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Active Moss biomonitoring of mercury in the mine-polluted area of Mt. Amiata (Central Italy)

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In the winter 2013, mercury concentrations in air from the mine-polluted area of Mt. Amiata (1738 m a.s.l.), in southern Tuscany (Central Italy), were measured by active moss biomonitoring.

This area is part of the geologic anomaly of Hg in the Mediterranean basin, which contains about 65% of the world's cinnabar (HgS). Mt. Amiata covers some 400 km^2 and is drained by several rivers. Esploitation activity at Abbadia S. Salvatore, in the SE sector of the mountain, sprang up during the 19th century as one of the largest mercury mining and smelting plants in Europe, after those of Almaden Spain. In this area, Sphagnum moss bags were exposed for about two months, from October to December 2013. At each site (10 sites), one covered and one uncovered moss bag were deployed. Concentrations of mercury in air were also investigated in the same sites with a portable spectrophotometer (Lumex RA-915M). After exposure, mosses were oven-dried, grinded and each sample was divided in two aliquots: one was analyzed for mercury by using a Hydra C cold vapor atomic absorption analyzer (INGV-Palermo), following 7473 US EPA method; the second was microwave digested in acid solution (HNO_3 + H_2O_2). Extraction solutions were analyzed by ICP-MS for total concentrations of a large suite of trace elements, including potentially toxic elements e.g. As, Cd, Cr, Cu, Mo, Sb, Se, V.

Mercury air concentrations measured with the Lumex showed extremely high values in the mine district of Abbadia, with median values ranging from 2,000 to 4,000 ng/m^3 and maximum values up to 20,000 ng/m^3, in contrast with the lower values (median values from 20 to 200 ng/m^3) measured in the distal sites few kilometres from the mine-district area. In agreement with these results, in the vicinity of the district uncovered bags were in the range of 10,000 – 100,000 ng/g of Hg, whereas in the distal sites they were in the range of 1,000 – 10,000 ng/g. The moss-blank (unexposed moss) was ~100 ng/g. Covered moss bags were not significantly enriched in Hg with respect to the concentrations recovered from the moss-blank, suggesting that the mercury trapped in the mosses was mainly in particulate form. The particles carried from the winds were probably associated with soils re-mobilization, as also confirmed by the associated enrichments of some lithophile elements (Li and lanthanides) and anthropogenic element (As, Cr, Cd, Fe, Se, V). These preliminary results confirm the intense contamination of the study area not only for mercury but also for other potentially toxic elements.