Stablization of mercury in riverbank sediments of the South River, Virginia (U.S.A.)

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Metal-bearing sediment particles from eroding riverbanks can be an ongoing source of bioavailable mercury (Hg) to aquatic ecosystems. Hyporheic zones in particular can be important sources of both inorganic and organic-complexed Hg, which can be rapidly transported to adjacent surface waters. The objective of this study was to investigate the release and treatment of dissolved and particle-bound Hg in water derived from the riverbank sediments of the South River, Virginia. A profile of sediment was collected along a riverbank. Samples were characterized to assess the potential for Hg release as both dissolved and particulate forms. A series of resuspension experiments was conducted to simulate erosion of the riverbanks into the river. Mechanisms controlling transport of Hg during a riverbank inundation event were evaluated through column leaching experiments, which were conducted under variable flow conditions. Carbon-based amendments were applied in batch experiments to limit the release of Hg from sediment containing either 70 mg kg^{-1} or 280 mg kg^{-1} of Hg. Continuous flow-through column experiments were conducted to evaluate the potential for treatment of both dissolved and particulate Hg under transport conditions.

Elevated concentrations of Hg were observed in the river water during the resuspension experiments. The highest concentrations of Hg released (up to 80 μg L^{-1}) were observed for sediment samples collected from near the top of the riverbank profile. Mercury release during the resuspension experiments showed a non-linear response as the mass of sediment was increased, suggesting a possible solubility control on aqueous Hg concentrations. In column experiments, Hg concentrations in the in the 0.45 μm-filtered fraction of the effluent varied from 0.15 μg L^{-1} for samples collected from the base of the riverbank to 8 μg L^{-1} for samples collected from the top of the riverbank. Filter size-fractionation of water column effluent suggested approximately 50% of the leached Hg was present in the dissolved phase, with the remainder in particulate form.

Results from batch and column experiments indicated that the addition of reactive media resulted in lower aqueous concentrations of Hg. The co-blending of carbon-based adsorbent to sediments resulted in decreases in aqueous Hg ranging from 43 to 89% in the South River water. The adsorption of Hg ranged from 32 to 202 ng Hg per g reactive material. Decreases of 98% of Hg in column effluent were observed following 35 pore volumes of flow, and 91% after 100 pore volumes of flow. Results from laboratory-based experiments indicated that the addition of reactive media resulted in lower concentrations of both dissolved and particulate Hg in the river water. The potential application of carbon-based amendments to the riverbank sediment may be an alternative approach to reduce Hg flux in the South River.

Use of stable (HOCN) and radiogenic (Sr) isotopes to determine the geographic provenance and traceability of artisanal cheeses of Quebec, Canada.

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Analysis of stable isotopes has often been used to determine the traceability of different food products [1]. The light stable isotope ratios in dairy products such as cheese can provide information for tracing geographical origin [4]. The province of Quebec is Canada's largest cheese producer and artisanal cheeses are becoming a larger part of this market. In this context, we selected artisanal cheeses from six different regions of the province of Quebec to study the applicability of light stables isotopes and radiogenic isotope (Sr) ratios as descriminants to provide geographic traceability.

The cheese samples were analysed for light stable isotope ratios (HOCN) which are mainly influenced by altitude, distance from the sea, use of fertilizer, rainfall, food type, temperature, longitude and latitude [2,3,6]. The Sr isotope analyses are indicative of the geology of the type of substrate of the grazing areas [5]. Prelininary results yeild $^{87}Sr/^{86}Sr$ ratios that vary from 0.70978 to 0.71347 for both winter and summer cheeses. These values reflect soils composed largely of glacial tills derived from either the Canadian Shield or Appalachain Orogen. Furthermore, we observed a direct correlation of the $^{87}Sr/^{86}Sr$ ratios of cheese, milk and soil from the grazing area. Stable isotope δD values vary beteween -107.57‰ to -56.38‰, and $\delta^{18}O$ between -18,64 ‰ to -6,45‰ for both winter and summer cheeses. Water and milk δD and $\delta^{18}O$ results are similar to chesse results but with and enrichment in $\delta^{18}O$ values. Stable isotope $\delta^{13}C$ values vary between -27.12‰ to -21.40‰ and $\delta^{15}N$ beteween 4.66‰ and 6.21‰ wich is representative of C_3 plant CO_2 fixation. These results allow us to conclude that the use of stable and radiogenic isotopes can provide geographical provenance and traceability of the artisanal cheese of Quebec.

[1]Kelly, Heaton & Hoogewerff (2005) Food Science and Technology 16, 555-567.
[2]Mariotti et al (1981) Plant soil, 62, 413-430.
[3]Moser & Rauert (1980) Berlin: Bornträger.
[4]Pillonel & al (2003) Lebensm. Wiss. u. Technol. 36, 615-623.
[5]Rossmann et al (2000) European Food and Research Technology, 211, 32-40.
[6]Smith & Epstein (1971) Plant physiology, 47, 380-384.