Multi-biomarker analysis of sediments for paleoclimate research

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Abstract

Lacustrine sedimentary cores provide continuous records of large-scale and local environmental modifications, intelligible thanks to specific organic markers that accumulated in these archives during past millennia. In order to improve our knowledge on ecosystem changes due to biomass burning events and human presence during the Holocene, an effective analytical method to detect organic compounds contained in sediment samples is needed.

We used Accelerated Solvent Extraction (ASE) technique followed by analysis with gas and liquid chromatographers coupled with mass spectrometers (GC-MS, IC-MS). The extraction of the molecules of interest from the sediments is made with a mixture of DCM:MeOH 9:1 v/v and it is followed by a 3 steps purification with silica gel columns. The first fraction is eluted with HEX:DCM 9:1 v/v and contains n-alkanes, indicators of vegetation, and polycyclic aromatic hydrocarbons (PAHs) as combustion proxies. Then, a second fraction is eluted with DCM and derivatized with the silylation process, in order to get the faecal sterols and stanols (FeSts), indicators of past human and grazing animals presence. These two fractions are analysed with the GC-MS technique. The third and last fraction is eluted with MeOH and contains the monosaccharide anhydrides (MAs), specific indicators of vegetation burning processes, which are analysed with IC-MS. Internal standards labelled C13 are used for the quantification and procedural blanks are extracted every batch of 12 samples.

The method may undergo variations, on the basis of the complex sediment matrices which not always lend itself to the same kind of treatment. However, the technique was applied in different lakes from different continents and the obtained results, compared with historical and climate literature data, seem to demonstrate the potentiality of the method as a resourceful instrument to reconstruct past burning events and human-ecosystem interactions.