A new opportunity to do things 'right': consider chemical speciation from scratch when studying TCEs

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Abstract

Metal contamination of aquatic and terrestrial ecosystems is a matter of concern. Metals are persistent and, many, potentially deleterious to living organisms, including man. When the situation looked under control –or, at least, extensively studied– for some notorious elements such as lead, mercury or arsenic, our industrialised civilisation started to use many elements that had remained essentially unused. They have now become essential components in a variety of applications ranging from information and communication technologies, semiconductors, electronic displays to 'green energy' related technologies. Their current strategic importance is such that they have been labeled as 'technology-critical elements' (TCEs) and initiatives at national levels are underway to secure their availability in the coming years. The degree of the current knowledge on their environmental fate and (eco)toxicity is not uniform, ranging from relatively well studied elements, such as the Pt group, to essentially unknown ones, such as Ta and Te, but the current information is generally insufficient to evaluate whether they are becoming emerging pollutants.

Substantial progress has been achieved over the last 30 years in our understanding of metal fate in environmental systems and their interactions with organisms but also a huge amount of research proved useless. The reason is that, in early toxicity studies, solution chemistry was generally overlooked: oversaturated solutions, uncontrolled complexation of trace metals, pH variations during experiments, etc. were more the rule than the exception. Similarly, the study of the behaviour of trace elements in natural systems remained largely phenomenological and plagued with methodological problems. The awakening to the crucial role of chemical speciation was a key turning point in the understanding of the behaviour of many elements. The incipient, and strongly needed, research on TCEs offers us a wonderful opportunity to avoid errors of the past (and some present) research by including chemical speciation considerations from scratch when designing our experiments and interpreting our results.