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The redox edge for polluted soils: a relevant tool for estimating the release of metals

S. Pénilla, N. Ozkan, F. Bordas & J.-C. Bollinger

Laboratoire des Sciences de l'Eau et de l'Environnement, Faculté des Sciences & Techniques,

123 avenue Albert Thomas, 87 060 Limoges, France

e-mail: penilla_sonia@yahoo.fr / tel: (+33) 555-457-589 / fax: (+33) 555-457-459

The historical or current activities of metallurgical industries have resulted in the input and accumulation of large quantities of metals in soils. The presence of such micropollutants in the soils poses both short and longer-term problems because of their mobility and thus their potential health risk. Several physico-chemical parameters such as pH, presence of organic or inorganic complexants and notably Eh could affect their mobility.

In the environment, various situations can cause significant variations in redox conditions: periodic flooding, a rising water table... These variations lead to the partial dissolution of soil components (iron and manganese oxides), releasing metals pollutants bound to them.

The objective of this work is to evaluate the impact of reductive conditions on the remobilisation of metals (Cu, Pb and Zn) from a soil polluted by a metallurgical factory. Contrary to previous studies where only one reductive condition was tested, the effect of an Eh gradient was here assessed by the use of chemical reagent solutions. Batch and columns experiments were conducted, varying reducers' nature and concentration. First, among all the tested reagents, sodium ascorbate seems to be the most adapted to impose reductive conditions. An Eh gradient range, from – 200 to + 200 mV, was thus artificially obtained. Then, results evidence that metals solubility increases when decreasing Eh and that the solubilization risk is different according to the metal considered.

Our study thus pointed out the existence of a 'Redox-remobilisation-edge' which

could mainly be due to various mechanisms of oxyhydroxides reductive dissolution. This result means that there is a close and very sensitive range of Eh values within what metals are strongly released from polluted soils. Moreover, Eh variations induced changes in the bonds between the metals and the soil, so that modifications of metal speciation were observed.

The major application of this study is the assessment and better understanding of metal behaviour in polluted soils when the redox potential is modified: for example, when successive wet and dry episodes or intensive organic amendment occur. Furthermore, our study emphasizes that this parameter must be taken into account in the existing predictive models of metal mobility. It can also be useful within the framework of the European Commission's Communication 'Towards a Thematic Strategy for Soil Protection' [COM(2002)179].