EUROPEAN SYNCHROTRON RADIATION FACILITY

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 via the User Portal:
https://wwws.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 form 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

- 1st March Proposal Round - **5th March**
- 10th September Proposal Round - **13th 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.

ESRF	**Experiment title:**	**Experiment number**:
Beamline: ID19	**Date of experiment**: from: 03 February 2018 to: 05 February 2018	**Date of report**:
Shifts: 6	**Local contact(s)**: Vincent Fernandez	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Dr Roger Benson*, University of Oxford

Dr Stig Walsh*, National Museums of Scotland

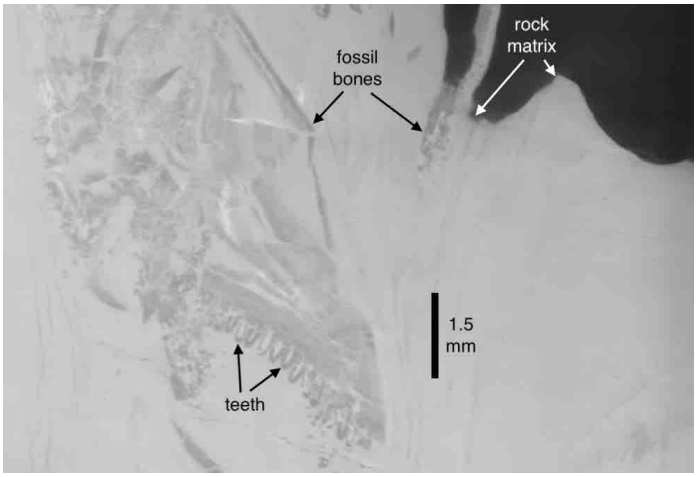
Report:

We brought two fossil specimens of transitional early land vertebrates from the Early Carboniferous: *Westlothiana lizziae* (NMS G.1990.72.1), and the only specimen of *Casineria kiddi* (NMS G.1993.54.1). These animals document evolutionary stages of adaptation to live on land and their skeletons are preserved within rock matrix, receiving only superficial study so far (Smithson 1989; Paton et al. 1999). The goal of the experiment was to visualise their anatomy of these important fossils in 3D, using high resolution phase-contrast tomography, and use that information to understand the origin of land vertebrates. We were allocated six shifts, having requested nine, due to a highly competitive round of proposals.

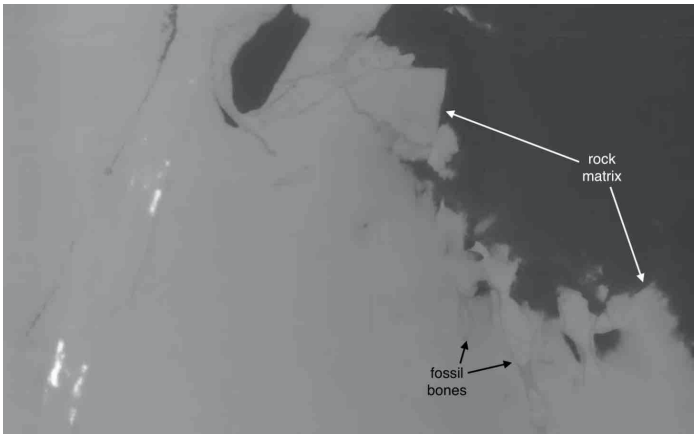
The experimental setup aimed for a resolution of 8.95 microns for both specimens, and we were able to rapidly achieve a good configuration that gave clear tomograms separating fossil bone from rock matrix, thanks to the assistance and experience of our local contact. Each specimen was scanned in multiple, overlapping regions of interest (15 for *Westlothiana*; 22 for *Casineria*), that were then stitched together to make a single image volume using scripts wirtten by our local contact.

We received the data in April 2018 and established they are of high resolution and quality. Segmentation and anatomical interpretation form the basis of a NERC (UK research council) PhD research project started by Mr Ben Igielman in October 2019. Progress is very strong, and the student has largely complete reconstruction of the skull anatomy of *Westlothiana*, and parts of the skeleton of both *Westlothiana* and *Casineria*. Example images are presented on the next page.

Currently expected outcomes include a PhD thesis and mutliple publications describing the fossil specimens and their implications for the evolutionary transition to life on land in vertebrates.



Close-up example from tomogram of *Westlothiana* showing excellent resolution and contrast between bone and matrix.



Close-up example from tomogram of *Casineria* showing excellent resolution but poor contrast between bone and matrix, probably due to the effects of metamorphism on the specimen.