1. Research activity

The principal aim of my PhD research is the improvement of fluids paleo-circulation models known in literature with an innovative approach, focused to assess the stratigraphic-lithological control on fluid flow. For this research, the proposed area are the Val d'Agri fault systems (south Apennines, Italy) where present-day fluid circulation is not well constrained and several socio-economic problems are still unsolved due to hydrocarbon extractions. The oil productive wells are concentrated only in the Apulian platform carbonates at the NE side of the valley while no hydrocarbon reservoirs occur in the same carbonates at the SW side of the valley. Probably, this is due to the different thickness of Irpinia mélange, that is the seal rocks of the reservoir. The starting hypothesis of my research is that at the SW side of the valley the seal rocks thickness is thin and so the throw of the extensional faults of the Monti della Maddalena fault system can interrupt the continuity of the seal and unblind the reservoir. Contrary, along the NE side of the valley the seal rocks thickness is thicker and so the extensional faults of the Easter Agri fault system detach in the Irpinia mélange. Through my research activities I expect to validate or reject this starting hypothesis.
My research is organized with a multidisciplinary approach. Through field work, and laboratory analysis, I will build at the end of three years of my PhD a regional model of paleo-circulation of fluids along the extensional Val d'Agri fault systems. In detail, I will proceed with following steps:

a) Preliminary analysis (1st year of PhD program)
   Regional geological study through bibliography, published maps, aerial/satellite images, and preliminary scouting work to assess as a first approximation the geometry of faults and identify the areas of greatest interest.
b) Meso-structural analysis (1st and 2nd years of PhD program)
   Through field work I will assess in detail faults geometry, kinematics, linkage, and density and connectivity of fractures for the areas of greatest interest identified in the previous step. I will realize geological-structural maps and

geological cross sections. Moreover, I will sample calcite mineralizations observed along tectonic structures for lab analysis.

c) Micro-structural analysis (1^{st} and 2^{nd} years of PhD program)
Through optical and cathodoluminescence microscopy I will analyze the sampled mineralizations to observe crystals geometry, their compositional variation, syn-tectonic micro-structures and so understand the relationship between mineralizations and seismic cycle phases.

d) Geochemical analysis (2^{nd} and 3^{rd} years of PhD program)
Over the sampled mineralizations coupled isotopic analysis of C, O and He (where possible) and clumped isotopes will be performed to assess the origin of primitive fluids through obtained temperatures. In addition, U-Pb and U-Th radiometric analysis will be performed to date the tectonic structures which interacted with fluids.

If the starting hypothesis for Val d'Agri faults system is validated, I expect a high temperature and a consequent deep origin for primitive fluids of the mineralizations along the Monti della Maddalena fault system while a low temperature and a consequent shallow origin for primitive fluids of the mineralizations along the Easter Agri fault system.

General goal of my PhD is the comparison of paleo-circulation model with present-day fluid flow to better understand relationship between fluids and extensional seismic events.

Recent scientific literature focused on the relationship between fluids and earthquakes. Understanding correctly fluid circulation along faults systems is fundamental to assess the seismic hazard, with particular regard to potential fault reactivations through fluid overpressures. This is even more important in oil productive field where induced seismicity is a potential threat, like in the Val d'Agri. Moreover, models of fluid paleo-circulation have other significant socio-economic applications, specifically for: a) hydrocarbon exploration and CO_2 storage; b) analysis of possible future migration of contaminating fluids; c) the use of geochemical variations in fluids during a seismic cycle such as potential seismic precursors.

2. Research products

a) Publications (ISI journals)
b) Publications (NON ISI journals)
c) Manuscripts (submitted, in press)
d) Abstracts