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Real-time measurements of chemical and isotope composition of atmospheric and volcanic CO_2 at Mt. Etna (Italy)

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We present unprecedented data of real-time measurements of chemical and isotope (δ^{13}C) composition of CO_2 in air and in fumarolic-plume gases collected at Mt. Etna volcano. Two campaigns of measurements were performed on 11 July and on 5-6 September 2013, by using a Delta Ray tunable diode laser. With the assumption of a two components mixing, a simple linear regression was applied to the data in order to obtain the volcanogenic δ^{13}C.

Data acquired along the route Catania–Etna, while car was moving, showed an excess of ^{13}C-depleted CO_2 when passing through inhabited centers due to atmospheric pollution produced by the cars exhaust. Fumaroles of Torre del Filosofo (2,900 m a.s.l.) displayed a δ^{13}C between -3.2$\pm$0.03‰ and -3.7$\pm$0.05‰ comparable to IRMS measurements of discrete samples collected in the same date and in previous investigations. Diluted plume gases were collected at more than 1 km from the craters and showed δ^{13}C=-2.2$\pm$0.2‰ accordingly with collected crater fumaroles.

Considering the huge amount of data that may be acquired in a very short time by Delta Ray, we demonstrate that the addition to the atmospheric CO_2 content of $\sim$100 ppm of CO_2 from an unknown source is enough to allow a mathematical calculation of the end-member with an uncertainty generally < 0.15‰This is feasible with the assumption of a binary mixing. We thus infer that the application performed at Mt. Etna may represent an historical step forward for the scientific community in volcanic surveillance.