



Crystal chemistry of chromium in New Caledonian lateritic soils

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New-Caledonia is a complex geological unit made of volcanic, metamorphic and sedimentary formations covering about 15000 km². One third of its surface is covered by ultramafic ophiolitic rocks (peridotites and serpentinites), which underwent strong alteration and erosion since their deposit about 30 millions years ago. This process resulted in the formation of relictual lateritic profiles made of iron oxides (hematite, goethite and maghemite) and clay minerals and exceptionally enriched in non soluble trace elements like Ni, Cr, Co and Mn [1]. The occurrence of large amounts of chromium in New Caledonian lateritic soils can represent a significant risk for the environmental quality depending on its crystal chemistry, including its redox state since Cr³⁺ is considered as an essential micronutrient and Cr⁶⁺ is classified as carcino-

genic by the International Agency for Research on Cancer (IARC). As a consequence, identification of the crystal chemistry, including redox state, of chromium occurring in New Caledonian lateritic soils is of primary importance to assess the actual risk for environmental quality.

XRD and Electron Probe Micro-Analyses (EPMA) results on identification and analysis of minerals hosting chromium indicate that this element is transferred from primary Mg-silicates (lizardite, enstatite and olivine) to secondary Fe (hydr)oxides (goethite and hematite) upon weathering of the parent materials (peridotites and serpentinites). This change in crystal chemistry goes with a strong increase in chromium concentration from about 4000 mg/kg in the most enriched primary Mg silicates (enstatite and serpentine) to more than 20000 mg/kg in the secondary Fe (hydr)oxides. In addition, since recent laboratory studies have shown that Mn oxides can enhance chromium mobility by oxidizing low soluble Cr^{3+} to very soluble Cr^{6+} [2-3], XANES spectroscopy was used to compare the redox state of chromium and the occurrence of Mn oxides along a selected weathering profile. The first results of such approach indicate that significant amounts of Cr^{6+} are detected in soil samples containing the largest concentration of Mn, which strongly suggest that Mn species play a key role on the redox state of chromium, and in turn, on the geochemical cycle of this element in New Caledonia.

Further studies are in progress in order to link the occurrence of Cr^{6+} along the studied weathering profile and the mobility of this element within this geological unit. In addition, the spatial relation between Mn oxides and chromium species will be further characterized at the micrometer scale in order to try to better understand the mechanisms of chromium oxidation by these Mn oxides.

This study is supported by the French ANR-ECCO program.

[1] Guillon, J.H. (1974). The geology of New Caledonia and the Loyalty Islands. Pp 445-452 in A. M. Spencer (ed.). *Mesozoic-Cenozoic Orogenic Belts*. Geol. Soc. London, London.

[2]- Fendorf S. E. and Zasoski R. J. (1992) Chromium(III) oxidation by δ -manganese oxide (MnO_2). 1. Characterization. *Environmental Science and Technology*, 26, 79-85.

[3]- Weaver R. M. and Hochella M. F. (2003) The reactivity of seven Mn-oxides with Cr^{3+} : A comparative analysis of a complex, environmentally important redox reaction. *American Mineralogist*, 88, 2016-2027.