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:** The emergence of mammalian physiology: life histories inferred from dental parameters of the gomphodonts	**Experiment number**:
Beamline: BM05	**Date of experiment**: from: 9 September 2020 to: 10 September 2020 from: 31 October 2020 to: 02 November 2020 from: 12 December 2020 to: 13 December, 2020	**Date of report**: August 25th, 2021
Shifts: 9	**Local contact(s)**: Paul Tafforeau Kudakwashe Jakata	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Jonah N Choiniere, University of the Witwatersrand
Roger BJ Benson, University of Oxford
Elsa Panciroli, University of Oxford
Elis Newham, University of Bristol

Report:

In this experiment, we sought to image cementum increments in serial dentition of several species of South African gomphodonts. The goal in collecting these data is to investigate the evolution of physiology and tooth replacement patterns around the origins of mammals. We were able to scan the following species in our experiment: *Massetognathus, Diademodon, Trirachodon, Procynosuchus,* and *Scalenodontoides*. Together, these species bracket the early and late evolution of gomphodonts, which represent an independent origin of herbivory with complex dental occlusion along the line leading to mammals.

The experiment was complicated by the COVID-19 lockdowns in South Africa and France. We were able to ship the specimens to France via Kudakwashe Jakata, who left employment at the University of the Witwatersrand to take up a postdoctoral fellowship at the ESRF. Scanning was done over several sessions when lockdown regulations would allow by Paul Tafforeau and Kudakwashe Jakata, and monitored remotely by Jonah Choiniere and Roger Benson. Imaging the specimens was complicated in part by the high resolutions required (1-5 microns), by the large size of the samples (up to 15cm-long skulls with teeth embedded in rock matrix as well as within the tooth row of the skulls), and by the complexity of locating the positions of serial teeth within a skull with small focal areas. However, the preliminary results were promising and suggest that we obtained useable data.

We took receipt of fully reconstructed data in early 2021. These data were intended to form the basis of the postdoctoral fellowship of Elsa Panciroli, but COVID-related issues in the timing of the experiment and the

nature of the fellowship indicate that Jonah Choiniere and Roger Benson will conduct the research on the experimental data separately.

Analysis of the data has not yet started. We anticipate a start date of October, 2021, with no predictable date for publication of our findings.