



PhD in INGEGNERIA AMBIENTALE E DELLE INFRASTRUTTURE / ENVIRONMENTAL AND INFRASTRUCTURE ENGINEERING - 39th cycle

Research Area n. 3 - Environmental and Hydraulic Engineering and Geomatics

**PNRR 118 PNRR Research Field: MULTISCALE CHARACTERIZATION OF INTERACTIONS
BETWEEN FLUIDS AND NATURAL POROUS MEDIA**

Monthly net income of PhDscholarship (max 36 months)

€ 1300.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

**Motivation and objectives of the research
in this field**

In recent years, climate change is altering surface and subsurface water balance and fluxes and, ultimately, our design and functioning of water stewardship initiatives. Fresh water is a vital component for humans and ecosystems. Its lack (e.g., during periods of droughts) or extreme local abundance (during flooding events) has created dramatically critical economic, social, and environmental issues. The National Recovery and Resilience Plan (PNRR; Mission 2) highlights the key role of water resources for the full ecosystem functioning. Groundwater (GW) is the receptor of more than 30% of fresh water in the world. By its nature, it is our water lung, potentially mitigating the rapid fluctuations recorded in the surface environment and enabling adaptation to the continuous and rapid variations related to climate change in an globally evolving world. At the same time, subsurface systems are still largely unexplored, and their characteristics (such as, e.g., porosity, permeability, and storage capacity) undergo spatial and temporal evolution that are still not completely characterized. The research focuses on the investigation of the evolution of subsurface properties due to bio-geochemical processes. This study is motivated by the critical importance of providing accurate assessments of the



	<p>importance of providing accurate assessments of the kinetics of reactive phenomena occurring at the fluid/solid interface. These elements are vital for a large set of engineering and environmental scenarios, including chemical weathering of rocks, geologic carbon sequestration and geogenic origin of carbon dioxide, nuclear waste disposal, or contamination of subsurface water bodies and soils.</p> <p>This research will contribute to PNRR Mission M2C4 (Protection of Land and Water Resources) providing technical and scientific expertise in (i) analyzing the temporal evolution of subsurface hydraulic properties influenced by natural and anthropogenic activities; (ii) providing a robust stochastic characterization of the behavior of bio-geochemical rates and their spatial increments; and (iii) identifying an appropriate interpretive model (or a set of viable models).</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The team involved in the project (see below) offers a broad expertise on surface-subsurface flow/transport modeling, uncertainty quantification, and probabilistic risk assessment.</p> <p>The present PhD project aims at developing new experimental/conceptual and computational method and tools to analyze the temporal and spatial evolution of subsurface properties. The experimental part of the research will be conducted at the SOLINANO (Solid-Liquid interface nanomicroscopy and spectroscopy) lab. The latter is an interdepartmental research laboratory focused on investigations of surface and interface electrochemistry, dissolution processes, rock transformation detected at the micro- and nano-scales and contamination of toxic organisms. SOLINANO is equipped with a comprehensive set of nano- and micro-instrumentation, including Atomic Force Microscopy (AFM) that allow the acquisition of rock dynamic changes in the controlled laboratory space. To analyze the multiscale nature of the phenomena, it is also envisioned to develop and analyze microfluidics experiments. All of the experimental results will then be subject to interpretation based on the set of theoretical tools</p>



	developed during the project.
Educational objectives	The main objective is to educate professionals and scientists who can design and develop autonomous research plans and activities with critical expertise in environmental and hydraulic engineering. The PhD will be empowered through critical expertise to effectively address challenges related to quantification of water systems behavior, their management and protection.
Job opportunities	This PhD path offers the possibility to continue a career in research as a postdoctoral researcher or research scientist in academia, research institutes, or private companies specializing in the development of innovative techniques on water management and protection. Main opportunities in the job market encompass top level management in Authorities involved in environmental policy, senior consultancy roles in engineering firms and in R&D departments within various industries.
Composition of the research group	2 Full Professors 2 Associated Professors 4 Assistant Professors 8 PhD Students
Name of the research directors	Monica Riva, Alberto Guadagnini

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	650.0 €
By number of months	6

National Operational Program for Research and Innovation



Company where the candidate will attend the stage (name and brief description)	--
By number of months at the company	0
Institution or company where the candidate will spend the period abroad (name and brief description)	To be defined during the project development. Possible candidates: University of Southern California, USC, USA; Université de Strasbourg, France; Université de Lausanne, Switzerland; Universitat Bremen, Germany
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

The PhD candidate will work at the Department of Civil and Environmental Engineering and attend the PhD Courses and all the educational activities of the PhD Program in Environmental and Infrastructure Engineering.

Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): approximately 1760,00 euros per PhD candidate per year, on average.

Teaching assistantship (availability of funding in recognition of support to teaching activities by the PhD student): there are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability and desk availability: individual assignment for the entire career. The PhD will have access to CFDHub (www.cfdhub.polimi.it), an Interdepartmental laboratory at PoliMi, with a state-of-the-art infrastructure and scientific computing system.