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Identification of active and capable faults (FAC) using geochemical (^{222}Rn, ^{220}Rn and CO_2) and geophysical (ERT) investigations: case study of the Rieti Basin (Lazio Region, Italy).

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The "Active and Capable Faults" are tectonic structures with a significant potential for displacement at or near the Earth's surface and/or that have been active in the last 40K years in an area which occurred eartquakes larger than 5.5. Knowing the most likely position of the FACs can help reduce the impact of future eartquakes on existing buildings/infrastructures and, consequently, perform a Risk Mitigation in areas with high seismogenic potential. In order to study and detect FACs, a multidisciplinary approach integrating structural geology, geophysics and geochemestry was applied in one of the most active sector of the Apennines, the Rieti Basin (Central Italy).

The strategy used was based on a series of profiles performed along the edges of the sedimentary basin, to identify the position of the fault systems by indirect and direct investigations. ^{222}Rn, ^{220}Rn and CO_2 concentrations and Electrical Resistivity Tomography (ERT) profiles were performed to investigate the soil gas spatial distribution, their migration mechanisms and to mark off permeability belts possibly corresponding to buried faults; then paleoseismological trenches were built to define the stratigraphic sequences, to take and date undisturbed rock samples.

234 measurements were performed along several profiles, highlighted average values of 49 kBq/m^3 of ^{220}Rn and 26 kBq/m^3 of ^{222}Rn. The highest values are located close to the fault planes, highlighted by ERT surveys, and overlap with other gas anomalous values, highlighting prevalent advective gas migration, where CO_2 acts as a carrier gas for radon along preferential leakage pathways. Obtained results show a good correlation between geophysical and geochemical data, shedding light on the fluid circulation in inter-seismic period. The soil gas technique has demonstrated useful in a geological environment characterized by sediment-rich alluvial plains. Particularly, ^{222}Rn measurements, often associated with other gases, have proved to be a low-cost and quickly method for detecting buried fault systems. So, it is possible to greatly reduce the area to be investigated directly with the trenches.

Finally, the realization of the trenches and the paleoseismological analysis made it possible to distinguish with good precision the real active and capable faults (Certain Faults).