Carbon Dioxide and stable isotopologues measurement to support OSI subsurface gas sampling

CTBT: SCIENCE AND TECHNOLOGY 2017 CONFERENCE

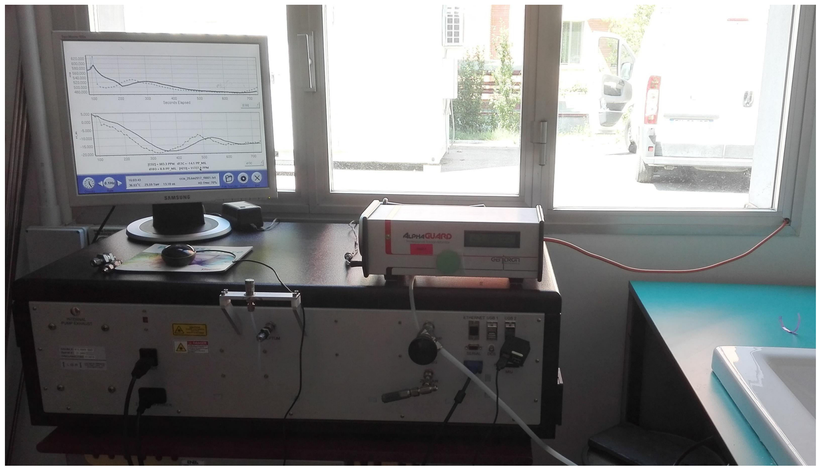
(T2.2-P08)

A. Rizzo, C. Telloli, C. Vaccaro°, P. Bartolomei, S. Salvi, R. Lorenzelli

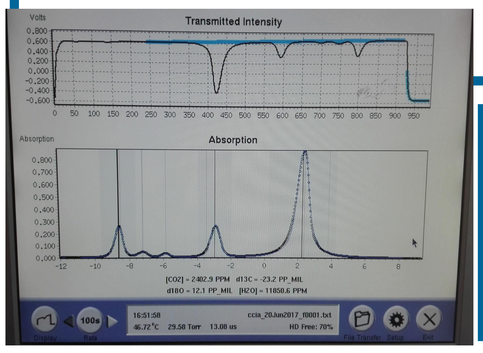
ENEA *- Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Bologna - ITALY*

*°**Univ. of Ferrara**, Ferrara - ITALY*

Sampling of subsurface soil gases represents one of the main On Site Inspection (OSI) activities for the verification of the Treaty. According to the scenario in which the OSI has been launched, the search logic framework could give to this activity an high priority. Generally, gas compositions are entirely different in air and deep-crust derived components and the usually higher concentration of helium, radon, methane and carbon dioxide in the subsurface gases drives the diffusion of these gases upward to the surface and the mixture with the air components; thus soil gas composition results from the mixing of these two components. In the OSI scenario the presence of buried structures and the production of high quantity of gases could influence the gas mixture migration and change its the final composition. Deep faults or fractures below the surface may provide pathways for the gases and carbon dioxide could act as carrier gas facilitating the migration upward from the deep crust or mantle.



We have designed and started to implement a new methodology to analyze $\delta^{13}C$ on site using a Carbon Dioxide Isotope Analyzer (CCIA) CRDS laser spectrometer, which allows to measure $\delta^{13}C$, $\delta^{18}O$, total CO_2 and H_2O in real time with high precision and accuracy and speed of measurement up to 1 hertz and it's transportable. It is based on the Off-Axis Integrated Cavity Output Spectroscopy (Off-Axis ICOS) as absorption cell, which traps the laser photons so that thousands of steps are carried out before leaving the cell.



CCIA was connect to Alphaguard, which collected soil gas by a probe pushing down in the ground at a depth of 50 cm. Thus it was possible to determine the radon content in the soil simultaneously to the CO_2 and $\delta^{13}C$.

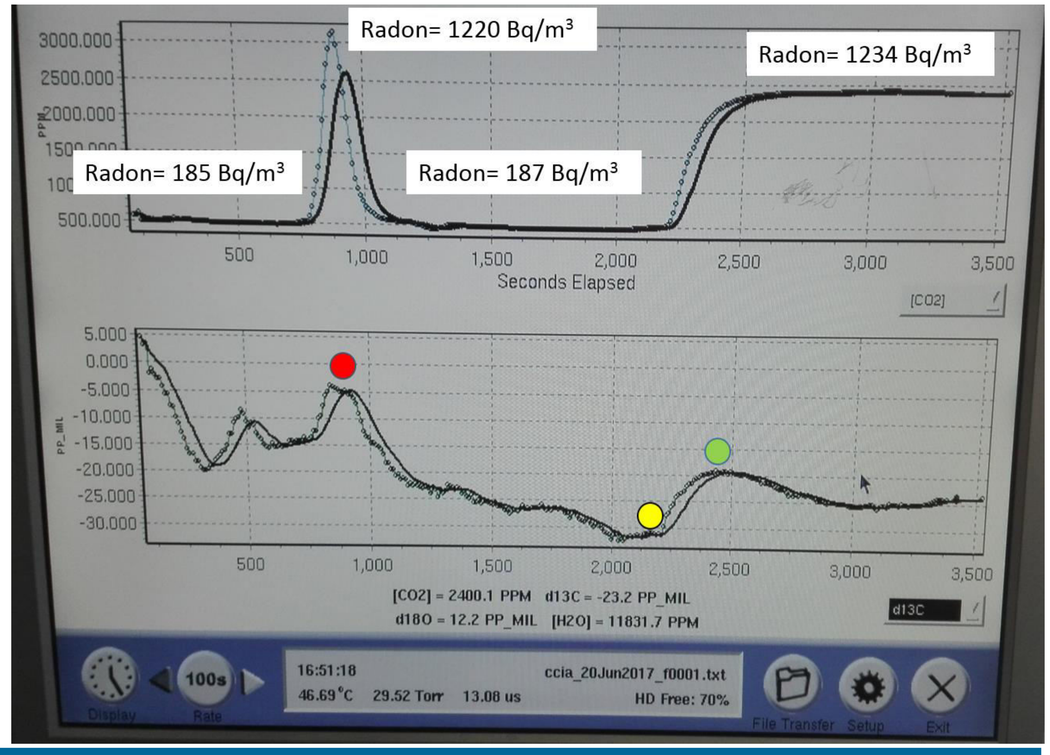
The d13C measurements combined with those of radon can confirm that sampling was done directly from the subsurface.

d13C graph

Red point ● represents the time of connection to the probe;

Yellow point ● disconnection;

Green point ● connection to the probe and d13C soil measure



Same trend

Data of radon concentration, on the white box in the graph, actually represent the different phases of the sampling and are in perfect agreement with the CO_2 and $\delta^{13}C$ data. The measurement of stable isotopologues of C during the subsurface gas sampling may be considered an auxiliary tool for the quality control of the sampling.

This work is carried out within the activities of the ENEA-CTBT team supporting the Italian National Authority for the Radionuclide NDC.