

# CHAPTER ONE

## Introduction

### J.W. Eerkens and H. Barnard

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Organic residues include a broad range of materials that can be analyzed at a macro-, micro- or molecular level. They represent the carbon-based remains (in combination with H, N, O, P and S) of fungi, plants, animals and humans. Organic residues have been extracted and studied from a variety of archaeological materials including ceramics, flaked stone, bone, coprolites, cooking stones, grinding stones, pigments and wood from shipwrecks. A wide range of biomolecules has been isolated including lipids, proteins, starches, DNA and plant lignin. Commonly studied residues include blood proteins from the surfaces of stone tools, fatty acids absorbed into the walls of cooking pots and hafting adhesives or sealants made from resin or pitch. These different residue sources have been studied by archaeologists to varying degrees, based on their ability to withstand decomposition in different depositional environments as well as the requirements of the analytical methods. Thus, lipids preserved in cooking pots are relatively well-studied because of their relative propensity to survive archaeologically and their amenable behavior in laboratory conditions. Techniques to isolate, identify and interpret proteins and peptides from similar contexts are still being developed while DNA from food residues has, to the best of our knowledge, not yet been studied.

Organic residue analysis is a relatively new technique to archaeology (Figure 1). The chapters of this volume bring together scholars from across the globe and attest to the diverse range of analytical methods, material types, spatio-temporal cultural units and research questions to which organic residue analysis has been applied (Table 2). They are partly the proceedings of a symposium on this subject, held on 31 March 2005 in Salt Lake City (Utah) during the 70<sup>th</sup> Annual Meeting of the Society for American Archaeology (Table 1), and partly the result of our invitation to contribute forwarded to many active in this field.

The study of ancient organic residues is inherently an interdisciplinary endeavor and judging by co-authorships in published articles, commonly brings together researchers from a range of scientific fields. We feel such collaborations are important if not critical to the development of the field (Barnard et al. 2007). While

archaeologists are in a unique position to interpret and give context to the results of residue studies *vis à vis* their experience with the artifacts, sites and regions that they study, they are often less familiar with biochemical techniques and the complex molecules found in many residues. Technicians and biochemists can provide important information by providing context to analytical results, but usually outside of an anthropological theoretical framework. Together they may fully appreciate the archaeological significance of the findings and identify the potential sources of the various biomolecules, be they contaminants, byproducts of decomposition or intact compounds. This interaction between scholars trained in archaeology with those trained in organic chemistry has resulted in the interdisciplinary field of 'archaeochemistry'. The formalization of this discipline in recent years now allows undergraduate and graduate students to tailor their education such that they will fit comfortably at the intersection of both archaeology and organic chemistry, with complementary training in analytical techniques. Programs specializing in this field have recently been established in both Europe and North America.

### Growth of Residue Studies

While most researchers would probably agree that organic residue analysis is an active field that is increasing in popularity and scope, we were interested in quantifying the growth of the field. To achieve this end, we performed a simple search of *Anthropology Plus*, a large database of the anthropological literature, including all major and many minor archaeology journals as well as edited volumes. We searched for all literature containing the words 'residue' or 'residues' in either the title or keywords. This search retrieved over 300 unique works. After winnowing titles that were obviously not related to organic residue analysis in archaeology (such as 'The modern Chinese family: ideology, revolution and residues'), we had compiled a list of 268 entries. This list is certainly not exhaustive of all archaeological studies of organic residues, but we feel it represents a fairly unbiased cross-section of self-identified works through the last 50 years. Indeed, many of the authors of chapters in this volume are represented in the list.

## Theory and Practice of Archaeological Residue Analysis

Session	Author(s)	Affiliation(s)	Title
<b>Morning session (Symposium 21): Theory</b>	Hans Barnard	Cotsen Institute of Archaeology, University of California, Los Angeles (USA)	Theory and Practice of Archaeological Residue Analysis and the 'Round Robin' Experiment
	Jim Cassidy	Department of Anthropology, University of California, Santa Barbara (USA)	Subsistence Change during the Final Neolithic in the Russian Far East as revealed by Fatty Acid Residue Analysis
	Marlize Lombard and Lyn Wadley	Natal Museum and the University of the Witwatersrand (South Africa)	Blind Testing for the Recognition of Residues using Light Microscopy: Results and Lessons learnt
	Robert Lusteck	Department of Anthropology, University of Minnesota (USA)	Residues of Maize in North American Pottery: What Phytoliths can add to the Story of Maize
	Sean Rafferty	Department of Anthropology, University at Albany (USA)	The Archaeology of Alkaloids
	Eleanora Reber	Department of Anthropology, University of North Carolina, Wilmington (USA)	The Well-Tempered Pottery Analysis: Residue and Typological Analysis of Potsherds from the Lower Mississippi Valley
<b>Afternoon session (Symposium 46): Practice</b>	Jelmer Eerkens	Department of Anthropology, University of California, Davis (USA)	Gas Chromatography Mass Spectrometry (GC/MS) Analysis of Fatty Acids in Ancient Potsherds
	Dana Beehr and Stan Ambrose	Department of Anthropology, University of Illinois, Urbana (USA)	Reconstructing Mississippian Diet in the American Bottom with Stable Isotope Ratios of Pot Sherd Residues
	Marcus Forster, Carl Heron, Ben Stern, Oliver Craig and Søren Andersen	University of Bradford (Great Britain), University of Rome (Italy) and the National Museum of Denmark	The Contents of Late Mesolithic/Neolithic Ceramics from Denmark
	Michael Gregg	Department of Anthropology, University of Toronto (Canada)	Survival of Organic Residues in Pottery from Southwest Asia during the Early Holocene
	Hanneke Hoekman-Sites	Department of Anthropology, Florida State University (USA)	Using Residue Analysis to Confirm Trade Connections at Pella, Jordan
	Mary Malainey	Department of Anthropology, Brandon University (Canada)	Fatty Acid Analysis of Archaeological Residues: Procedures and Possibilities
	Micala Rider, Paul Fish, William Longacre, Matthew Young and Mark Malcomson	Department of Anthropology, University of Arizona (USA)	Residue Analysis of Fatty Acids preserved in Pottery Sherds: Method of Interpretation to Account for the Possible Pitfalls in Analysis
	Ran Boytner	Cotsen Institute of Archaeology, University of California, Los Angeles (USA)	Discussant

Table 1: List of the presentations of the sessions on the 'Theory and Practice of Archaeological Residue Analysis' (Salt Palace Convention Center, 31 March 2005) during the 70<sup>th</sup> Annual Meeting of the Society for American Archaeology in Salt Lake City (Utah). For abstracts see [www.archbase.org/residue/](http://www.archbase.org/residue/).