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Diffusive emissions of hydrothermal methane and higher hydrocarbons from the soil at Nisyros (Greece)

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Methane plays an important role in the Earth's atmospheric chemistry and radiative balance being the second most important greenhouse gas after carbon dioxide. Methane is released to the atmosphere by a wide number of sources, both natural and anthropogenic, with the latter being twice as large as the former. It has recently been established that significant amounts of geological methane and higher hydrocarbons, produced within the Earth's crust, are currently released naturally into the atmosphere. Active or recent volcanic/geothermal areas represent one of these sources of geological methane and higher hydrocarbons. Here we report on soil gas flux measurements made at Nisyros a currently quiescent active volcanic system with strong fumarolic activity due to the presence of a high enthalpy geothermal system.

Methane and CO_2 flux measurements from the soils were made with the accumulation chamber method in Lakki plain covering an area of about 0.01 km^2 including the main fumarolic areas of Kaminakia, Ramos, Stefanos, Lofos and Phlegeton. The 127 measurements range from –3.4 to 1420 mg m^{-2} d^{-1} for CH_4 and from 0.1 to 383 g m^{-2} d^{-1} for CO_2.

The five fumarolic areas show very different methane degassing pattern Kaminakia showing the highest flux values. The estimated methane output of these areas range about 0.01 t/a at Phlegeton to about 0.25 t/a at Kaminakia. The total output from the entire geothermal system of Nisyros should not exceed 1 t/a. The results of the chemical analyses of the concurrently collected fumarolic gases of the island gave clues on probable methanotrophic activity within the soil. Microbial activity in the soil of Lakki plain also controls the diffusive emission of thermogenic hydrocarbons released from the hydrothermal reservoir, mainly consisting of alkanes, aromatics and alkenes, which are partially transformed into their derivatives, such as aldehydes, ketons and alcohols.