



## 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 via the User Portal:  
<https://www.esrf.fr/misapps/SMISWebClient/protected/welcome.do>

### Deadlines for submission of Experimental Reports

Experimental reports must be submitted within the period of 3 months after the end of the experiment.

### Experiment Report supporting a new proposal (“relevant report”)

If you are submitting a proposal for a new project, or to continue a project for which you have previously been allocated beam time, you must submit a report on each of your previous measurement(s):

- even on those carried out close to the proposal submission deadline (it can be a “*preliminary report*”),
- even for experiments whose scientific area is different from the scientific area of the new proposal,
- carried out on CRG beamlines.

You must then register the report(s) as “relevant report(s)” in the new application form for beam time.

### Deadlines for submitting a report supporting a new proposal

- 1<sup>st</sup> March Proposal Round - **5<sup>th</sup> March**
- 10<sup>th</sup> September Proposal Round - **13<sup>th</sup> September**

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.

### Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report in English.
- include the experiment number 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.



**Experiment title: The ones that got away: anatomy and evolution of exceptional early teleost fish fossils**

**Experiment number:**  
ES1077

<b>Beamline:</b> BM05	<b>Date of experiment:</b> from: 26/10/2021 to: 30/10/2021	<b>Date of report:</b>  <i>Received at ESRF:</i>
<b>Shifts:</b> 9	<b>Local contact(s):</b> Kathleen Dollman	

**Names and affiliations of applicants (\* indicates experimentalists):**

\*Sam Giles, University of Birmingham Earth & Env Science School of Geography Edgbaston West Midlands GB - B15 2TT Birmingham

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\*Jake Atterby, University of Birmingham GEES Edgbaston GB - B15 2TT Birmingham

## Report

The aim of the proposal was to image the skulls of exceptional three-dimensionally preserved early teleost fossils in order to better understand phylogenetic relationships and macroevolutionary patterns. We successfully imaged 34 specimens during this experiment, using 3 different detector setups (generating data with 8, 12 and 20  $\mu\text{m}$  voxel size respectively), for a total of 676 scans.

The experimental plan had to be adjusted during the experiment as the sample stage suffered a hardware failure. As a result, the translation motor which is used to move the stage laterally could not be used, making it impossible to perform so called half acquisition computed tomography, where an offset is applied on the centre of rotation to double the reconstructed field of view. This problem was circumvented for the most critical specimens, performing 2 acquisitions side by side that were concatenated later.

To prepare the data for computed tomography reconstruction, the position of the centre of rotation has to be indicated. Unexpectedly, this process that is normally automatised, had to be done manually for most of the datasets acquired after the sample stage failure. This extra step delayed the reconstruction of the data by several weeks. Once this was finally done, we proceeded with the other steps, comprising the tomographic reconstruction and any data processing necessary to correct for potential artefact (e.g., ring correction). Further IT hardware issues on the part of the users caused further delays, and the transfer of all datasets was completed in Spring 2022.

During the data processing, datasets representing the same specimen had to be merged: as the specimens were much larger than the vertical field of view (i.e., vertical beam size of 4 mm), each specimen required between 4 and 65 scans to cover it completely.

As mentioned above, a lateral concatenation was necessary for 3 of the specimens: the right and left side of these specimen were scanned separately and had to be merged to create a single dataset that could be studied. Tools to perform this process were existing at the ESRF but required some hands-on processing to achieve the desired results.

Processing of the data was delayed due to ill health and subsequent leave of a project team members, so analysis and description of the data is still ongoing. As segmentation of fossil data is time consuming and will take several months to complete, the details of the confidential data are omitted. However, data from ESRF scans will form the bulk of at least two thesis chapters for Jake Atterby's PhD. These scans have produced significant results relating to the braincase and endocast, as well as unprecedented insight into tooth histology. The data will also contribute to at least five distinct manuscripts: two on anatomy and relationships of early teleost groups, one on exceptional soft tissue preservation, one on dental morphology, and one on early vertebrate relationships. Other datasets will support undergraduate research projects in the next academic year.

Scanning of four specimens of the late Permian taxon *Acentrophorus* was ultimately unsuccessful. This was largely due to a lack of contrast between the fossil and the matrix, and also the highly compressed nature of the specimens. As a result, these scans yield very little insight into the anatomy of *Acentrophorus* and are unlikely to be segmentable or publishable. Scans of some specimens also revealed that internal structures were not preserved and therefore the material is not suitable for further study

