



Solid speciation and availability of chromium in ultramafic soils from Niquelândia (Brazil) : chemical and spectroscopic approaches

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Soils developed from ultramafic rocks (serpentine, peridotite and pyroxenite) are rich in metals, particularly in nickel and chromium. If the nickel dynamics and its impact on the ecology of ultramafic ecosystems have been widely studied, few works focus on chromium. Within the bedrock, Cr-containing minerals are mainly chromite, magnetite and to a lower extent serpentine and pyroxene. In the ultramafic tropical soils, the main Cr-bearing phases are commonly chromite, Cr-magnetite and Fe-oxides (Oze et al., 2004 ; Garnier et al., 2006). More than the total chromium content, it is the exchangeable Cr fraction that is related to toxicity. It is therefore essential to determine the total amount of Cr in the soil, its solid speciation, oxidation state that control the Cr mobility from the Cr-bearing phases to the exchangeable Cr form, in order to evaluate its bioavailability and potential impact on the biodiversity of the ultramafic ecosystems.

Chromium distribution, speciation and availability were investigated in two ultramafic soils from the Niquelândia massif (Goias state, Brazil). Chromium partitioning was investigated indirectly by selective sequential extractions (Quantin et al., 2002), which provide an operationally defined solid-phase fractionation. Sequential

extractions were completed by mineralogical study through XRD and SEM-EDXS. Chromium distribution and speciation were analyzed through μ XRF and μ XAS experiments, performed in LUCIA beamline (SLS, PSI, Villigen Switzerland, Flank et al., 2006). Chromium availability was studied by KH_2PO_4 and KCl extractions (Bartlett and James, 1996).

Cr contents are particularly high in those soils, ranging from 5,000 to 12,000 mg.kg^{-1} , and its partitioning among the solid phase varies with the position in the landscape and depth. Chemical extractions show that the main part of Cr is associated to amorphous and well-crystallized Fe-oxides (70% in average) and spinels. Synchrotron results confirm this partitioning through the analysis of elemental maps at the micron scale. The use of synchrotron techniques allowed us to identify Mn-oxides, that could not be unravelled by more classical techniques, due to their relatively low content and/or their poor degree of crystallinity. These minerals are recognized as Cr natural oxidizing mineral species. Even if the Cr-bearing phases are stable minerals, the amount of exchangeable Cr, and more precisely Cr(VI), is high, particularly in one soil profile where it reaches 1,000 mg.kg^{-1} .

Cr availability appears higher than in other similar ultramafic soils, suggesting the development of Cr-tolerant vegetation on these soils.

References

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