ESRF	**Experiment title:** Very high spatial reconstruction (1 micron) microtomography of bone micro structure	**Experiment number:** LS 876
Beamline: ID19	**Date of experiment:** from: 01/04/98 to: 03/04/98	**Date of report:** 1 sept 98
Shifts:	**Local contact(s):** Jose BARUCHEL	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Françoise PEYRIN*, CREATIS, INSA & ESRF
Murielle SALOME*, CREATIS, INSA & ESRF
Anne-Marie LAVAL-JEANTET, CREATIS, INSA
Peter CLOETENS*, ESRF & EMAT, RUCA, BELGIUM
Wolfgang LUDWIG*, ESRF
Stephane BONNET*, CREATIS INSA
Jennifer BARTHES*, ESRF

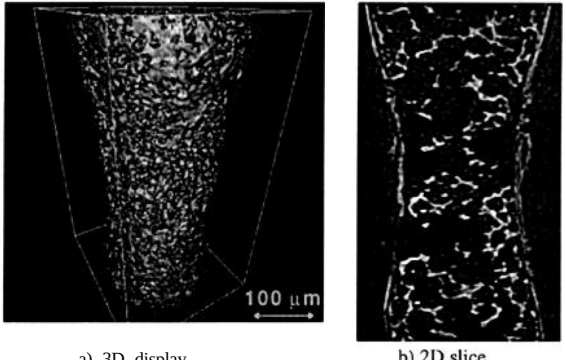
Report:

The purpose of this work was to study the feasibility of 3D bone architecture imaging at very high resolution from 3D Synchrotron Radiation Computed MicroTomography (SR CMT) at ESRF.

We used the Synchrotron Radiation Computed MicroTomography device implemented on ID 19. The system includes a double crystal, fixed exit monochromator, a rotation stage for the sample, and a 2D detector based on a Gd202S:Tb scintillator screen and the Frelon CCD camera. For micron level imaging, the detector was up graded by using a YAG:Ce crystal, and microscopy optics (magnification 10, numerical aperture 0.3). Under these conditions, the pixel size in the recorded images was 1.8 micrometers. The energy was set to 18 keV. The exposition time for each projection image was 35 sec., so that the total number of projections per sample was limited to 600 or 450 (total acquisition time per sample from 4 to 6 hours). Both absorption and phase imaging were performed. For phase imaging, the detector was set at 350 mm from the samples.

Three lmm thick bone samples were examined. Two were cut in a cortical femur rat cortical part (sample from Dr. A.M. Laval-Jeantet), and one was a metacarpal bone of mouse fetus prepared for a space experiment (sample from Dr. J. Van Loon, Amsterdam).

This later was imaged using the phase mode. Figure la) represents a 3D display obtained by ray-tracing after triangulation of the external surface. The voxel size in the 3D reconstructed images is 1.8 micrometers in the three directions of space. Figure lb) shows a slice through the sample perpendicular to the tomographic planes. From a detailed inspection of the volume, the characteristic features of bone growth may be identified. Although trabeculae are only mineralized cartilage at this stage, they are clearly apparent. These images will soon be compared to microscopy.



a) 3D display b) 2D slice

Figure 1 : Metatarsal mouse fetal bone sample; image size 170x145x270

Thus a spatial resolution at the micron level achievable by SR CMT should be especially well suited to experimentation's using rats or mouse in view of understanding the mechanisms of osteoporosis or evaluating the effects of treatments. Furthermore the images obtained from the others samples also show the potentialities of this resolution for a fine analysis of bone structure. The distribution of osteocytes is clearly visible. Using a lower energy and absorption images should allow to study bone calcification and the distribution of remodeling zones.