Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37086

Development of a DGT passive sampler for perchlorate quantification in groundwater: application to the European Metropolis of Lille (France)

LUDOVIC LESVEN[1], CAMILLE DANEL[1], DAVID DUMOULIN[1], GABRIEL BILLON[1] AND LISE CARY[2]

[1]Univ. Lille, CNRS, UMR 8516 - LASIRE - Laboratoire Avancé de Spectroscopie pour les Interactions, la Réactivité et l'Environnement, F-59000 Lille

[2]BRGM Orléans - Service Géologique National

Perchlorate (ClO_4^-) is a highly soluble and persistent anion increasingly detected at trace levels in groundwater. Because it interferes with iodine uptake by the thyroid gland, it poses a health risk, particularly for infants and young children [1]. In northern France, especially along the former World War I front line between Arras and Douai, perchlorate contamination has been linked to historical military activities and the use of Chilean nitrate fertilizers. In the European Metropolis of Lille (MEL), recent droughts have reduced groundwater recharge, requiring the use of boreholes with perchlorate concentrations approaching guideline values [2].

Improving monitoring strategies is therefore essential to better understand perchlorate sources and dynamics in aquifers. Perchlorate determination commonly relies on two-dimensional ion chromatography with conductivity detection, a costly and time-consuming technique.

To address these limitations, this study aims to develop and validate a passive sampler based on the Diffusive Gradients in Thin Films (DGT) technique for selective perchlorate accumulation in groundwater. Beyond preconcentration, DGT devices also allow depth-resolved concentration profiles [3]. Specific binding resins were selected and incorporated into DGT. Laboratory experiments were conducted to evaluate resin selectivity and capacity, determine gel stability and diffusion coefficients, and optimize elution prior to analysis by conventional ion chromatography. An in situ agitation system was additionally designed to minimize the formation of a diffusive boundary layer (DBL) in low-flow environments such as piezometers. Preliminary results demonstrate efficient perchlorate uptake, partial reduction of anion interferences, and improved detection limits through in situ preconcentration.

This approach provides a cost-effective and integrative tool for assessing perchlorate contamination and contributes to improved groundwater quality management in historically impacted regions.

[1]: Motzer, W. E. (2001). Perchlorate: problems, detection, and solutions. *Environmental Forensics*, *2*(4), 301-311.

[2]: Blain-Lefèvre, É., Jacob, S., Douché, C., Gaudré, S., Hérin, J., & Van Es, Y. (2026). Searching perchlorates sources in chalk aquifer of Nord–Pas-de-Calais. *Milieux*, *12*, 01.

[3]: Mohammadi, A., Corbett, T., French, A., Lehto, N. J., Hadfield, J., Jarman, P., ... & Hartland, A. (2022). Application of diffusive gradients in thin films for monitoring groundwater quality. *ACS ES&T Water*, *2*(4), 518-526.