Microbial Degradation and Community Changes to Crude Petroleum Oil in in Different Deep Oceans

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The Gulf of Mexico (GOM) oil spill in 2010 attracted international attention on the risk of oil contamination in deep-sea environments, especially as the number of offshore drilling platforms keeps increasing worldwide. However, little is known about the oil attenuation potential in the deep sea. It has been shown that environmental factors, such as the microbial community, nutrients, and temperature play an important role in oil biodegradation, but these factors vary according to different locations. In order to elucidate the relationship among nutrient conditions, microbial communities and the potential for oil degradation, we analyzed deep-sea water samples from different locations where oil drilling leases have been sold in the Eastern Mediterranean sea and Great Australian Bight (GAB).

Enrichments were carried out aerobically using five different conditions: oil, oil+ COREXIT, COREXIT, oil+ Phosphate (or $FeCl_2$) and oil+ Phosphate (or $FeCl_2$) + COREXIT. Serum bottles were connected with a Micro-OxyMax respirometer to detect CO_2 level every two hours. Bottles were sacrificed for the analysis of the microbial community at three sampling points and then sequenced with the Illumina MiSeq sequencer.

During the incubations, we observed diverse CO_2 evolution patterns upon different treatments. In the enrichments with Mediterranean water, the CO_2 accumulation in the treatment with oil and/or COREXIT was much higher than the control (seawater alone). $FeCl_2$ amendments lead to a slightly higher CO_2 accumulation. However, phosphate amended treatments produced much more CO_2 than those without phosphate. These results suggested that phosphate, rather than iron, is the limiting nutrient for microbial respiration of oil from that area. Unlike the Eastern Mediterranean Sea enrichments, the CO_2 evolution from treatments with oil in GAB water was lower than the seawater control, implying suppression of microbial respiration from crude oil. Enrichments with the $FeCl_2$ amendment had a higher CO_2 accumulation, suggesting iron is a potential limiting nutrient for microbial respiration in oil from the GAB. However, the respiration data of Eastern Mediterranean Sea and GAB was much lower as compared with GOM, indicating lower oil degradation potential at these two sites. What's more, the dissolved organic mater analysis revealed that