Geophysical Research Abstracts
Vol. 20, EGU2018-4676-1, 2018
EGU General Assembly 2018

Soils as natural filters for GHG: an imbalance between the expected CH_4 fluxes and the direct measurements

Walter D'Alessandro (1), Antonina Lisa Gagliano (1,2), Kyriaki Daskalopoulou (3,4), Konstantinos Kyriakopoulos (4), Marcello Tagliavia (2), and Paola Quatrini (5)

(1) Istituto Nazionale di Geofisica e Vulcanologia, sezione di Palermo, Palermo, Italy (w.dalessandro@pa.ingv.it), (2) Institute for Coastal Marine Environment, National Research Council, Torretta Granitola - Campobello di Mazara (TP), Italy, (3) DiSTeM, University of Palermo, Palermo, Italy, (4) Department of Geology and Geoenvironment, National and Kapodistrian University of Athens, Ilissia, Greece, (5) STEBICEF, University of Palermo, Palermo, Italy

The final composition of the atmosphere results from several processes and exchanges between all the Earth's spheres. Some of these are widely known and others, such as the methane degassing from hydrothermal areas, are still understudied. Methane plays a key role in climate change being an efficient greenhouse gas. Although it would be crucial, the total CH_4 output from geogenic sources is still not well defined; limitations in CH_4 output estimations are due to many factors concerning a scarce dataset availability, difficulty in direct measurements, and interaction with methane-consuming microbiota in the soil. Often, the CH_4 flux estimation was obtained indirectly, e.g. cross-correlating CO_2/CH_4 or H_2O/CH_4 values of the main gaseous manifestations with measured CO_2 or H_2O fluxes (Etiope et al., 2007). These methods are commonly used but, although acceptable in principle, may lead to strong over- or under-estimated values. This is particularly true when referred to hydrothermal systems like Nisyros Island (South Aegean Active Volcanic Arc, Greece) showing a wide range in the fumarolic CO_2/CH_4 ratios.
Nisyros' Island total CH_4 output has been previously estimated indirectly in 54 tons/year (Etiope et al., 2007). In 2013, a gas prospection was carried at Lakki Plain, the main exhalative area. Methane flux values were measured at 130 sites ranging from –3.4 to 1420 mg/m^2 day. Data were processed by sGs approach and the total flux was estimated in 1 ton/year. Soils were sampled at 10 sites with different T (27 to 70 °C), pH (1.4 to 3.7) and gas composition (e.g. H_2S from 0.3 to 3.6%). They were used for incubation experiments carried on an atmosphere enriched in methane. Consumption was detected in a range from 5 to 40 ng CH_4/gDW hour, with higher values in samples with milder environmental conditions (lower temperature and H_2S contents and higher pH).
The present study indicates that the previous estimate at Nisyros Island, made by cross-correlating CO_2 output data with the CO_2/CH_4 ratios of its gaseous manifestations, has been excessively large.
This result is not a surprise, over-estimation of the CH_4 output has been evidenced also for Pantelleria Island (Italy) and Sousaki (Greece). Also in these cases high methanotrophic activity in the soil has been confirmed, indicating a good efficiency of the soil to act as natural filter for GHG (D'Alessandro et al., 2009; 2011; Gagliano et al., 2014). Notwithstanding, the hydrothermal areas are a significant source of CH_4 but probably their contribution has been overestimated. Differences in the estimations derive from both disregarding methanotrophic activity within the soils and from an incorrect, and sometimes forced by the data availability, mean CO_2/CH_4 ratio of the fumarolic emissions used for the indirect estimation.
A lot has still to be done to assess the global hydrothermal CH_4 burden, but the importance of direct CH_4 flux measurements has to be underscored.

D'Alessandro et al., 2009, JVGR 187, 147–157
D'Alessandro et al., 2011, Geofluids 11, 97–107
Etiope et al., 2007, JVGR 165, 76–86
Gagliano et al, 2014, Biogeosciences 11, 5865–5875