Geophysical Research Abstracts
Vol. 15, EGU2013-13412, 2013
EGU General Assembly 2013

Where does the mercury in gaseous fluxes from soil come from? An applied stable isotope experiment

Maxwell Mazur (1), Chris Eckley (2), and Carl Mitchell (3)

(1) Department of Physical and Environmental Sciences, University of Toronto Scarborough, Toronto, Canada (maxwell.mazur@mail.utoronto.ca), (2) US Environmental Protection Agency, Seattle, USA (eckley.chris@epa.gov), (3) Department of Physical and Environmental Sciences, University of Toronto Scarborough, Toronto, Canada (carl.mitchell@utoronto.ca)

The flux of gaseous mercury from soils is controlled by a number of physico-chemical factors including temperature, soil mercury concentration, boundary layer conditions, soil moisture, and often most notably, solar radiation. It has been presumed that the shallowest soils constitute the main source of Hg for evasion since this Hg is closer to the surface and since the organic horizon and shallow A-horizon soils generally have the most organic matter, where Hg is sorbed and accumulated. The evidence for the predominance of near surface soil as the principal source of Hg for evasion has generally been correlational in nature however and no direct experimental evidence currently exists. This experimental laboratory study directly assessed the depth from which Hg evades by labeling different soil layers (1cm in thickness) with an enriched Hg stable isotope and measuring Hg fluxes under constant, but relatively low light conditions. Fluxes were measured using a dynamic flux chamber coupled to high-precision air pumps and gold traps. The gold traps were thermally desorbed and Hg isotopes were measured by ICP-MS. Under dry soil conditions, we found that most labeled Hg fluxes were very low, with no discernible pattern in relation to tracer depth. In some dry condition measurements where tracer fluxes were significant (up to 69 ng/m2 h), they were four or more times less than measurements made with wetter soils. When soils were wetted to field capacity and then allowed to dry over time, measured surface fluxes peaked approximately 24 hours after wetting and quickly declined. The largest fluxes (270 ng/m2 h) measured after wetting were observed when the isotope enriched layer constituted the surface layer. Significant fluxes were measured after wetting when the enriched layer was at 0, 1 and 2 cm, and fluxes generally decreased exponentially with depth. Fluxes after wetting, when the enriched layer was 5cm below the surface, were non-significant. Our data provide direct evidence to corroborate previous assumptions that the upper 2 cm of soil do indeed constitute the principal zone of Hg source and Hg transport for soil Hg emissions to the atmosphere.