Types of analysis applicable to Burials and Associated Funerary Objects in Texas

A Basis for Consultation Between TxDOT and Descendant Communities and Federally-Recognized Tribes

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Foreword

In the event of inadvertent discoveries of human remains, TxDOT works in close consultation with tribes every step of the way. As soon as remains are found, work is stopped, tribes are notified and TxDOT follows the wishes of tribes' in the treatment, analysis and final disposition of remains. No destructive analysis of human remains will take place unless agreed to by the tribe.

The purpose of this report is to serve as an informational resource for tribal consulting parties in order to facilitate consultation when human remains are discovered during TxDOT projects. Discussion of whether to preserve and protect a cemetery or to excavate it (and choice of appropriate field methods) is beyond the scope of this document. The report is organized according to whether or not an individual type of analysis involves destruction of the material studied. It is intended to facilitate discussion and consultation regarding burials that have been archeologically excavated.

To ensure the protection and appropriate treatment of unknown archeological sites uncovered after archeological review, TxDOT delineates clear and standardized procedures in its 2015 Section 106 Programmatic Agreement. Specifically, Stipulation XIII of the agreement document between TxDOT, the Texas State Preservation Office (SHPO), the Advisory Council on Historic Preservation (ACHP), and the Federal Highway Administration (FHWA) lays out standardized guidance for managing these types of discoveries to ensure compliance with all applicable regulatory statutes.

Introduction

The subject matter of archeology is the study of past individuals, groups, and cultures through examination of persisting physical traces of what they left behind. Because they represent the actual remains of people, and often include objects of ritual and symbolic significance placed with the body, burials represent one of the richest sources of archeological information. At the same time, because they represent physical remains and are imbued with inherent social and cultural value, burial merit particular care and respect.

In the case of prehistoric remains, Federal law (and in particular, the Native American Graves Protection and Repatriation Act, or NAGPRA) places particular emphasis on the rights of descendant communities in the decision-making process, and requires federal agencies (and their agents, including TxDOT) to work closely with such descendant communities in the planning and execution of projects.

TxDOT practices and sponsors archeological work as part of its overall responsibility to consider the impact of its actions on the environment, including the archeological record. This type of archeology is part of the discipline of cultural resources management, or CRM. In CRM archeology, burial excavation is generally avoided wherever possible, because avoidance is generally the treatment preferred by all interested parties. Where avoidance is not possible, archeological data recovery, followed by repatriation or reburial, is the likely outcome.

The goal of data recovery is to compensate for the loss cultural resources by careful study of the remains in the interval between disinterment and re-interment or repatriation. Such investigations may involve a wide variety of specialized studies. The following discussion highlights the general types of analysis that could contribute to archeological interpretation of burial features and associated funerary objects in Texas. It is framed broadly, and applicable to both prehistoric (P) and historic burials (H), although individual analyses may be specific to either (or both).

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Non-Destructive Analysis

Morphological analysis of human remains (P, H)
This type of analysis consists of examination and measurement of skeletal remains and is designed to estimate the age, stature, body size, and strength of the individual, as well as to note evidence of disease and trauma.

- Method:
  - Such analysis requires only a visual inspection and measurement of the remains. Some of this data may be collected in the field (as would information on body position and orientation, spatial relationships with grave furniture, etc.), but laboratory analysis of cleaned remains generally provides more complete, higher quality data.
- Result:
  - Comparisons among individuals would allow inferences on the general character and health of the population. For example, a recent study of dentition suggests that the Prehistoric Caddo did not typically intermarry with Central, Southern, and Coastal Texas Indian groups.

Lithic analysis (P)
This broad category includes the analysis of chipped and ground stone tools, and the debris produced by the manufacture and use of those tools. It might include intentionally-placed tools (grave offerings) and incidental debris and tools introduced during the process of inhumation. Lithic analyses can focus of typology (based on the premise that specific tool forms are indicative of specific groups and time periods), technology (methods of manufacture and/or use), or source (raw material provenance). Specialized analyses of this type include:

Non-destructive Lithic Analysis	Description	Method	Results
Use-Wear Analysis	This type of analysis addresses how a stone tool was used (examples: cutting, sawing, piercing, shaving, carving, scraping, and hammering) and on what kind of material it was used on (examples: soft/ hard plants, wood,	This is accomplished by examining the material for striations and polish under varying magnifications and lighting conditions, and comparing the results with known examples.	Among other questions, use wear allows us to infer whether a recovered tool was a favorite of the individual in life, or simply a symbolic offering made to help the deceased in the afterlife.

Non-destructive Lithic Analysis	Description	Method	Results
	soft tissue, bone, or hides).		
X-Ray Fluorescce (XRF)	The method is applicable to a wide variety of lithic raw materials, notably obsidian (which is relatively rare, only locally available, and was traded widely).	XRF analyzers determine the chemistry of a sample by measuring the fluorescent (or secondary) X-ray emitted from a sample when it is excited by a primary X-ray source. Once the domain of large, laboratory-based machines, XRF analyzers now include gun models usable in the field. Analysis consists of irradiating the target object with the instrument, and comparing the response with known standards.	This technique is used to determine the elemental composition of materials.
Ultraviolet Fluorescence	This much simpler technique used in Texas, where it is applicable primarily to cherts, which tend to visibly fluoresce in different colors (yellow, orange, etc.) or not at all under UV light, depending largely on their region of origin.	Analysis consists of illuminating the specimen with UV light and recording the response.	
Micro-artifacts Flotation	The method is used to locate organics for macrofloral analysis (see below) from sediments,	Heavy material is passed through a series of ever smaller screens.	Has the additional benefit to capture very small lithic artifacts. The micro lithic artifacts can thus be

Non-destructive Lithic Analysis	Description	Method	Results
	such as from vessels fill.		retained and studied.

Ceramic Vessel, sherd, and fired clay analyses (primarily P)

Much like lithic analysis, the term "ceramic analysis" subsumes a number of different types of technical and stylistic analyses, including both destructive and nondestructive techniques, and can address both intentionally placed vessels and fired materials inadvertently mixed into the grave fill. In addition to ceramic vessels, fired clay can represent other types of functional or decorative implements (e.g. pendants, ear spools, gaming pieces), or the remains of more pedestrian features (e.g., fired clay from a hearth).

Non-destructive Chert Analysis	Description	Method	Results
Vessel Reconstruction	In general, nondestructive techniques allow evaluation of vessel form and decoration.	Although glue is added, the process is typically reversible.	Analysis of ceramic vessels permits inferential (relative) dating of the vessel where a reliable sequence exists, and—coupled with radiocarbon dating—facilitates construction of such a sequence where it is lacking. Relative dating allows inference of the time period represented by the burial, and by implication the timing of both site occupation and—when considered in concert with other ages on the same type—the broader timing of vessel morphology and design elements. It also allows

Non-destructive Chert Analysis	Description	Method	Results
			one to examine cultural affiliation and map the location of political boundaries and spheres of influence among or between cultural groups at a variety of scales based on the designs and symbolism.

Faunal analysis (animal remains) (primarily P)
This includes a number of methods used to determine what animal species and elements are intentionally or unintentionally represented in the burials.

- Method:
  - Faunal identification generally entails visual comparison of the recovered materials with a reference collection of known animal parts.
  - Such analysis does not require destruction of the identified material. In most cases, this material represents raw material used to manufacture an implement used as a funerary offering, such as a bone or antler tool, or a marine shell. In other cases, it may represent material mixed in during burial or by subsequent disturbance.
- Results:
  - This information can allow the archeologist to infer the function and importance of an object, whether it is a tool (e.g., part of a flint knapping kit) or part of the clothing regalia of the individual.
  - By extension, it also facilitates inference about the specifics of interment behavior, status of the individual, and the role of status in the culture. In the case of exotics (e.g., shell from the Gulf of Mexico or the Pacific Ocean), it can also inform on the depth and extent of trade.

Although more perishable materials like fur and hide are rarely preserved prehistorically except in the dry shelters of southwest Texas (where they are unlikely to be affected by roads, and therefore out of TxDOT purview), historic burials can often preserve leather (e.g., shoes, belts) and ornaments made of animal products like ivory.

Faunal remains that have been made into utilitarian or non-utilitarian implements (e.g., a bison scapula hoe or a turkey bone flute) also provide information on the form and use of such objects, and their role in various aspects of the prehistoric society.

Burial artifacts are unique in that they are one of the few contexts where artifacts are removed from the cultural system before they are at the end of their use life, and provide a basis for interpretation of broken or exhausted stone, ceramic, and bone artifacts.

Macrofloral analysis (plant remains) (P)

This category includes the examination of plant remains that are large enough to be examined with the naked eye and low-power magnification. Because they quickly degrade, preservation of prehistoric, plant-based grave artifacts is negligible in open settings, but macrofloral remains (particularly coffin wood) are common in historic burials.

- Method:
  - Both type of information are usually obtained by processing sediment samples from the grave fill, and in particular from vessels interred with an individual, to separate plant remains from the sediment.
  - Therefore, the process is destructive, but only to sediment samples.
- Results:
  - Both macrobotanical (e.g., seeds, charcoal fragments) and microbotanical (e.g., pollen, phytoliths) remains can inform on economic uses of plants (e.g., as food or raw material) and environmental conditions (i.e., to help reconstruct the prehistoric environment at the time of burial).

Metal objects (H)

With very few exceptions (e.g., cold-hammered copper from the Great Lakes region), metal objects are not present in prehistoric burials in the Americas. Metal objects from historic burials includes coffin hardware, such as latches, hinges, plates, and screws; pins and tacks associated with coffin linings; apparel worn by the deceased such as cufflinks, earrings, and watches; and medical prosthetics such as pins, stents, and false limbs. Some historic burials (including early historic Native American burials) may also include metal grave artifacts.

- Method:
  - Most objects are readily identifiable, but older and obscure objects may require the input of a specialist, such as a metallurgist or a historian with specific expertise.

- Result:
    - All of these items can contribute considerably to relative dating of the internment, and to interpretation of the age (at death), general health (through life), and economic status of the individual represented.

Miscellaneous objects (H)

This category includes materials like plastic, rubber, and synthetic cloth. Like metal objects, they are typical of historic burials, particularly relatively recent ones. Most objects should be relatively straight-forward to interpret.

Stratigraphic Analyses (typically P)

This does not always apply, but in some cases inhumations may penetrate through older cultural strata and incorporate materials from those older strata as the burial pit is excavated and backfilled. In these cases, stratigraphic examination of the site matrix (burial pit and encasing sediments) is warranted to understand the sequence and character of site formation processes.

Spatial Analyses (P, H)

Spatial analysis of the placement and orientation of bodies and grave artifacts, construction and placement of burial pits, and relationship between burials other features and materials within a given site boundary, and between sites at a regional level, is critical to address the relationship of the funerary process to the broader culture. This analysis draws on many of the other methods described in this document, and represents one of the higher order interpretive goals of the process.

Destructive Analysis

Unlike the analyses detailed above, the analyses that follow require destruction of some aspect of the original burial contents. This category is innately controversial. It is subdivided into two subcategories: destructive analyses of ancillary materials, and destructive analysis of human remains and associated grave artifacts.

Ancillary Materials

Ancillary materials includes materials that were not intentionally included as grave offerings, such as lithic debitage, ceramic sherds, and charcoal fragments that were incorporated during backfilling of a burial pit dug into a site with a pre-existing artifact scatter. TxDOT acknowledges that the distinction of ancillary materials from NAGPRA objects may require special expertise and/or consultation with federally-recognized tribes during field investigations and laboratory analysis.

Lithic Artifacts	Description	Method	Results
Instrumental Neutron Activation Analysis (INAA)	This method examines the elemental composition of a material.	Nuclear irradiation	It can be used to compare the stone used in various stone tools, and to trace them to their origin if comparative samples are available. INAA is also applicable to ceramic artifacts.
Chemical analysis of organic material adhering to a vessel or stone tool(P)	This general class subsumes a variety of instrumental and chemical methods to identify plant or animal residue adhering to an artifact.	Chemical analysis	For burials this is usually used for identify what kind of food a vessel contained when there is no carbonized plant or animal remains to visually identify.

Ceramic Artifacts	Description	Method	Results
Bulk organic radiocarbon dating of ceramic sherds(P)	This method dates organic carbon contained within the body of a ceramic sherd. In theory, this would give a date range of when it was fired. This analysis is usually only used for non-NAGPRA artifacts but could be used if you had nothing else to date the burial except a ceramic sherd.	For each date, a portion of a sherd would be crushed, and the organic material imbedded in the fired clay would be chemically extracted and radiocarbon dated.	This allows one to date when the vessel was made and therefore infer the approximate age of the burial and when that style of vessel was in use.

Ceramic Artifacts	Description	Method	Results
Thermoluminescence dating of ceramic sherds(P)	This dating method measures energy captured by the atomic matrix of the clays since the vessel was fired.	Reheating the vessel frees this energy, which is released as a flash of light.	Measuring the strength of this flash under tightly controlled conditions allows one to date when the vessel was last heated to that temperature, and therefore infer the approximate age.
Micro-petrographic analysis(P)	This method is usually done on non-NAGPRA artifacts, such as potsherds mixed into the burial fill.	In this process, a ceramic sherd is imbedded in polyester resin and sliced so thinly that it can transmit light. This slice is mounted in a microscopic slide and analyzed with a binocular microscope.	Petrographic analysis can be used to to determine what the mineral constituents of the sherd are and how they are arranged. This allows a number of inferences, including insight into the manufacturing process, raw material sources, and firing conditions.
Radiocarbon dating of surface residue on ceramics(P)	This is the preferred method for dating burials as it does not require any destruction to the funerary object or human remains. This residue may include burnt food material (boil over), soot, or fire clouds (black smudges found on vessel surface from firing process).	To perform this analysis, a small sample of carbonized material is carefully removed from the surface of the funerary object and radiocarbon dated.	Usually gives the most accurate date.
Instrumental Neutron Activation Analysis (INAA)	This method examines the elemental composition of a material by nuclear irradiation.	Although not strictly a destructive technique, in practice this method uses small samples submitted to an out-of-state lab, which are irradiated and typically not returned.	It can be used to compare the source of clays in various vessels, and trace them to their origin if comparative samples are available. INAA is also applicable to lithic artifacts.

Destructive Analysis (cont.)

Microfloral and macrofloral analysis, (plant remains) (P)

The process is destructive, but only to sediment samples.

- Method:
  - This type of analysis involves processing sediment samples from the grave fill, and in particular from vessels interred with an individual, to separate plant remains from the sediment.
- Result:
  - Both macrobotanical (e.g., seeds, charcoal fragments) and microbotanical (e.g., pollen, phytoliths) remains can inform on economic uses of plants (e.g., as food or raw material) and environmental conditions (i.e., to help reconstruct the prehistoric environment at the time of burial).

Chemical and textural soil analysis (P)

These tests are most applicable when associated stratigraphic studies are performed.

- Method:
  - This suite of methods involves subjecting tiny samples of sediment to a variety of physical (e.g., grain size, bulk density, magnetic susceptibility) and chemical (e.g., carbonate, organic matter, iron, phosphate) analyses in the laboratory.
- Result:
  - This process can inform how the soil deposits came together.

Optically Stimulated Luminescence (OSL) (P)

This dating technique measures the amount of energy trapped in quartz sand grains since the last time it was exposed to sunlight.

- Method:
  - It works the same as TL dating, except that it is light rather than heat that resets the "clock".
- Results:
  - It is particularly useful for dating sites in eolian (wind deposited) settings, and for gauging the degree of disturbance of a sediment column by rodents and burrowing insects.

Direct Methods of Destructive Analysis

The following methods would require destructive use of tiny pieces of funerary artifacts or human remains recovered from the burials.

These methods are a description of the types of analysis possible, but are not implemented without the direction and consent of the tribes through the consultation process. While we recognize that they are very controversial with tribes, the purpose of including them in this report is to outline the potential results of direct dating and DNA analysis of human remains, and analyses of associated funerary artifacts.

Lithic and ceramic artifacts (P)

All of the destructive methods outlined above for ancillary lithic and ceramic artifacts are equally applicable to funerary artifacts. Because these artifacts are behaviorally associated with the subject burial, they are potentially far more informative than incidental artifacts incorporated during backfilling. At the same time, they represent a more significant impact on the burial contents.

Radiocarbon dating and stable isotope analysis of human remains (Primarily P)

Dates obtained directly from burials obviously provide the most accurate estimate of when each burial took place. In turn, that would allow for the understanding of how multiple burials at a given site are related to each other with a high degree of confidence, and it could provide accurate age estimates of when the site was occupied. Direct dating of burials provides direct evidence of the age of various vessel forms, decorative motifs, stone tools forms, and mortuary practices were in use.

- Radiocarbon dating can use either the collagen fraction or the mineral fraction of bone, but collagen is a better material because the mineral fraction is subject to exchanging carbon atoms with the environment, affecting the accuracy of the age.

- Stable isotope analysis examines the ratio between different isotopes of like carbon, nitrogen, and oxygen. Oxygen isotope analysis provides evidence of paleotemperatures and is typically applied to shell and sediments, but carbon and nitrogen isotope analysis of bone provide direct evidence of diet.
    - In the case of carbon isotopes, the distinction is between temperate zone plants that follow a metabolic pathway termed “C3”, and tropical grasses, which follow a different pathway termed “C4”.
    - The significance of carbon isotope analysis is that corn (maize) is a domesticated C4 grass, so it can be very informative about the role of corn in the prehistoric diet. In the same way, nitrogen isotopes can inform on the role of foods like mesquite and fish.

DNA Analysis of human remains (Primarily H)

This suite of techniques involves the use of materials containing intact DNA (e.g., bone, hair) to evaluate the genetic relationship between the individual in the burial and other individuals or groups. There are a number of different techniques for DNA analysis that can operate at a variety of scales, ranging from addressing broad genetic (ethnic) heritage to specific familial associations.

Because DNA degrades with time, the latter have the most direct utility because they can potentially match individuals with living descendants in a clear and unambiguous manner. However, if suitable samples could be obtained, DNA of prehistoric burials (and particularly multiple burials in a cemetery setting) could be spectacularly informative about social dynamics and community composition.

Radiocarbon dating of plant remains found in flotation of soil from vessels, in the burial pit fill, or in the surrounding matrix (P)

This method addresses what is generally very finely divided charcoal dispersed in sediment. The reliability of the date depends on many factors, not the least of which is the character of the context dated, because finely divided charcoal can have many sources. In general, dating of vessel fills is the most secure of these ages, because generalized charcoal floating in the grave shaft matrix is more likely to represent ancillary material pre-dating the burial.

Conclusion

The preceding list attempts to provide an overview of analytical techniques applicable to burials in Texas. It should not be considered an exhaustive statement, however as it does not capture all applicable extant methods, and new methods are being developed all the time. For example, it is important to mention a suite of techniques that are not analyses *per se*, but rather methods to capture artifacts and features in digital form for future study. These techniques include three dimensional (3D) laser scanning and structure-from-motion photography, where a suite of artifacts are used to construct a virtual replica of the object in question. Both of these methods provide opportunities to document grave offerings in a great deal of detail before they are repatriated. Of course, all such analyses are dependent on the outcome of the consultation process.

Per Sec. 106, TxDOT considers all forms of mitigation and prefers avoiding impacts to cemeteries entirely. However, it is an unfortunate truism that some cemeteries are not discovered until project development is too advanced to avoid them, and data recovery excavations are necessary. In these cases, TxDOT is committed to working closely with federally-recognized tribes to treat any and all remains with the utmost care and respect, and to resolve any related issues in an open, mutually-acceptable manner.