Utilization of Isotopes and Noble Gases in Hydrological and Geothermal Investigations

Instructors: Orfan Shouakar-Stash and Daniele L. Pinti

Course Objectives: This course is not just about theoretical understanding, but also about equipping you with practical proficiency in applying environmental isotopic techniques, including Compound-Specific Isotope Analysis (CSIA) and noble gases. It's designed to help you stay at the forefront of the latest advancements in characterizing crustal fluids, from shallow aquifers to high-enthalpy fluids, and the fate of contaminant loads. Whether you're an environmental professional, government scientist, regulator, consultant, researcher, student, or community stakeholder, this course is for you if you're engaged in managing and remedying contaminated sites or exploiting fluids for sustainable energy sources like geothermal resources. By the end of the course, you'll have the tools and knowledge to apply these techniques proficiently, making tangible contributions to your work in contaminated site management and sustainable energy utilization.

Course Overview: Positioned at the vanguard of environmental science, this course centers on contemporary developments in groundwater quality assessment. It aims to explore contaminants' origins and behavior within subsurface geochemical environments. Ecological isotopes, particularly CSIA, represent cutting-edge methodologies in contaminant studies. The curriculum encompasses foundational theory, supplemented by various field case studies. Topics encompass the utilization of environmental isotopes such as ^{13}C, ^{2}H, ^{18}O, $^{87}Sr/^{86}Sr$, ^{37}Cl, ^{81}Br, and ^{3}H to delineate contaminant origins and attenuation mechanisms within aquifers. Discussion extends to groundwater pollution from diverse sources, including LNAPLs, DNAPLs, and urban activities. Additionally, the course surveys recent advancements in ^{13}C-CSIA, ^{37}Cl-CSIA, ^{81}Br-CSIA, and ^{2}H-CSIA, elucidating their potential applications in contaminated site characterization. Furthermore, the course addresses the role of groundwater as a renewable energy source, particularly in hydroelectricity and geothermal energy production. Topics include source tracing and residence time determination, which are crucial for evaluating resource sustainability. While short-lived nuclides like ^{3}H and ^{14}C are well-suited for assessing young groundwater ages, geological fluids pertinent to geothermal energy often surpass the applicability of these methods, necessitating the utilization of alternative isotopic systems such as noble gases, actinides, or radiogenic isotopes. The course integrates theoretical discourse with global case studies to illustrate how these isotopes can refine understanding regarding the sources and ages of fluids implicated in energy resource utilization.

Daniele L. Pinti is a noble gas isotope geochemist, director of Geotop – one of the largest geoscience-oriented research centers in Canada – and full professor at the Earth and atmospheric sciences department of the Université du Québec à Montréal. In 1989, he obtained his MSc degree in Geology at the University of Rome, Italy, working on soil gases at Latera geothermal field, Central Italy. After a brief interval in the industry, he moved in 1991 at Université de Paris VI for a PhD in noble gas geochemistry applied to oil resources. In 1996, he joined the Earth and Planetary Science group at Osaka University, Japan, for a post-doctorate in Archean Geology, developing nitrogen isotopes as isotopic biomarkers with studies in Australia, Greenland, and South Africa. From 1999 to 2004, he was an assistant professor at the Université de Paris SUD, working on K-Ar dating. In 2004, he joined the UQAM, where he built a noble gas laboratory, with activities spanning from groundwater dating to geothermal resources. Since 2014, he is actively working on geothermal resources with projects in Mexico, Chile, Argentina, Iceland, La Reunion, Hawaii and Japan. He authored more than 110 scientific papers.

Dr. Orfan Shouakar-Stash
Director and CEO

Isotope Tracer Technologies Inc.
608 Weber St. N., Unit # 3
Waterloo, Ontario
Canada N2V 1K4

Cell: +1-519-590-7817
Tel.: +1-519-886-5555
Fax: +1-519-886-5575

Email: orfan@it2isotopes.com
Email: orfan@uwaterloo.ca

Dr. Shouakar-Stash is an Isotope Hydrogeochemist with 25 years of experience. He is the CEO of Isotope Tracer Technologies Inc. (IT^2); Dr. Shouakar-Stash is an Adjunct Professor at the School of Engineering at the University of Guelph. He is also an Adjunct Professor at the Department of Earth and Environmental Sciences, University of Waterloo. Dr. Shouakar-Stash's research interest relates to developing and implementing isotopic tools in organic and inorganic contaminant investigations, water resources, and water quality studies. He produced numerous isotopic technical methodologies and initiated and participated in many international and domestic collaboration research projects with researchers from various institutions across the globe. He authored and co-authored many scientific papers in international journals and delivered more than 75 presentations at international conferences, some of which were invited talks. He trained and supervised undergraduate and graduate students (M.Sc. and Ph.D. students), visiting scientists, and technical personnel. He has served as a peer reviewer in several international journals. He is an active member of several scientific associations and currently serves as the secretary of the International Association of Geochemistry and Cosmochemistry (IAGC). Dr. Shouakar-Stash serves on the Elements Executive Committee (An International Magazine of Mineralogy, Geochemistry and Petrology). He is the CEO and owner of IT^2. IT^2 is a state-of-the-art facility that offers a large variety of isotopic analyses on different materials. IT^2 is involved in projects and collaboration agreements with various government agencies, consulting companies, and research institutions and universities in Canada, the USA, Mexico, Europe, and other parts of the world.