

Microbial life in small water droplets enclosed in oil

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Microbial degradation of oil reservoirs is mostly taking place at the oil-water transition zone between the oil leg and the underlying water leg (OWTZ). However, we recently found microbial life in small water droplets dispersed in oil of the Pitch Lake in Trinidad, the world's largest natural tar lake. The water droplets were surprisingly densely populated with a very complex and diverse microbial community. FT-ICR measurements of the μL size droplets suggests that the organisms are actively degrading the oil as signature metabolites for anaerobic degradation of polycyclic aromatic hydrocarbons were identified. Stable isotope analysis of the water proved a deep subsurface origin of the water droplets implicating that they came directly from the below oil reservoir. We could find such microbe-containing water droplets in three different natural oil seeps indicating that they are a generic feature of oil reservoirs. The finding of life in the water droplets indicates that biodegradation can not only take place at the OWTZ but also in water pockets in the oil leg.

Furthermore, we developed a new method to analyse biodegradation of oil in microcosms (reverse isotope labelling) which was used to measure the anaerobic degradation of Trinidad oil. The method allowed for quantification of the evolved CO_2 and the determined degradation rates were taken to calculate the possible contribution of the water droplets to the overall biodegradation in the oil, which agreed with the geological time frames of oil degradation.

We furthermore analysed the microbial community compositions in hundreds of single water droplets. This allowed for developing a conceptual theory on the assembly of the microbial ecosystems and how core microbial communities establish in such settings.