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:** Simultaneous high magnification phase imaging and scanning X-ray fluorescence imaging of human erythrocytes: influence of malaria infection and hemoglobin abnormality	**Experiment number**: SC 4468
Beamline: ID 16a	**Date of experiment**: from: 22.06.2017 to: 27.06.2017	**Date of report**: 26.02.2018
Shifts: 15	**Local contact(s)**: Yang Yang	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

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Report:

The primary goal of the proposed experiment is to unravel how the hemoglobin abnormalities (HbAS, HbAC) influence the fine structures on/inside plasma membranes and the accumulation of hemozoin (crystallites of hemoglobin enriched with Fe) in the disease state using a combination of magnified phase imaging and scanning X-ray fluorescence at ID16A.

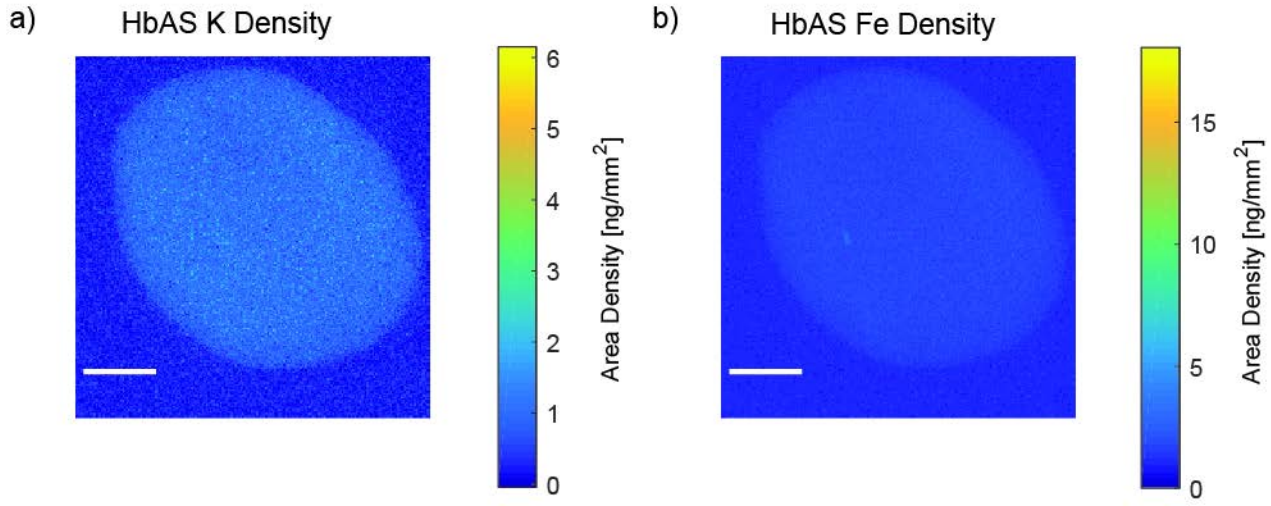

Figure.1 Elemental densities of a) potassium and b) iron determined for an uninfected HbAS (Pixel Size 50 nm, Scale bar 2µm)

As a reference, we obtained 2d elemental distributions of uninfected red blood cells of the wildtype HbAA and the hemoglobinopathies HbAS and HbAC using a 17 keV monochromatic X-ray beam setting the scanning step size to 50 nm. Figure 1depicts the elemental densities of potassium and iron measured for an uninfected HbAS cell, revealing a homogenious distribution of elements throughout the RBC cytoplasm.

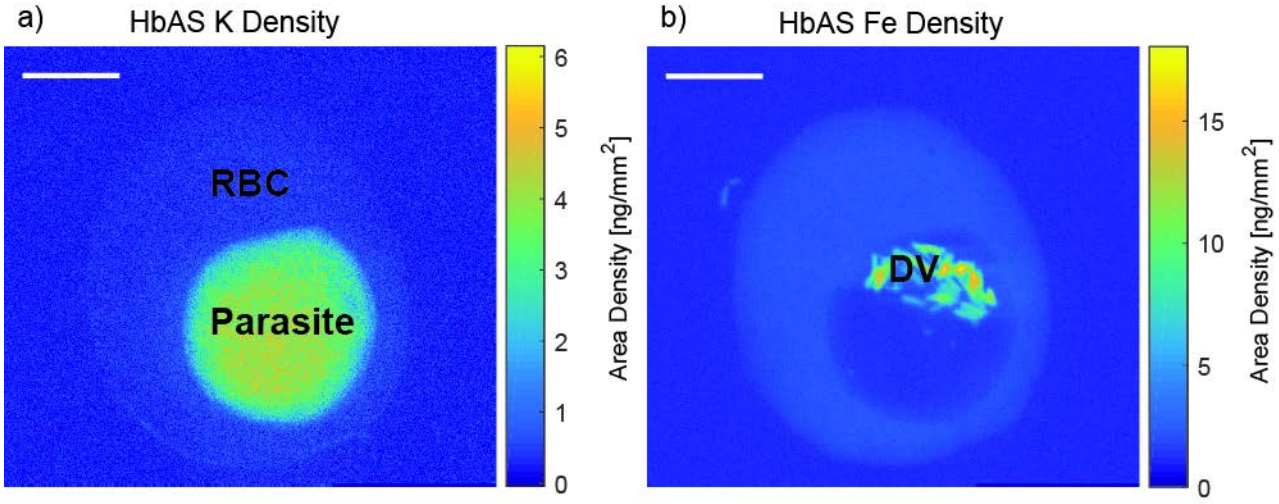

Figure.2 Elemental area densities of a) potassium and b) iron determined for an infected HbAS (Pixel Size 25 nm, Scale bar 2µm).

To investigate the fine structures appearing in infected cells the minimal stepsize of 25 nm was used. The corresponding elemental maps reveal among others the active pumping of potassium into the parasite occupied area (Figure 2a) and the formation of hemozoin crystallites in the digestive vacuole (DV) (Figure 2b). To obtain additional spatial information, 3-D tomographs were obtained by successively recording 2d phase contrast images and stepwise rotating the sample covering a total of 180° with 2000 steps. Main contrast is provided by the different concentrations of iron in the RBC. Hemozoin crysallites appear as contrast rich black rods

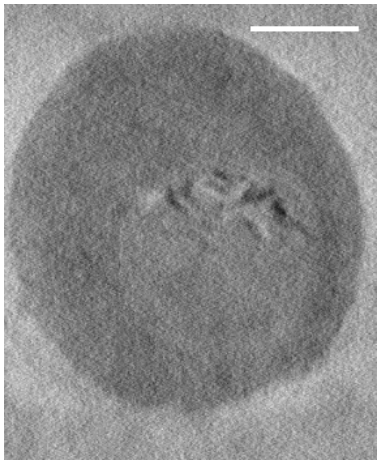

Figure.3 Single reconstructed phase contrast image of the infected HbAS cell presented in Figure 2. (Scale bar 2µm)

To quantify the differences among the hemoglobinopathies further data analysis is required, including the elemental distributions of sulfur and phosphor.