Stable isotope probing with ^{18}O-water to investigate microbial growth in environmental samples

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Growth of microbial taxa have been characterized through DNA Stable Isotope Probing (SIP) with ^{18}O-water in soils and fresh water samples from a range of ecosystems. Water with high ^{18}O content is an appealing tracer to use for microbial growth measurements because it is not an energy source nor a limiting nutrient while it is a universal substrate for all microorganisms and replication is required for DNA to become labeled with ^{18}O. By measuring how much the DNA of each taxon becomes enriched with ^{18}O when an environmental sample is incubated with $H_2{}^{18}O$, it is feasible to quantify that population's DNA replication rate, which is a proxy for growth. Recently, SIP has been improved by sequencing a marker gene in all fractions retrieved from an ultracentrifuge tube to produce taxon specific density curves, which allow estimation of atom percent isotope composition of each microbial taxon's genome. The accuracy of this estimate is dependent on our understanding of oxygen assimilation into microbial genomes which, while improving, remains incomplete. Oxygen content in carbon sources and variation in nucleotide metabolism will likely impact ^{18}O content of DNA replicated in an ^{18}O-water environment. While at first variation in oxygen assimilation patterns among microbial taxa will make ^{18}O-water SIP experiments more difficult to interpret, eventually it will likely provide new insights into what microorgansisms are doing in the environment.