MSc Research Project (6 months):

Exploring the origin and fate of methylmercury toxin accumulated in fish through compound specific Hg and C isotope fingerprinting

Laboratoire Géosciences Environnement Toulouse & University of Toulouse

Mercury (Hg) is a global contaminant of concern to human and ecosystem health. Mercury exposure to humans is mainly driven by fish consumption. Mercury health and socioeconomic costs are estimated to several billions € per year worldwide. The adoption of the International Minamata convention aims at reducing anthropogenic Hg emissions to ultimately reduce Hg levels in marine and freshwater fish. Both marine and freshwater fish tend to bioaccumulate the organic form of Hg, methylmercury (CH_3Hg), which is naturally produced from pollutant inorganic mercury in aquatic ecosystems. Despite improvements in environmental Hg science we still lack answers to some of the most fundamental questions on where, how and when CH_3Hg is formed in the aquatic ecosystems, before its incorporation in food webs.

The Hg group at the GET laboratory has developed new analytical tools which aim at measuring the stable isotopic composition of the carbon atom ($\delta^{13}C$) embedded in CH_3Hg. We think that $\delta^{13}C$ signature of the methyl ($-CH_3$) group of CH_3Hg accumulated in fish holds key information to trace its formation reactions and fate. The comparison between the $\delta^{13}C_{CH3Hg}$ values in fish and the $\delta^{13}C$ signature of different carbon sources (sediments, periphyton, phytoplankton, etc) present in aquatic ecosystems has the potential to trace its source. It is also known that the $\delta^{13}C$ signature of marine phytoplankton varies geographically ($\delta^{13}C$ isoscapes) at the global ocean scale, possibly hinting at the use of $\delta^{13}C_{CH3Hg}$ to better capture the oceanic sectors that favor CH_3Hg formation. Further, the possible variations in $\delta^{13}C_{CH3Hg}$ values occurring during CH_3Hg formation and /or degradation reactions needs to be investigated in laboratory experiments to better constrain the fate of this contaminant in the environment.

This 6 month (adjustable if needed, during the period 1/11/19 to 31/7/20) research project is part of the ANR MERTOX project (PI. David POINT) which investigates the origin of CH_3Hg in the global ocean. The work will consist of (i) conducting laboratory experiments to explore

changes in $\delta^{13}C_{CH3Hg}$ during key methylation and /or photodegradation reactions, and (ii), to analyze selected tuna fish samples from different ocean basins, exhibiting large phytoplankton $\delta^{13}C$ spatial variations. These experimental and field observation data will be combined to discuss how this new methodology improves our knowledge of the marine CH_3Hg cycle.

We are looking for a highly motivated MSc student who is interested by investigating the Hg cycle though the angle of molecular and stable isotopic approaches in relation with the carbon cycle in marine ecosystems. Students with a background in analytical chemistry, and/or biogeosciences are welcome to contact us. The trainee will be based at the University of Toulouse for about 6 months.

A dedicated PhD grant is available starting at the end of this MSc internship in the framework of the Marie-Curie ITN GMOS-Train project (Global Mercury Observation and Training network in support to the Minamata Convention) which starts on 1/1/20 (https://www.gmos-train.eu/)

Contacts:

david.point@ird.fr UMR GET- Geosciences Environnement Toulouse, 14 avenue edouard Belin, 31400 Toulouse

jeroen.sonke@get.omp.eu UMR GET- Geosciences Environnement Toulouse, 14 avenue edouard Belin, 31400 Toulouse

marina.renedo@ird.fr UMR GET- Geosciences Environnement Toulouse, 14 avenue edouard Belin, 31400 Toulouse

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