



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

Research Area n. 2 - Transport Infrastructures and Geosciences

PNRR 117 Research Field: ISOTOPE ANALYSIS AND MODELING FOR ENVIRONMENTAL
APPLICATIONS

Monthly net income of PhDscholarship (max 36 months)

€ 1195.5

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**

After more than 20 years since the first national law covering the procedures for remediation of contaminated sites, site owners and public authorities are still struggling to reach the concentration limits of contaminants in soil and water (PNRR M2C04). The main objective of the proposed PhD is to develop isotopes tools, such the innovative Compound-Specific Isotope Analysis (CSIA), for contaminated site characterization and remediation, particularly to demonstrate and quantify contaminants biodegradation removal processes. Contaminated site characterization and remediation has become a priority issue for health and safety reasons and for allowing a more rapid and efficient recovery of areas to be returned to the community. The high number of contaminated site along with the needs of more sustainable and low carbon remediations, make emerging biodegradation strategies like Monitored Natural Attenuation (MNA) and Enhanced Attenuation (EA) very attractive in this perspective. To this day, CSIA is the only analysis able to provide unequivocal documentation that biodegradation processes actually remove the contaminant; hence the primary importance of using CSIA for MNA and EA applications. Moreover, the CSIA will be combined with reactive transport modeling to create an innovative and integrated



	<p>transport modeling to create an innovative and integrated toolbox for MNA and EA performances and time-frame remediations provisions. The tools developed during this PhD will booster the use of MNA and EA applications by increasing the level of confidence and hence the acceptance of these emerging remediation techniques by the Environmental Authorities.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>A key part of the PhD program is represented by the development of innovative analytical techniques for isotope analysis. New instrumentations approaches will be investigated, such for example quadrupoles and multicollector mass spectroscopy. Laboratory experiments will be carried out in order to derive specific parameters (such for examples isotope enrichment factors) for further isotope analysis applications and modeling. Isotope reactive transport modeling tools will be developed by combining several existing software together (such for example MODFLOW-USG for flow conditions and PHREEQC for geochemical reactions). Finally Testing and applications of such techniques will be carried out at different contaminated sites already under investigation within existing projects carried out by the research group funded by Regional (Regione Lombardia) and International programs (EU-Interreg program).</p>
<p>Educational objectives</p>	<p>The PhD program will offer advanced training in development of analytical aspects of isotope analysis by the collaboration with worldwide recognized isotope facilities led by researches who developed CSIA methods such CI and H-CSIA. A unique training in reactive groundwater transport modeling including isotope data will be made available to the PhD student by the research group. The possibility of using the developed toolbox in numerous case studies already under investigation by the research group will ensure a mature degree of knowledges of isotope and modeling tools by the PhD students by the end of the study period.</p>
<p>Job opportunities</p>	<p>The unique experience and skills developed through this PhD program will ensure great career opportunities as chemist analysts in isotope or more in general</p>



	environmental labs, senior consultants for engineering companies, or as researcher in universities/research centers, and R&D departments as well as technician, manager or director in Environmental Authorities.
Composition of the research group	0 Full Professors 1 Associated Professors 4 Assistant Professors 1 PhD Students
Name of the research directors	Matteo Antelmi

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	597.75 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Isotope Tracer Technologies Europe Srl (Located in Milano) - http://it2europe.com/enter/
By number of months at the company	18
Institution or company where the candidate will spend the period abroad (name and brief description)	Isotope Tracer Technologies Inc (Located in Waterloo, Canada) - https://www.it2isotopes.com/
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p><u>Educational activities</u> (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): approximately 1630,00 euros per PhD candidate per year, on average.</p> <p><u>Teaching assistantship</u> (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.</p>



Computer availability and desk availability: individual assignment for the entire career.