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Continuous monitoring of the C isotope composition of CO_2-rich subsurface degassing at Tenerife, Canary Islands

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Tenerife is the largest island of the Canarian archipelago and several volcanic eruptions have occurred in the last 500 years, the last one in 1909. The main volcano-tectonic features of Tenerife Island are three main volcano-tectonic rifts trending N-E, N-W and N-S where, at the interception center is located Las Cañadas caldera and the stratovolcano Teide-Pico Viejo. Due to the approximately 1,500 wells and water galleries (1650 km) drilled during the last 150 years tapping the island's volcanic aquifer at different depths, Tenerife is a unique natural-scale laboratory for hydrological studies in oceanic volcanic islands. Ground waters are mainly Na^{+}-HCO_3^{-} water type, mainly due to the continuous volcanic CO_2 supply from the volcanic-hydrothermal system. A signi?cant number of these galleries show a CO_2-rich inner atmosphere, and gas bubbling has also been detected inside some galleries. Since 2002, an automatic geochemical station installed at the entrance of the horizontal drilling "Fuente del Valle" (TFE02 station), Arona, Tenerife, measures the activities of ^{222}Rn and ^{220}Rn in the gas discharged from a CO_2-rich gas bubbling spot located at 2.850 m depth. Interesting variations were recorded in the ^{222}Rn/^{220}Rn ratio after the period of 2004 anomalous seismicity and it has been demonstrated that this is a good control spot for volcanic surveillance (Pérez et al., 2007). Thus, in November 2016, a new type of laser based isotopic analyzer, a DeltaRayTM (Thermo Fisher Scientific) was installed in the TFE02 station to measure $\delta^{13}C(CO_2)$ directly in the gas discharged from the water. The gas, collected by means of an inverted funnel, is pumped (3 L min^{-1}) towards the gallery entrance, where the instrumentation is located, through a polyamide pipe. During the study period the recorded data show a range of $\delta^{13}C(CO_2)$ from -6.2 to -4.2‰ vs. VPDB, with an average value of -5.1‰.These values are comparable to those ones measured in the gas sampled directly at the gas bubbling spot ($\sim$-4.7‰ unpublished data) and analyzed with a Thermo Finnigan MAT 253 isotope ratio mass spectrometer, which supports the validity of the analytical method used. This is the first time that this type of instrumentation is used to continuously monitor the $\delta^{13}C(CO_2)$ isotopic composition of the gas discharged from a gas bubbling in a horizontal drill as a geochemical tool to evaluate the volcanic activity, in particular in Tenerife, a unique natural-scale laboratory for hydrological studies in oceanic volcanic islands. To correlate temporal variations in the $\delta^{13}C(CO_2)$ isotopic composition with changes in the seismic-volcanic activity of Tenerife, a longer observation period will be required.

References:

Pérez et al., 2007. Pure Appl. Geophys. DOI 10.1007/s00024-007-0280