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Revealing fossil anatomies and preservation pathways using advanced imaging

Keywords

- **Palaeontology:** taxonomy, systematics and palaeoecology of Palaeozoic arthropods
- **Taphonomy of well-preserved fossils:** authigenic mineralization of soft-tissues, depositional environments and rare earth element geochemistry
- **Development of advanced 2D imaging techniques:** synchrotron X-ray fluorescence, absorption, diffraction and scattering scanning, ultraviolet/visible luminescence imaging.
- **Field work:** fossil collection and stratigraphical study

Current Position

Since 2019/12 **SNSF researcher** University of Lausanne, Switzerland
Breathing new life into dead fossils: Can geochemical characterization of biomolecules be used to enhance paleontological anatomy descriptions and reveal the affinities of enigmatic fossil animals? PI of a *Spark* funding from the SNSF.

Former Positions and Education

- 2018/06-2019/11 **SNSF researcher** University of Lausanne, Switzerland
Shedding new light on the Fezouata biota (Lower Ordovician, Morocco) using advanced spectro-imaging techniques. PI: A. Daley
- 2016/05-2018/05 **Post-doctoral researcher** CNRS, USR 3461 IPANEMA, Gif-sur-Yvette, France
Fossilization and diagenesis in a Cretaceous Lagerstätte. Supervisor: L. Bertrand
- 2014/11-2016/05 **Post-doctoral researcher**, DIFFABS beamline, SOLEIL synchrotron, Gif-sur-Yvette
X-ray imaging and spectroscopy. Supervisor: D. Thiaudière
- 2011/11-2014/10 **PhD, Palaeontology**, Muséum national d'Histoire naturelle (MNHN), *best distinction*
The continental aquatic arthropod fauna from the Famennian (Late Devonian) of Strud, Belgium: taxonomy, palaeoecology and taphonomy using synchrotron 2D imaging.
Supervisors: G. Clément & S. Charbonnier

Publications

44 international peer-reviewed publications and 411 citations; H-index = 10 (from Google Scholar).

Highlighted publications:

Gueriau P. et al. 2020. Visualizing mineralization processes and fossil anatomy using synchronous synchrotron X-ray fluorescence and X-ray diffraction mapping. *Journal of the Royal Society Interface* 17: 20200216.

Gueriau P. et al. 2020. Oxidative conditions can lead to exceptional preservation through phosphatization. *Geology*.
Published online July 31, 2020. doi:10.1130/G45924.1

Georgiou R., **Gueriau P.** et al. 2019. Carbon speciation in organic fossils using 2D to 3D x-ray Raman multispectral imaging. *Science Advances* 5, eaaw5019.

Gueriau P., Bernard S. & Bertrand L. 2016. Advanced synchrotron characterization of paleontological specimens. *Elements* 12(1): 45–50.

Conference Presentations

19 talks (including one invited) in international conferences; 7 in national or local events.

Awards

Prize for the best poster presented by a student. 9th SOLEIL Users' Meeting, Palaiseau/ Saint-Aubin (France), January 23–24 2014.

Approved Research Projects

Research grants:

2019 call for “Spark rapid funding of unconventional ideas” projects of the SNSF. 94,891 CHF for the project I am currently employed on (**Principal Investigator**).

2015-2016 call for “Collaborative Research Projects” of the “France-Stanford Center for Interdisciplinary Studies. 15,000 US\$ for the project “X-Ray Imaging of Cultural Heritage – Bringing to Light our History” (**Co-proposer, in collaboration with U. Bergmann (SLAC, Stanford University) and L. Bertrand (IPANEMA)**).

2014 call for projects of the “ATM Interactions Minéral–Vivant” (MNHN). 1,500 € to conduct quantifications of trace elements in well-preserved fossils (**Principal Investigator**).

2014 call for projects of the “ATM Formes” (MNHN). 1,500 € to perform X-ray micro-tomography on well-preserved fossil crustaceans (**Principal Investigator**).

Allocation of synchrotron beamtime:

26 proposals allocated (9 as the main proposer) since February 2013 at SOLEIL, LNLS (Campinas, Brazil) and the ESRF, accounting for a total of 148 days of beam time. I have also participated in experiments at SSRL (Stanford), Diamond (UK) and the Swiss Light Source.

Teaching and Supervision of Students

Scientific imaging, postgraduate students, MNHN Doctoral School (ED 227), 2014–2018 (15 hours).

Palaeontology, 2nd year Bachelor, University of Lausanne, 2019 & 2020 (lectures: 5h; practicals: 20h).

Online “virtual palaeontology practicals”, 2nd year Bachelor, University of Lausanne, 2020.

Mapping and sedimentology field camps, 1st and 3rd year Bachelor, University of Lausanne, 2018–2020 (10 days Dingle peninsula, Ireland; 3 days Anti-Atlas, Morocco; 8 days Swiss Jura).

Supervision of 4 Bachelor, 3 M.Sc. and participation in the supervision of 5 PhD students.

Collections

Reorganization and databasing of the early vertebrate material from the Lower Devonian of Svalbard (1969 CNRS-MNHN expedition), MNHN Palaeontological Collections, 2011 (10 months).

Other Scientific Activities

Organisation of scientific conferences and meetings:

Initiator and organiser of the *Young Natural History scientists' Meetings* (2014–2019).

Chairman of the Palaeontology and Palaeo-environments session during the *Synchrotron Radiation in Art and Archaeology 2014 Meeting* (Musée du Louvre, Paris, September 2014).

Organiser of a symposium about fossil imaging and a mid-congress excursion at the SOLEIL synchrotron during the *5th International Palaeontological Congress* (MNHN, Paris, July 2018).

Reviewing work for international journals:

Multidisciplinary journals: incl. PNAS, Scientific Reports, PLoS ONE, R. Soc. Open Science; **Earth Sciences and Palaeontology journals:** incl. Geology, Earth-Science Reviews, Palaeo3, Journal of Systematic Palaeontology.

Others reviewing activities:

Synchrotron proposals (SSRL) and regional funding proposals (Ile-de-France, DIM MAP).

Public outreach:

Highlights: 1 web article on early terrestrial ecosystems (URL: <http://www.encyclopedie-environnement.org/vivant/premiers-ecosystemes-terrestres/>); 1 interview in the French scientific radio program “**la tête au carré**” of **France Inter** (November 11 2016); 3 CNRS press releases; 1 international scientific magazine article (Gueriau P. & Bertrand L. 2015. Deciphering exceptional preservation of fossils through trace elemental imaging. *Microscopy Today* 23(3): 20–25). I also acted as scientific advisor for French scientific magazine articles.