
Evaluating the diffusive gradients in thin-films technique (DGT) for the measurement of platinum group elements Rh, Pd & Pt in natural waters

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Abstract

The increased application of Platinum Group Elements (PGEs) (Pt, Pd, Rh, Ru, Os and Ir) in the last decades, especially as car catalysts but also in other applications, makes it necessary to monitor the concentration of these elements in the environment, investigate their environmental transformations and bioavailability. The passive sampling technique diffusive gradients in thin films (DGT), which is based on the diffusion of labile metal species through a diffusive hydrogel overlaid on a binding gel allows the determination of time-weighted average concentrations of labile metal species in situ. Moreover, it provides an important pre-concentration of the analytes on the binding gel which makes it possible to measure very low concentrations of trace elements in aquatic systems. The technique is well established for many elements, but has not yet been developed for PGEs.

The aim of this study was to develop the DGT technique to measure low levels of PGEs in surface waters. The method development involves several different steps: 1) the selection of an appropriate resin or binding phase for the PGEs, 2) selection of an appropriate diffusive gel, 3) development of an efficient elution method for the PGEs from the resin gel, 4) evaluation of the linear response in function of the deployment time, 5) determination of diffusion coefficients for the PGEs in the diffusive gel. Different binding resins specifically developed for PGEs were evaluated. Adequate blank values and linear response ($R^2 = 0.99$) in function of the time were obtained for Magpie Polymers (MPX 317 and MP 102) and Purolite (S985) and diffusion coefficients could be determined. An aqua regia elution method gave a recovery of over 80% of the PGEs from all tested resins' gels.

Preliminary deployments in the Zenne River, Belgium, show that Rh, Pd and Pt can be quantified by the newly developed method.

Keywords: speciation, bioavailability, PGEs, SF ICP MS, surface waters, DGT, Diffusion coefficient

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