Thallium sorption onto illite and smectite: implications for Tl mobility in the environment

L. A. MARTIN[1]*, C. LATRILLE[2], M. F. BENEDETTI[3]

[1]Institut de Physique du Globe de Paris, Paris, France. (*correspondence : martin@ipgp.fr)
[2]Den-Service d'Etude du Comportement des Radionucléides (SECR), CEA, Université Paris-Saclay, F-91191, Gif-sur-Yvette, France.
[3]IPGP - Sorbonne Paris Cité - Univ. Paris Diderot UMR CNRS 7154, Paris, France.

Thallium (Tl) is a trace element with both calcophilic and lithophilic behaviour. Consequently Tl is mainly encountered in S-rich minerals and K-rich minerals (*e.g.*, feldpsars, micas,…). Weathering of these minerals and mining activities are sources of Tl for the environnement. Tl compounds are also volatile at high temperature and some amounts of Tl are released in the surrounding environments of cement production plants for instance. Tl belongs to Technical Criticals Elements (TCEs)[1] so the interest in understanding Tl geochemistry and its cycle in the environment is increasing.

Tl mobility is generally attributed to interaction with oxides (aluminium, iron and manganese oxides) and silicates. Recents studies identified clays minerals, especially illlite [2,3] as an important retention phase in soil for Tl. However, processeses responsible of Tl sorption onto clays are unknown.

In this study, Tl sorption onto both illite and smectite, two major clay minerals found in soil was investigated. Four matrices, Na-illite, Ca-illite, Na-smectite and Ca-smectite were used in batch experiments for sorption isotherms (as functions of pH and Tl concentrations) with ^{204}Tl as radioactive tracer. Results were analyzed by liquid scintillation and modelled with a Multi-site ion exchanger model.

Results show a higher affinity for illite than for smectite. With log K_d ($mL.g^{-1}$) up to 4, Na-illite has the strongest affinity for Tl. Exchange of Tl with Na^+ cation is more extensive than Ca^{2+} which is consistent with the fact that Tl^+ is the main Tl species in solution. In conclusion, this work brings new insights on the phases that control Tl mobility and how it can affect its cycle in the environement (*e.g.*, from soil to suspended particulate matter in aquatic systems).

[1]Cobelo-Garcia et al. (2015) *Environ. Sci. Pollut. Res*. **19**, 15188-15194. [2]Jacobson *et al.* (2005) *Science of the Total Environment*, **345**, 191-205. [3]Voegelin *et al.* (2015) *Environ. Sci. Technol.* **49**, 5390-5398