MUHAMMAD MUQEET IQBAL, PhD

HYDROLOGY • GROUNDWATER SCIENCE • ENVIRONMENTAL GEOCHEMISTRY • REACTIVE TRANSPORT

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ACADEMIC PROFILE

Environmental geoscientist with interdisciplinary expertise in hydrology, groundwater science, hydrogeochemistry, and subsurface transport. My research investigates how hydrological conditions, mineral–water interactions, and colloidal processes influence the mobility and fate of dissolved elements in geological systems. I combine laboratory experiments, geochemical and reactive-transport modelling, and advanced X-ray imaging to understand transport processes across pore and continuum scales. My background spans environmental engineering, water science, hydrogeology, and environmental geochemistry, including MSc training in groundwater-flow modelling and groundwater–surface water interactions. My current teaching at Sorbonne Université covers hydrology, hydrogeology, GIS, and geomorphology.

RESEARCH INTERESTS

Groundwater hydrology and aquifer systems • Hydrogeochemistry and groundwater quality • Reactive transport modelling in porous media • Colloidal transport and permeability evolution • Hydrological processes, flood analysis and water-resource sustainability

TEACHING EXPERIENCE

Teaching and Research Associate (Temporary) | Sorbonne Université — Paris, France | 2026–present

- Teach hydrological processes and water-cycle dynamics, groundwater flow and aquifer systems, geospatial analysis using QGIS, and geomorphology at undergraduate and graduate levels; prepare teaching materials and course activities.
- Develop and deliver applied hydrology case studies, including flood modelling using rainfall–runoff analysis and unit hydrograph methods, alongside quantitative problem-solving activities.

Student mentoring and teaching support

- Mentor a PhD student on contaminated-groundwater remediation using colloids and diffusiophoresis, from microfluidics to column-scale experiments (2025–2026).
- Supervised an MSc student at the University of Brest on organic-colloid transport in porous media (2022).
- Trained undergraduate, MSc, and BTS students in liquid chromatography, ICP-MS, TOC analysis, experimental methods, and analytical-data interpretation.
- Supported English-language teaching and career-development sessions for Master's students, including academic application strategies (2025–2026).

RESEARCH EXPERIENCE

Postdoctoral Researcher | French National Center for Scientific Research (CNRS), ISTO — Orléans, France | 2024–2026 | ERC Consolidator Grant No. 101043288

- Investigated colloidal transport and retention, particle-induced clogging, permeability evolution, and multiphase-flow perturbations in geological porous media.
- Designed and operated flow-through experiments and sintered-glass porous-media systems; quantified particle retention and transport using time-resolved 4D X-ray microtomography.
- Developed Python- and MATLAB-based workflows for 3D image registration, segmentation, quantitative pore-scale analysis, and interpretation of transport mechanisms.
- Collaborated with CNRS, the University of Toulouse, the University of Ghent, and European research infrastructure partners.

Marie Skłodowska-Curie Early-Stage Researcher / PhD Researcher | University of Rennes — Rennes, France | 2020–2023 | H2020 PANORAMA ITN, Grant No. 857989

- Investigated rare earth element (REE) adsorption, redox behavior, mineral–water interactions, and reactive transport using quartz and goethite model systems.
- Developed mechanistic CD-MUSIC surface-complexation and reactive-transport models and tested predictions against batch and dynamic column experiments using PHREEQC, HYDRUS, and COMSOL.
- Integrated synchrotron X-ray absorption spectroscopy with laboratory geochemical experiments to investigate element–mineral interactions.
- Worked with academic and industry partners including Rennes Chemistry School, Belgian Nuclear Research Centre, Amphos21, and Cordouan Technologies.

Research Consultant | United Nations University – Institute for Integrated Management of Material Fluxes and Resources (UNU-FLORES) — Dresden, Germany | 2019–2020

- Contributed scientific analysis on water resources, soil–water interactions, climate adaptation, and water scarcity.

Research Assistant | International Groundwater Resources Assessment Centre (IGRAC) — Delft, Netherlands | 2019

- Analyzed groundwater-level and hydrochemical datasets and contributed to quantitative groundwater assessment and managed aquifer recharge studies.

Research Assistant | Center for Global and Strategic Studies — Islamabad, Pakistan | 2016–2017

- Contributed to research articles and policy documents on water, climate change, and environmental policy.

EDUCATION

PhD, Earth and Environmental Sciences | University of Rennes, France | 2020–2023

Marie Skłodowska-Curie Fellow. Dissertation: "Reactive Transport of Rare Earth Elements in Porous Media: Experimental Investigation and Mechanistic Modeling." Supervisors: Rémi Marsac and Khalil Hanna. Defended November 22, 2023.

MSc, Water Science & Engineering | IHE Delft Institute for Water Education / TU Dresden / University of Lisbon | 2017–2019

Erasmus Mundus GroundwatCH Scholar. Thesis: "Assessing the Denitrification Potential of Managed Aquifer Recharge." Training included hydrogeochemistry, groundwater-flow modelling using MODFLOW, groundwater–surface water interactions, field characterization, QGIS, and PHREEQC.

BSc, Environmental Engineering | National University of Sciences & Technology, Islamabad, Pakistan | 2012–2016

Thesis: "Point-of-use Water System Combining Solar Disinfection and Filtration." Recipient of the Best Industrial Project Award.

PUBLICATIONS

- Iqbal, M., Le Doare, J., Davranche, M., Dia, A., Dutruch, L., Maxit, B., Grandia, F., Hanna, K., & Marsac, R. (2026). Effects of iron-organic matter colloids on transport of rare earth elements in saturated porous medium. Environmental Science & Technology. Article ASAP. https://doi.org/10.1021/acs.est.5c13901.
- Iqbal, M., Zhang, K., Davranche, M., Dia, A., Dutruch, L., Vantelon, D., Ratié, G., Maxit, B., Hanna, K., & Marsac, R. (2024). Facet-dependent adsorption of rare earth elements (REEs) and actinides onto goethite: REE pattern variability and cerium anomaly. Environmental Science & Technology, 58(49), 21729–21739. https://doi.org/10.1021/acs.est.4c04406.
- Iqbal, M., Marsac, R., Davranche, M., Dia, A., Hanna, K., & Marsac, R. (2023). A mechanistic surface complexation approach for the prediction of rare earth element reactive transport in quartz porous media. Chemical Geology, 634, 121601. https://doi.org/10.1016/j.chemgeo.2023.121601.
- Ratié, G., Zhang, K., Iqbal, M., Vantelon, D., Mahé, F., Rivard, C., Komárek, M., Bouhnik-Le Coz, M., Dia, A., Hanna, K., Davranche, M., & Marsac, R. (2023). Driving forces of Ce(III) oxidation to Ce(IV) onto goethite. Chemical Geology, 121547. https://doi.org/10.1016/j.chemgeo.2023.121547.

MANUSCRIPTS IN PREPARATION

- Iqbal, M. et al. Time-resolved X-ray microtomography: silver particle retention and transport. Intended for Advances in Water Resources.
- Iqbal, M. et al. Dynamics of nanoparticles in porous media: insights from 4D X-ray microtomography. Intended for Environmental Science & Technology.

RESEARCH FUNDING, FELLOWSHIPS & PROJECT EXPERIENCE

2025–2026 EXCITE Network – Horizon Europe. Research participation at University of Ghent involving advanced X-ray imaging infrastructure and porous-media research.

2024–2026 ERC Consolidator Grant No. 101043288. Postdoctoral research at CNRS/ISTO on colloidal control of multiphase flow in geological porous media.

2020–2023 Marie Skłodowska-Curie Fellowship, PANORAMA, Grant No. 857989. €136,202 fellowship supporting doctoral research on REE environmental transfer and reactive transport.

2017–2019 Erasmus Mundus GroundwatCH Scholarship. €49,000 scholarship for MSc training in Water Science & Engineering.

SELECTED RESEARCH COLLABORATIONS

SCK CEN, Belgium — Speciation and reactive transport modeling of rare earth elements; HYDRUS 1D/2D; mobility and reactivity in Boom Clay.

Amphos21, Spain — COMSOL modeling of Fe-rich organic colloid and REE transport in sand-column systems.

Cordouan Technologies, France — Dynamic light scattering and characterization of iron-organic matter colloids used in REE transport experiments.

University of Ghent, Belgium — Advanced X-ray microtomography and quantitative pore-scale characterization of particle transport and retention.

UNU-FLORES / TU Dresden, Germany — Water scarcity, climate adaptation, and sustainable resource management.

SELECTED PRESENTATIONS (+20)

- InterPore 2026, Nantes — Time-lapse X-ray microtomography of particle transport and retention in porous media (oral).
- InterPore 2025, Albuquerque, USA — Colloid-induced mobility of non-aqueous phase liquid in porous media (oral).
- Goldschmidt 2025, Prague — Effects of iron-organic matter colloids on REE transport in saturated porous media (oral).
- SETAC 2023, Dublin — Rare earth elements binding to goethite: experimental and modeling investigations (oral).
- Goldschmidt 2021, Lyon — Reactive transport of REEs: surface complexation with quartz and modeling investigations (oral).
- IAH Congress 2019, Málaga — Assessing the denitrification potential of aquifer recharge (poster). More than 20 scientific presentations
- **Invited seminars (7)**: BRGM (2026), ISTO Orléans (2023), Antwerp (2023), Rennes (2023), Cordouan Technologies/Bordeaux (2023), Amphos21/Barcelona (2022), Jacobs University/Bremen (2021).

ACADEMIC SERVICE & LEADERSHIP

- **Peer reviewer:** Geochimica et Cosmochimica Acta; Environmental Science & Technology; Applied Geochemistry.
- Chair, Minisymposium, InterPore 2026: Porous Media for a Green World: Energy & Climate.
- Session Chair, France InterPore Chapter / 17e Journées d'Études des Milieux Poreux, 2025.
- Session Chair and Organizing Committee, SURF2 Conference, Rennes, 2022.
- Student Representative and Steering Committee Member, (H2020) Innovative Training Network, 2020–2023.
- Organized research webinars and coordinated student presentations within an international doctoral network.

TECHNICAL & COMPUTATIONAL EXPERTISE

Hydrology & groundwater	Groundwater flow and aquifer systems; MODFLOW; ModelMuse; groundwater datasets; managed aquifer recharge
Hydrological analysis	Rainfall–runoff analysis; unit hydrograph methods; flood-modelling case studies (teaching experience)
Reactive transport & modelling	PHREEQC; HYDRUS 1D/2D; COMSOL; OpenFOAM; column transport; breakthrough curves
Hydrogeochemistry	REE geochemistry; aqueous speciation; mineral–water interfaces; adsorption; redox processes; surface complexation
Experimental & analytical methods	Batch adsorption; flow-through systems; sand/porous-media columns; ICP-MS; TOC; DLS; liquid chromatography; synchrotron XAS
Imaging & quantitative analysis	4D X-ray microtomography; Dragonfly 3D; ImageJ/Fiji; Avizo; pore-scale segmentation; image registration
Programming & geospatial analysis	Python; MATLAB; quantitative image analysis; workflow automation; hydrochemical datasets; QGIS

AWARDS, DISTINCTIONS & PROFESSIONAL MEMBERSHIPS

- Academic Excellence Award, NUST Pakistan, 2012–2016.
- Best Industrial Project Award, NUST BSc thesis, 2016, for a decentralized water-treatment system.
- Nominated principal candidate, **Fulbright MSc Degree** Program, 2017.
- Nominated for Commonwealth Scholarship, Queen Mary University of London, 2017.
- Nominated for fully funded InnoEnergy Master's program, European Union, 2017.

Professional memberships: European Association of Geochemistry; International Society for Porous Media (InterPore); American Society of Environmental Engineers; Society of Environmental Toxicology and Chemistry (SETAC).