

Preface

There is growing interest in the application of analytical techniques to archaeological materials; however, many archaeologists and students of archaeology have little or no background in the natural sciences. The purpose of this book is to explain archaeological science to archaeologists. Analytical techniques are presented in a manner that the average North American archaeologist can understand. Sample requirements, potential benefits, and limitations of each approach are outlined so that an archaeologist can be a better informed consumer. It is not intended to train archaeological scientists.

The work is written with the assumption that the reader is familiar with archaeological terminology and methodology; in this respect, it is more suitable for senior undergraduate- and graduate-level students. It can also serve as a reference guide for academic researchers and cultural resource management archaeologists interested in employing these techniques, researchers supervising students who employ them, or those who simply want to better understand their application.

The information presented should enable an archaeologist to understand and critically evaluate

- the suitability of various analytical techniques to address particular archaeological questions;
- the data generated through the application of these techniques;
- the validity of archaeological interpretations made on the basis of the data.

The book is divided into four parts, Basic Science, Applications, Materials, and Instrumentation. Basic Science consists of six chapters covering the concepts from chemistry, physics, and the biological sciences upon which the analytical techniques are based. This scientific primer may be required by some readers to fully understand the rationale and theory behind sample selection, processing, and analysis. Descriptions of atoms, elements, molecules, and their properties are given in Chapter 1. Electromagnetic radiation, Chapter 2, is particularly relevant to the spectroscopic techniques covered in Chapters 34–36, and 39. The principles of radioactive decay, described in Chapter 3, are applicable to the dating techniques described in Chapters 8 and 9 and analytical techniques described in Chapters 32 and 39. Not surprisingly, the stable isotopes described in Chapter 4 are relevant to

Chapter 13. The organic compounds described in Chapter 5 are those analyzed in Chapters 8 and 13 (collagen), 14 (lipids), 15 (blood and other proteins), and 16 (DNA). The topics covered in Chapter 6 are broadly relevant to the study of organic compounds as well.

Part II, Applications, includes chapters describing principles, procedures, and issues related to the most common applications of scientific methods to archaeological materials. After a brief examination of methodological considerations (Chapter 7), several dating techniques are considered. Radiocarbon dating is presented in Chapter 8; other radioactive decay-based dating techniques, uranium series, potassium–argon and argon–argon, and fission track are described in Chapter 9. Trapped charge dating techniques, which include thermoluminescence, optically stimulated luminescence, and electron spin resonance dating, are considered together in Chapter 10. Amino acid racemization, obsidian hydration, cation-ratio dating, and archaeomagnetism are presented together in Chapter 11. General issues related to provenance studies are discussed in Chapter 12. The analysis of the stable isotopes of archaeological interest, carbon, nitrogen, strontium, lead, oxygen, and hydrogen, is described in Chapter 13. Lipid residue analysis (Chapter 14), blood and protein analysis (Chapter 15), and ancient DNA and the polymerase chain reaction (Chapter 16) are described in the final chapters of Part II.

Case studies involving the analysis of specific material types are presented in Part III. The analyses of the fundamental constituents of archaeological materials are described separately from the analysis of residues introduced through use. The materials discussed include pottery (Chapter 17), flaked and ground stone tools (Chapter 18), bone and teeth (Chapter 19), cultural rock (Chapter 20), organic artifacts (Chapter 24), paint, pigment, and ink (Chapter 25), metal and glass (Chapter 26), plant remains (Chapter 27), matrix and other environmental deposits (Chapter 28), and other materials (Chapter 29). The analysis of food residues from pottery (Chapter 21) and other artifacts (Chapter 22) is discussed separately from non-food residues (Chapter 23).

Sampling considerations, sample introduction, and the analytical techniques employed, together with descriptions of instrument components, are presented in Part IV. Although the material is presented in lay language, the reader should be familiar with the relevant concepts presented in Part I, Basic Science.

This work is different from other books on archaeometry with respect to target audience and scope. It is specifically for archaeologists without a strong background in science rather than archaeological scientists. Those wishing more advanced treatments should consult Pollard and Heron (1996), Ciliberto and Spoto (2000), Pollard et al. (2007), and volumes in *The Advances in Archaeological and Museum Science Series*, edited by Martin J. Aitken, Edward V. Sayre, and R. E. Taylor. Archaeological science topics in this text include dating techniques and the analysis of organic and inorganic materials, which makes this text broader in scope than Henderson (2000) but narrower than Brothwell and Pollard (2001). In contrast with Lambert (1997), case studies only represent one part of this text, Part III. The basic scientific knowledge required for understanding archaeological science (Part I), the rationale and issues surrounding analytical approaches (Part II), and

the instrumentation (Part IV) are also emphasized. In addition, the majority of case studies consider the analysis of New World archaeological materials.

My personal experience equipped me to take on the task of writing this book. Before transferring to anthropology, I was enrolled in an undergraduate honours chemistry program. As a senior undergraduate, I used instrumental neutron activation analysis to examine the trace element composition of Precontact period Aboriginal pottery. As a graduate student, I received training in both nuclear magnetic resonance spectroscopy and mineralogical thin section analysis. My doctoral research included the processing and analysis of archaeological and experimental residues and the potential plant and animal food sources using gas chromatography. I continue to analyze archaeological residues extracted from a variety of materials in my laboratory using gas chromatography with mass spectrometry. In addition, I have several years of experience as a field archaeologist in both academic research and cultural resource management settings, during which I obtained age estimates for archaeological materials using radiocarbon and thermoluminescence dating. I first taught a senior undergraduate and graduate level course in archaeological science to archaeology students with social science backgrounds in 1999.

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