

Renaud MERLE

Isotope Geochemist

Personal details

French citizen.

Born 20 October 1976 in Talence (Gironde, France), in a relationship, one child.

Languages: French (mother tongue), English (fluent), Italian (scholar), Sweden (basic commands), German, Spanish and Portuguese (notions).

Professional address

Department of Earth Sciences, Natural Resources and Sustainable Development, Uppsala University, Villavägen 16, 75236 Uppsala, Sweden.

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Academic Education

- **2018:** Habilitation, University of Strasbourg, France, awarded 28-06-2018.
 - **2002-2006:** PhD thesis in Geochemistry at University of Nantes, France (in collaboration with University of Nice, France), awarded 30-05-2006.
 - **2001-2002:** Master degree in Petrology-Geochemistry at University of Western Brittany (Université de Bretagne Occidentale, Brest, France).
 - **2000-2001:** «Maîtrise» in Earth Sciences, University of Clermont-Ferrand (France).
 - **1999-2000:** Bachelor degree in Earth Sciences, University of Clermont-Ferrand (France).
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Employment

- **July 2020-ongoing:** Researcher and lecturer, Department of Earth Sciences, Natural Resources and Sustainable Development, Uppsala University, Sweden.
 - **July 2018-July 2020:** Researcher, Naturhistoriska Riksmuseet, Stockholm, Sweden.
 - **December 2015-November 2016:** Research Associate, Research School of Earth Sciences, Australian National University.
 - **September 2012-May 2015:** Research associate, Department of Applied Geology, Curtin University, Australia (part-time: 50%).
 - **February 2012-December 2013:** Sessional lecturer, Department of Applied Geology, Curtin University (part-time: 40%).
 - **2011:** Research fellow, Dipartimento di Geoscienze, Università di Padova, Italy.
 - **February-June 2010:** Research associate, John De Laeter Centre of Mass Spectrometry, Department of Applied Physics, Curtin University.
 - **2009:** Post-doctoral fellow, School of Earth and Environment, University of Western Australia.
 - **2007-2008:** Post-doctoral fellow, Dipartimento di Geoscienze, Università di Padova.
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Experience in Geoscience Research

- Extensive knowledge of U-Pb, Sm-Nd, Rb-Sr, Lu-Hf, Re-Os isotopic systems:
 - U-Pb geochronology on minerals (titanite and zircon using annealing and chemical abrasion) and extra-terrestrial material (chondrules using step-leaching dissolution) by ID-TIMS (Isotopic Dilution Thermo-Ionisation Mass Spectrometry).
 - Sr-Nd-Pb-Hf systematics on whole rocks using TIMS and MC-ICP-MS (multi-collection inductively coupled mass spectrometry).
 - Sr-Pb-Hf systematics on separated minerals: Sr and Pb on plagioclase and K-feldspar by ID-TIMS, Hf on zircon by MC-ICP-MS.
 - Re-Os systematics on mafic rocks by ID-TIMS.
 - In-situ U-Pb geochronology on terrestrial and lunar materials (zircon, Ca-phosphate and opal) by Secondary Ion Mass Spectrometry (SHRIMP and IMS 1280).
 - Determination of mineral compositions from terrestrial and extra-terrestrial rocks by Electron Microprobe.
 - Determination of K isotopic composition by TIMS on natural and artificial (isotopic tracer) materials.
 - Good knowledge of in-situ determination of halogen (F, Cl, Br, I) content and Cl isotopes in phosphates by IMS 1280.
 - Good knowledge of $^{40}\text{Ar}/^{39}\text{Ar}$ dating technique in rocks and minerals.
 - Experience in determination of O and Si isotopes in opal by IMS 1280.
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Scientific Interests

- Age and origin of Large Igneous Provinces.
 - Petrogenesis of intraplate alkaline volcanic rocks.
 - Formation and evolution of continental crust.
 - Chronology and chemical characteristics of lunar volcanism and chemical evolution of lunar mantle.
 - Early history of solar system (planetary formation and evolution and cratering history).
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Scientific output

- 57 peer-reviewed scientific articles published in international journals since 2005.
 - 27 since 2020.
 - 15 articles published as first author.
- Co-author in a peer-reviewed book chapter in 2018.
- 2494 citations, 342 in 2025, h-index = 29, i10-index (papers >10 citations) = 44 (source: Google Scholar on 27th January 2026).

- Contribution to 20 abstracts presented in international conferences since 2020.
 - Two articles published in journals of professional organisations in 2023 and 2024.
 - One opinion article published in Nature Astronomy in 2025.
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Teaching Experience

- **2020-ongoing (20% employment): Department of earth sciences, Uppsala University.**

“Green transition: perspectives and challenges for future raw materials” (Öppet för klimatet – grön omställning): distance course for professional in green transition, 3 credits) – autumn semester 2025:

- *Course syllabus: Basic geology, inorganic chemistry, supply security, ethical aspects of green transition, material recycling, energy systems.*
- 3 lectures (45 mins each)

“Extraterrestrial resources” (Master program in Sustainable development, 3rd year, 5 credits, ~15 students) - course co-ordinator:

- *Course syllabus: Formation of solar system and chemical elements, overview of type of resources, space exploration, remote sensing applied to resources exploitation, in-situ utilization of extraterrestrial resources.*
- 6 lectures (45 mins each).

“Our natural resources” (Master program in Sustainable development, 3rd year, 10 credits, ~60 students) – “Minerals and metals” block:

- *Course syllabus: Elements and metals of economic interest; formation of ore deposits; frontier resources.*
- 4 Lectures (2 x 45mins each).
- 2 field trips (1 day each).

“Energy security in local and global energy systems” (Master program in Sustainable development, 3rd year, 5 credits, ~10 students):

- *Course syllabus: Global energy systems, energy resources and security, carbon dioxide capture, energy production, energy transition and energy systems in the future.*
- Lecture: “Cosmochemistry, geology and geochemistry of Lithium” (2 x 45mins).

“Planet Earth” (Master program in Geoscience, 1st year, ~20 students):

- *Course syllabus: basics in Geology*
- Lecture: “Formation of our solar system” (1 x 45 mins).

- **2013: Department of Applied Geology, Curtin University.**

- Semester 1:

Geology 111 (Mining engineering, 1st year): Introduction to general geology

▪ *Course syllabus: Crystallography - the rock forming minerals, physics and chemistry of the earth, plate tectonics and the geological cycle. Igneous, sedimentary and metamorphic petrology. Stratigraphy, geological time and maps. Structural geology.*

- 236 students, 12 hrs per week during 12 weeks (144 hrs).

- Semester 2:

Geology 291 (2nd year): Field work

- Course syllabus: *Field mapping techniques, recording of lithological and structural information from igneous, sedimentary and metamorphic rocks.*

- 50 students, 5 days (Albany and Margaret River region, Western Australia).

Geology 292 (2nd year): Field work

- Course syllabus: *Geological field mapping, application of appropriate field technique to support the generation of a field map.*

- 50 students, 5 days (Kalgoorlie area, Western Australia).

- **2012: Department of Applied Geology, Curtin University.**

- Semester 1:

Geology 111 (Mining engineering, 1st year): Introduction to general geology

- Course syllabus: *Crystallography, rock forming minerals, physics and chemistry of the earth, plate tectonics and the geological cycle. Igneous, sedimentary and metamorphic petrology. Stratigraphy, geological time and maps. Structural geology.*

- 100 students, 8hrs per week during 12 weeks (116 hrs).

- Semester 2:

Geology 112 (Mining engineering, 1st year): Resource geology

- Course syllabus: *Principal ore minerals and their identification. The nature, mineralogy and morphology of the major types of mineral deposits. Metals, fuels and industrial minerals. Mineral exploration including geochemical and geophysical exploration. Introduction to mining geology. Ore minerals and types of ore deposits, coal, petroleum and natural gas.*

- 30 students, 6h per week during 6 weeks (36 hrs).

- **2009: School of Earth and Environment, University of Western Australia.**

- Semester 2:

Field work (3rd year):

- Course syllabus: *Geological field mapping of high-grade metamorphic rocks, structural and metamorphic geology.*

- 50 students, 5 days (Albany, Bremer bay and Hopetoun areas, Western Australia).

- **2004: University of Nantes – France (teaching assistant).**

- Semester 1:

Introduction to Hydrology and hydrogeology (1st year): Practicals

- Course syllabus: *Introduction to concept of water table, mapping of drainage basins, porosity of rocks, water cycle and resource management.*

- 150 students, one-week course (30 hrs).

- **2003: University of Nantes – France (teaching assistant).**

- Semester 2:

Introduction to basin geology (1st year): Practicals

- Course syllabus: *Basin geodynamics, multi-disciplinary approach of basin geology (geophysics, regional geology, observations of thin sections of sedimentary rocks), stratigraphy of sedimentary rocks.*

- 150 students, one-week course (20 hrs).

Introduction to geological maps (1st year): Practicals

- Syllabus: *Reading and understanding geological maps, basic concepts of geological cross sections.*

- 150 students, one-week course (20 hrs).

Fieldwork Experience

- Sampling campaigns:
 - Oceanic campaign, Marion Dufresne research vessel (2001): 18 days, Mediterranean Sea, North Atlantic; sediments coring.
 - SW Portugal (2003, 2006): two weeks; Late Cretaceous Alkaline Volcanic Province.
 - Nullarbor plain, WA (2010): 12 days, Mason Gully meteorite recovery (Desert Fireball network expedition).
 - SW WA (2013): four days, Bunbury basalts (SW Western Australia).
 - SW WA (2013): three days, Bunbury basalts (SW Western Australia).
 - Victoria (2014): six days, Newer Volcanic Province (western Victoria, Australia).
 - Macquarie Island (2017): 15 days, sampling the oceanic lithosphere of Macquarie Island
- Organisation and logistics of fieldworks.
- Skills in field mapping of volcanic and metamorphic terrains.

Co-supervision of PhD theses

- Adam Mat'ó, Masaryk University (Czech Republic): *Petrogenesis of ultramafic lamprophyres from Alnö island (Central Sweden)*. Principal Supervisor: Lukáš Krmíček (Brno University). Completion expected in October 2026.
- Qiang Jiang, Curtin University: *Geochronology and geochemistry study of subantarctic oceanic magmatism: implications for plume-lithosphere interaction and multi-stage plate-plate interaction*. Principal Supervisor: F. Jourdan (Curtin University). Completed in August 2021.
- B. Ware, Curtin University: *Kalkarindji and Karoo-Ferrar Large Igneous Provinces: Contrasting Origins and Climatic Impacts*. Principal Supervisor: F. Jourdan (Curtin University). Completed in April 2017.
- K. Oostingh, Curtin University: *Geochronology and geochemistry of the Newer Victoria Province*. Principal Supervisor: F. Jourdan (Curtin University). Completed in September 2016.

- H. Olierook, Curtin University: *Geometry and geochronology of the Bunbury Basalt, Western Australia*. Principal Supervisor: N. Timms (Curtin University). Completed in February 2015.

Supervision of Master theses

- A. Paravella, Uppsala University-Pavia University (Erasmus program): *Deciphering the formation of the lunar breccia NWA 12384: Chemical characterisation and Pb-Pb dating*. Principal supervisor. Completion in June 2025.
- G. Morantes Pacheco, Uppsala University: *The green charge: advanced battery technologies for a sustainable future*. Co-supervisor. Completed in May 2024.
- M. Varlet, Uppsala University: *Future availability of cobalt: predicting future production and the possible impact of environmental, societal, and governance conflicts on cobalt production*. Co-supervisor. Completed in May 2023.
- B. Klaus, Uppsala University: *Making space exploration sustainable: a quantitative assessment of valuable elements for implementation of in-situ utilisation of lunar resources*. Principal supervisor. Completed in May 2022.
- C. Peng, Uppsala University: *Assessment of metal contents (Ni, Co and PGEs) in asteroids as a potential source of valuable elements for a future green energy society*. Principal supervisor. Completed in May 2022.

Grants

Research grants:

- **Merle R.**, Debaille V., Nemchin A., Whitehouse M., *Modification of the Moon's mantle by impacts preserved in the chemistry of rare lunar basalts*, Vetenskapsrådet **2025**, 4 460 000 SEK.
- Whitehouse M., Jeon H., Kenny G., **Merle R.**, Nemchin A., *Meteorite bombardment in the inner solar system, a lunar regolith perspective*, Vetenskapsrådet **2021**, 4 200 000 SEK.
- **Merle R.**, Whitehouse M., Nemchin A., *How to differentiate rocky planet-insight from the basaltic volcanism of the Moon*, Vetenskapsrådet **2020**, 3 360 000 SEK.
- **Merle R.**, Bostock H., Jourdan F., Olierook H., *Age and origin of the magmatism along the transpressional Australian-Pacific plate boundary*, Australian Antarctic Science Program **2017**, AUD 115 005.
- Jourdan F., Olierook H., **Merle R.**, Coffin M., Whittaker J., Halpin J., *The Kerguelen Large Igneous Province: dynamics of a pulsating mantle plume*, Australian Antarctic Science Program **2017**, AUD 75 553.
- Olierook H., **Merle R.**, Jourdan F., Whittaker J., *Time constraints on the world's clearest oceanic curved fracture zone: implications for a global plate reorganisation in the Cretaceous*, Australian and New Zealand International Ocean Discovery Program Consortium grant **2016**, AUD 10 000.
- **Merle R.**, Jourdan F., Manatschal G., *Magmatism on the Iberia-Newfoundland passive margins since 200 Ma*, Australian and New Zealand International Ocean Discovery Program Consortium grant **2014**, AUD 20 000.

- **Merle R.**, Cawood P., Nemchin A., *Combined U-Pb, O and Hf isotope study of granites from New England Fold Belt (Eastern Australia): implications to growth of continental crust*, University of Western Australia Research and Development Award **2010**, AUD 20 350.

Education grants:

- Höök M., **Merle R.**, Kuchler M., *Green transition and challenges for the raw materials of the future*, Short course for professionals in green transition, Development grant Uppsala University-Faculty of natural sciences and techniques **2025**, 250 000 SEK.

Technical skills:

Intensive work on:

- TIMS
 - MAT Finnigan 262 (Os isotopic ratios measurements, U-Pb dating, K isotopic composition).
 - Thomson TSN 206 TIMS (U-Pb dating and Sr-Rb isotopic ratios measurements).
 - Thermo Triton (U-Pb dating).
 - VG Sector (Sr and Pb isotopic ratios measurements).
- Electron microprobe CAMECA SX 50.
- Scanning electron microscope Philips XL 30, Zeiss Evo 40XVP and Thermo-Fisher Quanta FEG650.
- Secondary ion mass spectrometer SHRIMP II instrument and IMS 1280 (in-situ U-Pb isotopic ratios measurements).

Occasional work with:

- Electron microprobes JEOL 8530F and JEOL JXA-8200.
- MC-ICP-MS VG plasma 54 (Hf isotopic ratios).
- MC-ICP-MS Neptune (U isotopic ratios measurements).
- LA-ICP-MS Elan DRC-E (trace elements analyses in clinopyroxenes).
- Perkin-Elmer Elan 6000 quadrupole ICP-MS (Re measurements).
- VG 354 thermal-ionization mass spectrometer (Pb isotopic measurements).
- IMS 1280 (Si, O and Cl isotopic ratios measurements, Cl, Br, I, F content determination).
- ISA LabRam dispersive Raman spectrometer (measurements of radiation damage in zircons).

Intensive work in ultra-clean lab for:

- Weighing of micro-samples and isotopic tracers with microbalances.
- Microchemistry on column with ion-exchange resins.
- Ultra-pure reagents preparation.

Sample preparation:

- Rock cutting and crushing
- Thin sections preparation and crushing
- Mineral separations with Frantz magnetic separator, heavy liquids and hand-picking under binocular.

- SIMS sample preparation: sample mounting in resin, polishing, coating.
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Service to the research community

- Session chair and science organising committee member of conferences:
 - Member of the science organising committee for the European Lunar Symposium, 21-26 June 2026, Nancy, France.
 - Member of the science organising committee for the European Lunar Symposium, 22-27 June 2025, Munster, Germany.
 - Theme chair (Theme 4: Volcanism, magmatic systems, and hazards), Goldschmidt conference, Prague, Czech Republic, 6-11 July 2025.
 - Chair of the Moon session, Annual Meeting of the Meteoritical Society, Brussels, Belgium, 28 July-02 August 2024.
 - Chair of the geochronology session of the Swedish geological society, 150 years anniversary meeting, Uppsala, Sweden, 17-19 August 2022.
 - Peer-review:
 - Regular reviewer for major Earth and planetary sciences journals: Nature, Science, Nature astronomy, Nature geoscience, Lithos, Journal of Petrology, Geochimica Cosmochimica Acta, Journal of Geophysical Research-Solid Earth, Geophysical Research letters, Earth and Planetary Science Letters.
 - Reviewer for grant schemes: NSF, DFG, Mardsen fund (New Zealand), NASA.
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Popular science publications and communications

- Articles in journal of professional organisations:
 - **Merle R.**, Höök M., Troll V.R., Assessing the plausibility of mining lunar titanium, *European Geologist*, 57, **2024** (doi: 10.5281/zenodo.12205838).
 - **Merle R.**, Troll V.R., Höök M., Kuchler M., Byrne P., Donoso G., Extra-terrestrial resources: a potential solution for securing the supply of rare metals for the coming decades? *Geology Today*, 39, 225-230, **2023**.
 - Invited talks:
 - European Federation of Geologists webinars (30 May 2023): *Formation and chemical evolution of the Moon as the key to assess its potential metal resources* (<https://eurogeologists.eu/efg-webinar-formation-and-chemical-evolution-of-the-moon-as-the-key-to-assess-its-potential-metal-resources>).
 - Slovak geological society (15 January 2026): How to differentiate a rocky planet: insight from the volcanism of the Moon (<https://www.youtube.com/watch?v=-MCFnHH7VO8>).
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