

**Project name:** Synchrotron x-ray microtomography study of iron ore pellets

**BEAM-TIME APPLICATION (Project) REPORT**  
**dd.mm.yyyy - dd.mm.yyyy** *(Date of the report to be added)*

**General information**

<b>Name of the rapporteur</b>	<b>Name of the rapporteur's organisation</b>
Dr. Fredrik Forsberg	LKAB
<b>Type of research (nanotechnology/health care/chemistry etc.)</b>	<b>Name of the research facility</b>
Mineral processing, Iron making	HZG/PetraIII/HEMS
<b>Date of the measurement, duration</b>	<b>Location of the event</b>
16-17 May 2013	Hamburg, Germany (DESY/HZG)
<b>National Industrial Liaison Officer from rapporteur's country participating in the measurement</b>	
<i>Dr. Marc Thiry (...although not from the rapporteur's country)</i>	

**Description of the project**

<b>Research description (short summary as written in the application)</b>
<p>The oxidation from magnetite to hematite at temperatures around 1000 °C is a fundamental reaction for the iron ore industry. It both ensures sufficient permeability due to the physical changes in the structure of iron ore pellets and supplies a considerable amount of the heat necessary for the process, due to the exothermic nature of the reaction.</p> <p>Earlier studies with X-ray tomography have shown that it is possible to characterize the crack networks in pellets under reduction.</p> <p>We propose a time-resolved X-ray tomography study where single pellets are studied at 3 temperatures (900, 1100, 1250 °C) in air (or in an atmosphere with controlled content of oxygen). The heat treatment should preferably be 20 minutes long with as many scans as possible during this period. The objectives should be to detect cracks and structural changes in the pellet structure and if possible, characterize the phase transformation itself from the density differences between magnetite (5,17-5,18 g/cm<sup>3</sup>) and hematite (4,95-5,16 g/cm<sup>3</sup>).</p>

**Summary of activities (experiments performed, beam-time used, preliminary overview of results, next steps and other relevant information)**

A small size iron ore pellet, with diameter 4.5 mm, were scanned two times – before and after heat treatment in furnace, at 1000 deg. C for 20 minutes. At the time there was no in-situ furnace stage available at the beamline so the sample had to be removed and placed in a standard furnace between the scans, which is not optimal since the cooling of the samples in air might give rise to variations in chemical composition and structure which might disturb the analysis. Although the set-up was not optimal, the study will still give important information regarding the impact the heat treatment has on the internal structure, given this temperature and duration. In the future however it would be of interest to perform a similar study using an in-situ furnace stage.

Due to technical problems at the beamline there was not possible to perform any experiments the first day (16 May). However, thanks to a lot of hard work from the staff, the system was up and running the next day (17 May). The complete study was hence performed during this second day.

From the initial analysis that have been carried out on the results from the two scans it is hard to draw any conclusions. It is hard to see any differences between the structure before and after the furnace process. We haven't yet been able to compare specific features or regions within the data sets, due to large rigid body rotations between the two scans, which is a result of the fact that the sample was removed between the scans. Hopefully this can be solved with appropriate software.

Unfortunately all the reconstructed slices from both of the two scans contain severe artefacts, which deteriorate the results. This has most likely to do with a non-symmetric beam profile during the scans. This was never detected or corrected during the actual scans, probably due to the tight time schedule and the technical problems that occurred.

**How would you describe cooperation and assistance from national contact points while preparing and carrying out the research at large scale facilities?**

They have been of great help.

**Other personal remarks**

**Annexes**

**Annexes**

(list of annexes; meeting minutes, graphical illustrations, tables and other supplementary data)