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Local permeability changes, passive degassing and related gas hazard at the Baia di Levante area (Vulcano island, Italy)

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Vulcano, the southernmost island of the Aeolian archipelago (Italy), is presently characterized by active fumarolic fields located along the rim of La Fossa cone and the shoreline of the Baia di Levante beach, in the northern portion of the island.The Baia di Levante fumarolic vents are fed by a shallow hydrothermal aquifer heated by magmatic gases rising from the deep down, with a spatial distribution strongly affected by the local fracture network. These fractures are the expression of a deformation field, dominated by a northward motion to Lipari, abruptly decaying to the Vulcanello peninsula, immediately northward of the Baia di Levante beach.
Variable rates of fluid transfer to the surface, following permeability changes affecting the fracture network are among the results of stress field variations over time which induce fluctuations in the pressure state of the hydrothermal system. Under these conditions, increments in hydrothermal gas flow, able to cause an increase of gas hazard, could be determined by a rearrangement of the shallow permeability distribution induced by changes in the deformation field. In this case not associated to any variation in the volcanic activity state.
Since 2009 an huge gas flow increment has been noticed in some undersea vents of the Baia di Levante area, leading to increase of gas hazard in their immediate surroundings. On the contrary, the acquired data from the INGV volcanic surveillance program didn't suggest any correlated increase of the magmatic fluid component in the degassing activity.In July 2015, we carried out multi-parametric geochemical surveys in this area, based on direct (thermocouple) and indirect (thermal infrared camera and pyrometer) soil temperature, soil CO_2 flux, atmospheric concentration of CO_2 and H2S measurements at low elevation (one meter a.s.l.). The chemical and isotopic composition of low temperature fumarole gases was determined too.The comparison of the new data with previous surveys carried out in the same area, and the general information from the INGV monitoring programme exclude a possible renewal of volcanic activity as the source for the observed anomalies.The most reliable cause for the observed localized gas flow anomalies should therefore be referred to a rearrangement of the local shallow permeability field driven by geodynamic stress variations. The differential subsidence rate acting in the Baia di Levante area, as resulting from the geodetic data from literature, could be accounted as the engine able to close and open fractures, modifying the permeability distribution and, finally, conveying major amount of gases in restricted areas where an increased gas hazard is observed.