CHARACTERIZATION OF ORGANIC RESIDUES FROM ARCHAEOLOGICAL ARTEFACTS USING GC×GC-TOFMS

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Headspace solid-phase microextraction (HSSPME) and gas chromatography – mass spectrometry (GC-MS) have traditionally been used, in combination with other analyses, for the chemical characterization of organic residues recovered from archaeological specimens. Recently, in many life science fields, the use of comprehensive two-dimensional gas chromatography – time-of-flight mass spectrometry (GC×GC-TOFMS) has begun providing numerous benefits over traditional one-dimensional gas chromatography approaches. However, organic residues from archaeological specimens present a unique challenge in that; 1) they are usually extremely minimal in amount, 2) they are often highly degraded, 3) information regarding exposure conditions and contamination is not available, and 4) non-destructive sampling is preferred. This study represents the first use of GC×GC-TOFMS to characterize archaeological specimens of interest from an experimental reference collection. Solvent extractions and direct analysis was performed on materials such as ivory, bone, antlers, animal tissue, human tissue, sediment, and resin. A generic volatile analysis method was used in order to assess the initial suitability of this technique for screening the chemical characteristics of discovered samples. Several samples generated stronger signals than anticipated, including bone, resin and sediment. The samples analyzed by direct headspace extraction appeared to give unique signatures based on their characteristics, and produced a higher response than for the solvent extracted residues. In addition, resins prepared by heating for different lengths of time appeared to provide distinctly different volatile signatures, suggesting that GC×GC-TOFMS may be capable of differentiating alterations to resin in future studies. Further development of GC×GC-TOFMS methods for archaeological applications will provide a valuable tool to uncover significant information on prehistoric technological changes and cultural behavior.