	Experiment title: Disrupted tooth formation: Chromosomal abnormalities in Turner Syndrome and the effect on tooth mineral arrangement imaged by energy dispersive Laue diffraction	**Experiment number**: **LS-2672**
Beamline: BM28	**Date of experiment**: from: 20.07.2017 to: 26.07.2017	**Date of report**: 25.02.2020
Shifts: 18	**Local contact(s)**: Didier Wermeille	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Helga Lichtenegger

Institute of Physics and Materials Science, BOKU Vienna, Austria

Maisoon Al-Jawad*

Dept of Oral Growth & Dev Medical Sciences, Queen Mary University, London, UK

Laszlo Vincze

Department of Analytical Chemistry, Ghent University, Ghent, Belgium

Pieter Tack*

Department of Analytical Chemistry, Ghent University, Ghent, Belgium

Tilman Gruenewald*

ID13, ESRF, Grenoble, France

Harald Rennhofer

Institute of Physics and Materials Science, BOKU Vienna, Austria

Wim Bras

BM26, ESRF, Grenoble, France

Ella de Pauw*

Department of Analytical Chemistry, Ghent University, Ghent, Belgium

Asadullah Rathore*

Dept of Oral Growth & Dev Medical Sciences, Queen Mary University, London, UK

Report:

Summary:

The experiment aimed at investigated the impact of the genetic syndrome Turner syndrome (TS) on the crystallographic texture of hydroxylapatite in teeth. This experiment aimed in understanding how the crystalline arrangement in teeth is influenced by the TS and compared healty teeth. In order to map out the complex textural arrangements in teeth, we used the recently established method of energy dispersive Laue diffraction (EDLD) as it allows to capture a considerable portion of the 3D reciprocal space in one shot without sample rotation and high spatial resolution. We were able to obtain a complete dataset of TS affected teeth at various developmental stages as well as the healthy teeth control group. Due to the experimental nature of setup of the setup and detection scheme, we experienced some problems with the alignment which rendered the beam time in total less efficient.

Samples and setup

Setup

This experiment is the second time we used the highly experimental white beam setup at BM28. We could improve the design of the setup considerably by introducing a motorized collimation scheme as well as a more optimized detector positioning strategy. In brief, the experimental setup required using the white beam from the BM28 bending magnet and its collimation with three pairs of slits, to avoid excessive heat load on a single element. Further downstream, the sample illumination was defined with a pair of Huber collimation slits and excessive air scattering was reduced by using the combination of a 100 µm top hat pinhole with an integrated collimator glued to it. This collimator was placed about 1 mm upstream of the sample. The sample was mounted on a specfically designed sample holder for flat samples and was moved by the scanning motors of the diffractometer. A 200 µm gold beam stop, mounted inside a kapton half-sphere was mounted directly down stream (less than 500 um), downstream of the sample and the detector was placed immediately after the kapton sphere in order to maximize the covered diffraction angle.

The detector was mounted on the BM28 diffractometer arm with a custom-made adaptor plate.

The detector was an energy dispersive 2D energy dispersive detector (SLCam), supplied by the user group.

The detector was integrated into the SPEC scanning scheme by sending an external trigger to the data acquisition system. Although this solution incured some seconds overhead per scan point, it allowed for a robust interfacing between the beamline and the detector.

Samples

The sample set contained two first mollars from Turner syndrome affected patients as well as a set of matched control teeth. The teeth were cut vertically and prepared as thin, polished sections of about 30 µm thickness.

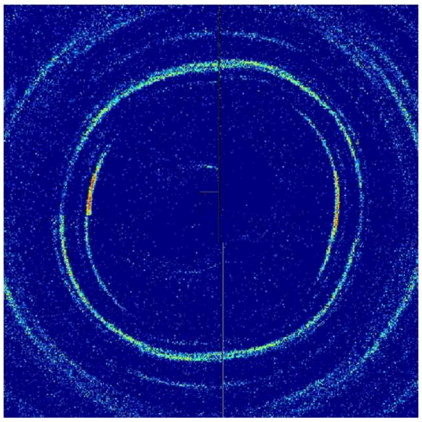

Figure 1: Diffraction pattern of enamel from the 10 keV channel. Note that the non-perfect alignment of the diffraction patterns before integration accounts for distorted diffraction rings, an effect that will be corrected by the data treatment.

Principal outcome

The experiment proved to be more difficulat than last time in terms of alignment. The white beam could be obtained very easily but aligning the setup, especially the last pinhole took us considerably longer than anticipated but we finally suceeded.

In turn, this means that we were only able to obtain data on two samples (one mesh and line scan as well as a line scan on a reference sample). Despite not being ideal in terms of statistics, the data set should provide us with sufficient information to proceed with the data analysis and eventually, a publication.

Conclusions and further proceedings

In conclusion, we were able to obtain enough data to answer questions on the texture and crystallographic development of teeth affected by turner syndrom. The development of the data processing routines is taking considerably more time than anticipated but approaches to treat the data have been indentified.
Pending successful data processing, we anticipate to publish a scientific paper on the results.
We want to acknowledge the critical support from our local contact and the whole BM28 team during the beam time and in the preparation of it. We are very grateful for their help and willingness to host such an invasive experiment.