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Warming Deep Soils: Depth dependent functional-microbial community responses

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Soil microbial communities mediate the decomposition of soil organic matter (SOM), making them key players in the global carbon cycle. Warming experiments to date mostly examined the reaction of microbial communities in the uppermost soil horizons, often observing a decrease in microbial biomass and fungal abundance. However, growth conditions for microorganism are very different in subsoils due to lower carbon concentrations, differing organic C incorporation pathways and SOM stabilization mechanisms. This makes it very likely that microbial communities in subsoils react differently to warming with a thus unknown effect on the large subsoil carbon pool.

We analyzed soil cores from one of the first long-term whole soil profile warming experiments conducted on an Alfisol in a coniferous temperate forest in the Sierra Nevada, CA, US. The soils have been warmed to 1m depth by +4°C for 4.5 years. We analyzed soil samples for free extractable lipids and calculated different molecular proxies to discriminate SOM sources and degradation.

The average chain length of fatty acids indicates more plant-derived SOM in the upper soil and more microorganism-derived SOM in deeper soil in warmed compared to control plots. The ratio of saturated vs. unsaturated fatty acids argues for reduced decomposition in the upper soil with warming, whereas decomposition accelerates in deeper soils. Although these trends were not statistically significant, these findings would suggest a depth dependent change of SOM degradation with warming. Interestingly, previous studies at this site found similar temperature sensitivities at all depths. Our results will provide new insights into the response of subsoil microbial communities to predicted rises in global temperatures and the subsequent effect on SOM.