Current projects in the Environmental Geochemistry Group for the Academic Year 2026/2027

Background

We are interested in understanding the chemical and geochemical mechanisms that control the movement of elements and their isotopes in different environments, natural and in engineered alike. This way, we hope to address our (still very) incomplete understanding of fundamental environmental system processes and the lack of simple engineering solutions required for a sustainable society.

The focus of current projects is on

1. sustainable water and waste management,
2. biogeochemical cycles, in particular atmospheric transport and deposition and pollutant and nutrient dynamics,
3. proxy development, in particular stable isotope systems and their fractionation processes.

We study molecular and global processes by conducting field work and analysing the samples collected, by designing sophisticated laboratory experiments and investigating interface and solution processes, and by developing computational models to make testable prediction about processes in the environment.

Our research offers the potential to apply rigorous ideas in chemistry, biology, and physics to transform our understanding of chemical and geochemical processes in different environments with a wide range of important applications.

Current projects

1. Impact of climate change on trace metal cycling
    a. Impact of salinity on biogeochemical cycles in coastal and floodplain soils (Hanif, EJSS, 2024; Northover, Sci Rep, 2022)
    b. Impact of ocean acidification on phycosphere chemistry and trace metal uptake in algae (Liu, ISEM, 2023)
    c. Impact of wildfires on geochemical cycling in soils

2. The non-traditional role of siderophores and organic micropollutants in trace metal cycling
    a. Actinide mobility in the near field of nuclear repositories (Kirby, PhD)
    b. Siderophores – a bug or feature of nature (Northover et al, J Exp Bot, 2021, Sci Rep, 2022)
    c. Mechanisms of DMA and PDMA in acquisition and uptake of micronutrients in rice (Rocco, J Food Agr Chem, 2025)
    d. Developing conceptual frameworks for ligand–surface–metal interactions (Northover, PhD; Kirby, PhD)

3. Predictive modelling of stable isotope fractionation of metals and PFAS
    a. Structure-fractionation and reactivity-fractionation relationships for PFAS and metals using electron structure calculations (Northover, PhD; Suzie, MSc; Markovic, PhD)

b. Quantification of isotope fractionation during geochemical processes in the environment (Alfadel, PhD; Kiyun, MSc; Arnold, PhD; Dong PhD)
c. Conceptual isotope fractionation model for the plant-soil environment and during combustion (Weiss et al., Chem Geol, 2021)

4. Sustainable waste and water treatment using next generation sorbents
    a. Multifunctional sorbents for removal of arsenic and dyes (Bullen, PhD; Heiba, PhD)
    b. Phosphorus removal using highly selective ion exchange resins (Seges et al, Env Sci: Wat Res Technol, 2022; Karpati, MSci)
    c. Arsenic speciation and removal using ImpAs (Eikelboom, in press)

5. Predictive modelling in interface processes
    a. Predictive modelling for PFAS removal in water treatment (MSc Zheng)
    b. Predictive modelling for REE mobility in subsurface environments (Martin Li)
    c. Software development for water scientists (MSc Teo and MSc)
    d. Development of next generation kinetic adsorption laws (Bullen, Langmuir, 2023)
    e. Energy budgets in Arsenic water treatment plants

6. Tropospheric Aqueous-Phase Chemistry: Kinetics, Mechanisms
    a. Air pollution and ocean fertilization – an emerging climate threat
    b. Analytical method development for pH and trace elements determinations in low pH and high salinity solutions (SuChen, J Power Sources, 2026)
    c. Solution controls on dissolution and photo oxidation in low pH and high salinity solutions (Sarawud, PhD; Guillemet, PhD)

7. Atmospheric transport and deposition of mineral dust and trace elements
    a. Characterisation of natural aerosols and their global atmospheric cycle: Teleconnections, Chemical Characterisation, Impact of Environmental Change (Shotyk 2002; Kylander, PhD; Ferrat, PhD; Resongles, in press)
    b. Dynamics of urban PM: Impact of long range transport and changing policies (Mengli, Commun Earth and Environment, 2025; Resongles et al, PNAS, 2021)

8. Environmental lead in the 21st century
    a. Hotspots identification: From Measurement to Modelling
    b. Lead exposure during recycling of acid lead batteries

9. Aqueous chemistry of actinides in high salinity and alkalinity solutions in the near field of nuclear waste
    a. Parameterisation of activity models (YuChen, J Power Sources, 2025)
    b. Analytical development for ISE (Sarawud, PhD)
    c. Colloid formation in organic rich environments (Kirby, JRNC, 2025)

What are we looking for

We are looking for motivated hard working students with an excellent background in the appropriate subject, e.g. chemistry, earth or environmental science, physics, mathematics, or engineering, and with the willingness to learn computational and/or laboratory methods as needed. Skills developed will include advance experimental and numerical modelling methods, with extensive training provided.

Successful applicants have a proven aptitude for practical, experimental and /or analytical work and a genuine passion for research.
The candidate will have the opportunity to develop their career and profile by presenting at international conferences and publishing in high impact journals. The projects involve interaction with other research groups within and beyond ESE.

Next steps

If you are interested in working with us and a project offered within our group, please contact me (d.weiss@imperial.ac.uk) for more information and discussions. Applications should be made through the college online application system (www.imperial.ac.uk/study/pg/apply/how-to-apply). Important information about the college PhD application process can be found on the following page (http://imperial.ac.uk/study/pg)