EVALUATION OF THE DIFFUSION GRADIENT IN THIN-FILMS (DGT) TECHNIQUE FOR MEASURING TRACE METAL CONCENTRATIONS IN FRESHWATERS

by

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ABSTRACT

The recently developed Diffusion Gradient in Thin-films (DGT) technique is based on a simple device that accumulates metals in situ, over time in a Na resin gel. Metal ions diffuse through a hydrogel membrane and are rapidly bound by the resin. The many advantages associated with the DGT technique (simplicity, *in situ* technique, low detection limits, and ability to measure many metals) have lead to its rapid application in aquatic environments.

Caveats have been recognized with the DGT technique when it is used in aquatic environments. These include: the ability of strongly complexed organic-metal molecules to diffuse through the hydrogel and become complexed by the resin gel, and in freshwater lakes with a low concentration of cations (Ó [cations] =2 x 10^{-4} M), it is hypothesized that the diffusion coefficient of metal ions entering the DGT device increases. Both of these caveats overestimate the concentrations of labile inorganic metals in the deployment solution.

The hypothesis that deploying DGT devices equipped with two different hydrogel formulations (“open” and “tight”) will provide reasonable measurements of DGT-labile “organic” and “inorganic” concentrations of Mn, Cd and Pb was tested in the field. DGT devices were deployed in three lakes (Lake Tantaré, Lake St. Joseph and Lake Memphremagog). To compare the responses of the DGT devices with the total dissolved metal concentration (< 0.20 µm) of each lake, *in situ* dialysis samplers were deployed simultaneously. Overestimation of DGT-labile “inorganic” concentrations of Mn and Pb, and overestimation of DGT-labile “organic” Cd was observed when compared to the measured total dissolved metal concentrations in the lakes.

The hypothesis that DGT devices equipped with a Ca form of the resin gel (as an alternative to the sodium based resin gel in the DGT device) will reasonably measure Mn, Cd and Pb labile metal concentrations in freshwater lakes with low cation concentrations was tested. DGT devices with the Ca form of the resin gel were deployed in Lake Tantaré, Lake St. Joseph and Lake Memphremagog. Overestimation of DGT-labile metal concentrations of Mn, Cd and Pb were observed with the Ca resin gel in the lakes when compared to the measured total dissolved concentrations.

The implication of these findings is that the DGT technique should not be used in freshwaters with low cation concentrations (Ó [cations] =2 x 10^{-4} M), typical of lakes found in the Canadian environment, until the caveats of the technique have been resolved. Extreme caution should be used when drawing conclusions regarding the concentrations of inorganic and organic metal species, since it has been found the DGT devices with the two different hydrogel formulations overestimate the inorganic metal concentration relative to the organic metal concentration in aquatic environments.