BRANCHED GDGT VARIABILITY IN SOILS AND PARTICLE MATTER FROM THREE CATCHMENTS WITH MARKED TEMPERATURE SEASONALITY

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Branched glycerol dialkyl glycerol tetraethers (brGDGTs) are common lipids in terrestrial environments that are purported to originate chiefly from soil bacteria. The distribution of brGDGTs has been related to both soil pH and air temperature, which has been expressed in a series of indices. Thus, the degree of cyclisation of the brGDGTs, expressed in the cyclization ratio of branched tetraethers (CBT), would be related to soil pH, and the degree of methylation, expressed in the methylation index of branched tetraethers (MBT, or modified as MBT') relates to both soil pH and air temperature. As brGDGTs are well preserved in the sedimentary records, the MBT-CBT indices are applied in paleoenvironmental reconstruction studies. The estimates are derived from two global soil calibrations, which have however relatively large calibration errors, about 5.0 °C and 0.8 pH units. These have been attributed to a range of factors, including soil properties, or the use of atmospheric temperature rather than soil temperature. Some studies have also argued that temperature overestimates from the MBT-CBT index might be explained by the seasonal brGDGT production. However, no significant seasonal pattern in the distribution of brGDGTs have been found so far.

In here we assess further the occurrence of seasonality in the production and distributions of brGDGTs by undertaking their monthly analysis for over 1 year in both soils and in particulate matter derived from the run off of three different catchments. The locations considered have a marked seasonal temperature cycle, which was expected to maximize the possibility of detecting any seasonal bias in the production and composition of brGDGTs. The sites are located in two high mountain environments in the Pyrenees (Ulldeter at 2364 m a.s.l., with temperatures ranging from -2.8 °C in January to 12.7 °C in July; and Montcortés at 1027 m a.s.l. with temperatures ranging from 1.1 °C in January to 22.0 °C in July) and one site in southern Norway (Øsaker at 45 m a.s.l., with temperatures ranging from -10.9 °C in December to 17.1 °C in July). At Ulldeter two sediment traps were deployed to collect seasonal run off from snow melt in an ephemeral stream (2300 m a.s.l.), and in the Ter River (2274 m a.s.l.). In Montcortés the sediment trap was located in a karstic lake at 20 m depth. In Øsaker the sediments were collected by filtrating of water from the nearby Glomma River.

Our results show that brGDGT soil abundance has a large variability that it is not directly related to a seasonal meteorological parameter, but most probably to the soil properties. However, the brGDGT distributions and their derived climate proxies (MBT, CBT) are relatively stable throughout the study period. In the suspended particulate matter in the river or settling particulate matter in traps the brGDGT composition is related to their source soils, but despite the seasonal variability in the fluxes, the brGDGT indices remain relatively constant during the sampling period too. Our study shows that the impact of seasonality on brGDGT distribution can be discarded as a significant factor to explain biases in brGDGTs derived proxies.