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First measurements of gas output from bubbling pools in a mud volcano at the periphery of Mt Etna (Italy): methodologies and implications for monitoring purposes

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Gases and brines emitted in the southern sector of Mt Etna from mofettes, mud pools and mud volcanoes come from an hydrothermal reservoir hosted within the clayey formations of the sedimentary basement (Chiodini et al., 1996). The gas emitted consists mainly of CO_2, with CH4, N2 and He as minor species. CO_2 and He stable isotopes indicate a clear magmatic origin for these gases, and their compositional changes during either eruptive or rest periods closely parallel that of crater fumaroles (Paonita et al., 2012). Altough these manifestations are the most significant CO_2 emitters outside the crater area, their mass output has never been measured.
We present the first measurements of gas flux from several bubbling mud pools in a mud volcano located in the village of Paternò (Lon 14.89° Lat 37.57°), in the southern flank of the volcano.
We performed gas measurements using a home-made apparatus, able to capture all the bubbles over an area of 0.4 m2. Over an area of about 7000 m2, we measured the flow rate of every single bubbling pool, providing that it had a minimum flux rate of 0.5 l/min. The maximum measured flow rate for a single pool was 15 l/min. A preliminary estimate of the total CO_2 output over the whole mud volcano is in the order of few t/d. At the same time, we measured the chemical composition of emitted gases in various pools, characterised by different gas flow rates, to calculate the output of CO_2 and verify the effect of eventual chemical fractionation processes upon gas chemistry.
During the same campaign of direct measurements, we also used a commercial infrared laser unit (GasFinder 2.0 from Boreal Laser Ltd) for measurement of volcanic CO_2 path-integrated concentrations along cross-sections of the atmospheric plumes in the area. The GasFinder was set as to measure CO_2 concentrations at 1 Hz rate. During the field campaigns, the position of the GasFinder unit was sequentially moved so as to scan the plumes from different viewing directions and angles. The positions of both laser source and retro-reflectors were chosen so to have the target CO_2 plume in between retro-reflectors and the GasFinder, and to realize the complete coverage of the degassing area. We therefore explored the possibility to combine the available path-integrated CO_2 concentration data to derive a two-dimensional mapping of CO_2 over the mud volcano.
The periodic survey of total CO_2 output in a subset of vigorously degassing pools, paralleled to the chemical and isotopic measurements routinely performed in selected pools, would offer a robust monitoring tool in a peripheral sector of the volcano.

Chiodini G., D'Alessandro W. and Parello F. (1996) Geochemistry of gases and water discharged by the mud volcanoes at Paternò, Mt. Etna (Italy). Bull. Volcanol. 58, 51–58.
Paonita A., Caracausi A., Iacono-Marziano G., Martelli M., Rizzo A. (2012) Geochemical evidence for mixing between fluids exsolved at different depths in the magmatic system of Mt Etna (Italy). Geochim. Cosmochim. Acta 84 (2012) 380–394.