

What controls abundance and activity of microbial life in subsurface sediments? New insights from scientific drilling.

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Abstract

It is commonly accepted that the deep sedimentary biosphere harbours a vast and diverse microbial ecosystem that forms an active interface between biological and geological element cycles. While the total number of cells and their contribution to the global living biomass are still the subject of debate, the discussion becomes futile if we just focus on the numbers, instead of identifying the factors that control microbial abundance in subsurface sediments.

However, even the most accurate predictions of the abundance and biomass of subsurface life provide no information about the metabolic capabilities of this massively underexplored ecosystem. Although much progress has been made with regard to detection and quantification of microbial activity in subsurface sediments, many processes remain elusive.

From a practical standpoint the biggest challenge for deep biosphere exploration is still the lack of sensitivity of many turnover quantification methods, which is mainly caused by two factors: The first one is the very low turnover rates, formation of appreciable amounts of product or consumption of a substrate taking up to millions of years and therefore extend way beyond human timescales; the other factor are very short residence times of detectable compounds. For example, organic substrates produced by abiotic cracking reactions or hydrogen from radioactivity-induced radiolysis are immediately consumed by the microbes, keeping concentration levels below the minimum detection limit.

In such cases modelling can provide reliable estimates, although there are also inherent problems associated with this approach, e.g. the availability of high quality geochemical and petrophysical data.

The lecture will review recent advances in detection and quantification of subsurface biomass and activity and present the conclusions that could be drawn from these new data. Additionally, the lecture will also highlight the technical challenges that still lie ahead of us.