

Environmental dynamics of chromium in ultramafic systems : a combined approach

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Ultramafic rocks are known to hold large amounts of chromium and nickel, compared to other geological settings. Deep weathering of these peculiar rocks under tropical conditions leads to a relative enrichment of these metals that can result in the formation of laterite ores. Despite these very high contents in laterite covers developed on ultramafic rocks, chromium availability is generally low. This is due to the major occurrence of chromium as Cr(III) associated to secondary iron oxides and primary chromite [1, 2]. However, KH_2PO_4 extractions have shown high hexavalent chromium availability in Ferralsols developed on ultramafic rocks in Brazil and New Caledonia [1-4] and in mine tailings in India [5]. Moreover, mining and metallurgical activities have shown their potential at releasing trivalent (Cr(III)) and hexavalent (Cr(VI)) chromium in the colloidal form into the environment via runoff [6]. All these observations raise the question of the actual driving mechanisms of chromium mobility in ultramafic environments.

By combining mineralogical, geochemical, X-ray absorption spectroscopy and isotopic approaches, we assessed the solid speciation and bioavailability of chromium and gained further insights into the actual mechanisms driving chromium behavior in different ultramafic systems under the tropics (Brazil, India, New Caledonia). Despite a major occurrence of chromium as Cr(III) associated Fe-oxides and, to a lesser extent to chromite [1], microscale investigations revealed the close association of Cr(VI) with both Mn-oxides and Fe-oxides [3,7], this latter fraction of chromium being highly labile [3]. Although, these latter results confirm the importance of Mn-oxides for oxidation of Cr(III) into Cr(VI), they also emphasize the key role played by Fe-oxides on the retention/dispersion of oxidized chromium in soils. These conclusions can be extended to mining residues where similar observations were done.

[1] Fandeur et al., 2009, *American Mineralogist* 94, 710–719, [2] Garnier et al., 2006, *Journal of Geochemical Exploration* 88, 206–209 [3] Garnier et al., 2013, *Geoderma* 193–194, 256–264