ESRF	**Experiment title:** In-situ analysis of extraterrestrial particles by X-ray microfluorescence	**Experiment number**: CH741
Beamline: ID22	**Date of experiment**: from: 25 January 00 to: 1 February 00	**Date of report**: 27/03/00
Shifts: 18	**Local contact(s)**: Alexandre SIMIONOVICI	*Received at ESRF:*

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CH741 was performed as a continuity of experiment CH547 (November 1998), with the idea of using line ID22 to analyse in-situ grains trapped inside low density (d < 0.1) polymer foam collectors, exposed outside the MIR station for nearly one year (PIE experiment). The goals of this second run of analyses were to locate the grains, that are mainly in the 1 µm - 10µm size range, inside the collectors and try to discriminate between orbital debris and particles of extraterrestrial origin by compositional criteria. As the experiment took place in January of this year, its interpretation is not yet fully achieved and we only give very rough conclusions.

During our 18 shifts, we performed a 2D (vertical and horizontal) mapping of 6 foam samples (size of each sample : 20x25x13 mm^3), using a large monochromatic beam (100 to 200 µm in size, at 14 keV), that allowed us to give the positions of the trapped grains, as well as their fluorescence spectra for Z > 18. For some grains, we better identified the particle with mappings by steps of 1,5 by 5 microns performed with a microbeam obtained by using a FZP lens of large acceptance. In particular, in-situ Fe-XANES spectra could be obtained.

A preliminary result is that the discrimination between orbital debris and extraterrestrial particles, that is one of the goals of the in-situ Xray µfluorescence experiments, is not so straightforward as it appeared in the previous experiments. For most grains, no clear origin can be anticipated and only large families of grains can be suggested: low Z grains, nearly pure Fe grains, Fe rich grains, etc... Of course, this has to be refined, once the spectra will be analysed. The main criterion for inferring an extraterrestrial origin for a grain is that it shows a « chondritic composition », as measured in what are called the chondritic meteorites, originating from the least differentiated objects of the Solar System, and characterized, for example, by a Fe/Ni ratio of ~ 18. By analysing individual grains originating of the Murchison carbonaceous chondrite, that were implanted in a piece of foam identical to the PIE foams, we showed that this ratio could vary by more than a factor of 3, and, thus, could not be taken as an unambiguuous signature of an extraterrestrial origin of an individual grain.

As suggested in the previous report, we tentatively showed during this run that in-situ identifications are alltogether possible for grains trapped in low density material, not only the foam used in this PIE experiment, but also in other low density materials, like the expanded silica-aerogel of the STARDUST mission (successfully launched in February 1999 by NASA, it will bring back, in 2006, cometary grains of the comet Wild 2, trapped in aerogel of density ~0.06). For that, we selected a few grains, on which mappings by steps of 1,5 by 5 microns were performed, using a FZP lens of large acceptance, coupled with a few microns large pinhole installed in front of the sample. Apart from the precise localization, at less than 10 microns in each direction, and elementary distribution obtained for some elements, that were obtained without too many difficulties, we also performed Fe-XANES experiments in-situ the foam. The information that can be obtained is related to the chemical bound of that element in the grain and our experiments show that such an information can indeed be obtained for trapped grains. For that we compare the spectra obtained with those of given standards (of course outside the foam). A very preliminary result is that XANES spectra can be obtained in-situ and variations observed from grain to grain. Much more work is needed in order to extract conclusions from our observations and completely interpret our data.

Our results have major implications concerning the extraterrestrial dust collection techniques and the possibility to analyse extraterrestrial grains trapped in a low density matrix ; in particular, they show that ESRF µbeams will play an important role in the future analyses, as they are likely to provide an essential tool for a high resolution, non destructive, in-situ analysis. For some of the trapped grains, either too small (≤ 5 µm) or too « fluffy » to be extracted, they might represent the only investigation tool accessible for analysis.

This work is submitted to Planetary and Space Science.