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Institut des sciences de la Terre d'Orléans (ISTO), UMR 6113 CNRS-UO, université d'Orléans, Géosciences, BP 6759, 45067 Orléans cedex 2, France

1. Introduction

The mobility of trace elements in soils is often discussed because of consequences for their bioavailability and thus their potential ecological toxicity. Numerous studies showed that oxides and oxi-hydroxides could be an important sink for trace elements [1] and [2]. In many soils, trace elements tend to accumulate in oxides and oxi-hydroxides that act as scavengers [7], [9] and [10]. Indeed, as a recent example, extraction for As speciation in contaminated soils showed that As originating from irrigation was partly retained by Fe-oxi-hydroxides [3]. Other experiments also showed that adding Fe-bearing compounds to contaminated soils reduces As mobility, but increases Pb and Cd mobility [8], thus indicating that further investigations are required to elucidate trace-element mobility in soils. However, soil oxides and oxi-hydroxides play a significant role in controlling trace element mobility and new conditions leading to dissolution of oxides and oxi-hydroxides should be carefully considered.

2. Effect of temporary high water content on iron-reducing bacterial activity

If chemical dissolution of oxides and oxi-hydroxides can be recorded as being a consequence of a change in the redox potential alone caused by reductive conditions [4] and [5], microbial activity often plays also a significant role in the dissolution processes when easily biodegradable organic compounds are available. Thus, with batch experiments using samples collected in the topsoil horizon of a New Caledonia Ferralsol, Quantin et al. [11] and [12] showed that bacterial dissolution of Fe and Mn oxides occurs under anaerobic conditions and increases with the amount of glucose that was added to the samples.

These results were recorded for water-saturated soil samples, but a recent study showed that water soil saturation was not necessary for iron dissolution in a Ferralsol from Cameroon and a Gleysol from France [13]. This study showed that reduction–dissolution of ferric iron was not directly correlated to the rates of anaerobic mineralization. Thus, water saturation of the samples was not, as often considered, a prerequisite for significant iron-reducing bacterial activity. This would indicate that in natural environments, bacterial dissolution of oxides and oxi-hydroxides does not require waterlogging.

3. A significant variation in trace-elements mobility

Among consequences of bacterial reduction and dissolution of oxide and oxi-hydroxides, trace elements associated with them are also released. Dissolved Mn oxides were thus shown as being a major source of easily mobilisable Co and Ni in New Caledonia Ferralsols because of microbial activity under reducing conditions [11]. If, as shown by Stemmler et al. [13], microbial reduction of Fe oxides occurs at high soil water content but does not require soil water saturation, then release of trace elements associated to oxides and oxi-hydroxides can occur in soils for a larger range of conditions than those leading to waterlogging.

4. Conclusion

These new results show clearly that in the absence of waterlogging, increasing the occurrence of high water contents, might be enough to deeply change trace-element mobility in soils. This might happen in newly intensively irrigated soils. In the long term, among potential impacts that are discussed as consequences of climate change, an increase in precipitation is often considered in many areas [6]. This should also result in an increase in the occurrence and duration of high water contents in soils. In these different situations, increasing occurrence of high water contents will lead to new conditions that are favourable to mobility of trace elements. Thus, toxic trace elements immobilised in oxides and oxi-hydroxides should be released, with dramatic consequences for the surface water quality.

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