} with iron-reducing bacteria really transform this iron oxide into large GR crystals unambiguously identified by transmission

electronic microscopy (electronic diffraction and EDX analysis) and X-ray diffraction. Although, this mercury reduction is a purely abiotic process, it could be strongly favored by biological activity when the latter one is involved in green-rust formation. If such phenomemon occurs in the river, it should operate in an anaerobic environment, possibly inside the flocs, or in the sediments. In order to validate such hypothesis we are now looking for such green rust mineral in the Sinnamary river.