



Long term monitoring at Solfatara of Pozzuoli (Campi Flegrei, Italy): 1998-2014, fifteen years of soil CO₂ flux measurement.

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With a flux of deeply derived fluids of ~ 5000 t/d and an energetic release of ~ 100 MW Solfatara of Pozzuoli is one of the largest studied volcanic-hydrothermal system of the world. Since 1998, soil CO₂ flux surveys were performed using the accumulation chamber method over a large area (1.45 km²), including the volcanic apparatus and its surroundings. The statistical elaboration of CO₂ flux, also coupled with the investigation of the CO₂ efflux isotopic composition, allowed to characterize both the CO₂ flux connected to biological activity in the soil and that feed to the degassing of the hydrothermal system. A geostatistical elaboration of CO₂ fluxes based on sequential Gaussian simulations, allowed to define the spatial structure of the degassing area, pointing out the presence of a well defined diffuse degassing structure interested by the release of deeply derived CO₂ (Solfatara DDS). Solfatara DDS results well correlated to volcanic and tectonic structures interesting the crater area and the eastern area of Pisciarelli. With the same approach the total amount of CO₂ release was estimated to range between 754 t/d and 1530 t/d in the last fifteen year (with an error in the estimate varying between 9 and 15 %). Also the extension of the DDS experienced relevant variations varying between 4.5×10^5 m² to 12.3×10^5 m². In particular two major changes occurred in the extension of the DDS, the first consisted in its doubling in 2003-2004 and the second in further enlargement of $\sim 30\%$ in 2011-2012, the last occurring after period of decreasing trend which interrupted 4-5 years of relative stability. These variations mainly occurred external to the crater area in correspondence of a NE-SW fault system where fluxes increased from background to values typical of the endogenous source. The first event was previously correlated with the occurrence in 2000 of a relatively deep seismic swarm, which was interpreted as the indicator of the opening of an easy-ascent pathway for the transfer of magmatic fluids towards the shallower portion of the hydrothermal system; the second event of DDS enlargement well correlates with the recent unrest phase of the system, characterised by an acceleration of the ground uplift. The comparison of the CO₂ flux data with the chemical composition of the main fumaroles suggests that the enlargements in the extension of the DDS are controlled by processes of pressurization of the buried gas plume feeding the Solfatara manifestation.