PL 1

Environmental chemistry of elements: elemental speciation at last

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It is well recognized that metals and metalloids occur in the environment under a large array of chemical species. These species have different chemical properties which control their fate, transformation, reactivity and translocation between the different compartments of the environment. It also controls their toxicity. At present, our understanding of trace elements only relies on total concentrations and hence and transfer between different compartments of the environment is mostly realized on global budget assessment.

Sustainable development requires a precise and accurate assessment of the information related to elements and their species. We cannot any more by-path this information for sound environmental management, safe control of food or effective process control in industry. If we compare the knowledge that we now have on the fate of organic contaminants we are much more advanced in understanding the chemical properties, reactivity and transfer in the environment. Global models based on their chemical species allow anticipating the global fate and impacts of the organic species in the environment.

One can wander why such approaches have only been developed so late with regards to information related to elements and their species. It is most often stated that regulations need to be in place so that metal species are definitely considered as a primary source of information. Instrument development (hyphenated techniques) and sample preparation have made tremendous progresses with regards to simplification, cost-efficiency and possibility of routine operation. This first aspect should already contribute to facilitate the wider use of metal species assessment in general. More important now is the new enforcement of the REACH (Registration, Evaluation and Authorisation of CHemicals) European legislation. This legislation will require that all new chemical species will require to be evaluated prior introduction in industrial applications. The toxicity of the products will also have to be assessed. This legislation will certainly profoundly promote and motivate development around metal speciation. Indeed in the future, the toxicity of chemical compounds will be assessed via QSAR (Quantitative Structure- Activity Relationship). We have to also process all metal species through the same approach bringing to evidence that metal species of a same element do not have the same reactivity, toxicity and chemical properties. We will have to put into perspective and demonstrate via molecular modelling what we already intrinsically know. It will also be of paramount important to understand the fate and pathways of elements in the environment since we will then take into account the different physico-chemical properties of the elemental species and hence be in a position to model on a global scale their translocation between the different compartments of the environment.

We will present a comparative assessment of the use of QSAR approach and impact on our vision of trace elements species and discuss these implications for trace element speciation in the environment and its application for sustainable growth.