Geophysical Research Abstracts, Vol. 9, 04572, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04572
© European Geosciences Union 2007

A study into the impact of a naturally-occurring CO_2 gas vent on the ecosystem of a Mediterranean pasture (Latera, Italy).

S.E. Beaubien (1), G. Ciotoli (1), P. Coombs (2), M.C. Dictor (3), C. Haveland (4), C. Joulian (3), M. Krüger (4), V. Laperche (3), S. Lombardi (1), J.M. Pearce (2), C. Scheib (2), R.A. Shaw (2), J.M. West (2)

(1) Dipt. di Scienze della Terra, Università di Roma "La Sapienza", Rome, Italy, (2) British Geological Survey, Keyworth, UK, (3) Bureau de Recherches Géologiques et Minières, Orleans, France, (4) Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover, Germany.

Recent research into CO_2 geological storage has shown that it has great potential to be a safe and effective way to rapidly decrease short-term anthropogenic CO_2 emissions. Despite this progress, however, it is critical that governments and the public at large are convinced of its safety and convinced that the scientific community has studied all possible scenarios, including the unlikely event of a leak into the biosphere and its eventual effect on the ecosystem.

To address this issue a preliminary geochemical and ecosystem study has been conducted by the EC-funded Network of Excellence "CO2GeoNet" on a naturally occurring CO_2 leak occurring within the Latera geothermal field (central Italy). CO_2, and some other trace gases, are produced at a depth of approximately 2000m below this extinct volcanic caldera via thermo-metamorphic reactions and then migrate along faults to the surface. Release of these gases to the atmosphere typically occurs from gas vents, which are points characterised by a relatively small core of elevated gas flux surrounded by an ever-decreasing zone of influence caused by lower vertical fluxes and the lateral diffusion of gas away from the vent centre. One such gas vent was chosen for the present study due to its well defined and isolated nature, its location within a naturally-vegetated field used for pasture, and the wide range of soil gas CO_2 concentrations and CO_2 flux rates across its width. This vent is clearly visible due to a 5m wide core of exposed soil surrounded by an approximately 40m wide elliptical

area of variably-impacted vegetation.

Surveys were conducted in late September 2005 and mid-June 2006 along a 1m wide, 50m long corridor starting from the southern side of the non-vegetated core and extending towards the north across the vent centre, various zones influenced by the vent, and finally into background conditions. This profile provided a detailed transect which crossed a complete spectrum of CO_2 flux rates, CO_2 soil gas concentrations, and soil gas compositions. Preliminary work involved detailed soil gas measurements at different depths (10, 20, 50 and 80 cm) in order to define the system, as well as CO_2 flux measurements in 2006. At the same time a botanical survey was conducted using a $0.5m^2$ quadrat, and this data was combined with the gas geochemistry results to choose 12 specific points along the profile for sampling with a hand auger. At each of the 12 points samples were collected from two depth intervals (10-30cm and 50-70cm) for microbiological, macrofaunal, pore water chemistry, mineralogical, and water content measurements.

The large number of samples collected and analysed, the two different seasons studied, and the complex, multi-disciplinary nature of the research has resulted in the creation of a unique database. A preliminary interpretation of this data has shown a clear correlation between the gas geochemistry and the distribution, characteristics and communities of various macro and micro fauna at the Latera gas vent test site. For example the botany surveys indicate that: i) the non-vegetated core corresponds with very elevated CO_2 flux and soil gas CO_2, H_2S and CH_4 concentrations; ii) grasses then dominate the transect from 6 to 20 m where CO_2 flux rates are moderate, CO_2 concentrations progressively decrease from 100% to 2%, and H_2S and CH_4 are essentially not present; and then iii) clover is dominate in the background area from 20 to 50m. Limited incubation measurements show that the background has methane production rates 4 times higher than those in the vent, the activity of aerobic methane oxidising bacteria show a negative response to high CO_2 concentrations, and sulphate reducing bacteria activity was highest in the interval where H_2S starts to disappear. Molecular CE-SSCP fingerprints of Bacteria along the CO_2 gradient revealed a population shift and a much greater diversity only when the CO_2 concentration decreased below 100%. Less complex fingerprints were also obtained for Archaeal populations, showing, as expected, that Archaea members were less represented that Bacteria ones; here a clear population shift was observed when the CO_2 concentrations decreased below 50%. As expected, soil pH decreases with increasing CO_2 content and especially in the zone of high H_2S concentrations within the central area of the vent. CaO concentrations decrease with increasing pH. Fe_2O_3 and Mn_3O_4 concentrations vary inversely with CO_2 concentration, and Mn_3O_4 has a very strong negative correlation with pH.