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Carbon dioxide diffuse degassing at Solfatara of Pozzuoli from 1998 to 2004.

C. Cardellini (1), R. Avino (2), S. Caliro (2), G. Chiodini (2), F. Frondini (1), D. Granieri (2), R. Pettirossi (1) and M. Todesco (3)

(1) Dipartimento di Scienze della Terra, Università di Perugia, (gochem@unipg.it / Phone: 0039-0755852698), (2) Osservatorio Vesuviano, INGV-Napoli, (3) INGV, Bologna

Most quiescent volcanoes release large amounts of CO_2 trough soil diffuse degassing. Recent studies at Solfatara volcano showed that the direct expulsion of hydrothermal gases from a relatively small area, and related phenomena, are the main process through which the Campi Flegrei magmatic system dissipates its energy (Chiodini et al., 2001). The estimated energy is much higher than other known fluxes of energy released within the caldera structure during this non-eruptive period, i.e. mainly through thermal conduction, seismic events and ground deformation (Chiodini et al., 2001). Physical modeling of hydrothermal fluid circulation recently showed that intense magmatic degassing lead to significant amounts of ground deformation, due to heating and pore pressure build-up (Todesco et al., 2004). Hydrothermal fluids play also a role in triggering shallow seismic activity (Bianco et al., 2004).

Six surveys of CO_2 flux from soil were performed at the Solfatara of Pozzuoli in the period 1998-2004. Each survey consisted in about 400 measurements homogeneously distributed over an area of 1.4×10^6 m^2 including the Solfatara tuff cone and the its surroundings. The probability distribution of the flux values put in evidence the coexistence of two statistical populations of fluxes. One population, characterised by high values (mean value from 1200 to 4000 g m^{-2} d^{-1}) is related to the degassing of hydrothermal CO_2 (hydrothermal population), the other, characterised by lower values (mean value from 14 to 53 g m^{-2} d^{-1}) is generally referred to the biological CO_2 produced in soil (background). During the period 1998-2004 a general decrease of the mean value of the hydrothermal population was observed while a continuos increase of mean value of the background population occurred after February 2003 survey. This increase is not simply referable to the seasonal variation of the background CO_2,

however observed in the area, because it involves both periods of high and low soil biological CO_2 productivity(i.e., dry and wet seasons). Mapping and quantification of CO_2 diffuse degasssing were performed by sequential gaussian simulations method (Cardellini et al., 2003). The CO_2 flux distribution shows the presence of a well structured diffuse degassing structure (DDS, Chiodini et al. 2001), interesting the Solfatara cone and the surroundings in particular the eastern sector, that is evidently correlated to the main tectonic and volcano-tectonic structural element of the area. On the base of the probability maps of CO_2 flux, (Cardellini et al., 2003) the DDS was defined by a probability higher than 50% for CO_2 flux to be larger than 50 g m^{-2} d^{-1}, selected as a reasonable upper limit for a background flux. Since July 2000 the DDS expanded passing from about 450000 m^2 up to about 1000000 m^2 of April 2004, with an evident increase in the area external to the Solfatara cone in correspondence of the main fault system NE-SW oriented (Chiodini et al., 2001; Bianco et al, 2004).

To summarise, a decline in the CO_2 flux values was observed in the period 1998-2004, but with a more diffuse low magnitude degassing of hydrothermal CO_2.

Even if the observed behaviour is certainly controlled by the presence of volcano-tectonic structure, it is consistent with results from physical modelling of hydrothermal fluid circulation through a homogeneous porous medium (Chiodini et al., 2003; Todesco et al., 2004). Recent evolution was described as a sequence of alternating periods of strong and week magmatic degassing, feeding the shallow hydrothermal system. As a consequence, the two-phase plume feeding surface manifestation undergoes cyclical shrinking and enlargement episodes. The corresponding CO_2 flux at the surface is higher when the plume is more concentrated, and it declines as the plume is spreads radially. Two alternative hypothesis could be formulated to explain the present behaviour: 1) a deepening of the gas source inducing a larger but less intense anomaly at the surface, 2) a response of the CO_2 degassing at surface to the seismic swarm of July-August 2000, located 1-2 km E - SE the Solfatara crater and induced by the upward migration of a pressure front triggered by an excess of fluid pressure and to a readjustment of the inflated system occurring along some lubricated structures (Bianco et al., 2004).

References.

Bianco F., Del Pezzo E., Saccorotti G. and Ventura G (2004). The role of hydrothermal fluids in triggering the July-August2000 seismic swarm at Campi Flegrei, Italy: evidence from seismological and mesostructural data. J. Volcanol. Geother. Res. 133 (2004) 229-246

Cardellini C., Chiodini G., Frondini F. (2003). Application of stochastic simulation to CO_2 flux from soil: mapping and quantification of gas release. J. Geophys. Res., 108

(B9), 2425-2425.

Chiodini G., Frondini F., Cardellini C., Granieri D., Marini L., and Ventura G. (2001). CO_2 degassing and energy release at Solfatara volcano, Campi Flegrei, Italy. J. Geophys. Res., 106, 16213-16221.

Chiodini G., Todesco M., Caliro S., Del Gaudio C., Macedonio G. and Russo M. (2003) Magma degassing as a trigger of braydseismic events: the case of Phlegrean Fields (Italy). Geophys. Res. Lett., 30 (8), 1434-1438.

Todesco M., Rutqvist J., Chiodini G., Pruess K. and Oldenburg C. M. (2004) Modeling of recent volcanic episodes at Phlegrean Fields (Italy): geochemical variations and ground deformation. Geothermics, 33,531-547.