



# Microplastic in sediments of the Norwegian Continental Shelf

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#### Plastic in the environment

- **7** Global plastic production: over 300 million tonnes/year
- **T**hrow-away society
- **7** Of this, only 50 % is reused
- Globally, only 5 % of the plastic is recycled





https://antinuclear.net/2010/06/15/call-to-limit-consumption-energy-and-water-use/consumer-society/

https://www.dailymail.co.uk/sciencetech/article-3206442/Watch-humanity-ruinoceans-Nasa-animation-shows-vast-garbage-islands-taken-seas-35-years.html

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#### Plastic in the ocean

#### Estimated amounts of plastic in the ocean





#### Published on Wednesday, December 17, 2014 by Common Disson

#### Where is All the 'Missing' Plastic? At the Bottom of the Ocean, Study Finds

The deep sea floor could be the ultimate resting ground for the products of our disposable society,' researcher says



http://pmdvod.nationalgeographic.com/NG Video/465/947/smpost 1500475553317.jpg

Cozar et al. PNAS 2014; Eriksen et al. Plos One 2014; NGI Eunomia, Plastics in the Marine Environment, 2016; Hidalgo-Ruz et al. ES&T 2012

#### What causes plastic to sink? Generation of field-weathered microplastics

- Rooftop exposure
- April '16 –february '17



■ Deployed feb. – october 2017



#### What causes plastic to sink? Column experiments

#### Measurement of sinking rate in still water for

- Microplastics
  - $\circ~$  Granules 300  $\mu m$  4 mm
  - o Fibers
  - o Different density
- o Water

- Density and Temp.
- Filtered
- Weathering
  - o Pristine
  - Weathered microplastics





### What causes plastic to sink?

- Several factors, e.g.:
  - High density
  - Organism uptake
  - Biofilm growth and aggregation
  - Phto-oxidation and mechanical stress





www.dailymail.co.uk/news/article-4690526/The-bottom-ocean-filled-plastic-bottles.html Sinkers: PET, PVC, Nylon, Polyacrylate, Polycarbonate, Polyacetate, etc.

#### The Method

- Bauta Microplast
  Sediment Separator
- ZnCl/CaCl
- 1,53 g/cm<sup>3</sup>



#### Density separation



Plastic, charcoal and organic matter float, other materials sink

ZnCl<sub>2</sub>:CaCl<sub>2</sub>

#### Transfere to filter (45 $\mu$ m)







## Chemical oxidation of non-plastic material

Note: Plastic is not the only material with a low density that can survive this procedure. Notably charcoal, porous glass/ceramic & sea shells can survive.



Based on Hydrogenperoxide



Before

After





Photos of spiking material (x10 magnification). A and B: PET powder (75-250  $\mu$ m); C: PE fibre (1 cm x 16  $\mu$ m); D: PET pellet (3 mm).

Recovery blanc: Known polymers added to sediment sample free of plastic (pretreated)



 $f_{recovery}$  for granulat and fiber = 0.77

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Analyzing the particles using FT-IR

#### Microplastic in sediments from The Norwegian **Continental Shelf**



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35 sediment samples, sampled during the regional environmental sediment monitoring on the NCS on behalf of the Oil & Gas industry in 2017

Northern North Sea

**Central North Sea** 



https://www.miljodirektoratet.no/globalassets/publikasjoner/m1231/m1231.pdf

### Sediments results – Station Ula - 06



A: overview of processed sample;

B: representative picture of sample showing many granules (< 500 μm);

C: observed, red granule (>1000  $\mu m)$  among smaller granules (<500  $\mu m);$ 

D: white fibre < 1000  $\mu$ m.

#### Sediments - results





### Microplastic in Polycheates

 Polycheates collected at or near many of the sampling stations, stored in Formalin.



*Oweniidae* Foto: Jakob Cyvin (NGI/NMBU, 2018)

#### Microplastic in Polycheates





### Bio acumulation

Sample/station	Location	Polychaetes Items/g ww (Iower estimate)	Sediments lower estimate Items/g dw (DNV GL, 2018b)	Sediments Max Items, dw (DNV G 2018b)	s /g L,	Items min BSAF (g dw / g ww) <sup>1</sup>	Items max BSAF (g dw / g ww) <sup>2</sup>
Reg1-02	Central North Sea	563	<lod< th=""><th>0.38</th><th></th><th>1482</th><th>-</th></lod<>	0.38		1482	-
Reg1-04	Central North Sea	713	<lod< td=""><td>9.2</td><td></td><td>77</td><td>-</td></lod<>	9.2		77	-
Reg1-06	Central North Sea	519	0.54	9.7		54	961
Reg1-09	Central North Sea	339	0.029	0.73		465	11700
Reg1-14	Central North Sea	14	0.05	0.42		34	286
Val-02	Central North Sea	3250	0.75	7.5		435	4334
Val-15	Central North Sea	1827	<lod< td=""><td>4.8</td><td></td><td>381</td><td>-</td></lod<>	4.8		381	-
ULA-06	Central North Sea	5333	3.10	29.0		184	1720
VI-30	Northern North Sea	1855	3.4	8.8		211	550
KF2-6	Barents Sea	194	0.071	0.94		207	2737
KRT-14	Barents Sea	1253	0.2	0.59		2142	6264
All areas Average ± SD (min-max)						515 ± 674 (34 - 2142)	3569 ± 3869 (286 - 11700)

### Take home messages

- Tendency for higher microplastic concentrations at locations close to oil and gas installations, but the results vary and are not statistically conclusive
- Most common plastic types: chlorinated PE, paint resins, rubber materials, polyacrylamides and PET – all high-density polymers, expected to sink
- Several low-density particles were found in some of the samples, but rarely were these the majority
- The results support the hypothesis that sediments are the ultimate environmental sink for oceanic plastic
- Many plastic types, no basis to point at particular sources
- Microplastic found in the biota samples
- Acumulation of plastic particles in biota by several orders of magnitude

