



## Endogenous gas hazard at Pizzillo (Stromboli Island, Italy)

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In open-conduit volcanoes like Stromboli or Etna, the major degassing is associated to the plume emission from the craters. However the presence of faults and fractures acts as preferential pathway for gas escaping to the surface, thus there is also a relevant CO<sub>2</sub> diffuse degassing from the soil from most of the edifice. In the inhabited areas on these volcanoes, natural gases can accumulate in houses generating potential hazards. Pizzillo is one of the anomalous degassing zone located near the sea shore, in the inhabited area of Stromboli. It is well known to local people for the presence of a mofette lethal to small animals and of a shallow thermal aquifer (T= 35-42 °C). It has a high dissolved CO<sub>2</sub> content and is mostly fed by sea water and heated by gas rising from depth. High CO<sub>2</sub> concentration has been found in the soil (17 % and 40 %, at 50 and 100 cm depth). Chemical and isotopic data of soil gas indicate a deep magmatic provenance. Interesting anomalies of CO<sub>2</sub> and other dissolved gases, including C and He isotopes, have been recorded in this thermal shallow aquifer before the 2002 eruption onset and the 5 April 2003 paroxysm, suggesting an increasing input of gas released from an uprising magma body. The presence in this coastal zone of NE-SW trending fractures is confirmed also by the results of a shallow electromagnetic survey carried out in 2004 using a multifrequency (625 to 19,925 Hz) GEM 300 with investigation depth of 30 to 50 m depending on ground resistivity. Most of the CO<sub>2</sub> emission of Pizzillo occurs along a N64E° trending fracture extending uphill toward Rina Grande, and along which a series of flank collapses occurred. The CO<sub>2</sub> soil flux map, carried out over 3200 m<sup>2</sup>, delineates two anomalies oriented NE-SW on both sides of a house, that is severely exposed to gas hazard. This house, where people mostly live during summer, is located just in the middle of the most CO<sub>2</sub> soil emissive zone. It has a window very near to the rock cut from where most CO<sub>2</sub> is emitted. As such a location is severely exposed to gas hazard, indoor CO<sub>2</sub> air concentration was repeatedly measured within a ground room where the gas, denser than air, could accumulate up to reach dangerous levels. An automatic Dräger X-am 7000 devise, which records CO<sub>2</sub> concentration every minute, was used; it was placed at 10 cm from the ground. The first measures, carried out from 29 July to 2 August 2006, gave very dangerous concentration values up to 8 vol.% that were always recorded in periods of no or very low wind. A longer survey was carried out from 7 March to 15 May 2007, during and after the last Stromboli eruption, with some interruptions due to power cuts. Results confirm the high gas hazard of this house, as immediately lethal CO<sub>2</sub> air concentration (10 %) is often reached or exceeded. In order to ascertain from where the gas was coming, a second Dräger was placed on the windowsill at 2 m from the ground. Results clearly show that CO<sub>2</sub> was mostly entering the room from this window, as very high concentrations were found with peaks shortly preceding those recorded near the ground. This prevented to recommend room aeration, which is the most elementary precautionary measure in these cases. We suggested the owner to wall up that window and impermeabilise the floor. During five days of measurements, carried out in January 2008 after the completion of these works, [CO<sub>2</sub>] was mostly at its normal air value.