EUROPEAN **S**YNCHROTRON **R**ADIATION **F**ACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** The chemical preservation of insects in amber revisited: insight from 3D X-ray Raman scattering	**Experiment number**: ES-858
Beamline: ID20	**Date of experiment**: from: 17/10/2018 to: 23/10/2018	**Date of report**: 01/03/2020
Shifts: 18	**Local contact(s)**: Christoph Sahle	*Received at ESRF:* **01/03/2020**

Names and affiliations of applicants (* indicates experimentalists):

Georgiou Rafaella[1,2]

Pierre Gueriau[3]

Christoph Sahle[4]

Loïc Bertrand[1,2]

[1]IPANEMA, CNRS, ministere de la culture, Université de Versailles Saint-Quentin-en-Yvelines,Université Paris-Saclay, BP 48 St. Aubin, 91192 Gif-sur-Yvette, France.
[2]Synchrotron SOLEIL, l'Orme des Merisiers, BP 48 St. Aubin, 91192 Gif-sur Yvette, France.
[3]Institute of Earth Sciences, University of Lausanne, Geopolis, CH-1015Lausanne, Switzerland.
[4]ESRF–The European Synchrotron, 71, avenue des Martyrs, CS40220, 38043 Grenoble, France.

Report:

The in situ two-dimensional (2D) and 3D imaging of the chemical speciation of organic fossils is an unsolved problem in paleontology and cultural heritage. Here, we use x-ray Raman scattering (XRS)–based imaging at the carbon K-edge to form 2D and 3D images of the carbon chemistry in two exceptionally preserved specimens, a fossil plant dating back from the Carboniferous and an ancient insect entrapped in 53-million-year-old amber. The 2D XRS imaging of the plant fossil reveals a homogeneous chemical composition with micrometric "pockets" of preservation, likely inherited from its geological history. The 3D XRS imaging of the insect cuticle displays an exceptionally well preserved remaining chemical signature typical of polysaccharides such as chitin around a largely hollowed-out inclusion. Our results open up new perspectives for in situ chemical speciation imaging of fossilized organic materials, with the potential to enhance our understanding of organic specimens and their paleobiology.

More details can be found in the paper published : Georgiou, Rafaella, et al. "Carbon speciation in organic fossils using 2D to 3D x-ray Raman multispectral imaging." *Science advances* 5.8 (2019): eaaw5019.