



Quantification of methane output from mud volcanoes and mofettes south of Mt. Etna (Italy)

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Abstract

Mud volcanoes can produce flows up to 10^3 t y^{-1} , representing the largest visible expression of geologic methane emissions (Etiope and Klusman, 2002). Several sites with remarkable emissions of methane occur in the region south of Mt. Etna volcano and were investigated in order to assess their total output of CH_4 . Most of the studied emissions are located on the southwest boundary of Mt. Etna, near the town of Paternò. They consist of three mud volcanoes (known as Salinelle) and one spring with bubbling gas (Acqua Grassa). Another site (Naftia Lake) with huge gas emissions (about $80,000 \text{ m}^3 \text{ d}^{-1}$ of bubbling gas into a lake) is located further southwest of Mt. Etna in an area of extinct Quaternary volcanism on the northwest margin of Hyblean Mts. In all of these areas most of the gas is composed of CO_2 . The origin of the highest CO_2 emissions is clearly magma, likely to be the same that feeds volcanic activity at Mt. Etna. In the studied areas degassing to the atmosphere occurs mostly through tectonic structures, probably at a regional scale. The origin of methane is basically from two sources: biogenic and thermogenic. Preliminary isotopic data from the investigated mud volcanoes indicate a thermogenic origin of methane ($\delta^{13}\text{C}$ of -44 to -64 vs. PDB and δD of -140 to -150 vs. SMOW), best accounted for by the higher-than-normal geothermal gradient affecting the sedimentary basement of the volcano.

Focused CH_4 degassing was measured at each emission vent using devices that measure the air speed. In total, 146 measurements were carried out. In each of the surveyed areas, efflux measurements at individual sites were summed to obtain the total mass efflux. This efflux was then multiplied by the density (0.68 kg/m^3 at 1.013 bar and 20°C) and the average molar fraction of CH_4 , in order to obtain the CH_4 efflux values.

Methane contents were measured in the same bubbling gases by gas-chromatography on samples collected in glass samplers connected to an inverted funnel placed on the gas emission. Methane output values ranged from $7.4 \cdot 10^{-8}$ to $2.8 \cdot 10^{-4} \text{ kg s}^{-1}$. These values are in agreement with previous data measured by Etiope et al. (2002) in the Salinelle area near Paternò.