

## **Soil CO<sub>2</sub> degassing path along volcano-tectonic structures in the Pico-Faial-São Jorge islands (Azores archipelago)**

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The Azores archipelago (Portugal) is composed by nine volcanic islands located in the triple junction of the North American, Eurasian and Nubian plates. Nowadays the volcanic activity in the archipelago is characterized by low magnitude seismicity and the presence of secondary manifestations of volcanism, such as hydrothermal fumaroles, thermal and cold CO<sub>2</sub>-rich springs as well as soil diffuse degassing areas. Soil CO<sub>2</sub> degassing (concentration and flux) surveys were performed at Pico, Faial and São Jorge islands to identify possible diffuse degassing structures (DDS). Since the settlement of the Azores, in the 15th Century, these three islands were affected by seven onshore volcanic eruptions and at least six destructive earthquakes. These islands are crossed by various tectonic structures with main WNW-ESE direction, and conjugate NNW-SSE trending faults.

A total of 2855 soil CO<sub>2</sub> concentration measurements were carried out and values varied from 0 to 20.7 vol.%. Soil CO<sub>2</sub> flux measurements, based on the accumulation chamber method, were also performed at Pico and Faial islands in the summer of 2011 and values varied from absence of CO<sub>2</sub> to 339 g m<sup>-2</sup> d<sup>-1</sup>. The highest CO<sub>2</sub> emissions were recorded at Faial Island and were associated to the Pedro Miguel graben faults, which seem to delimit the CO<sub>2</sub> diffuse degassing and were interpreted as the pathways for the CO<sub>2</sub> ascending from deep reservoirs to the surface. At São Jorge Island, three main degassing zones are identified in the intersection of different faults or associated with hidden WNW-ESE tectonic structures. The highest CO<sub>2</sub> concentrations measured at Pico Island were also associated to a WNW-ESE trending graben structure (Lagoa do Capitão). The final diffuse degassing maps showed not only that anomalous CO<sub>2</sub> degassing correlates with the main tectonic structures recognized for these islands, but also that areas associated to the youngest volcanic systems are characterized by very low CO<sub>2</sub> emissions.

Pico Island geomorphology is dominated by a 2351 m height central volcano that has several steam emissions in its top. In this area the highest soil CO<sub>2</sub> concentration measured was 7.6 vol.% and maximum temperature was 77 °C. Gas composition of the Pico fumarolic area, sampled during June 2016, shows water vapor as the main gas released (~0.49 for the ratio dry gases/H<sub>2</sub>O) together with the presence of N<sub>2</sub>, CO<sub>2</sub>, O<sub>2</sub> and Ar. Considering the importance of the tectonic control on the plumbing systems of the Azorean volcanoes, and the correlation between the degassing areas and the tectonic structures, results here presented are important to characterize the CO<sub>2</sub> emission in quiescent periods of activity and consequently to identify future periods of volcanic unrest.