

New insights into mercury exchange between air and substrate

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Mercury (Hg) can be emitted to the air from Hg-enriched and unenriched substrates, as well as deposited to terrestrial surfaces from the air as wet and dry deposition and subsequently re-emitted. The relative magnitude of these processes is important to understand for developing regional and global biogeochemical mass balances, and assessing the effectiveness of regulatory controls. Mercury emissions often follow a diel pattern with emissions highest during midday. Light is thought to be a dominant parameter driving emissions with temperature, atmospheric turbulence and precipitation all demonstrated to exert some control. This paper presents new insights into other parameters important in controlling Hg air-substrate exchange.

Recent work has shown that soil moisture content and atmospheric ozone significantly enhance Hg emissions from enriched and unenriched substrates. Evaporation of moisture from soils is also thought to be an important process whereby Hg within the soil column is transported by mass flow to the soil-air interface. It has been suggested that with increasing anthropogenically derived atmospheric oxidants in the air Hg emission from soils may increase.

Little work has been done to investigate the potential for dry deposition of elemental Hg to soils and the potential for re-emission of Hg deposited by dry or wet processes. Field and laboratory studies have shown that elemental Hg is dry deposited to substrate. Laboratory experiments have shown that factors controlling deposition include air Hg concentrations, dark versus light conditions, soil pH, and atmospheric chemistry. Data from a field experiment using stable Hg isotopes amended in a simulated light rain event to desert soils indicated that HgCl₂ is not rapidly re-emitted.

Mercury geochemistry of the Scioto River, Ohio: Impact of agriculture and urbanization

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In April 2003 during a high flow event we sampled the Scioto River, a major central Ohio tributary to the Ohio River, for a number of chemical and physical constituents, including total and dissolved Hg. Seven locations were sampled, from the headwaters, which run through row crop agricultural lands, to just south of Columbus, the 15th largest city in the USA. The total Hg concentration increased continually downstream with the highest concentrations observed at Commercial Point, just below two large sewage treatment plants that serve metro Columbus. The highest Cl⁻ concentration was also observed there. The highest NO₃⁻ concentrations were found in the agriculturally dominated portion of the river. The highest dissolved Hg concentration occurred in downtown Columbus. Using the flow data from the day that the samples were collected, Hg yields were calculated at three locations within the basin: at Prospect (P) in the northern, ag-dominated part of the basin; at Bellepoint (B) located between two reservoirs, just north of Columbus proper; and at Downtown Columbus (D). The dissolved Hg yields in ng km⁻² sec⁻¹ increased by a factor of 2 from P to B and then another 50% at D. The particulate Hg yields increased only 10% from P to B, but 30% from B to D, with the particulate Hg yields being about ~2.5 to 4.5X greater than the dissolved ones. These data suggest that yields of particulate Hg are more affected by urbanization than agricultural activities. The cause of the increasing yields of dissolved Hg as the river proceeded downstream is not clear at this time. We assume the last increase is due to input from the urbanized portion of the watershed. As demonstrated previously by Mason and Sullivan (1998) in Washington, DC, it appears that urbanized regions retain a lower percentage of atmospherically deposited Hg than other landscape types.