CHROMATOGRAPHIC AND MASS SPECTROMETRY TECHNIQUES (GC-MS, LC-MS) APPLIED TO ARCHAEOLOGICAL MATERIALS

Valeria P. Careaga

Department of Organic Chemistry, Faculty of Exact and Natural Sciences, University of Buenos Aires

Organic residue analysis is a rapidly growing field within archaeometry and heritage science. It is an essentially interdisciplinary area of research specialized in the study of anthropogenic residual organic molecules and their degradation and transformation products preserved over time within diverse archaeological matrices. Such studies require analytical methodologies with high selectivity, specificity, and sensitivity studies. Chromatographic techniques coupled to mass spectrometry are some of the most powerful methods for the identification and structural characterization of a broad range of molecular species, from small molecules to high molecular weight compounds.

Residue analysis targets compounds that are nonvolatile, relatively stable, and mostly insoluble in water, which enables their survival within archaeological porous inorganic matrices, such as ceramics. Usually, this includes the detection of food substances such as lipids (e.g., acylglycerides, fatty acids, sterols, long chain alcohols, terpenoids, waxes), and other compounds such as alkaloids, proteins and carbohydrates.

In particular, the study of lipid residues in archaeological ceramic artifacts provides insight on past culinary practices and foodways. Residual lipids are complex mixtures due to multiple uses and life history of artifacts, including transformation processes that these biomolecules undergo over time. The application of both gas chromatography-mass spectrometry (GC-MS) and high performance liquid chromatography-mass spectrometry (LC-MS) allows the characterization of a set of biomarkers that provide information for identifying the origin of organic residues in archaeological ceramics.

Selected archaeological materials will be presented as case studies, including pottery vessels used for cooking and archaeological pipes, illustrating how the study of organic residues can provide insight about their use and function.

Intended audience: undergraduate and graduate students of chemistry, physics and related sciences.

Learning outcomes: understand the information provided by chromatographic techniques coupled with mass spectrometry and establish a criterion for their application according to the specific research question related to the sample.