

How can we quantify the contribution of each Ni bearing phase to the total Ni exchangeable pool? An isotopic exchange kinetic model

I. ZELANO^{1,2}, Y. SIVRY^{1*}, C. QUANTIN³, A. GELABERT¹,
M. THARAUD¹, A. MAURY¹, S. NOWAK⁴,

K. PHALYVONG¹, O. ABOLLINO² AND M. F. BENEDETTI¹

¹UMR 7154, Université Paris Diderot – IPGP

(*correspondance :sivry@ipgp.fr)

²Università degli Studi di Torino, Italy

³UMR 8148 IDES, UPS-CNRS

⁴UMR 7086, CNRS Univ. Paris Diderot, Sorbonne Paris-Cité

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The toxicity of a metal is closely related to its bio-available pool which represents the metal fraction efficiently uptaken by the biosphere [1]_ENREF_3. The size of this pool can be efficiently assessed using Isotopic Exchange Kinetics (IEK) technique. The IEK curves integrate the combination of all sorption reactions involved during exchanges between dissolved metal and metals onto different mineral/organic surfaces of the sample.

In this study an IEK Model is developed to describe both qualitatively and quantitatively the contribution of each Ni bearing phases to the Ni total exchangeable pool (E_{Ni}) in the specific context of ultramafic systems (UM), information hardly accessible with other techniques. IEK curves were first obtained for pure Ni bearing phases: two types of serpentines, chlorite, smectite, goethite and hematite. Results were then fitted with a pseudo first-order kinetic model that allowed to assess, for each phase, the number and relative sizes of exchangeable pools (E_{Ni}^i) as well as their kinetic constants, $k_i(\text{min}^{-1})$. These kinetic reaction constants associated to each E_{Ni}^i pool allowed to discriminate between different type of exchange processes. Among the investigated phases, smectite and chlorite are the ones quantitatively furnishing the highest contribution to Ni exchangeable compartment, and qualitatively holding k values of 1.93 min^{-1} and 0.61 min^{-1} , resp., several orders of magnitude higher than other phases (ranging from $2.12 \times 10^{-2} \text{ min}^{-1}$ to $8.08 \times 10^{-5} \text{ min}^{-1}$), probably involving the formation of outer-sphere complexes. The characterization of pure phases was then used for developing a model able to predict the contribution of each bearing phase in natural soil/ore samples of UM complexes of Barro Alto and Niquelandia (Goiás State, Brazil).

[1] Alexander, M. *Environ. Sci. Technol.* **2000**, 34, 4259-4265.