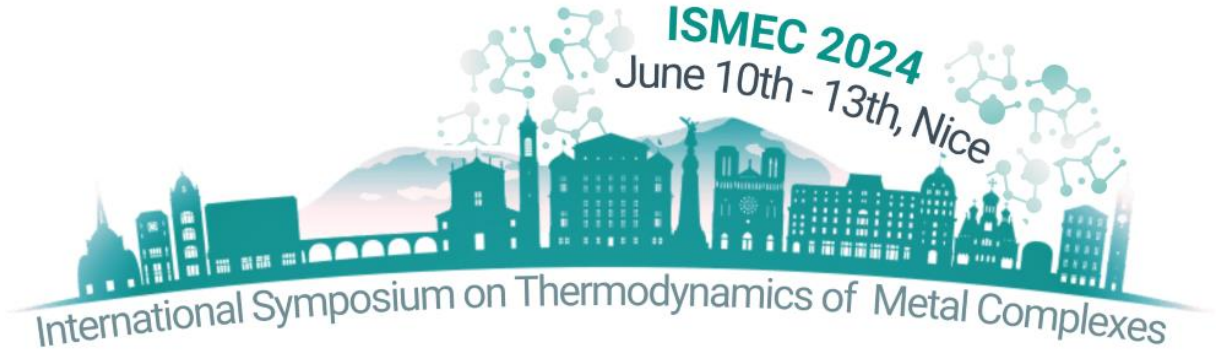

Germanium in aqueous solution, a nice example of the intricacies of the chemistry of hydrolysed chemical elements

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Germanium (Ge) is a chemical element in group 14 of the periodic table whose economic importance and use is growing due to its critical technological applications in polymerisation catalysis, infrared optics and fibre optic systems. Germanium, although relatively little studied compared to other chemical elements such as lead, mercury or arsenic in terms of environmental and toxicological aspects, had already received attention in certain scientific communities in the past, in particular in oceanography and geochemistry. In both cases because of its similarity to silicon: in the first case because it is taken up by diatoms and has been proposed for use in paleoclimatic studies [1] and, in the second, because it provides a tool for studying the weathering of silicates [2].

The only stable oxidation state of germanium in aqueous solution is IV; the element exists as the neutral species $Ge(OH)_4$ over a wide pH range. Germanium is also present in natural systems as monomethyl and dimethyl Ge.

Despite countless rather debatable claims and publications on this subject in the recent past (e.g. the book *Miracle Cure: Organic Germanium* [3]), Ge has no proven biological function in any known organism, and no beneficial pharmacological effects associated with the ingestion of Ge compounds are scientifically recognised. It is important to note the complete misunderstanding of what is meant by "organic germanium" that plagues the literature relating to the element's magical properties.

In this communication, our recent work on germanium [4–8], both in laboratory experiments and in environmental systems, will be presented and discussed. It will be shown that only a thorough understanding of the behaviour of an element in solution can allow us to interpret field results and to critically evaluate the analytical methods used to obtain them.

In particular, the following will be discussed:

- the results of our recent study in which equilibrium constants have been determined for Ge(IV) complexes with about 50 low molecular weight organic ligands, mainly bidentate oxygen and/or nitrogen donors,
- the surprising inertness of some systems such as germanium poly(aminocarboxylates), which makes them intractable by conventional continuous potentiometric titrations,
- the first results on the aqueous equilibria of methylated germanium species,
- the interpretation of speciation measurements in lakes of contrasting physico-chemical characteristics in the light of the above results.

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