



HAL
open science

ISIDORE probe for trace metal speciation: from equilibrium to dynamic approach

Corinne Parat, Estelle Ricard, José-Paulo F Pinheiro, Rute F Domingos, Marc F Benedetti, Isabelle Le Hécho

► To cite this version:

Corinne Parat, Estelle Ricard, José-Paulo F Pinheiro, Rute F Domingos, Marc F Benedetti, et al.. ISIDORE probe for trace metal speciation: from equilibrium to dynamic approach. 9th International Conference on Interfaces Against Pollution (IAP), Univesitat de Lleida, Sep 2016, Lleida, Spain. pp.ISBN 978-84-608-9990-7. hal-01506344

HAL Id: hal-01506344

<https://hal.science/hal-01506344>

Submitted on 12 Apr 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

ISIDORE probe for trace metal speciation: from equilibrium to dynamic approach

Corinne Parat¹, Estelle Ricard¹, José-Paulo Pinheiro², Rute F. Domingos³, Marc F. Benedetti³ and Isabelle Le Hécho¹

¹ Université de Pau et des Pays de l'Adour, CNRS UMR 5254, IPREM-LCABIE, 64000 Pau, France.

² Université de Lorraine, CNRS UMR 7360, LIEC, 54500 Vandœuvre-les-Nancy, France

³ Institut de Physique du Globe de Paris, Université Sorbonne Paris Cité, Paris, France

E-mail contact: corinne.parat@univ-pau.fr

Up to now, different approaches have been proposed for in situ trace metal speciation, based on the deployment of in situ devices such as Donnan Membrane device (DMT) and then analysis by ICP-MS [1], or by means of preconcentration systems hyphenated with electrochemical detection such as gel integrated microelectrode (GIME) probe [2] or a direct in situ electrochemical stripping speciation method such as Absence Gradient Nernstian Equilibrium Stripping (AGNES) [3]. Although numerous in situ methods have been proposed, currently there is no reliable *in situ* probe for trace metal speciation at concentration levels present in natural systems. Regarding autonomy problems of *in situ* probes, electrochemical devices have the advantage of being easily available in smaller sizes and with the possibility to be operated with batteries.

This work presents the probe ISIDORE developed for in situ trace metal speciation [4]. This probe is based on the hyphenation between a DMT and a screen-printed electrode through a flow-cell (Figure 1), allowing a direct in situ detection and avoiding thus all problems inherent to sampling, transport and storage. The acceptor solution of the DMT was first optimized for electrochemical detection with a composition of 3 mmol L⁻¹ Ca(NO₃)₂ and 3 mmol L⁻¹ of sodium acetate buffer at pH 4.5. Under these conditions, the simultaneous determination of Zn, Pb and Cd is possible at low detection limits. The lower volume of the acceptor solution yielded a much faster equilibrium time, 6 h, as compared with the common 36 to 48 h deployment needed to reach equilibrium. The possibility of using the accumulation slope with ISIDORE is studied to further reduce the analysis time and obtain dynamic information on the nature of the metal complexes [5].

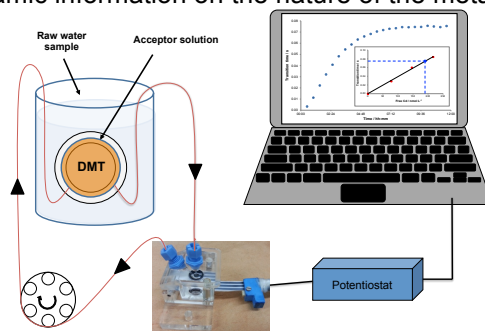


Figure 1: ISIDORE Probe scheme

References

- [1] E.J.J. Kalis, Weng, F. Dousma, E.J.M. Temminghoff, W.H. Van Riemsdijk, Measuring Free Metal Ion Concentrations in Situ in Natural Waters Using the Donnan Membrane Technique, *Environmental Science & Technology* 40 (2005) 955.
- [2] M.-L. Tercier-Waeber, F. Confalonieri, M. Koudelka-Hep, J. Dessureault-Rompré, F. Graziottin, J. Buffle, Gel-integrated voltammetric microsensors and submersible probes as reliable tools for environmental trace metals analysis and speciation, *Electroanalysis* 20 (2008) 240.
- [3] C. Parat, L. Authier, A. Castetbon, D. Aguilar, E. Companys, J. Puy, J. Galceran, M. Potin-Gautier, Free Zn²⁺ determination in natural freshwater of the Pyrenees: towards on-site measurements with AGNES, *Environmental Chemistry* 12 (2015) 329.
- [4] C. Parat, J.P. Pinheiro, ISIDORE, a probe for in situ trace metal speciation based on Donnan membrane technique with related electrochemical detection part 1: Equilibrium measurements, *Analytica Chimica Acta*, 896 (2015) 1.
- [5] L. Marang, P. Reiller, M. Pepe, M.F. Benedetti, Donnan membrane approach: from equilibrium to dynamic speciation, *Environmental Science & Technology* 40 (2006) 5496.

Acknowledgements - The authors acknowledge support of this research from the French national research agency ANR and the Portuguese national funding agency for science, research and technology (FCT-ANR/AAG-MAA/0065-2012 - SPECIES) and the Conseil Départemental des Pyrénées Atlantiques (CD64)