Environmental Effects Of Arctic Oil Spills: Oil Biodegradation & Persistence

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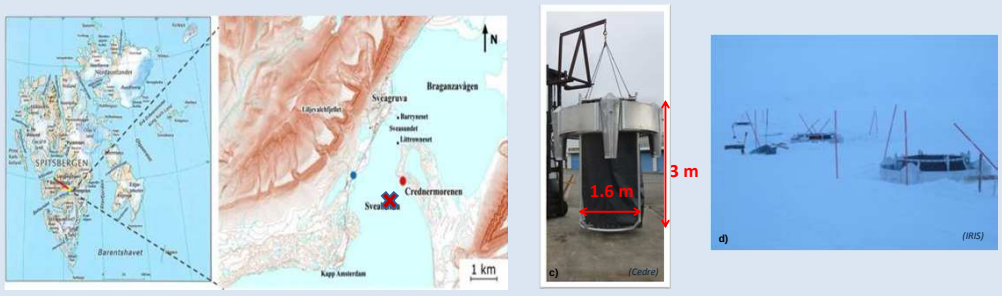
Objective: Field Arctic petroleum exposures designed to assess, in natural conditions, the persistence and biodegradation of oil following different treatment scenarios, according to regular response options used at sea, such as natural attenuation, *in situ* burning and dispersion.

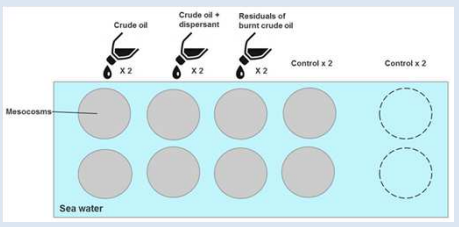
Study area / Mesocosms

Oil exposures conducted in large semi-contained mesocosms specifically designed for Arctic conditions, placed in the Svalbard archipelago.



a) Map of the Svalbard archipelago, b) the Svea fjord and the mesocosms location (red cross), c) Mesocosm applied during the campaign and d) Mesocosms deployment.

Treatments



Response options monitored

- ✓ Natural attenuation : 20 L oil / mesocosm (m)
- ✓ Dispersion : 20 L oil + 1 L dispersant / m
- ✓ In Situ Burning : 2 L residue / m

Natural attenuation

Dispersion

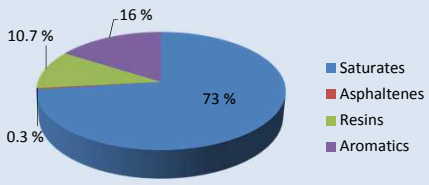
Burned residue

Products

Oil

✓ Kobbe (GOLIAT oil field, Barents sea)

Chemical composition



Physical properties

Density (at 2°C, g/mL)	0.816
Viscosity (at 2°C , $10s^{-1}$, mPa.s)	6
Surface tension (mN/m)	27.73
Interfacial tension (mN/m)	13.44
Pour point (°C)	- 39

Burned residue

- ✓ INERIS facilities (France)
- ✓ 2 L residue obtained from 20 L of KOBBE oil

Dispersant

- ✓ Concentrated dispersant (3rd generation)
- ✓ FINASOL OSR 52 (TOTAL Fluids)

Sampling and Analyses

- ✓ 5 time steps (4 during icing period, 1 after ice break up)
- ✓ From February to July 2015
- ✓ Sampling of sea ice and seawater
- ✓ storage at -20 °C

Most Concentrated Layer (oil)

- ✓ GC/FID : Fingerprint of the oil
- ✓ GC/MS: Quantification of individual compounds (PAHs, alcanes)

Seawater (3 dephts: 0 m, 1 m and 2 m)

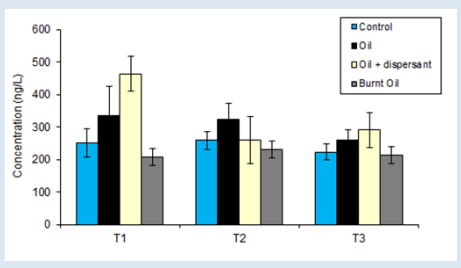
- ✓ SBSE/TD/GC/MS: Quantification of **dissolved** compounds (PAHs)

Core sections (Top, Middle, Bottom)

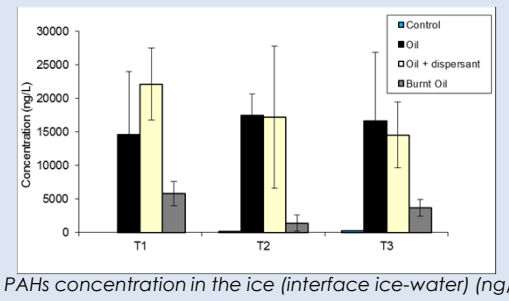
- ✓ Melted ice: SBSE/TD/GC/MS
- ✓ If supernatant oil: GC/FID + GC/MS

Preliminary results

1 - Seawater : SBSE/TD/GC/MS analyses



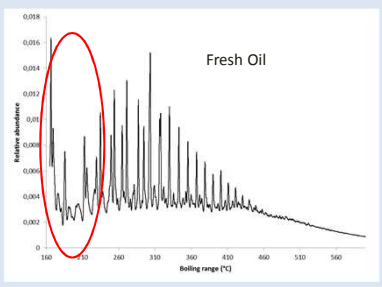
PAHs concentration in seawater (ng/L)

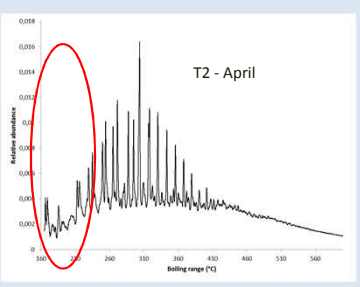


PAHs concentration in the ice (interface ice-water) (ng/L)

- ✓ No contamination in the Control and no cross contamination between mesocosms
- ✓ High variability
- ✓ Migration of the dissolved compounds in the ice

2 - Most concentrated layer : GC/FID analyses





- ✓ Loss of light compounds

➡ **Provides robust information for NEBA (Net Environmetal Benefit Analysis) related to Arctic spills**

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