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Nicolosi (Catania) 7 | 9 giugno 2011

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a cura del Comitato Organizzatore

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Indice

Impact of Volcanic Emissions on Trace Elements Contents Measured in Endemic Plants at Mt. Etna (Italy)

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Land use on Mount Etna has been well described as a series of concentric zones changing with altitude [Chester et al., 1985]. The area below 1000 m is extensively cultivated with orchard plantations, vineyards, cereals, pistachio and hazel shrubbery. The zone between 1000 and 2000 m is covered by woods (pines, chestnuts, oaks, beeches and birches). Above 2000 m, the desert zone, the ground is usually characterized by volcanic ash and lava flows where only few pioneer plants resist to the extreme environment.

Biomonitoring may be defined as the use of organisms and biomaterials (biomonitors) to obtain informations on certain characteristics of a particular medium (atmosphere, hydrosphere etc.). In particular the accumulation of trace metal in mosses, lichens and plant leaves has long been used in studies on the impact and spatial distribution of pollution. Recently such biomonitoring techniques have been applied also to ascertain the impact of contaminants naturally released by volcanic activity [Le Guern et al., 1988; Bellomo et al., 2007; Watt et al., 2007; Martin et al., 2009; Quayle et al., 2010; Martin et al., 2011].

In the present study a biomonitoring survey, using leaves of trees (*Betulla aethnensis, Pinus nigra and Populus tremula*) and two endemic species (*Senecio aethnensis* and *Rumex aethnensis*) above treeline level, was performed on Mt. Etna, in order to evaluate the dispersion and the impact of volcanic emissions. Samples of leaves were collected in summer 2007-2008 from 30 sites in the upper part of the volcano (800-3000 m a.s.l). Acid digestion of samples was carried out with a microwave oven (HNO_3 + H_2O_2), and 44 elements were analyzed by using plasma spectrometry (ICP-MS and ICP-OES).

Major constituents in Senecio and Rumex leaves are K, Ca, Mg, Na, Si, Al and Fe ranging from about 10^3 to 10^5 ppm. Manganesium, Sr, Rb, Ba, Zn, B, Cu show also relatively high concentrations (10^1-10^3 ppm) while the remaining elements (As, Bi, Cd, Ce, Co, Cr, Cs, Ga, Li, Mo, Ni, Pb, Sb, Sc, Se, Th, Tl, U, V, Y and lanthanide series) display much lower values (10^1-10^{-3} ppm). Nearly all investigated elements show their highest concentrations in the samples collected closest to the degassing craters. Increased concentrations are also found in the samples collected on the eastern flank of Mt. Etna, which, being in the downwind direction with respect to the summit vents, is most impacted by volcanic emissions (fig.1). The high concentrations of many toxic elements in the leaves allow us to consider these plants as highly tolerant species to the volcanic emissions, and suitable for biomonitoring researches.

Leaves collected along two radial transects from the active vents on the eastern flank, highlight that the levels of metals decrease from one to two orders of magnitude with the distance from the source. Figure 1 shows for example the measured concentrations of Thallium. The decrease is stronger for volatile elements, which are highly enriched in the Etnean volcanic emissions, (As, Bi, Cd, Cs, Pb, Sb, Tl) than for more refractory elements (Al, Ba, Sc, Si, Sr, Th, U). The different species of plants show significant differences in the bioaccumulation processes for most of the analyzed elements, in particular lanthanides, which are systematically enriched in Rumex leaves. Needles of pine (non-deciduous tree) represents a good tool for biomonitoring investigation because they are important tracers of accumulation with time as showed in figure 1.

The present study further confirms that biomonitoring has a strong potential in tracing the impact and geographic distribution of volcanic emissions.

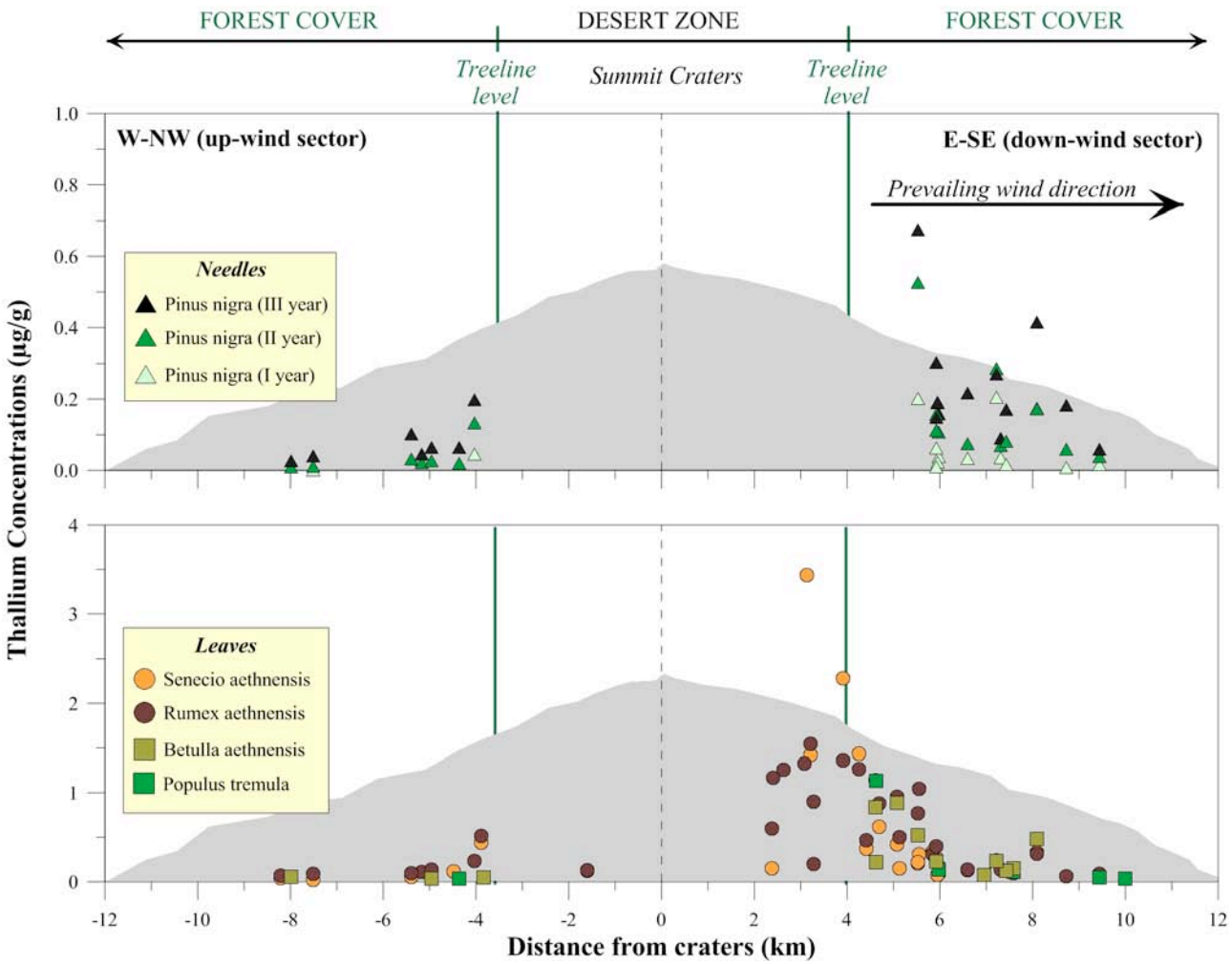

Figure 1. Spatial and time distribution of Thallium concentrations in the five studied plants species.

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