Surveying Air-borne Mercury at the Landscape Level

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Atmospheric deposition of mercury on water and land surfaces is now recognized as a significant component of its overall geochemical cycling. Routine network sampling of regional background concentrations within the US is ongoing and is revealing information about temporal variability and the relative contributions of Hg vapor, wet and particulate deposition. These studies are complimented by extensive local sampling at sites known to contain sources of Hg.

The purpose of this study is to develop an inexpensive method of surveying terrestrial habitats at the landscape scale to identify locations which repeatedly have higher than average air-borne deposition of Hg. For the purpose of this study, the definition of air-borne Hg is that which adheres to a thin layer of sticky material poured into plastic Petri dishes which are exposed to air while attached to telephone poles. These locations were dispersed within the city limits of Waynesboro, Harrisonburg and Staunton VA.

From the outset it is realized that each sample which is collected is not complete and subject to various sampling errors such as variability in the impaction of insects and dust due to air movement, and the inability of the samplers to hold the entire sample during more intense precipitation events such as thunderstorms and hurricanes. Therefore, the technique is likely to underestimate Hg presence and does not provide an absolute measure of atmospheric Hg. However, all of the plates are exposed to similar sources of error which for the moment are considered to be random.

The samplers are simple in design with “tangle trap” (a commercial insect trap coating) being used to create a sticky surface which remains after repeated exposure to precipitation. The materials cost approximately one dollar per sampler and replicate samplers were stapled adjacent to each other on each telephone pole. These samplers cost only a fraction of the amount that must be invested in any of the various other passive units on the market, and are even more economical in comparison with automated fixed position deposition and pump dependent atmospheric gas sampling units. Furthermore the costs are kept down by doing the Hg analysis locally on the James Madison University campus with a Perkin Elmer FIMS continuous flow cold vapor atomic absorption spectrophotometer. We can sample 100 locations, with 200 samplers total for example, at a cost less than $500. Whereas, 200 passive samplers at $250 each would cost $50,000 initially and 200 total Hg analyses from a contract laboratory would conservatively be $10,000; about 120X the cost. Our contention is that if locations of interest within the landscape can be identified with this relatively inexpensive screening process, then more detailed and precise studies can follow where appropriate.

The present status of this screening process is that we have established networks of plates within the city limits of Waynesboro during three different years. Duplicate samplers were set out at 135 locations in the most recent and extensive study. Because of damage

and vandalism, only about two thirds of the initial number of samplers were collected each time. Because the duration of each study was different, the Hg deposition was calculated as μg Hg/m^2/day for comparison. Similarly, in the most recent studies smaller samplings of 25 locations each were distributed within the city limits of both Harrisonburg and Staunton, VA. It was anticipated that these locations would represent random 'background' levels of Hg deposition in comparison with Waynesboro, VA, which has documented floodplain soil Hg contamination associated with the South River situation. For each of the study periods, the grand mean Hg concentration of all plates that were recovered in that group was calculated. Each sample location was scored with respect to the standard deviation from this grand mean and the high and low locations determined for each study. The landscape distribution patterns were compared and those which repeatedly had higher (or lower) air-borne Hg concentrations were identified. The locations have been mapped and a fourth year study is under way. Several interesting observations have already emerged from the data including the presence of some consistently high Hg locations near the South River downstream from the center of Waynesboro and several locations within the Harrisonburg, VA 'control location' which appear to have Hg concentrations as great as those found in Waynesboro. This unanticipated result is also presently under study. We do not think that the traces of air-borne Hg which are being detected are sufficient to cause environmental alarm in themselves; however, this particular study was not designed to make that determination. This could be evaluated by the establishment of a permanent atmospheric deposition (and Hg vapor) monitoring station at one or more of the locations identified as having consistently high survey concentrations.