ESRF	**Experiment title**: High resolution Mossbauer spectroscopy of iron-nickel meteorites: exploration of magnetic remanence carriers from the early Solar System	**Experiment number**: ES-387
Beamline: ID18	**Date of experiment**: from: 22.03.2016 to: 25.03.2016	**Date of report**: 09.09.2016
Shifts: 9	**Local contact(s)**: Rudolf Rueffer rueffer@esrf.fr	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Roberts Blukis, Department of Earth sciences, University of Cambridge

Dr Richard Harrison*, Department of Earth sciences, University of Cambridge

Report:

The experiment was highly successful. In 3 days (9 shifts) of beamtime provided 69 spectra were obtained from 3 different meteorite samples: Esquel pallasite, Tazewell IIICD iron and Estherville mesosiderite. 56 of these obtained from the first two samples are going to be used in a publication titled "A high spatial resolution synchrotron Mössbauer study of the Tazewell IIICD and Esquel pallasite meteorites". Publication is currently in pre-publication stage for final edditing before submission. The abstract is attached below.

ABSTRACT

Metallic phases in the Tazewell IIICD iron and Esquel pallasite meteorites were examined using ^{57}Fe synchrotron Mössbauer spectroscopy. Spatial resolution of ~10-20 μm was achieved, together with high throughput, enabling individual spectra to be recorded in less than 1 hour. Spectra were recorded every 5-10 μm, allowing phase fractions and hyperfine parameters to be traced along transects of key microstructural features. The main focus of the study was the transitional region between kamacite and plessite, known as the 'cloudy zone'. Results confirm the presence of tetrataenite and antitaenite in the cloudy zone as its only components. However, both phases were also found in plessite, indicating that antitaenite is not restricted exclusively to the cloudy zone, as previously thought. The confirmation of paramagnetic antitaenite as the matrix phase of the cloudy zone contrasts with recent observations of a ferromagnetic matrix phase using X-ray photoemission electron spectroscopy. Possible explanations for the different results seen using these techniques are proposed.

This study was aided by SEM images obtained previously to assist in finding relevant areas for examining with X-rays as there was no system in place to directly observe sample and the area illuminated by X-rays during the experiment. After experiment SEM images (Fig. 1.) were used to confirmed the right areas have been measured by observing that the relation between obtained spectra (Fig. 2.) and position of known features in SEM images are logical. The green bars (Fig. 1.) correspond to line profiles obtained by measuring a spectrum every 5-10 microns. Orange circles represent positons of spectra shown in Fig. 2. The result after fitting spectra in profile 1 is shown (Fig. 3.) together with simulation data.

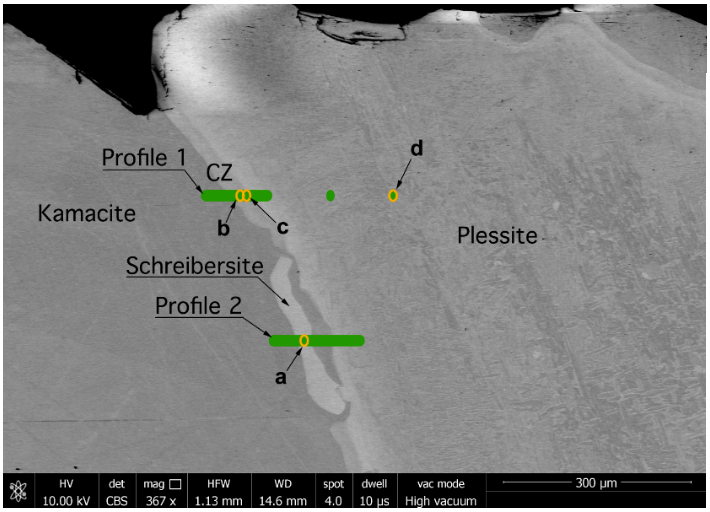

Fig. 1.

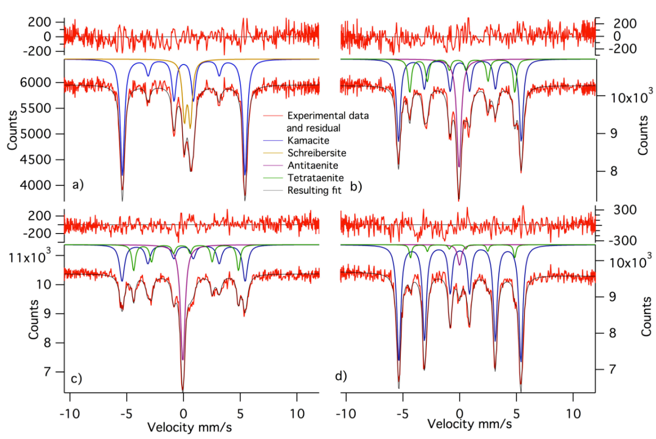

Fig. 2.

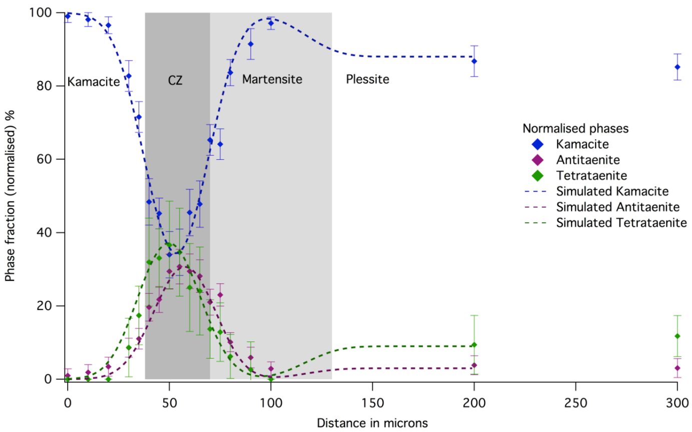

Fig. 3.

The same research outlined above is also going to be presented on a poster in 2016 AGU Fall meeting.
The data from 13 spectra obtained from Estherville mesosiderite is going to be used in a separate publication that is currently in early draft stages.