

Introduction

Context

- Formation of gas hydrates in oil and gas pipelines

Objectives:

- Study the influence of GLL flow pattern on hydrate formation and plugging
- Detect agglomeration and deposition over time and space
- Test an anti-agglomerant additives

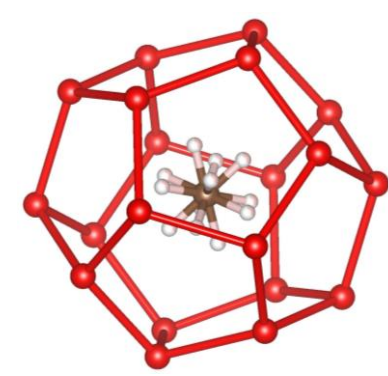


Figure 1 - Cage S1 (WordPress, 2018).

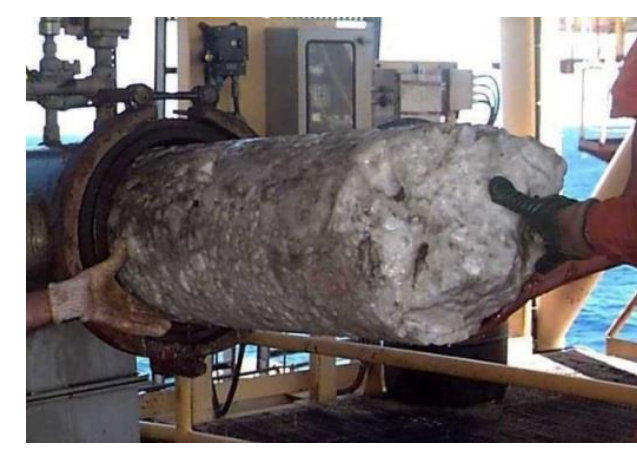


Figure 2 - Hydrates removed from a pipeline during a cleaning operation.

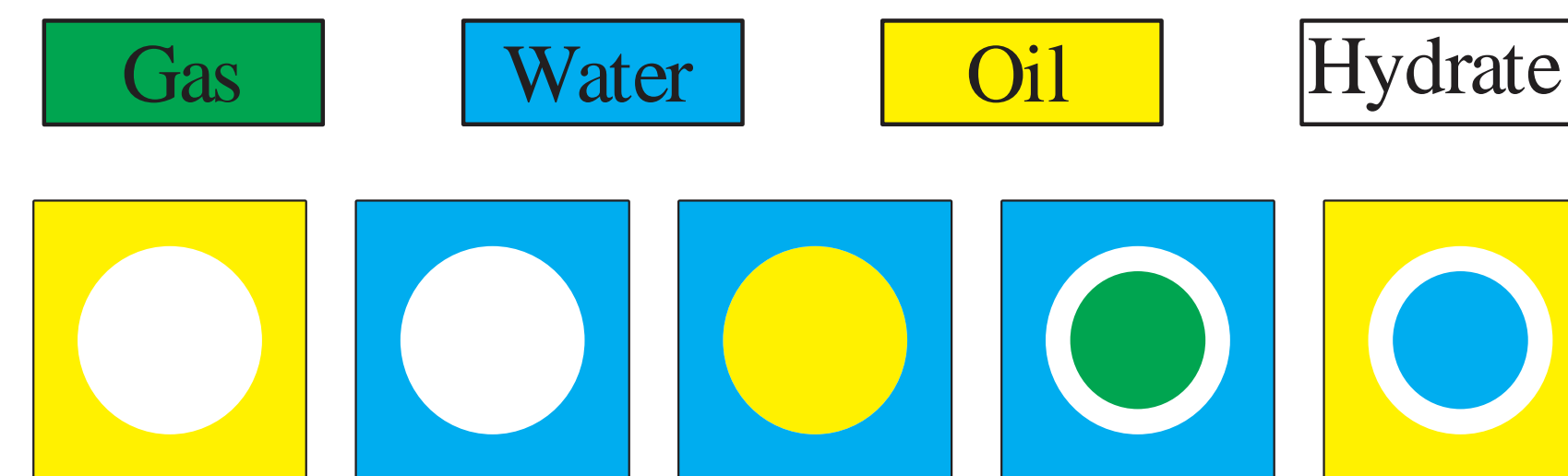
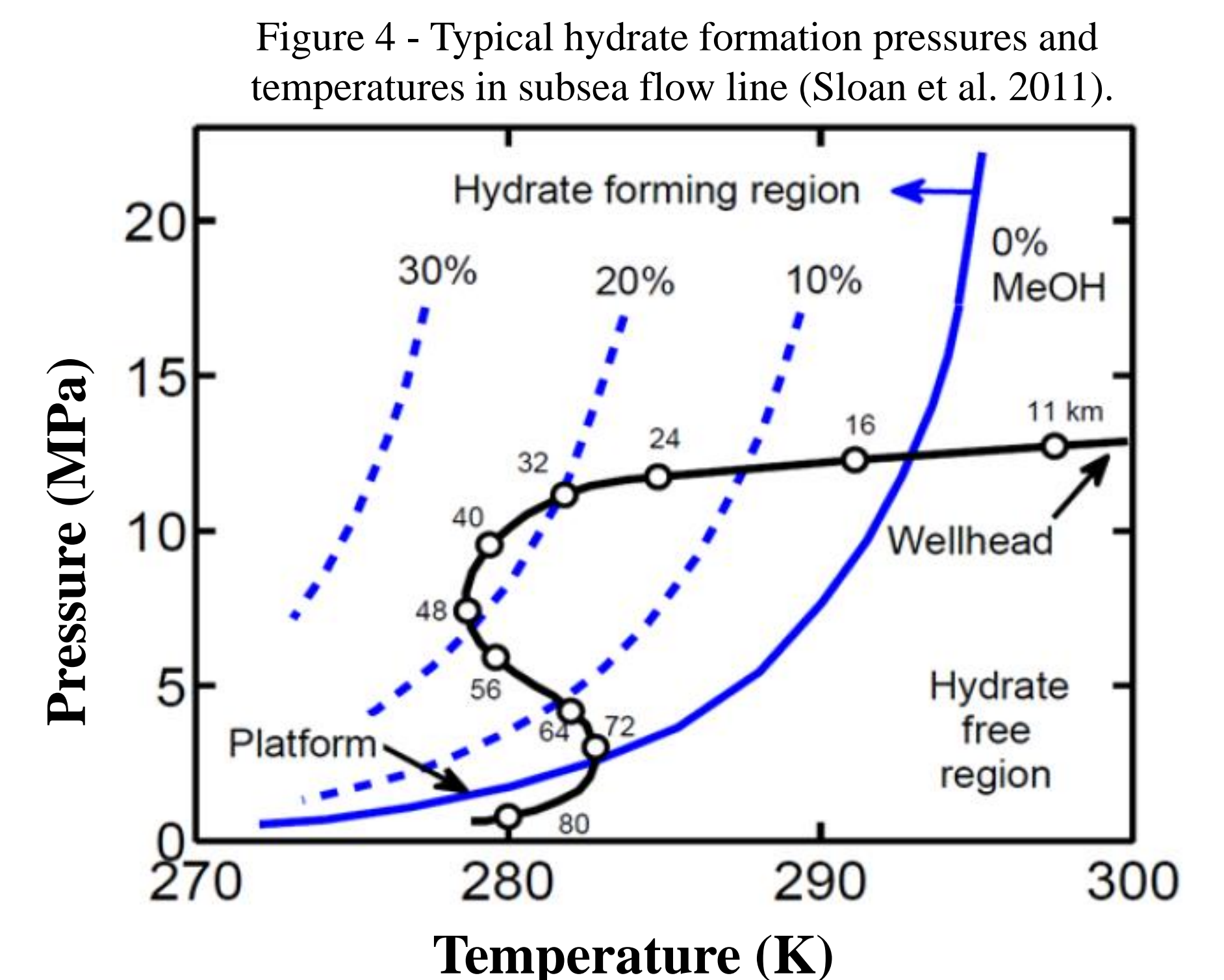


Figure 3 - Hydrate particles morphology.

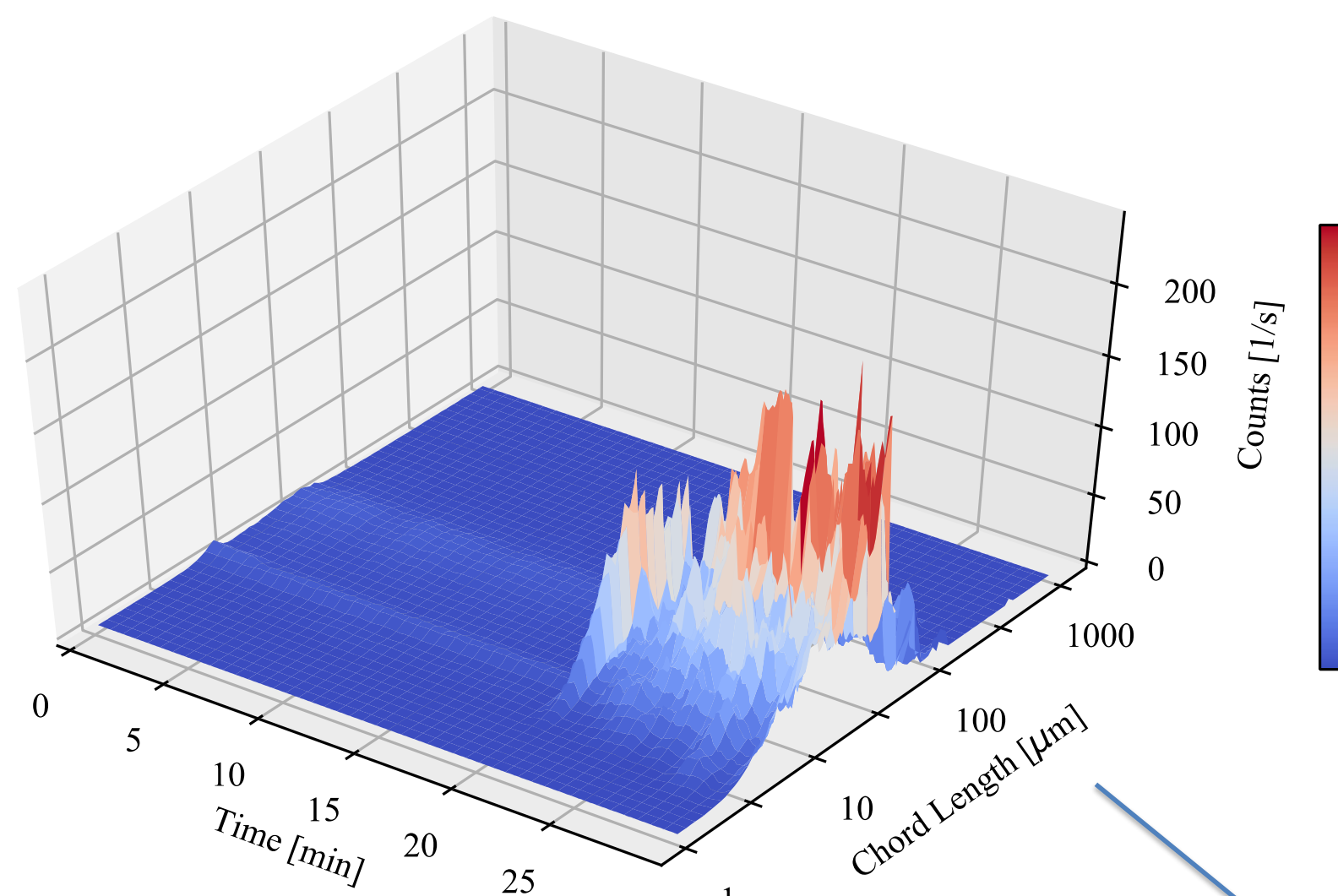


Experimental methodology and results

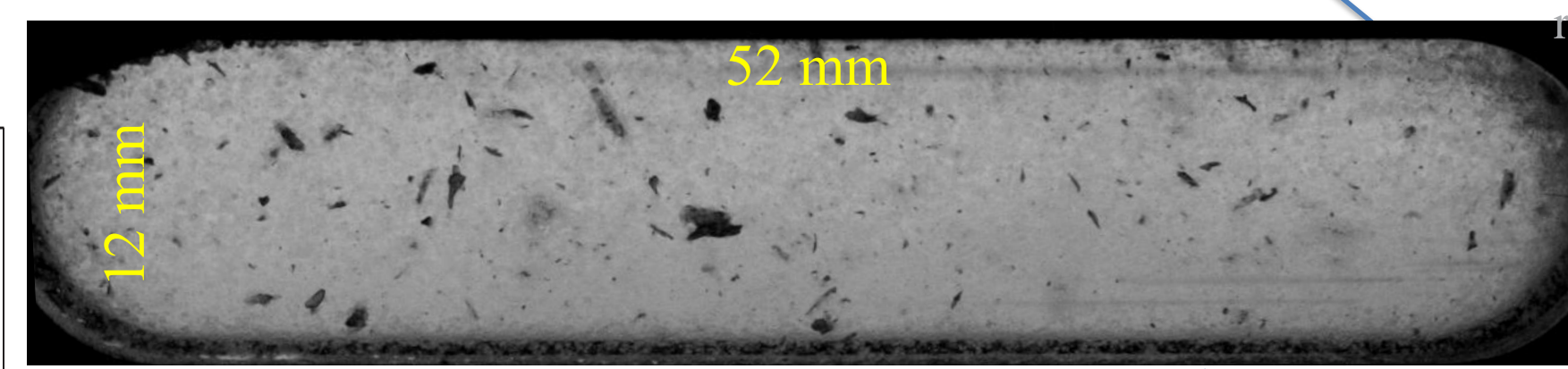
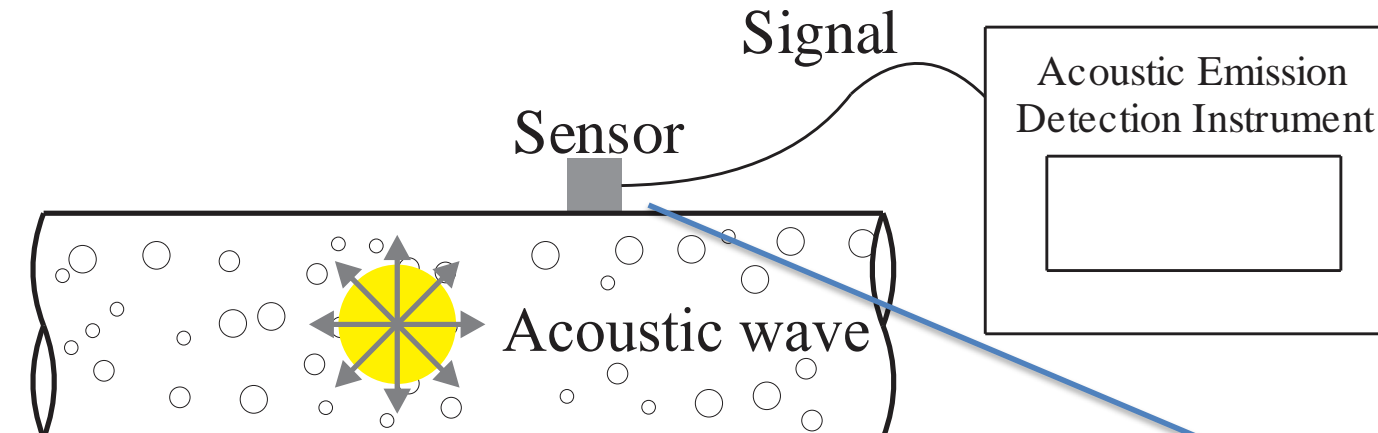
Operational conditions:

- 100-500 L/h
- Up to 75 bar
- 0-30 °C
- ~53m
- Water, oil, gas, salt, AA

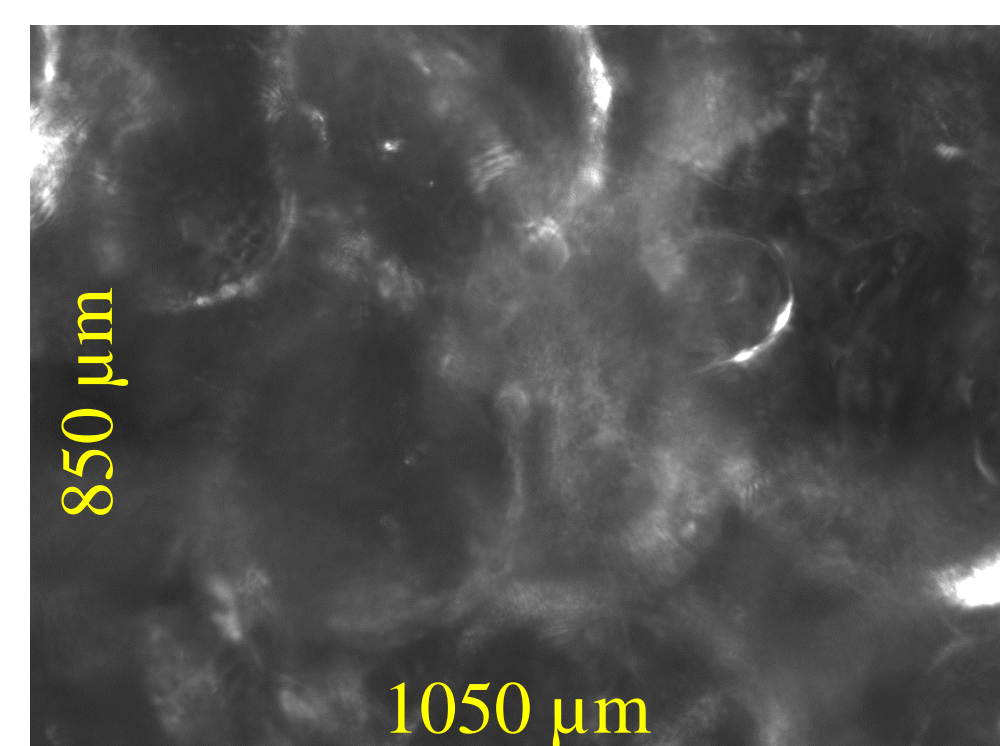
Focused beam reflectance measurement



Acoustic emission



High speed imaging



Particle video microscopy

Figure 5 - Overview of an experiment with hydrate formation (30% water cut, 200 L/h, 30 g/L of NaCl).

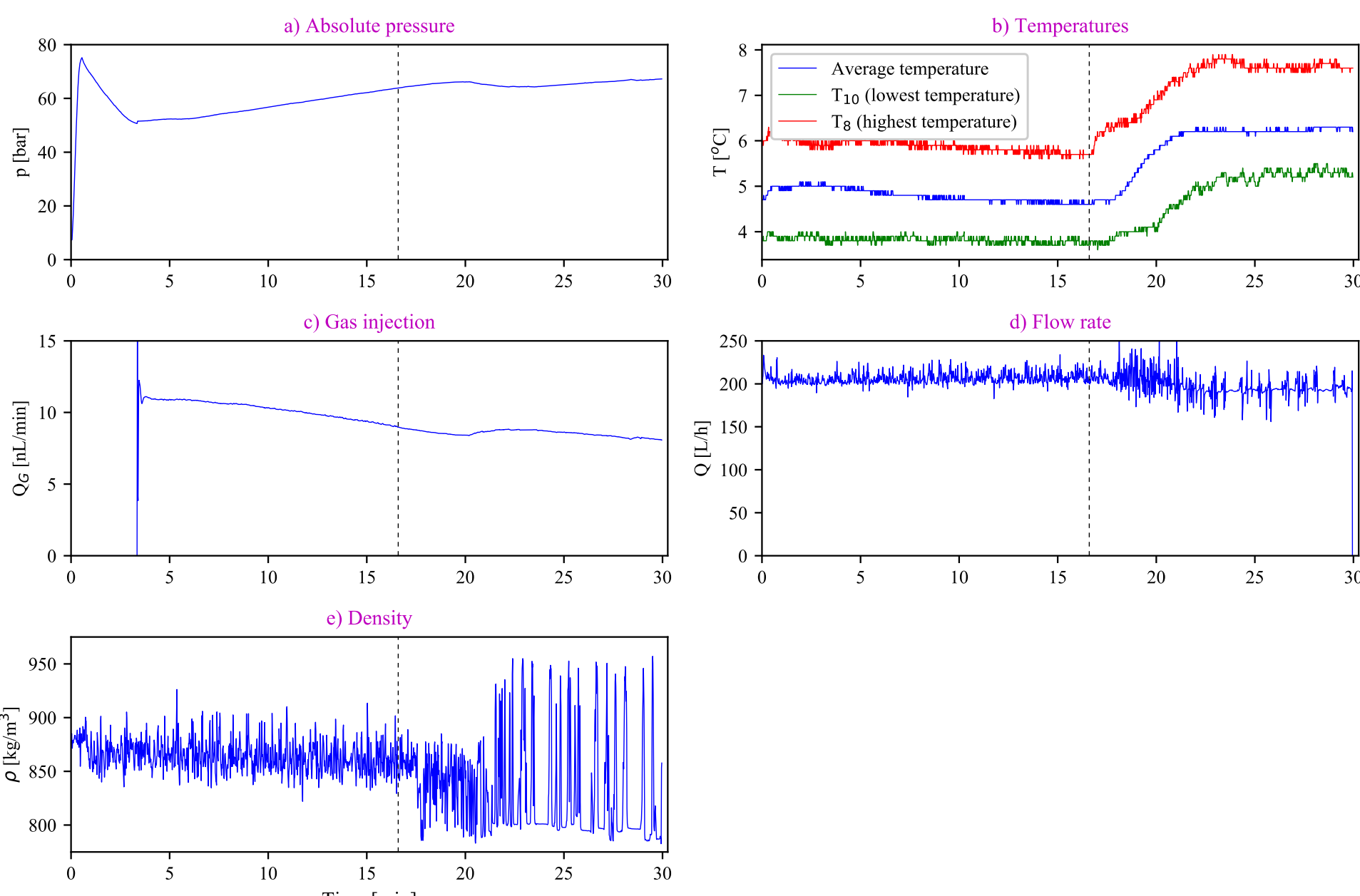


Figure 6 - Pressure drops measurements for a crystallization test (30% water cut, 200 L/h, 30 g/L of NaCl).

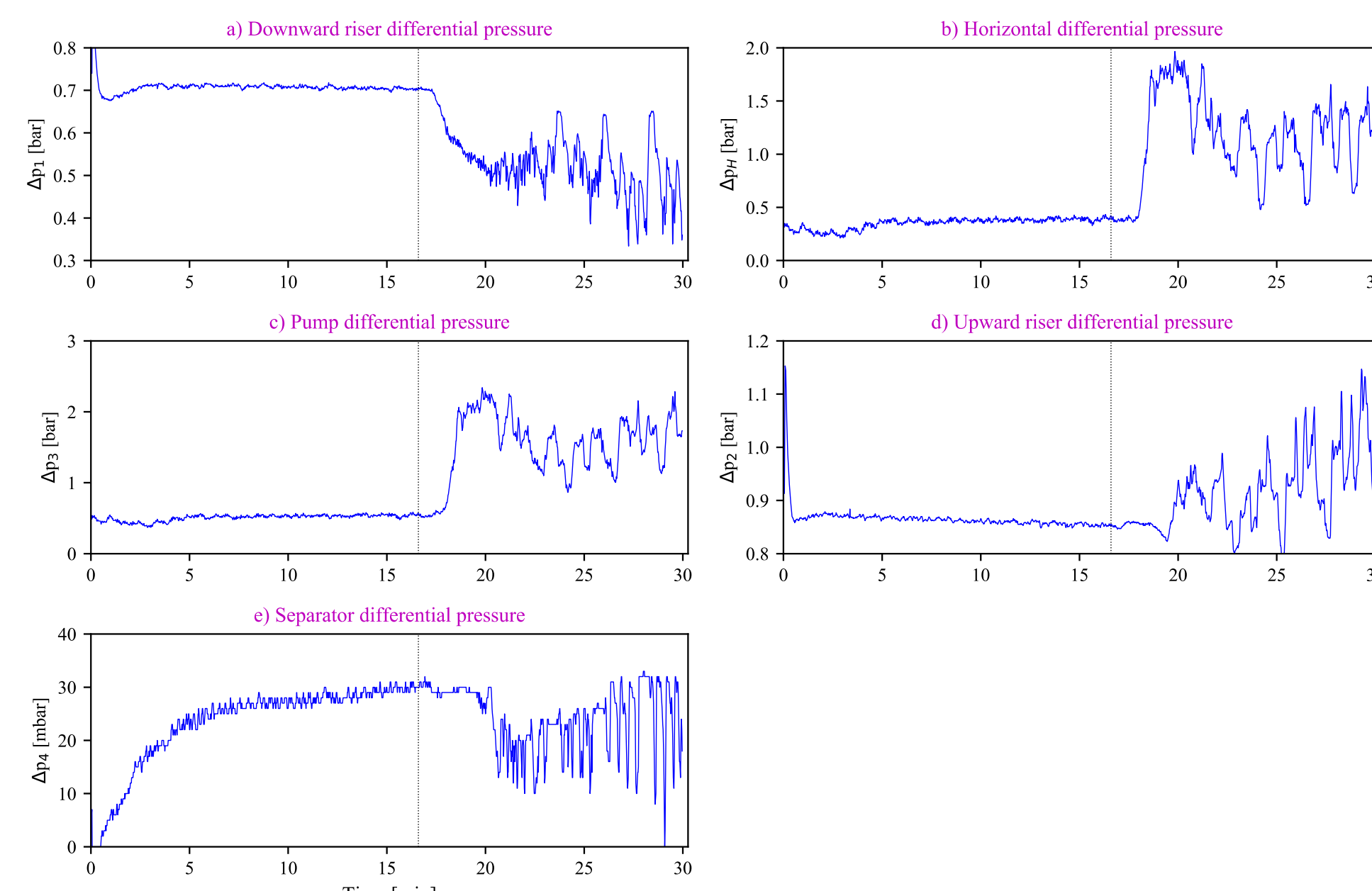


Figure 7 - Detection of hydrate chord length distribution using the FBRM (30% water cut, 200 L/h, 30 g/L of NaCl).

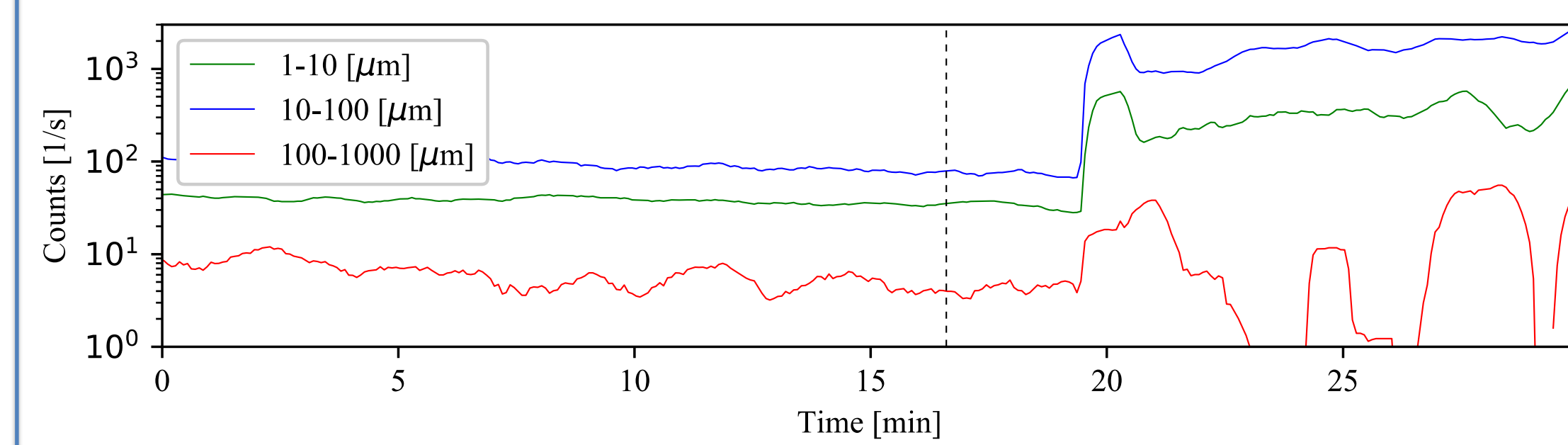


Figure 8 - Detection of hydrate particles flowing in the pipe using acoustic emission measurement (30% water cut, 200 L/h, 30 g/L of NaCl).

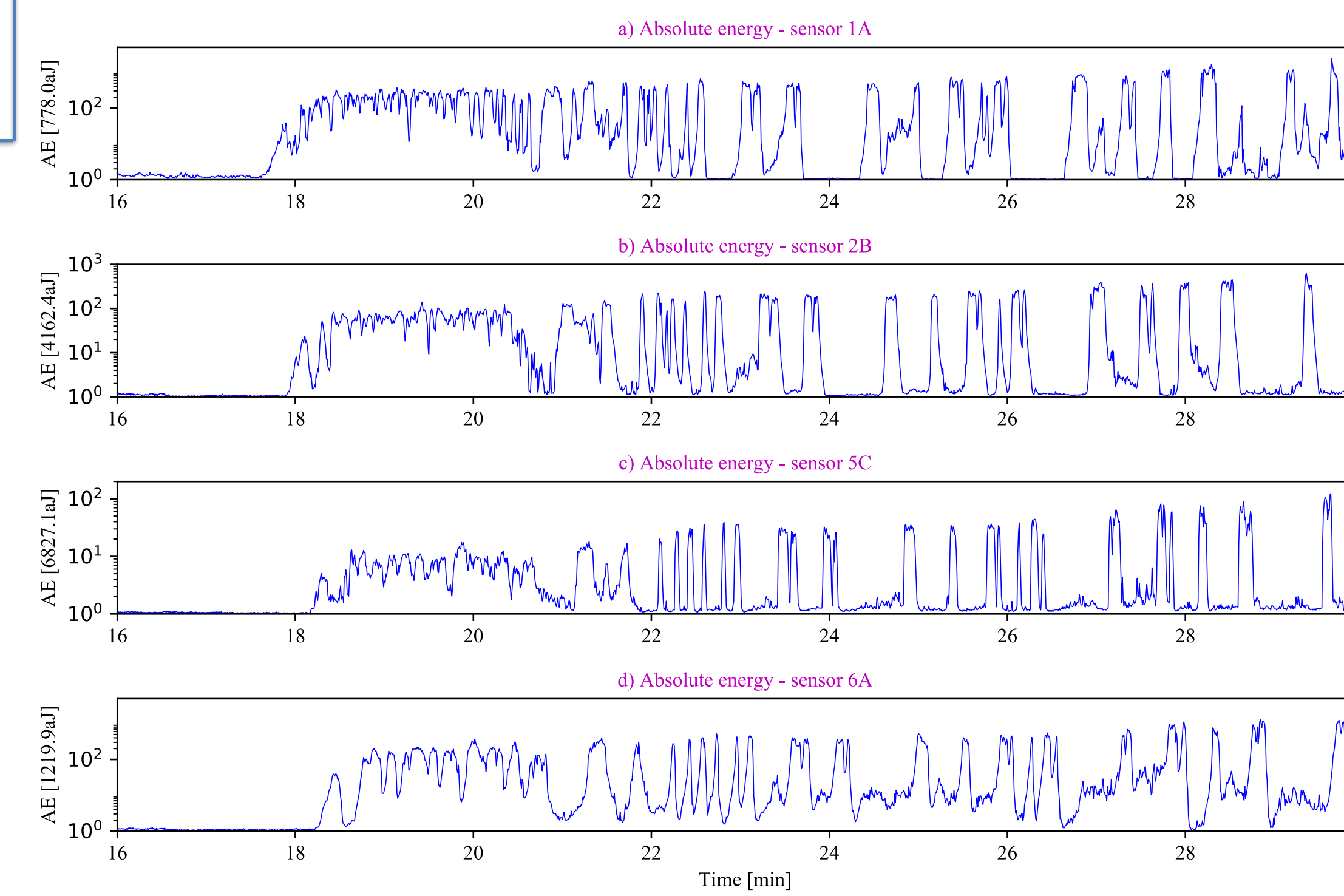
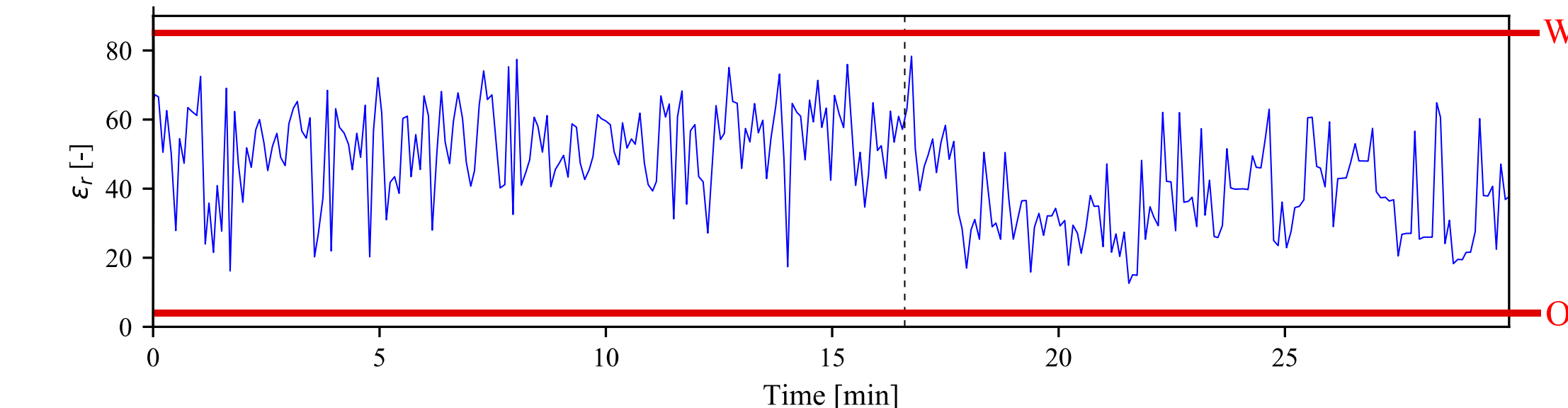


Figure 9 - Detection of continuous phase using dielectric measurement (30% water cut, 200 L/h, 30 g/L of NaCl).



Conclusions

- Acoustic emission may help characterize the flow pattern and track growth and deposition.
- For systems with well dispersed hydrates, some indications confirm that the absolute energy is proportional to the hydrates fraction.
- Evidence that phase inversion may partially occurs (tests with 50% and 80% water cut).

Perspectives

- Compare acoustic emission and permittivity measurements with high speed imaging to identify flow patterns.
- Test an AA additive at high water cuts.
- Understand better the mechanisms of hydrates transportability and plugging tendencies.