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Geothermal mercury output at Nisyros Volcano (Greece)

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Nisyros (Greece) is an active volcano in the eastern part of the South Aegean Active Volcanic Arc (SAAVA), hosting a high-enthalpy geothermal system. On June 2013, an extensive survey on Hg concentrations in different types of matrices (fumarolic fluids, atmosphere, soils and plants) was carried out at Lakki plain, an area affected by widespread soil degassing and fumarolic manifestations. To investigate the spatial distribution of mercury emission and its possible relationships with diffuse degassing of hydrothermal fluids, Hg concentrations in soils were related to their physicochemical parameters (e.g. temperature, soil-pH, hydrothermal gases and elemental C, N and S concentrations). Furthermore, leaves of Cistus and Erica (two local plants) were collected at the same sampling sites and their Hg contents were quantified. The concentrations of gaseous elemental mercury (GEM), H2S and CO_2 were simultaneously measured in both the fumarolic emissions and in the atmosphere at the investigated sites.
Mercury concentrations in the fumarolic gases ranged from 10,500 to 46,300 ng/m3, while the Hg concentrations in air showed high background values within the Lakki Plain caldera (from 10 to 36 ng/m3) with their maximum values (up to 7100 ng/m3) measured in the fumarolic areas. In the sites outside the caldera, the Hg concentrations in air were relatively low (from 2 to 5 ng/m3). A positive correlation between Hg and both CO_2 and H2S values in the air exists, highlighting the important role of fumarolic and soil gases as carrier for GEM. On the other hand, soil Hg (concentrations from 0.023 to 13.7 μg/g) showed no significant correlations with CO_2 and H2S in the soil gases whereas a positive correlation with total S content and an inverse one with the soil-pH were noticed. These correlations evidenced the complexity of the processes involving Hg carried by hydrothermal gases while passing through the soil. Total Hg concentrations in plants, ranging from 0.010 to 0.112 μg/g, had no direct correlation with soil Hg at the same sampling site. It is noteworthy that Cistus leaves presented higher values of total Hg than Erica leaves. Taking into consideration that Hg is a toxic element and is not readily absorbed by the roots, the main pathway of plant Hg uptake is probably transpiration through leaves; consequently, the higher specific leaf surface area of Cistus favoured Hg accumulation.
Even though the GEM concentrations in air within the caldera of Nisyros are sometimes many orders of magnitude above the global background, the measured levels should not be considered dangerous for the human health. Values exceeding the WHO guideline value of 1000 ng/m3 are very rare (less than 0.1% of the measurements) and are only found in areas close to the main fumarolic vents, where the access to tourists is prohibited. Those areas are also characterized by elevated H2S concentrations, which are more dangerous than mercury's concentrations.