The project FLUIDS: Detection and tracking of crustal fluids by multi-parametric methodologies and technologies

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Fluids permeate and diffuse within the shallow crust being as originated by internal or external natural sources or by industrial activities for modern energy exploitation and production.

Fluid-induced stress changes can reactivate faults and cause earthquakes. In volcanic environments fluids play a key role in controlling the evolution of magmatic processes and eruption. The reliable imaging of fluid storages and accurate tracking of their movements is therefore critical in evaluating the nature and likelihood of future natural/induced earthquake or volcanic activity and their relative hazard monitoring and assessment.

The project FLUID has been recently approved by the Italian Ministry for Research and has the ambitious goal to build up and experiment the next generation of deep (crust and mantle-derived) fluid monitoring systems aimed at their timely detection and space-time tracking. This objective is achieved by developing and applying an integrated, multi-parametric and multi-disciplinary approach for mapping and tracking fluid movements in volcanic, tectonic and industrial exploitation, sub-surface, geological environments. Innovative methodologies and technologies will be developed to reconstruct the 4D (space and time) variations of rock properties in the fluid-filled porous medium and to detect and characterize fluid-triggered natural effects as well as the induced micro-seismicity, electric crustal properties changes, earth surface ground deformation and geochemical signatures of fluid presence and diffusion.

The project will develop activities and scientific products in the following research directions:

- **Multi-parametric data acquisition and management** aimed at data acquisition, integration and sharing/publishing for scientific and public information purposes;
- **4D multi-parametric crustal imaging** aimed at setting up and testing different geophysical/geological methodologies to image the underground in space and time, and at
comparing the obtained images for an effective and reliable tracking of fluids;

- **Induced phenomena and/or triggered effects by fluid diffusion** aimed at investigating fluid properties and movements, developing new methods & technologies for their detection and tracking through their triggered effects and finding their correlation with geophysical observables;

- **Characterization and modeling of fluids migration at test-sites from regional to the local scale**: through the application of the developed multi-parametric and multi-disciplinary approaches to different test-sites in volcanic, tectonic and industrial exploitation geological environments in Italy.

Results of this project are expected to have a broad scientific-technological impact through the development and application of new, integrated multi-parametric methods & technologies for fluid detection and space-time tracking. As for its socio-economic impact, the project will deliver “best practice” recommendations for managing fluid-induced seismicity for a sustainable and safe exploitation of all the energy resources that involve injection/withdrawal of fluid into/from the subsoil. Forecasts of induced seismicity using multi-parametric observed systems of induced seismicity represent the planning and decision-making tools for mitigating the associated risk for population living nearby industrial sites but also active hazardous tectonic and volcanic regions.