Medically-derived ^{131}I as a tracer in aquatic environments

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Iodine-131 ($t_{½}$ = 8.04 d) has been measured in Potomac River water and sediments in the vicinity of Blue Plains, the world's largest advanced wastewater treatment plant. It serves all of Washington, DC, treats an average of 1.4 x 10^9 L d^{-1} and has a maximum capacity of >4 x 10^9 L d^{-1}. Concentrations of ^{131}I detected in sewage effluent and in the river suggest a continuous dischage of the isotope from Blue Plains. Surface water ^{131}I ranged from 0.076 ± 0.006 to 6.07 ± 0.07 Bq L^{-1}. Partitioning in sewage effluent and river water suggests that ^{131}I is associated with colloidal and particulate organic material. Iodine-131 was detected in sediments to depths of 5 cm with specific activites between 1.3 ± 0.8 and 117 ± 2 Bq kg^{-1} dry weight. The behavior of ^{131}I in the Potomac River is consistent with the cycling of natural iodine in aquatic environments. It is discharged to the river via sewage effluent, incorporated into particulate matter and deposited in sediments where it is subject to diagenetic remineralization.

Additionally, dissolved ^{131}I showed a strong, postive correlation with δ^{15}N values of nitrate in the river. Surface water $\delta^{15}NO_3$ values ranged from 8.7 ± 0.3 to 33.4 ± 7.3‰ with dissolved inorganic nitrogen (NO_3+NO_2) concentrations between 0.38 ± 0.02 and 2.79 ± 0.13 mgN L^{-1}. δ^{15}N in sediments ranged from 4.7 ± 0.1 to 9.3 ± 0.1‰. Sediment profiles of particulate ^{131}I and δ^{15}N indicate rapid mixing or sedimentation and in many cases remineralization of a heavy nitrogen source consistent with wastewater nitrogen.

Sewage effluent discharges of ^{131}I to surface water can be used to study the rates and mechanisms controlling natural iodine cycling. Iodine-131 coupled with δ^{15}N can be an excellent tracer for the short-term fate of wastewater nitrogen. The utility of ^{131}I is not limited to the Potomac River. The presence of medically-derived ^{131}I has been documented in several aquatic environments and is readily measureable in sewage effluent. Continuous discharges of this radioisotope in sewage effluent are likely to be widespread. Further study of ^{131}I in receiving waters can provide valuable insight into the fate and transport of this radioisotope in the context of large scale accidental releases.

Volatile abundances and Pb isotopes in melt inclusions from Iwate volcano, Japan

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The pre-eruptive volatile content of magma is of fundamental importance for understanding melting processes, as well as eruption dynamics. However, since volatiles in magma are largely degassed during subaerial eruptions, it is difficult to estimate their pre-eruptive concentrations based on the measurements of volcanic whole rocks. Melt inclusions trapped in early crystallizing olivine retain dissolved volatiles of magmas at depth (e.g. [1]).

Iwate volcano is located on the volcanic front of the North-east Japan arc on the Honshu Island. The Iwate samples are one of the most undifferentiated rocks on the volcanic front of Japanese island arcs. The olivine hosted melt inclusions of the 1686 eruption of Iwate volcano are basaltic to basaltic-andesitic in composition.

The melt inclusions have Pb isotope compositions ^{207}Pb/^{206}Pb (0.836 to 0.850) and ^{208}Pb/^{206}Pb (2.079 to 2.094). These compositions are homogeneous and close to MORB values. The volatile contents (H_2O, S) are highly variable and reaches values comparable to that of Izu Oshima melt inclusions (up to 3.57 wt% and 1798 ppm, respectively; [2]). F and Cl concentrations are highly clustered between 113 and 183 ppm and 285 and 408 ppm, respectively. This low F and Cl magma, yet with arc H_2O content, may represent partial melting of a highly depleted mantle wedge with no or little metasomatism.

[1] Sobolev (1996) *Petrol.* 209–220. [2] Ikehata, Yasuda & Notsu (2010) *Miner. Petrol.* 143–152.