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Are native mosses a reliable biomonitor of mercury dispersion around a passive source?

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The study of gaseous mercury dispersion around a known source is commonly focused on time-evolution on a single location using automatized measurement equipment that allows to get a great number of time-serial data. But often the challenge is more to characterize the area affected by higher levels of atmospheric mercury during a restoration work than to get a more complete comprehension of mercury dispersion factors. The monitoring of an extended area around the restoration works often requires expensive equipment and a lot of work in the field and in data treatment, especially if the study requires a time-evolution of mercury presence in the area before, during and after restoration works. Biomonitors has been used to overcome these limitations. The use of transplanted mosses has been standardized along the European Union to biomonitor air quality in extended areas. This work has asses the possibility of use native mosses to do this job, taking advantage of their ubiquity, easy sample treatment and low cost total mercury analysis.

To accomplish this objective, we performed a kinetic study of mercury uptake by local mosses in a controlled environment, and used native mosses to monitored mercury dispersion around Almadén, location of the largest mercury mine worldwide, inactive since 2008. All mosses samples were thoroughly washed immediately after sampling and oven-dried at 35 ºC during three days. Total mercury determinations were made by Atomic Absorption Spectrometry, while thermal desorption was the method used to get mercury speciation data.

The kinetic study shows different behaviour between the two specimens considered. Sample1 shows inconsistently behaviour, which was also related with its painful appearance, evidencing a hard adapting to the new ambient. Our observations indicate than the stress produces a decrement of the initial concentration around the twentieth day and extremely high level of Hg uptake around fortieth day. Despite that, Sample2 showed a gradual increase in mercury concentration, reaching a content of 317.5 ng g-1 after 45 days of exposure.

The spatial study included a map of mercury content in mosses and gaseous mercury contents in the atmosphere. A relationship between the higher gaseous mercury levels and total mercury in mosses has been found, but main wind directions show a contrasting pattern. Probably the main factor involved in mosses uptake was not mercury dispersion controlled by winds, at least in a medium term; however, TGM measurement during the survey showed a similar dispersion pattern around mining facilities. Does this mean that mercury content in mosses do not represent mercury uptake in a long period? The kinetic study shows a quick response of mosses to uptake available mercury from the atmosphere in the absence of stress, and a different pattern if moss specimen is under stress. Almadén is a semiarid region, with frequent dry periods that could cause mosses inactivity during certain periods. This intermittence can be a serious limitation to the usage of native mosses to biomonitor mercury dispersion around a source.

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