210 Newly-identified polyfluoroalkyl surfactants in the freshwater fish C. commersonii following AFFF deployment at the Lac-Mégantic railway accident

G. Munoz, Universite de Montreal / Chemistry; M. Desrosiers, CEAEQ; S. VO DUY, Universite de Montreal / Chemistry; P. Labadie, H. Budzinski, CNRS; J. Liu, McGill Univ / Civil Engineering; S. Sauve, Universite de Montreal

On July 6th 2013, an unmanned train derailed downtown Lac-Mégantic (Québec, Canada), causing a spill of nearly 6 million liters of crude oil, destroying large parts of the city center, and claiming the lives of 47 people. In the emergency response to contain the fire, the deployment of aqueous film forming foams (AFFFs) lasted for approximately two days and > 30,000 liters of foam concentrate were applied. At least 4 out of the 7 firefighting formulations contained fluoroalkylated surfactants (PFASs), organofluorine chemicals whose persistence, bioaccumulation potential and adverse effects have been documented in the literature. The present study examines the environmental occurrence of historic and newly-identified PFASs in the benthic fish Catostomus commersonii and sediments collected from the adjacent Lake Mégantic and Chaudière River (downstream from the AFFF-impacted site). 28 target and 90 suspect-target PFASs were therefore investigated using ultra-high performance liquid chromatography polarity-switching electrospray ionization coupled to Orbitrap mass spectrometry. Seven zwitterionic or cationic PFASs were synthesized to provide for model analytes for method validation and semi-quantification purposes. In sediments, zwitterionic PFASs dominated PFAS composition profiles (~94%) while perfluoroalkyl acids (PFAAs) were less prevalent (~3%). Levels of PFAAs remained moderate in fish muscle (e.g., PFOS: 0.36–2.5 ng g^{-1} wet-weight), with little or no significant temporal trend when comparing 2013 or 2014 fish samples with 2011 archived samples. In contrast, fluorotelomer sulfonates peaked in the immediate weeks or months that followed the accident, as did several zwitterionic PFASs such as fluorotelomer sulfonamide betaines (8:2 FTAB, 10:2 FTAB) and fluorotelomer betaines (especially 9:3 FTB, 11:3 FTB, 7:1:2 FTB, 9:1:2 FTB and 11:1:2 FTB). With time, levels of betaine-based PFASs gradually decreased in fish, possibly indicating attenuation by biodegradation of the fluorine-free moiety, supported by the observation of likely FTAB metabolites such as fluorotelomer carboxylates and fluorotelomer sulfonamides. These metabolites may convert to PFAAs in the long-run.

211 Transport of Poly- and Perfluoroalkyl Substances in Groundwater, Cape Cod, MA

A.K. Weber, Harvard Univ; L.B. Barber, USGS / National Research Program; D.R. LeBlanc, USGS / New England Water Science Center; C.D. Vecitis, Harvard Univ / John A Paulson School of Engineering and Applied Sciences

Since the 1950s poly- and perfluoroalkyl substances (PFASs) have been used for many applications owing to their high stability and the combination of their surfactant, hydrophobic, and oleophobic properties. Groundwater PFAS contamination has arisen as a concern because of the widespread current and historical use of PFAS-containing aqueous film-forming foams (AFFFs) for fire suppression. Research is needed on PFAS transport properties in groundwater, as these contaminants pose a unique threat to groundwater quality owing to their persistence, bioaccumulation, ubiquity, and adverse human health effects. A site on Cape Cod, Massachusetts, where fire training activities involving AFFF were conducted from 1970 to 1985 has been investigated to understand the subsurface transport of PFASs. More than 100 groundwater samples were collected along a transect extending 1.1 km downgradient from the fire-training area and analyzed with LC-MS/MS to visualize the subsurface PFAS distribution along the groundwater flow path. Land disposal from 1936 to 1995 of secondary treated wastewater effluent onto infiltration beds located 500 m hydraulically downgradient from the fire training area resulted in a wastewater plume that comingles with the PFAS plume. PFAS transport properties were investigated upgradient of and within the wastewater-contaminated zone by comparing PFAS distributions to wastewater-affected geochemical parameters such as specific conductance, pH, temperature, and concentrations of dissolved organic carbon, dissolved oxygen, and dissolved iron. Perfluoroalkyl acids (PFAAs) with short chain lengths and PFAA precursors exhibit unexpected transport rates in the field when compared to results reported in the literature and laboratory partitioning experiments conducted with sediment cores from the field site. Distinctly different PFAS compositions in shallow groundwater below the vadose zones at the fire training area and wastewater-infiltration beds indicate that these are two compositionally different PFAS sources, suggesting that the PFAS composition in groundwater samples can be used to identify potential sources. This work contributes to the understanding of how PFASs migrate from point sources and identifies some mechanisms that could impact transport.

212 Perfluoroalkyl acid concentrations in historical drinking water samples collected from the Greater Cincinnati Region

S.F. Nakayama, National Inst for Environmental Studies / Centre for Health and Environmental Risk Research; M. Yoshikane, IDEA Consultants, Inc.; K. Dasu, M. Mills, USEPA / National Risk Management Research Laboratory; M. Wright, USEPA / National Center for Environmental Assessment; S. Ehrlich, Univ of Cincinnati / College of Medicine

The Health Outcomes and Measures of the Environment (HOME) Study is an epidemiological study conducted in Greater Cincinnati area (Geraghty, et al., 2008), to examine the effects of low-level exposures to prevalent neurotoxicants in a cohort of 400 children followed from 16 weeks of gestation to 5 years of age. As part of the study, serum and drinking water samples were collected during 2003–2006 from each participant's home. Poly- and perfluoroalkyl substance (PFASs) concentrations were measured in serum samples of 6–8 year-old female participants (Pinney SM, et al. 2014). Elevated concentrations of perfluorooctanoic acid (PFOA) were found in 94% of the participants living in one area compared to the National Health and Nutrition Examination Survey (NHANES) 95th percentile for children 12–19 years (8.4 ng/mL), median 22.0 ng/mL. This was speculated to be derived from an industrial source upriver of the Ohio River through drinking water. Drinking water samples were collected directly from the taps into 500-mL HDPE containers and stored frozen until the time of lead analysis in 2007. The samples were transferred to smaller size tubes and stored again at –20 C until our analysis in 2016. The sample volumes were approximately 10 mL. We used a newly developed on-line solid phase extraction method to analyse PFASs in these drinking water samples. In a pilot scale analysis of 25 samples, median concentrations of PFOA and perfluorooctanesuflonic acid (PFOS) were 10 and 7.6 ng/L, respectively, which were comparable to the previously reported levels such as NHANES. The maximum levels for PFOA and PFOS were 108 and 98.6 ng/L, respectively. Some of the samples exceeded the newly established US Environmental Protection Agency (USEPA) Drinking Water Health Advisories for PFOA and PFOS (70 ng/L combined PFOA and PFOS). The full-scale analysis results for 400 samples will be reported and discussed in detail for the presentation. Disclaimer: The views expressed in this abstract are those of the authors and do not necessarily reflect the views or policies of the USEPA. The findings and conclusions of this article are solely the responsibility of the authors and do not represent the official views of the National Institute for Environmental Studies, Japan.

213 Perfluoroalkyl and polyfluoroalkyl substances associated with aqueous film forming foams in Canadian surface waters

L. D'Agostino, S.A. Mabury, Univ of Toronto / Dept of Chemistry

Dozens of novel perfluoroalkyl and polyfluoroalkyl substances (PFASs) have recently been identified in aqueous film forming foams (AFFFs), but environmental detections of these compounds are limited and they have not been previously detected in surface waters. Surface water samples were collected from rivers and lakes in Southern Ontario and Nunavut, including AFFF-impacted sites, urban rivers, and rural sites. Surface water samples were extracted by mixed-mode weak anion exchange solid