	Experiment title: Supercritical microfluidic study for CO2 geological storage	**Experiment number**: **EV-132**
Beamline: ID19	**Date of experiment**: from: 15/07/2015 to: 17/07/2015	**Date of report**: 02/09/2016
Shifts: 6	**Local contact(s)**: Lukas Helfen	*Received at ESRF:*

Names and affiliations of applicants (*indicates experimentalists):
MORAIS Sandy (ICMCB)*
MARRE Samuel (ICMCB)*
BERNARD Dominique (ICMCB)*
DIOUF Abdou Khadre (ICMCB)*

Report:

In spite of the serious electrical shutdown that occurred the 14th of July, we've been able, thanks to the scientific and technical staff of ESRF, to use efficiently the allotted shifts.
As proposed in the proposal we scanned two kinds of microfluidic devices: (i) devices with a static geometry (for fluid flow and inert tracer transport studies) needing a single mosaic-scan and (ii) a device with a dynamic geometry (for reactive fluid flow studies) requiring various scans at different times. We acquired a mosaic of 44 scans for the static geometry, 3 scans of the microfluidic device without reactive particles, and 18 scans corresponding to two reactive flow experiments. ***Unfortunately, for a still unexplained reason, it has been impossible to reconstruct correctly a single volume from these data sets.*** L Helfen worked hard on this problem looking for adapted reconstruction methods, but unsuccessfully. A test performed in December 2015 with an empty microfluidic device produced a data set for which no problem of reconstruction occurred. Consequently, the problem was not linked to the samples properties. A new experiment has been scheduled for April 2016.

The microfluidic device with its connexion bloc (Fig. 1) has been placed on a sample holder machined at ICMCB after discussion with the local contact (Fig. 2).

On the projections CO_2 bubbles and needle shape particles were visible (Fig. 3) indicating some possible experimental problems.

All the reconstruction methods gave 3D results like the one presented Fig. 4 and 5. Horizontal sections (i.e. in the plane of the microfluidic device) were partly blurred, but informative (needle shape particles are clearly visible). Looking at perpendicular sections (Fig. 5) the reconstruction problem clearly appeared: Presented images correspond to sections through the microfluidic device in the planes indicated by the black lines. The 3D volumes were unusable.

This problem existed for the reactive flow experiments, but also for the static case as shown Fig. 6 and 7. The test performed in December 2015 gave good results as shown Fig. 8 (reconstruction with only 25% of the projections).

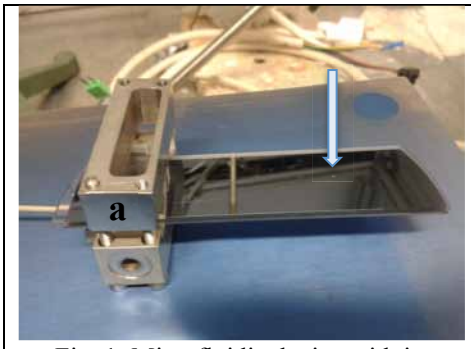

Fig. 1: Microfluidic device with its connexion bloc (a). The zone to scan is the small white dot indicated by the arrow.

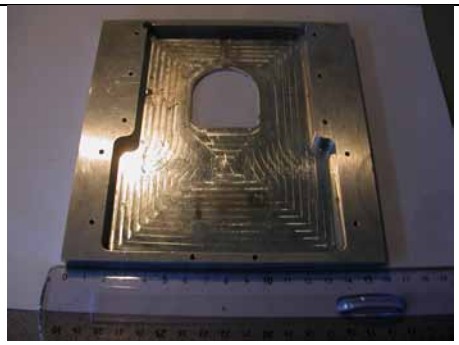

Fig. 2: Sample holder machined at ICMCB.

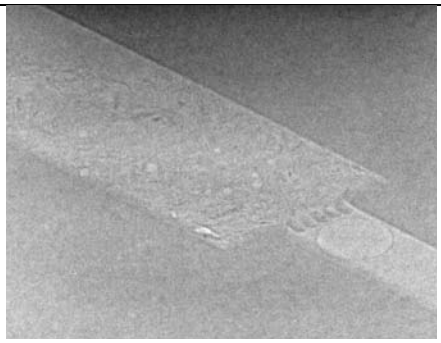

Fig. 3: A projection with a crude flat field correction.

Fig. 4: Horizontal section of a 3D volume reconstructed from a set of projections like the one presented Fig. 3.

Fig. 5: Sections of the reconstructed 3D volume perpendicular to the section presented Fig. 4.

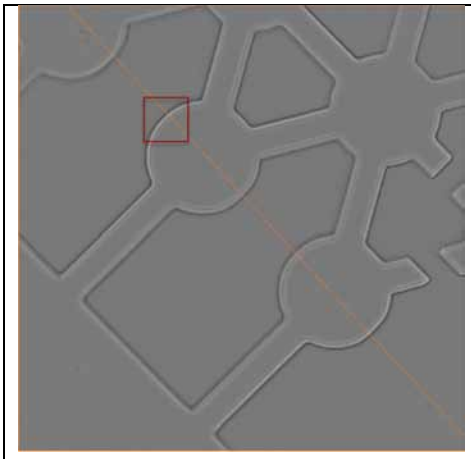

Fig. 6: Horizontal section of one of the 3D reconstructed volumes composing the 4 x 11 acquired mosaic.

Fig. 7: Zoom on a section perpendicular to the section presented Fig. 6 of the micro fluidic device (orange line) showing the limits in the red square.

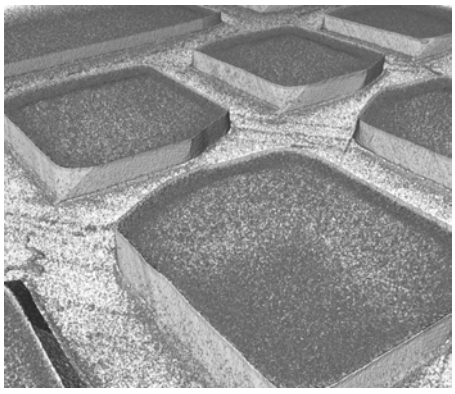

Fig. 8: 3D reconstruction from the data acquired in December 2015 as a new test.