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Is hydrocarbon seepage from hot subsurface petroleum reservoirs seeding the cold ocean with thermophilic bacteria?

Casey Hubert (1), Alexander Loy (2), Bo Barker Jørgensen (3,4)

(1) School of Civil Engineering & Geosciences, Newcastle University, Newcastle upon Tyne, United Kingdom (casey.hubert@newcastle.ac.uk), (2) Department of Microbial Ecology, University of Vienna, Vienna, Austria, (3) Max Planck Institute for Marine Microbiology, Bremen, Germany, (4) Center for Geomicrobiology, Aarhus University, Aarhus, Denmark

Natural microbial communities can be extremely diverse owing to the presence of several low abundance taxa—the so-called rare biosphere. Many rare taxa in the marine environment consist of dormant organisms that constitute a natural microbial 'seed bank'. In permanently cold Arctic sediments of Svalbard fjords, this seed bank includes thermophilic bacteria that were estimated to make up about 0.01% of the total microbial population. Experimentally heating Arctic sediments to 50°C stimulated diverse anaerobic heterotrophs that were naturally present as dormant endospores able to survive the cold *in situ* temperatures (<4°C). By combining quantitative spore-germination assays with ^{210}Pb decay-determined sediment accumulation rate measurements, a constant annual influx of 10^8 thermophilic spores per square meter of seabed was estimated for Smeerenburgfjorden, Svalbard. This suggests that Arctic thermophiles must be supplied from a large, warm habitat, likely in the deep subsurface biosphere. The 16S rRNA gene sequences of these bacteria confirm their genetic affiliation with endospore-forming taxa within the *Firmicutes*—a group often highlighted by molecular diversity surveys as predominant in subsurface petroleum systems. Comparisons to 16S rRNA gene databases show that the most closely related bacteria to the Arctic thermophiles come from petroleum reservoirs, particularly the deep, hot oil reservoirs in the North Sea.

This discovery suggests that leaky subsurface petroleum reservoirs may be seeding the ocean with dormant thermophiles. Upward seepage of hydrocarbon fluids through the seabed is widespread and may represent an important transport mechanism for microbe dispersal: bacteria that were once indigenous to petroleum reservoirs may eventually be distributed in the cold ocean and its sediments, joining the ranks of the marine microbial seed bank. While these 'misplaced' and numerically rare organisms may often go undetected in traditional molecular surveys of marine samples, targeted assays could capitalize on their natural occurrence and utilize them as vital bioindicators of hydrocarbon seepage in offshore oil and gas exploration. This presentation will consider the microbiology and biogeography of Arctic thermophiles in relation to potential new ways to explore for oil and gas in frontier regions like the deep sea and the Arctic, where significant petroleum reserves are thought to remain undiscovered.