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Impact of temperature on Thaumarchaeota in soil: lipid profile and diversity in enrichment cultures and mesocosms

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In the domain Archaea, the phylum Thaumarchaeota has been defined very recently (2008) and has been found to be widely spread in the aquatic environment and in soil, where it can represent as much as 1-5% of prokaryotes. Thaumarchaeota are considered to play a key role in the biogeochemical cycles, especially in CO_2 fixation and aerobic ammonia oxidation. To date, Thaumarchaeota have been mainly investigated in aquatic settings, where their lipid profile is known to vary with the temperature, whereas at the same time there is not a lot of knowledge about soil Thaumarchaeota. The objective of this work is to examine the impact of temperature on the lipid profile and diversity of Archaea and specifically Thaumarchaeota in soil.
To this aim, two Thaumarchaeota pure cultures from soil, Nitrososphaera viennensis and Nitrosotalea devanaterra, are incubated at three different temperatures ranging between 20°C and 42°C. Their lipid profile is then analyzed by high performance liquid chromatography coupled to mass spectrometry. In parallel, the lipid profile of Archaea is associated with the diversity of Thaumarchaeota in enrichment cultures of two types of soils (organo-mineral and plant compost), which are incubated at different temperatures. As the third part of this study, mesocosm experiments are set up, to observe the general archaeal lipid profile and archaeal diversity over three months of incubation, between 30°C and 42°C for the organo-mineral soil and 37°C and 65°C for the compost.
The results of the compost mesocosm experiments show that the lipid distribution does not change significantly over three months of incubation at the different temperatures. This could mean that the Archaea are growing slowly, leading to a slow lipid turnover, which is not detectable after three months. Slow lipid turnover has been shown before in a study in peat in which it took over one year to detect changes in the lipid composition (1). For the soil mesocosm experiment these results still need to be confirmed. DGGE is currently under way to assess the modifications of the archaeal population over this time period.
(1) Huguet, A., Francez, A-J., Jusselme, M. D., Fosse, C. and Derenne, S. Organic Geochemistry, Elsevier, 2014, 73, pp.109-112