EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

ESRF

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

Reports supporting requests for additional beam time

Reports can 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:** Fibrolamellar tissue of sauropod bones and recent heavy mammals: hierarchical study of vascular and cells structure and their influence in loaded cortical bone.	**Experiment number**: EC-939
Beamline: ID19	**Date of experiment**: from: 25/05/2012 to: 28/05/2012	**Date of report**: 24/02/2016
Shifts: 9	**Local contact(s)**: Paul Tafforeau	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Maitena Dumont*, Department of Organismal Biology, Uppsala University, Norbyvägen 18A, 752 36 Uppsala, Sweden

Report:

Experiment:
The aim of the experiment was to do a series of scans on an ontogenic series of sauropod bones core drill. Two different resolution size were chosen: 3.5 and 1.5µm to visualize respectively the vascularization and the cells in the bones.

Preliminary results:
The experiment permit to:

1) Visualize qualitatively the vascularization in sauropod (**Fig. 1A, B**) at the two different resolution. The 3.5µm permit to visualize the vascularity along all the bone cortex. Different regions of interest through the bone cortex were selected and scanned at a 1.5µm resolution size

2) Visualize the bones cells (osteocyte lacunae) in the different taxa studied and quantify their volume and density (**Fig. 1C**).

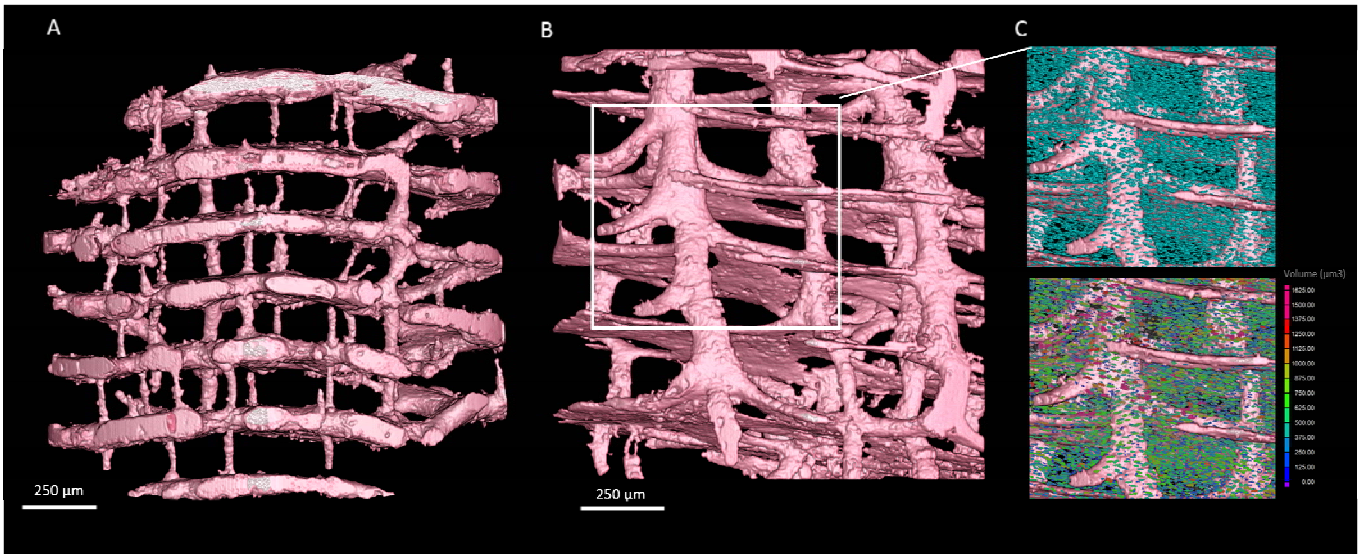

Figure 1: Virtual 3D of the vascularization of a juvenile sauropod bone (A) compared to an adult one (B). (C) the osteocyte lacunae (cells of the bone) in blue were segmented and their volume analysed.

3) Quantify the vascularization segmented in the taxa studied: size, orientation (**Fig. 2**).

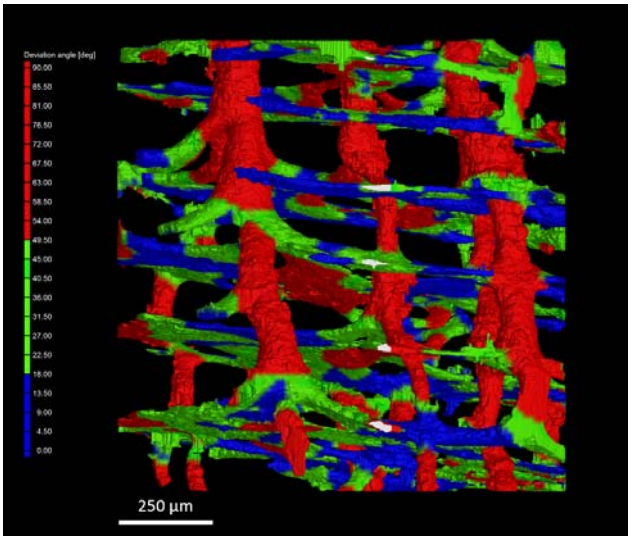

Figure 2: Virtual 3D reconstruction of the vascularization in an adult sauropod bone and corresponding vascular orientation analysis; radial canals are in red, longitudinal ones in blue, and oblique ones in green.

Congress abstract:

Results will be presented at the ICVM-11 (*International Congress of Vertebrate Morphology*)in Washington USA (29th June to 3rd July)

Maïtena Dumont, Anthony Herrel , Paul Tafforeau, Sophie Sanchez. Walking with giants: is the cortical bone structure and vascularization adapted to load bearing in large terrestrial vertebrates?

The cortical bone of long bones is perforated by vascular canals. This interconnected network is an integral component of the bone microstructure and undergoes continual change throughout life. Bone remodelling will affect the vascular organization, i.e. its size, volume and orientation. The external loads experienced by the long bones will shape the cortical microarchitecture. Sauropods are an ideal group to study this question because of their great body mass and late ontogenetic remodelling. We used propagation phase-contrast synchrotron microtomography to precisely characterize and quantify the vascular cortex organization of the long bones of sauropods in 3D. The vascular volume, orientation, and connectivity were used to understand the impact of growth and bone remodeling on bone integrity. Sauropods present in their early stages of development, a peculiar laminar vascular organization made of longitudinal "plates". This organization is kept in periphery at the adult stage where a decrease of the cortical porosity goes along with a narrowing of the longitudinal plate and a consecutive enlargement of the radial canals. The late bone remodeling observed in adult sauropods results in a reduction of the canal size and generates a more tubular longitudinal architecture, similar to large mammals' long bone.

These vascular organization are discussed in a growth development and mechanical perspective.

Awards and funding obtained to perform this research:

- 2015: Young researcher award from the 'Fondation des Treilles" France. Research award obtained for the project entitled "Walking with giants: the 3D organization of the limb long-bones in giant terrestrial vertebrates" 10 Keuro.
- 2016 to 2017: Wenner-Gren Foundation one year postdoctoral fellowship (Sweden), to work further on synchrotron data at Uppsala University with Dr. Sophie Sanchez, for analysing the vascularization of large terrestrial tetrapods (sauropods and extant mammals) (**Fig. 1 & 2**)