Marine sediment oil degradation capacity and effects of dispersant – Lessons in monitoring the deep sea and remediation potential

Lloyd Potts*, Peter Collinson (BP), Heike Hoffmann (Intertek), Jim Anderson (UoA), Ursula Witte (UoA)

*School of Biological Sciences, University of Aberdeen, Cruickshank Building, St Machar Drive, Aberdeen, AB24 3UL; lloyd.potts@abdn.ac.uk

Context
The Faroe-Shetland Channel (FSC) is an area of deep-sea (>1000 m) oil exploration. An oil spill here could result in the transport of oil to the seabed as evidenced following Deepwater Horizon (2010). Seabed microbial communities are known to degrade oil yet their abilities may vary with depth. Furthermore, dispersant is often applied in response to spills and is known to have variable effects.

Aims
1. To assess remediation potential of oil contaminated deep-sea sediments with and without dispersant application.
2. To determine hydrocarbon degradation capability of sediments from two different depths (135 m, shallow and 1000 m, deep) within the FSC.

Conclusions and Applications
This research shows that bacterial communities can respond to oil contamination but that dispersant application has differing and potentially adverse effects on remediation potential. Further, sediment microbial communities are capable of degrading a range of hydrocarbons. This information may aid monitoring strategies as the detection of hydrocarbon-degrading microbes indicates natural attenuation; resulting in natural and environmentally friendly contamination clean up. However, deep-sea sediments may be remediated slower than shallow marine and coastal environments.

Response of microbes to oil contamination and dispersant use

Methodology
Sediment cores obtained from the FSC were incubated for 71 days at 0°C under three treatments:
1) CONTROL (no oil added)
2) OIL only
3) OIL + DISPERSANT

Results

Differences in oil degradation potential at different sea depths

Methodology
Microbial communities from 135 and 1000 m deep FSC sediments were incubated for 42 days at 20°C with two HC mixtures:
1) MODEL OIL
2) DIESEL

Results

Analysis of the bacterial communities in the top layer of sediment revealed:
CONTROL treatment showed a different response compared to when oil was added - Geospsychrobacter oil deposition to deep-sea sediments selected for hydrocarbon-degrading microbes - Mortella/Colvellia application modified the microbial response with potentially adverse effects - Fusibacter Detection of hydrocarbon degraders suggests biodegradation of oil components.

Sediment microbial communities from the FSC significantly degraded a range of hydrocarbons with similar rates of degradation for two different hydrocarbon types. There was higher degradation ability in the shallower station. This correlated with differences in bacterial community composition suggesting a site-specific response.