CHEMICAL AND MINERALOGICAL CHARACTERIZATION OF ETNEAN VOLCANIC EMISSIONS USING ACTIVE BIOMONITORING TECHNIQUE (MOSS-BAGS)

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Biomonitoring may be defined as the use of organisms and biomaterials (biomonitors) to obtain information on certain characteristics of a particular medium (atmosphere, hydrosphere etc.). In particular, mosses accumulate large amounts of trace metals, making them good bioaccumulators to estimate atmospheric pollution. The moss-bags technique, introduced in the early 1970', has become very popular. Such active biomonitoring technique is particularly useful in highly polluted areas and has been extensively used in industrial and/or urban areas to examine deposition patterns and to recognize point sources of pollution. The main objective of this study, which represents the first application of the moss-bags technique in an active volcanic area, was to test its efficacy in such environment. Complementary objectives were: to determine the different behaviour and the areal dispersion of volcanogenic elements emitted from Mt. Etna; to characterize the morphology and mineralogy of particles transported in the plume-system, basing on microscopy investigation. A mixture of Sphagnum species was picked in a clean area, treated in laboratory (rinsed, dried and packed) and exposed in field for 1 month. Sites were chosen considering the prevailing wind at Mt. Etna's summit. Milled samples were analyses for major and trace elements concentrations, after microwave digestion (HNO3 + H2O2), by ICP-MS and ICP-OES techniques. Morphology and mineralogy of volcanic particulate were investigated by using a SEM with EDS. Analyses clearly showed the efficacy of the moss-bags technique also in this peculiar environment. Several elements were strongly enriched in the mosses exposed to the volcanic emissions. The highest enrichment was measured close to the summit crater, but evidences of metals bioaccumulation were also found in downwind sites, at several km from the volcanic source. The accumulation factor (exposed/unexposed moss) allowed us to distinguish a group of elements (Tl, Bi, Se, Cu, As, Cd, S), which are highly mobile in the high temperature volcanic environment. Also alkali metals showed a significant increase in their concentrations, probably because of their affinity for the halide species carried by the volcanic plume. Microscopic observations evidenced sulphate and halide crystals on particles trapped by the mosses. Mosses exposed at sites directly fumigated by the volcanic plume showed crystal growth also directly on the moss surface.

Keywords: biomonitoring, moss-bags, trace elements