The $^{220}Rn/^{222}Rn$ ratio to characterize the post-earthquake near-surface crustal deformation within the framework of probabilistic plant risk assessment

VOLTATTORNI[1*] N., GASPARINI[1] A., CINTI[1] D., PROCESI[1] M., GALLI[1] G.

[1]Istituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata 605, Rome, Italy (*correspondence: nunzia.voltattorni@ingv.it, andrea.gasparini@ingv.it,daniele.cinti@ingv.it, monia.procesi@ingv.it, gianfranco.galli@ingv.it)

Earthquake-induced permanent ground deformation can significantly impact the safety of industrial plants. In particular, the frequency of occurrence of secondary faults, especially far from the primary structures, should be considered in order to not underestimate the true distribution of faulting after a major earthquake. During April 2009, a Mw 6.3 earthquake occurred in the Abruzzo region (Central Italy), close to the city of L'Aquila. Soon after the main shock, a soil gas survey was carried out performing ^{222}Rn and ^{220}Rn, soil and flux gas measurements. Results highlighted the spatial influence of active tectonic on gas migration toward the surface. Anomalous soil gas values were found at major faults and even where there were no faults known in literature. During summer 2015, the soil gas survey was repeated in order to both assess the natural degassing in absence of seismic events and quantify the spatial domain of tectonic discontinuities inferred during the previous campaign. The comparison of results from the two surveys highlights that soil permeability strictly depends on seismic stress variations. The changes in the $^{220}Rn/^{222}Rn$ ratio observed during the two surveys suggest a higher gas flow rate induced by the changes in the vertical permeability of soil and, presumably, in the structural assessment. This would indicate that the crustal deformation fields that result from large earthquake may cause post-seismic fault displacement especially on secondary tectonic structures contributing significantly to the seismic hazard of probabilistic nuclear, geothermal, CO_2 storage or, in wider terms, industrial plants.