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# Healing Practices and Ritual Feasts Among the Nabateans: A Study of Absorbed Residues From Ceramics on the Ad-Deir Plateau

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# on the Ad-Deir Plateau

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ABSTRACT

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Eastern Cistern B on the Ad-Deir Plateau is unusual in its breadth and variety of ceramic vessels represented by thousands of sherds. These sherds raised significant questions about the purpose and use of the vessels that they originally came from. This thesis argues that the ceramic vessels that were deposited in Eastern Cistern B represent the deposited remains of an ancient Nabataean ritual feast. Furthermore, this thesis also helps to answer the questions surrounding what the ceramic containers once held and their relationship to that ritual meal. This thesis identified residues absorbed within the ceramic fragments through the use of a gas chromatographer-mass spectrometer analysis. The data demonstrated that the vessels once contained remains of medicinal plants, such as crocus, oleander, and others as well as post deposition contaminants throughout the majority of the samples. Those contaminations and other limitations mentioned in this thesis may provide a basis for future investigations for absorbed residue analysis in Petra, Jordan. In turn, the relationship between the medicinal plants and the feast at Eastern Cistern B suggests that a healing ritual possibly accompanied a meal suggesting archaeologists begin examining this and other associated events that accompanied ritual feasts in and among the Nabataeans and in the ancient Near East more broadly

Keywords: Petra, medicinal plants, gas chromatography, Nabataeans

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# 1 Introduction

The ancient city of Petra, which is located in modern Jordan is most often recognized today by its famous tomb facades (See Figures 1.1 and 1.2). The ancient Nabataeans established their kingdom in the Southern Levant before the 4th century B.C.E. and were later absorbed by the Roman Emperor Trajan in 106 C.E.[1] Though Nabataean tombs are the most eminent features within Petra, archaeologists have contributed to the ever-growing wealth of knowledge that constitutes ancient Nabataean culture. Archaeologists have revealed a large range of Nabataean cultural practices that included distinct attitudes toward the dead as well as unique religious and architectural adaptations taken from surrounding ancient Near Eastern and Mediterranean cultures.[2] Petra itself was a hub for international trade that was primarily focused on the incense

1 A number of scholars who have worked with the Qasr al-Bint temple complex have been able to distinguish early levels dating to the 4th century B.C.E. that indicates that there was some building activity occurring at that time that may correlate with the earliest stages of the Nabataean Kingdom. See: David F. Graf, "Appendix: The Chronology of the Qasr al-Bint Complex," *Journal of Roman Archaeology* 19 (2006): 446; François Renel and Andreas Kropp, "The Hellenistic Levels under the Temenos of the Qasr Al-Bint at Petra," *Annual of the Department of Archaeology of Jordan* 52 (2008): 69; François Renel et al., "Dating the Early Phases Under the Temenos of the Qasr Al-Bint at Petra The so-Called Hellenistic Levels," *Supplement to Proceedings of the Seminar for Arabian Studies* 42 (2012): 11–13.

2 Stephan G. Schmid, "The 'Hellenisation' of the Nabataeans: A New Approach," *Studies in the History and Archaeology of Jordan* 7 (2001): 407; Judith McKenzie, *The Architecture of Petra* (Oxford: Oxbow Books, 2005). See Stephen G. Schmid's work on some of the general influences of Hellenistic architectural styles on Nabataean culture and Judith McKenzie's book for a broad overview of the various architectural styles that were influenced by Hellenism.

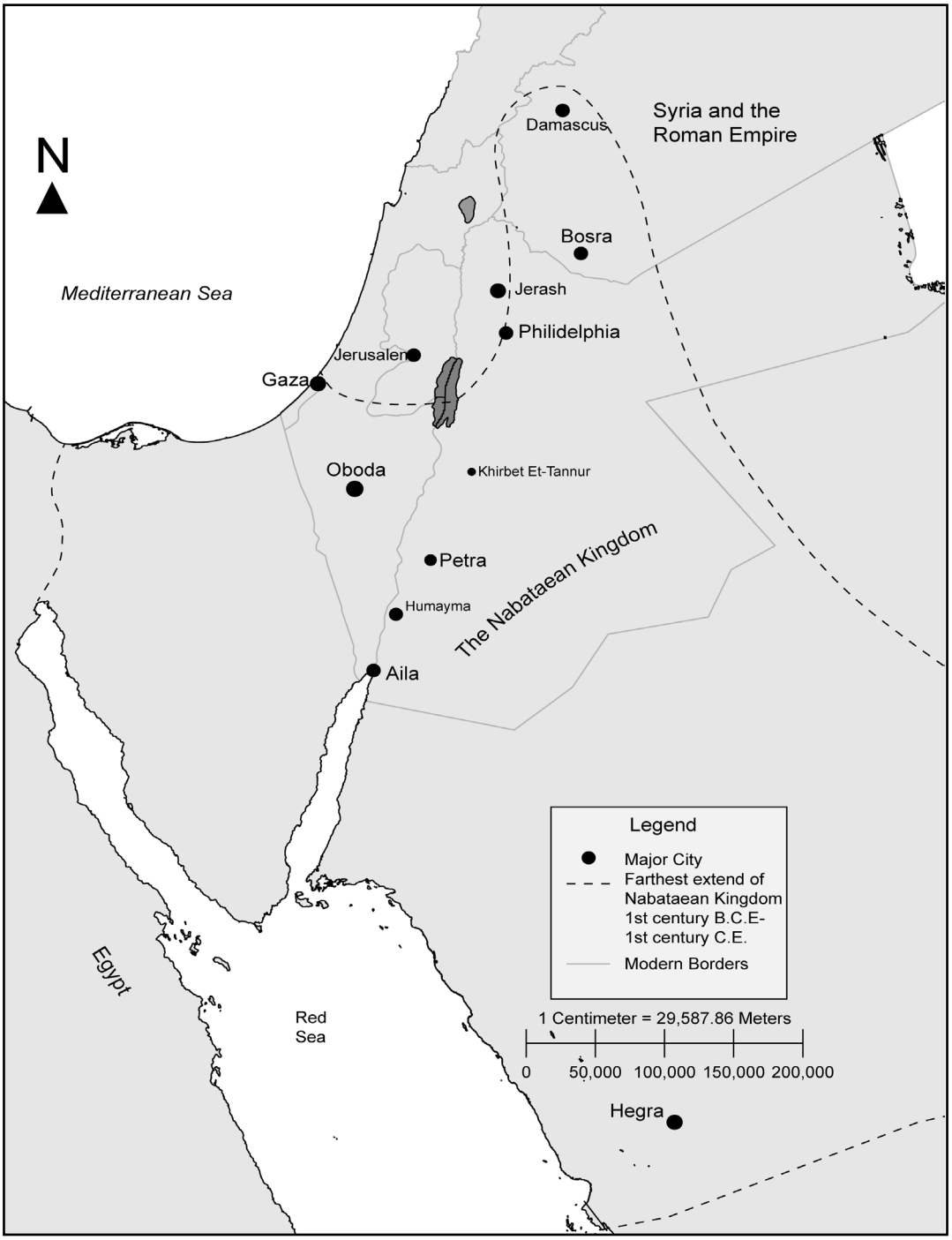


Figure 1.1. Map of the ancient Nabataean Kingdom. Drawn by the author.

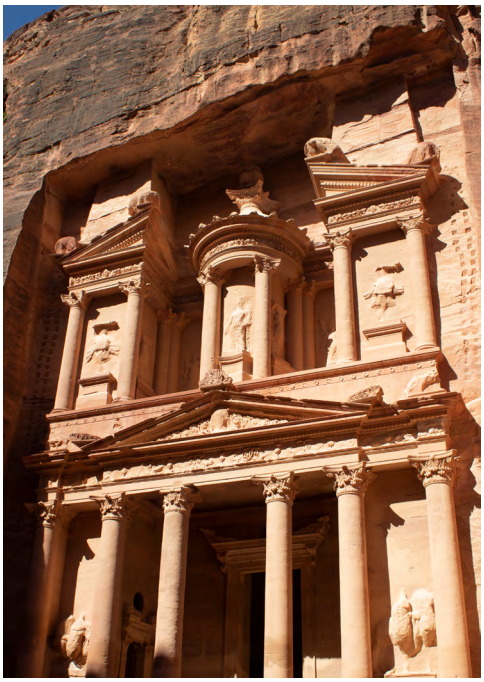

Figure 1.2. The Khaznah or Treasury, a famous tomb facade in Petra. Photo by the author. .

from Yemen and southern Arabia.[3] Both frankincense and myrrh were widely used by various ancient Near Eastern and Mediterranean peoples in their religious worship. Nabataean trade extended west to Italy and east to at least India if not China making the Nabataean Kingdom extremely wealthy and contributing to their eclectic architecture.[4] Thus, studies that address Nabataean culture have wider applications to other ancient peoples and especially the Hellenistic and later Roman worlds of the Mediterranean basin.

3 Though trade may have primarily focused on incense, there is evidence that the Nabataeans also traded silk and other foreign goods from distant lands, such as India and China. See J. Thorley, "The Silk Trade between China and the Roman Empire at Its Height, 'Circa' A. D. 90-130," *Greece & Rome* 18, no. 1 (1971): 73; Fergus Millar, "Caravan Cities: The Roman Near East and Long-Distance Trade by Land," *Bulletin of the Institute of Classical Studies. Supplement*, no. 71 (1998): 121; Juan Pablo Sánchez Hernández, "Pausanias and Rome's Eastern Trade," *Mnemosyne* 69, no. 6 (2016): 966; Cynthia Finlayson, "The Women of Palmyra--Textile Workshops and the Influence of the Silk Trade in Roman Syria," in *Textile Society of America Symposium Proceedings* (Silk Roads, Other Roads: Proceedings of the 8th Biennial Symposium of the Textile Society of America, Northampton, Massachusetts, 2002), 1, .

4 Millar, "Caravan Cities: The Roman Near East and Long-Distance Trade by Land," 69; Taco Terpstra, "Roman Trade with the Far East: Evidence for Nabataean Middlemen in Puteoli," in *Across the Ocean: Nine Essays on Indo-Mediterranean Trade*, ed. Federico De Romanis and Marco Maiuro (BRILL, 2015), 73; Hernández, "Pausanias and Rome's Eastern Trade," 966.

## Ad-Deir and Eastern Cistern B

Petra is situated among the escarpment formed between the Jordanian desert plateau in the East and the Wadi Arabah in the West (See Figure 1.1). The ancient author, Athenodorus of Tarsus, found that the mountainous terrain afforded the city natural protection (*Geographia* XVI.4.21). The Ad-Deir Plateau is one of the most famous areas in Petra because it hosts one of the largest façades that is commonly known as 'The Monastery'. The name derives from a tradition in which the Plateau and the monument were used as a monastery in the Christian Period (4th to early 7th centuries C.E.). The Ad-Deir Plateau lies on the western edge of Petra and is elevated more than 180 meters above the city center.[5] The Plateau can only be accessed relatively easily through two passages at the northern and southern ends. There is evidence that the Nabataeans established a large processional way at the southern end of the Plateau that would have facilitated both political and ritual practices.[6]

The Ad-Deir Plateau houses numerous water catchment systems that serviced the various monuments and structures on the Plateau, one of which was Eastern Cistern B (ECB) (See Figure 1.3). ECB is one of seven cisterns connected via rock-cut channels. These water channels are located at the base of Jebel Fatouma that constitutes the eastern edge of the Ad-Deir Plateau.[7] ECB is unique because a rock fall preserved the artifact assemblage below. The sherds from the sealed layers for this thesis were consequently excavated by the BYU Ad-Deir Monument and Plateau Project (AMPP) from 2013-2021.[8] Additionally, there are remains of a room, possibly a small banqueting hall, above ECB that may have collapsed sometime after the 2nd or 3rd centuries

5 The Ad-Deir Monument and Plateau Project (AMPP) conducted an intensive GIS mapping project of the entire Plateau in 2014. The AMPP crew planned and flew a UAV over the Plateau in which they had to calculate minimum safety heights. It is from that calculation that the number presented here is taken. See: Cynthia Finlayson, "Ad-Deir Monument and Plateau Project Annual Report" (Petra, Jordan: Brigham Young University, 2014).

6 A part of the multi-year GIS survey of the Ad-Deir Plateau was to map the various entrances onto the Plateau. See: Cynthia Finlayson, "Ad-Deir Monument and Plateau Project Annual Report" (Petra, Jordan: Brigham Young University, 2015).

7 All ceramic samples tested in this thesis were used with permission from the Ad-Deir Monument and Plateau Project director, Dr. Cynthia Finlayson.

8 Finlayson, "AMPP Annual Report," 2015.

Figure 1.3. Eastern Cistern B and the collapsed room above it at the end of the 2019 field season. Photo by the author. .

C.E. (See Figure 1.3).[9] The ceramics that were sealed below offer a unique chance to study ancient Nabataean pottery from an archaeological context that has been sealed for over 2000 years. Though some seasonal looting has occurred, the integrity of the sherds and the stratigraphy have remained relatively constant given the great depth of the cistern (just over 7m). and its related erosional soil deposits.[10]

In addition to new ceramic analyses that may stem from studies of the pottery assemblage from ECB, there is an inscription above the collapsed room that states a ritual feast had occurred

9 The room was first observed in the initial survey of the Ad-Deir Plateau in 2014 with subsequent excavations of the room in 2015. See: Finlayson, "AMPP Annual Report," 2014; Finlayson, "AMPP Annual Report," 2015.
10 Cynthia Finlayson, "Ad-Deir Monument and Plateau Project Annual Report" (Petra, Jordan: Brigham Young University, 2019).

there.[11] The inscription associated with the collapsed rock-cut room suggests that the space may have acted as a banqueting or symposium hall and presents the possibility that vessels from such a ritual were discarded in the cistern immediately below. Additionally, the ceramics from ECB seem to suggest that a feast did occur there since both cooking and serving vessels were predominately found alongside fine dining plates and cups rather than significant remains of water carrying vessels that should have logically been dropped or broken in ancient times as part of water retrieval from such a massive cistern complex. Thus, studies of ECB may also contribute to the understanding of Nabataean feasting practices and possibly the importance of water and water catchment systems in Nabataean ideologies.

This thesis thus seeks to answer a basic question about Nabataean society, specifically, what things did they store in their ceramic vessels? To answer this question, this thesis uses scientific methods and analytical techniques to identify absorbed residues in ancient ceramic vessels from ECB. While residue analyses have been developed over the past fifty years, archaeologists have only recently begun to investigate the residues in ceramics from Jordan.[12] For example, Bethany Walker and Silvia Polla have identified food remains in Islamic cookwares from Tell Hisban and Abdulraouf Mayyas and Khaled Douglas have identified beeswax lining in Iron Age pottery from sites in the northern parts of modern Jordan.[13] These instances demonstrate that absorbed residue analyses have great potential for ceramic studies in Jordan.

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11 Fawzi Zayadine and Suleiman Farajat, "The Petra National Trust Site Projects: Excavation and Clearance at Petra and Beihda," *Annual of the Department of Antiquities of Jordan* 35 (1991): 284. The full transcript of the inscription and its associated features are discussed at greater length in Chapter 5 of this thesis.

12 Richard P. Evershed, "Biomolecular Archaeology and Lipids," *World Archaeology* 25, no. 1 (1993): 74.particularly lipids, can frequently be detected in ancient materials. The structures and compositions of mixtures of lipids can provide direct evidence for their origin, and hence, evidence for human activity in the past. An important concept in the field of biomolecular archaeology of lipids is that of 'biomarkers'. Archaeological biomarkers are characteristic compounds (or mixtures of compounds

13 Bethany J. Walker et al., "Residue Analysis as Evidence of Activity Areas and Phased Abandonment in Medieval Jordanian Village," *Journal of Islamic Archaeology* 4, no. 2 (2017): 217; Abdulraouf Mayyas S. and Khaled Douglas, "Organic Residues in Iron Age II Pottery Vessels from Jneneh, Jordan," *Mediterranean Archaeology and Archaeometry* 15 (2015): 31.

My thesis is unique because it is the first study to use absorbed residue analysis to potentially understand ritual feasting among the Nabataeans of Petra. As such, this study has identified flora residues that suggest medicinal plant use. This thesis argues that the plant residues identified using absorbed residue analysis represent a healing event that took place either in conjunction with or before a Nabataean ritual feast. Thus, the chapters within this thesis are set out to demonstrate that the plant remains represent known ancient medicinal concoctions as well as that a ritual feast did occur at or near ECB.

## Thesis Outline

Chapter 2 of this research project includes the basic contextual and methodological information used throughout the thesis discussion. Specifically, Chapter 2 introduces a basic history of the Nabataeans and Petra and outlines the major historical events associated with the rise of the Nabataean Kingdom in the 4th century B.C.E. and its eventual absorption by Rome in 106 C.E. Chapter 2 also provides an overview of Eastern Cistern B within the archaeological contexts of the Ad-Deir Plateau. Additionally, the methodology used in this thesis is discussed with careful consideration for the parameters for the gas chromatographer-mass spectrometer technique with relation to the identification of the residues extant within the pottery fragments retrieved from this site.

Chapter 3 outlines specific plants that my study could identify by absorbed lipid residue analysis. While the data focuses primarily on the possible medicinal plants used by the ancient Nabataeans, this chapter also includes some of the non-medicinal plants that may have been consumed by them in a feasting context. Specifically, Chapter 3 discusses several plant residues that correspond to specific plant species such as foxglove, oleander, sea squill, crocus, and almonds. Each section is dedicated to a specific plant and summarizes the ancient historical and ethnographic work that mentions the healing or symbolic properties of the aforementioned

plants. The second half of the chapter is dedicated to several contaminates that were common on the Ad-Deir Plateau that may have impacted the results of my study.

Chapter 4 is a short chapter on some of the limitations of using a gas chromatographer-mass spectrometer. I observed machine limitations such as an inability to identify degraded material as well as a propensity to distinguish unknown compounds as modern medicinal drugs, such as prednisolone, which were not present anciently. Additionally, I found that sampling was restricted to ceramic sherds that were large enough to pulverize at least 2 grams for each trial. This sampling method restricted the selection of sherds to fragments that were both thick enough to allow absorption and large enough to sample. Thus, the tests discussed in this thesis did not include Nabataean fine ware fragments that are often too thin and small for such chemical analyses of their contents but focused on larger Nabataean coarse ware sherds.

Chapter 5 discusses the various definitions of ritual feasting that have been proposed by archaeologists and how they have influenced the parameters for this study. Additionally, Chapter 5 discusses the types of feasts that Brian Hayden has categorized and the types of material evidence that archaeologists could identify in their excavations.[14] The approaches that are discussed in the first part of Chapter 5 are then applied to the available evidence from ECB to demonstrate that a ritual feast potentially occurred near or at this cistern complex. After establishing that a feast occurred at ECB, this chapter then discusses the healing event or ritual that potentially accompanied a Nabataean symposium.

Chapter 5 also discusses some of the possible explanations for the appearance of medicinal plant consumption in feasting contexts such as the possibility of an associated healing ritual. It is also possible that the plants that were selected and consumed granted the participant certain powers or health. Since the plants identified in this study were primarily medicinal in

14 Brian Hayden, "Fabulous Feasts: A Prolegomenon to the Importance of Feasting," in *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, ed. Brian Hayden and Michael Dietler (Tuscaloosa, United States: University of Alabama Press, 2001), 121–27.

nature, it is most likely that health and healing played a part in their selection. Additionally, as is demonstrated by the squill plant, some of the plants also performed ritualistic functions. Unfortunately, a single occurrence of such events will rely on future studies to confirm the hypothesis set out in this thesis. However, the research lays a foundation for such future investigations

This thesis then concludes with a review of the data and ritual feasting elements of Eastern Cistern B to demonstrate that the consumption of medicinal plants could be utilized with a Nabataean *mrzḥ*ʾ. The new data presented in this thesis thus demonstrates that events associated with ritual feasts are detectable and that future scholarship should investigate the unique occasions that accompanied ritual feasts beyond just the consumption of foodstuffs.

# 2 The Nabataeans, Eastern Cistern B, and Methodology

The Nabataeans of the Southern Levant have a unique history and culture that was afforded by the physical and political landscape of the ancient Near East. The ancient Nabataeans created complex water management systems to cope with the harsh desert conditions of the Southern Levant. Additionally, various competing political entities and cultural groups in the ancient Near East contributed to the development of Nabataean culture. Thus, it is important to understand both the history and geographical location that the Nabataeans lived in to recognize the significance of some of their cultural practices, such as healing and feasting. This chapter outlines three topics that set up an interpretive framework for this study. First, the history of the Nabataeans is discussed from the rise of the Nabataean Kingdom sometime in the 4th century C.E.[1] This chapter discusses the absorption of the Nabataean Kingdom into the Roman Empire in 106 C.E. This chapter also discusses the Ad-Deir Plateau wihtin the context of Petra and more specifically Eastern Cistern B (ECB), on the Ad-Deir Plateau. This thesis chapter discusses the methodology used and the historical and geographical aspects of Petra and the Nabateans that are critical to this study.

1 Graf, "Appendix," 446; Renel and Kropp, "The Hellenistic Levels under the Temenos of the Qasr Al-Bint at Petra," 69; Renel et al., "Dating the Early Phases Under the Temenos of the Qasr Al-Bint at Petra The so-Called Hellenistic Levels," 11–13.

Modern historians and archaeologists alike have used the term "Nabataean" to identify the material culture that the ancient inhabitants of Petra and other sites in the Southern Levant left behind between the 4th century B.C.E. to the 3rd or 4th centuries C.E. The expression "Nabataean" is an efficient classification tool; however, the Nabataean Kingdom was a conglomerate of Arab tribes that were indigenous both to the Southern Levant and Northern Arabia, as well as sedentary Edomite groups.[2] Additionally, the Nabataeans intensively interacted with surrounding ancient Near Eastern and Mediterranean populations, which led to the adoption and adaptation of various cultural practices.[3] Therefore, this study looks at the historical and cultural influences on Nabataean ritual feasts.

## Historical Sketch of the Nabataeans

The exact origins of the Nabateans are unfortunately unknown since no written histories or archaeological materials that can be associated with them are seemingly extant from before the 4th century B.C.E. They were most likely a nomadic group or a conglomerate of Bedouin tribes, though some scholars have urged that the prehistory of the Nabataean Kingdom and Nabataean ethnogenesis be approached with caution since the historical records are not always clear and are at times contradictory.[4] The archaeological record of Jordan and the Southern Levant demonstrate various layers of occupation and abandonment, such as at the ancient site of Sela, Jordan, where an Edomite era city had clear ties with other major powers, such as

2 David Mattingly et al., "The Making of Early States: The Iron Age and Nabatean Periods," in *Archaeology and Desertification: The Wadi Faynan Landscape Survey, Southern Jordan*, ed. Graeme Barker, David Gilbertson, and David Mattingly, 2008, 271.

3 Peter Parr, "The Beginnings of Hellenisation at Petra," in *Le Rayonnement Des Civilisations Grecque et Romanie Sur Les Cultures Peripherique* (Paris: E. De Boccard, 1965), 527; Schmid, "The 'Hellenisation' of the Nabataeans: A New Approach," 407.

4 For example, Jan Retsö has suggested that archaeologists should not automatically assume that the Nabataeans were Arabs since some ancient authors do not state that the Nabataeans are Arabs or from Arabia, whereas Robert Wenning has suggested that scholars should not discount the probably nomadic heritage of the Nabateans. See Jan Retsö, "Nabataean Origins — Once Again," *Proceedings of the Seminar for Arabian Studies* 29 (1999): 115; Robert Wenning, "Towards 'Early Petra': An Overview of the Early History of the Nabataeans in Its Context," in *Men on the Rocks: The Formation of Nabataean Petra*, ed. Stephan G. Schmid and Michel Mouton (Berlin: Logos, 2013), 8.

the Babylonians.[5] Petra itself has various historic and prehistoric sites, such as the Edomite settlement on Umm Al-Biyara that dates to the 7th and 6th centuries B.C.E.[6] Patterns of occupation and abandonment may suggest that local populations were consistently changing lifestyles based on the economic opportunities presented to the several groups (Diodorus 19.94.2). However, the people who lived in the Southern Levant in the later 5th and the 4th centuries B.C.E. were ethnically diverse with Edomite and various Arab tribes, living within the same area that slowly came under the same administrative power that came to be known as the Nabataean King.

The earliest historical account of the Nabataeans was recorded in Diodorus Siculus' *Bibliotheca Historica,* where he quoted Hieronymus of Cardia, an ancient Greek historian who lived during the time of Alexander the Great.[7] Diodorus' written record placed the first encounter between the ancient Greeks and Nabataeans around 312 B.C.E. when the Macedonian general Antigonus I Monophthalmus (Antigonus the One-Eyed) attempted to seize control of areas that are now a part of modern Jordan and Palestine (Diodorus 19.96.1).[8] Diodorus also provides details concerning the culture of the Nabataeans, which included notes on the Nabataean nomadic lifestyle, such as the reluctance to plant crops and the Nabataean reliance upon animal husbandry (19.94.2-95.2).[9] Diodorus illustrated characteristics and attributes that are distinctly

5 Rocio Da Riva, "The Nabonidus Inscription in Sela (Jordan): Epigraphic Study and Historical Meaning," *Zeitschrift Für Assyriologie Und Vorderasiatische Archäologie* 110, no. 2 (2020): 176.

6 Piotr Bienkowski, ed., Umm Al-Biyara Excavations by Crystal-M. Bennett in Petra 1960-1965, Levant Supplementary Series 10 (Oxford: Oxbow Books, 2011), 139.

7 Diodorus Siculus, *The Library of History*, trans. Charles Henry Oldfather, vol. X (Loeb Classical Library, 1954). See book XIX, chapter 94.

8 Siculus. See book XIX, chapter 94. Antigonus I Monophthalmus was a Macedonian general who served under both Philip II and later Alexander the Great. He inherited parts of Asia Minor that bordered the Mediterranean, but eventually made incursions into Ptolemaic-held territories near and in Egypt. It was during these expeditions that Antigonus encountered the ancient Nabataeans.

9 Siculus. See book XIX, chapter 94. Siculus further mentions, "They live in the open air, claiming as native land a wilderness that has neither rivers nor abundant springs from which it is possible for a hostile army to obtain water. It is their custom neither to plant grain, set out any fruit-bearing tree, use wine, nor construct any house; and if anyone is found acting contrary to this, death is his penalty." This is an apt description of nomadic life, which if it is accurate, would firmly place the Nabataeans into the category of semi-nomadic to fully nomadic. Furthermore, Siculus wrote, "They follow this custom because they believe that those who possess these things are, in order to retain the use of them, easily compelled by the powerful to do their bidding." The Nabataean desire for a disassociation with sedentary groups further implicates not only their nomadic way of life but possibly their attitude

nomadic, which is supported by limited archaeological work before the 2nd century B.C.E., though scholars have questioned the accuracy and validity of Diodorus' work [10] The Nabateans were most likely a locally powerful nomadic group that began to settle down in the 4th century B.C.E. and rose to local prominence in the 2nd century B.C.E.[11]

The Nabataeans quickly expanded their kingdom and incorporated sedentary populations in the Southern Levant as suggested by the appearance of coins with the names of Nabataean Kings (early 2nd century B.C.E.) that mark the further economic and political independence of the Nabataean Kingdom from the Hellenistic Kingdoms that had ruled the Southern Levant for the previous two-hundred years.[12] Scholars have obsereved the expansion of the Nabataean Kingdom by the appearance of Nabataean pottery, specifically the fine painted wares that are characteristic of Nabataean craftsmanship in sites throughout the Southern Levant. For example, early Nabataean Painted fine wares appear in areas north of Petra at Mudayna Thamud, which Maria-Louise Sidoroff and Mary Ownby suggest demonstrates Nabataean political and cultural expansion as well as their possible control over local settlements and villages.[13]

Nabataean growth continued and accelerated beginning in the second half of the first century B.C.E. under the successful reigns of several Nabataean kings. The incorporation of Hellenistic and sedentary practices, such as the construction of monumental architecture and the mass production of goods, like ceramic vessels, demonstrate the political and economic growth of the Nabataean Kingdom. The development of the Nabataean Kingdom continued until the Roman Emperor Trajan annexed the lands under the Nabataean Kingdom in 106 C.E. Though

towards such sedentary groups as the ancient Greeks who were encroaching into their territory. However, this second-hand account of the Nabataeans may be inaccurate given current archaeological evidence.

10 Robert Wenning, "The Nabataeans in History," in *The World of the Nabataeans* 2 (Stutgart: Franz Steiner Verlag, 2007), 28.

11 See footnote 1

12 Ya'akov Meshorer, "Nabataean Coins," *Qedem* 3 (1975): 9–12.

13 Maria-Louise Sidoroff and Mary Ownby, "Preliminary Petrographic Study of Nabataean Painted and Unpainted Fine Ware Bowls from Mudayna Thamad, Jordan," in *Studies on the Nabataean Culture II*, ed. Nabil I. Khairy (Amman: University of Jordan, 2016), 198–200.

the Nabatean Kingdom lost its autonomy, individuals continued to call themselves "Nabateans" under Roman rule, as demonstrated by inscriptions from Palmyra, Syria in the post-annexation period around 132 C.E.[14] Furthermore, Nabataean potters continued to produce their distinct pottery into the 4th and 5th centuries C.E. The ceramic assemblage discussed in this thesis is from Eastern Cistern B and corresponds to the period of the Nabataean Kingdom between 50 B.C.E to the early 2nd century C.E. or approximately down to the period of annexation by the Roman Empire.

## Eastern Cistern B and the Ad-Deir Plateau

The ancient world of the Nabataeans has captivated scholars and the public alike since its reintroduction to the West by Richard Burkhart in the early 1800s.[15] Since then, archaeologists have come to the ancient city of Petra to understand its rich history and unique culture. Individuals such as David Roberts and Antoine-Alphonse Montfort contributed to the understanding of Petra and the Ad-Deir Plateau through their art in the 1830s.[16] Despite many casual visitors to the Ad- Deir Plateau in Petra throughout the 1800s, it was not until Alois Musil surveyed the Plateau in 1907 that the site was studied scientifically. Additionally, it was not until a year later that Gustaf Dalman sought to understand the religious importance and features of the area.[17] Later scholars also surveyed the Ad-Deir Plateau and its monuments, such as Manfred Lindner in 1988, which provided initial information for later exploration and excavation begining

14 The inscription is from an equestrian, ʿUbaidu who belonged to the Rawaḥa tribe. This inscription is significant because it is direct evidence that the name "Nabataean" had significant cultural meaning as an appellation for individuals even after the annexation of the Nabataean Kingdom in 106 C.E. See: Javier Teixidor, *The Pantheon of Palmyra* (Leiden: BRILL, 1979), 86–87.

15 John Lewis Burckhardt, *Travel in Syria and the Holy Land* (Echo Library, 2006).

16 David Roberts, El Deir Petra March 8, 1839, Lithograph, color, 1839, https://www.loc.gov/item/2002717535/; Antoine-Alphonse Montfort, The Dair in Petra, 1838, lead pencil, 1838, https://collections.louvre.fr/en/ark:/53355/cl020017035.

17 Gustaf Dalman, *Petra und seine Felsheiligtümer* (Leipzig: J.C. Hinrichs, 1908); Alois Musil, *Arabia Petraea* (Wein, Austria: A. Hölder, 1907).

in 2015.[18] The most recent archaeological explorations of the Ad-Deir Plateau have been conducted by the Ad- Deir Monument and Plateau Project (AMPP) beginning with aerial survey in 2013 and excavation beginning in 2014 and continuing into 2022 and have found numerous religious sites and features.[19] AMPP has extended previous surveys to incorporate a wider area to further understand the historical uses of the Plateau in conjunction with the water management systems.[20]

The Ad-Deir Plateau lies on the eastern edge of Petra, Jordan. It is a unique location because of its elevated position more than 180 meters above the city center and with only limited access to the Plateau through two passages at the northern and southern ends of the Plateau (See Figure 2.1). The Plateau itself is home to various structures with secular and religious functions. The Ad-Deir Monument or 'The Monastery' as it is commonly known, is an impressive façade that may have originally acted as a symposium hall or temple.[21] Two long benches to either side of a raised platform along the back attest to its former function as a religious site where banqueting may have occurred.[22] A key attribute of the ancient success of the Plateau was the Nabataean's ability to create diverse water catchment and storage systems to provide water for local inhabitants and visitors.

*Eastern Cistern B*

One such water containment device that the Nabataeans created was Eastern Cistern B (ECB). ECB is located at the base of Jebel Fatuma on the Ad-Deir Plateau and is one of eight cisterns that form a linked system (See Figure 2.2). ECB is roughly rectangular, measuring

18 Manfred Lindner et al., "New Explorations of the Deir-Plateau (Petra)," *Annual of the Department of Antiquities of Jordan* 28 (1984): 163–81.

19 Dalman assigned numbers to the features that he noted on his survey with D followed by the number (e.g., D453). The AMPP survey also assigned numbers to the features on the Ad-Deir Plateau (e.g., 230, or 230.1 depending on the area and possible associations). This chapter utilizes both number systems side by side.

20 Finlayson, "AMPP Annual Report," 2019.

21 Peter Alpass, *The Religious Life of Nabataea* (BRILL, 2013), 63–64; John F. Healey, *The Religion of the Nabataeans* (Leiden: Brill, 2001), 48–49; Dalman, *Petra und seine Felsheiligtümer*, 272.

22 For an in-depth analysis of Nabataean architecture, including the Ad-Deir Monument, see: McKenzie, *The Architecture of Petra.*

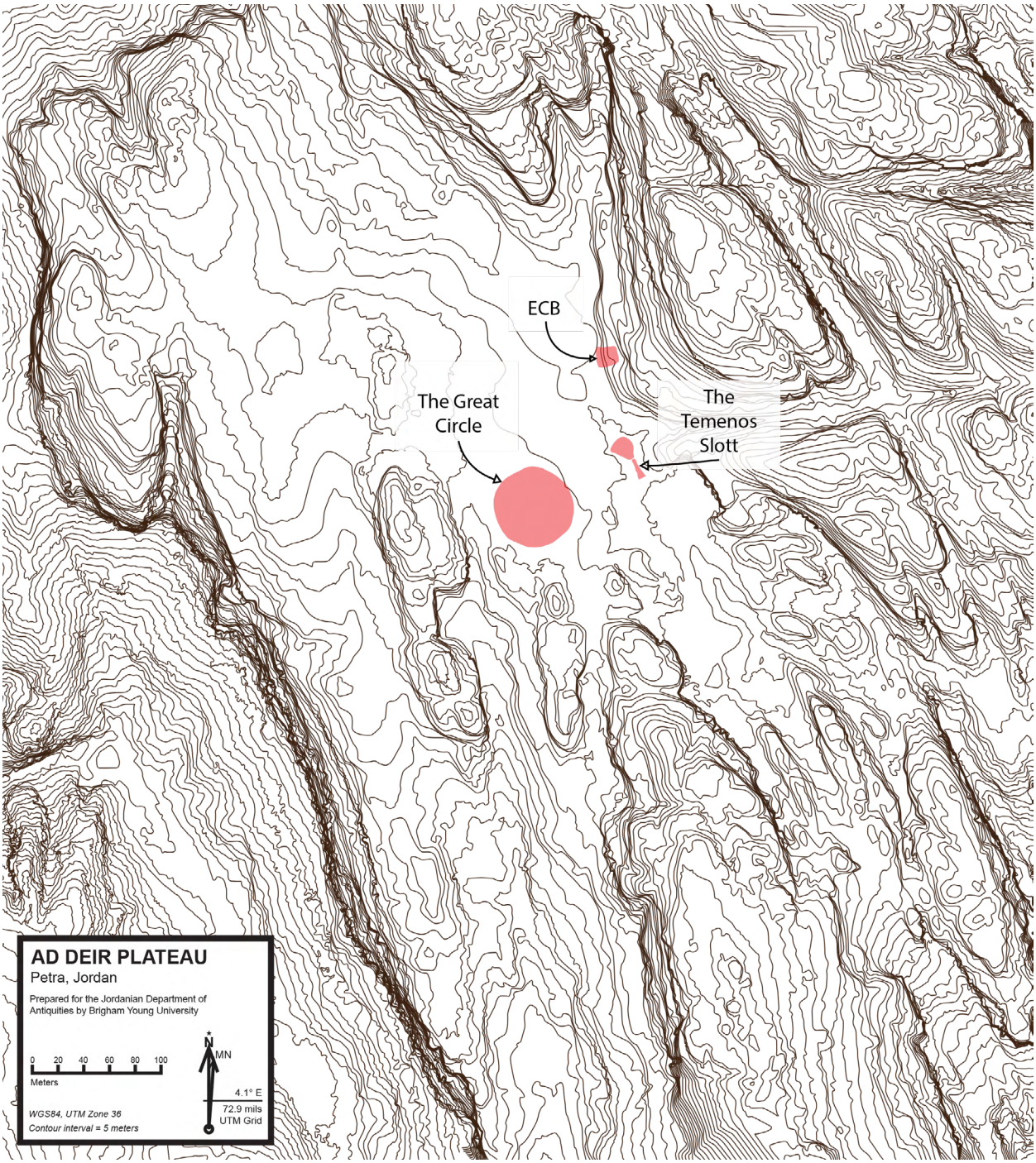



Figure 2.1. Topographic map of the Ad-Deir Plateau with emphasis on the AMPP excavation areas. Map drawn by Scott Ure and used with permission from AMPP director, Dr. Cynthia Finlayson.


Figure 2.2. Eastern Cistern B alongside other cisterns at the base of Jebel Fatouma. Photo taken by the author.

approximately 11m x 6m and is situated along a NW-SE axis. The cistern has an average depth of approximately 7m, and it is possible that it once held close to 500 cubic meters of water, when nearly full.[23] Ancient Nabataean engineers lined the interior of ECB with five layers of plaster that gave the cistern its water retention capabilities.[38] The ancient Nabataeans linked ECB with Eastern Cistern C through a stone-cut water channel that terminates in the SW corner of ECB. The ancient water specialists also carved a hole in the NE corner of ECB to allow for the final cistern (Eastern Cistern A) to fill in the case of heavier than usual rainfall.[24] Large covering stones from surrounding cisterns also suggest that at some point the ancient Nabataeans covered ECB with large ashlar blocks to reduce evaporation and limit debris deposits in the collected water. As previously noted, there is also a rock-cut room directly above ECB with an associated inscription directly above it that states "The *mrzh'* (feast or symposium) of Obodas, the God"

23 Cynthia Finlayson, "Ad-Deir Monument and Plateau Project Annual Report" (Petra, Jordan: Brigham Young University, 2021).

24 It is possible that Eastern Cistern A was constructed for the occasional super flood, such as in the case of a hundred-year deluge.

possibly indicating that the room served as a symposium hall or that a ritual feast occurred at another place nearby.[25] The relationship between the inscription and the cistern remains are central to my research, as pottery used in a ritual symposium could have been easily discarded into ECB below.

There was a large rock fall and collapse that covered the entire cistern, which created a sealed context that provides a unique opportunity to study the deposits left behind. The rockfall, which may be associated with the 363 C.E. earthquake in the Southern Levant, is in the first two meters below the modern surface level. Ceramic finds below the rockfall suggest ECB may have fallen out of use as a Nabataean cistern sometime in the 2nd C.E. However, excavations by AMPP found Nabataean era coins in lower strata associated with ceramic finds that suggest the Nabataeans used the cistern from at least between the years 100 B.C.E to 100 C.E. This trend matches other numismatic evidence found on the Ad-Deir Plateau. For example, of over 900 coins found north of the Temenos slot, 88% were from the reign of the Nabataean King, Aretas IV (about 9 B.C.E. to 40 C.E.).[26] Coins and ceramic sherds from the upper strata of ECB suggest that there was a later Byzantine Era use of the Plateau, but it seems that the monks who lived in the vicinity of ECB had very little interaction with this particular cistern.[27]

*The Pottery*

This thesis uses samples taken from the ceramic assemblage that originated from deposits in ECB on the Ad-Deir Plateau. The assemblage consists of thousands of individual sherds that embody a wide range of Nabataean fine and coarse ware vessels that date between the 1st century

25 Zayadine and Farajat, "The Petra National Trust Site Projects: Excavation and Clearance at Petra and Beihda," 284. The possibility that the room above ECB is a symposium hall is discussed further in Chapter 4.

26 Dr. Cynthia Finlayson, personal communication.

27 The few coarse ware sherds that date to the Byzantine periods of the 4th and 5th centuries C.E. are mostly large jugs that were likely intended for the storage of some viscous material. Eastern Cistern B had long since fallen out of use by the late 2nd century C.E. and so the Byzantine-era jugs were probably not intended for water collection from ECB. Additionally, the sherds account for less than 1% of total diagnostic rim pieces recovered between 2014 and 2017 which suggests the activity near ECB had greatly reduced from the previous Nabataean period (4th century B.C.E. – 106 C.E.).

B.C.E to the 3rd century C.E. The collection represents five seasons of excavation at ECB by the AMPP team and consists of ceramic sherds, specifically from the years 2014 to 2019. While the AMPP expedition has focused on five different areas of excavation throughout its course, the majority of ceramic sherds for the lipid analysis outlined in this thesis originated from ECB. The collection is currently housed at the Museum of Peoples and Cultures (MPC) at Brigham Young University.

The pottery sherds from ECB embody a large variety of ancient Nabataean ceramic types and forms ranging from fine painted plates and cups to large storage jars and cooking vessels. The AMPP team recovered many sherds that could be refitted to make whole or semi-whole vessels while at other times complete plates or bowls were found in-situ. The majority of Nabataean fine ware vessels recovered from ECB correlate with the height of the Nabataean period (100 B.C.E to 100 C.E.) and may suggest a large feast had occurred near ECB. Additionally, the coarse wares from ECB represent over 230 distinct rim types that are common at other Nabataean sites.[28] Even the pottery forms that were recovered from ECB have variations in size within the same types that may suggest specialized vessels that may further relate to feasting activities. The expansive range of vessel types and the extended period that the ancient Nabataeans utilized the cistern allows for a new critical insight into the contents of some of these vessels through absorbed lipid analysis.

## Methodology

To determine what some of the ancient Nabataean vessels once contained I analyzed the absorbed organic residues trapped within the ceramic fabric of Nabataean sherds through a gas chromatographer-mass spectrometer (GC-MS). I used the sample preparation method outlined by Richard Evershed, however, due to different machines, some testing and experimentation

28 Jake Hubbert, "Roman Expansion and Nabataean Coarse Wares New Evidence from the Ad-Deir Plateau in Petra, Jordan" (Senior Thesis, Brigham Young University, 2019), 30.

were required to find settings that could reasonably demonstrate the absorbed residues.[29] Residue analysis has recently begun to be used in the Southern Levant to understand questions concerning local consumption. While absorbed residue studies have yet to be applied to ceramics from the historical Nabataean period (i.e., 300 B.C.E. to 100 C. E.), it has been successfully applied in Jordan on ceramics from Islamic and Iron age occupations.[30]

This study employs absorbed lipid, or fatty organic material, analysis. Archaeologists first used absorbed residue analysis in 1970 and this methodology was most notably pioneered by M. D. Thornton and his associates.[31] They used gas chromatography to understand its chemical composition of a substance known as "bog butter."[32] Lipid extraction on ancient ceramics was first successfully achieved by J. Condamin and his team in France in the late 1970s and was complemented by similar experiments by G. Duma in 1972.[33] The process that Condamin established continued to be the leading method until 1990.[34] In 1990, Richard P. Evershed, C. Coley, and C. Heron expanded and established the method that archaeologists utilize today.[35] As a result of improved technology this method has become more widely explored and accepted by archaeologists in identifying organic residues from ancient ceramics.

Samples for my study were prepared using the process set out by Evershed and his associate H. A. Mottram.[36] Specifically, samples were selected using both random judgmental and

29 44 H. R Mottram et al., "New Chromatographic, Mass Spectrometric and Stable Isotope Approaches to the Classification of Degraded Animal Fats Preserved in Archaeological Pottery," *Journal of Chromatography* A 833, no. 2 (February 19, 1999): 209–21.

30 Walker et al., "Residue Analysis as Evidence of Activity Areas and Phased Abandonment in Medieval Jordanian Village," 238–40; Mayyas and Douglas, "Organic Residues in Iron Age II Pottery Vessels from Jneneh, Jordan."

31 M. D. Thornton, E. D. Morgan, and F. Cleoria, "The Composition of Bog Butter," *Science and Archaeology* 2 (1970): 20–25.

32 Thornton, Morgan, and Cleoria.

33 Duma 1972; Condamin et al. 1976.

34 E. D. Morgan et al., "Gas Chromatographic Analysis of Fatty Material from a Thule Midden," *Archaeometry* 26, no. 1 (1984): 43–48; M. Patrick, A. J. de Koning, and A. B. Smith, "Gas Liquid Chromatographic Analysis of Fatty Acids in Food Residues from Ceramics Found in the Southwestern Cape, South Africa," *Archaeometry* 27, no. 2 (1985): 231–36.

35 Evershed et al. 1990. Recent studies, such as those by Mathe, Mayyas, and Douglas, used Evershed's methods.

36 Mottram et al., "New Chromatographic, Mass Spectrometric and Stable Isotope Approaches to the Classification of Degraded Animal Fats Preserved in Archaeological Pottery."

sampling strategies. A random number generator was used that selected samples from a specific year, and then either a specific bag number or date depending on the year.[37] Once a bag was selected, I sorted through the available sherds to find those suitable for testing (i.e., had more than two grams of mass and originated from a part of the vessel that would have had the most contact with the stored material). Mostly body and base sherds were selected as well as rim sherds that had enough of the body that had the best chances for a successful result.[38]

Once samples were selected, they were photographed and logged. This was followed by clipping off pieces of the ceramic that equaled two grams that were then crushed using a mortar and pestle. The mortar, pestle, and clippers were all washed first with water and then with acetone and allowed to dry in between each sample. The associated dust was bagged and taken to a lab that housed the GC-MS. The samples were poured into a marked test tube and were then mixed with a chloroform-methanol mixture set at a ratio of 2:1. Once the chloroform-methanol mixture had been poured into the test tube with the ceramic dust, the tubes were sealed and placed in an ultrasonic bath for 15 minutes to mix. Afterward, the organic and inorganic components of each sample were separated in a centrifuge for two minutes and then the process was repeated. After the second run samples were extracted and placed in GC-MS test tubes that held 5 ml, which were allowed to evaporate to a higher concentration at which point they were processed through the GC-MS.

This research used a Thermo Fischer Trace GC Ultra with an auto-sampler, fussed silica column, and attached mass spectrometer. The sample volume was set at 5.00 µl with two plunger strokes sampled at the bottom of the vial. Injection depth was kept at the standard for the auto-sampler with no pre- or post-injection dwell time. After each injection, the auto-sampler washed itself in two solvents twice followed by two rinses. The mass spectrometer's acquisition time

37 For example, sherds from Eastern Cistern B from 2015 and 2016 have specific bag numbers assigned out of the entire lot for their given years, whereas in later years bag numbers were consolidated to a specific date.

38 A part of the original study was to identify a relationship between vessel form and function.

was based on the GC run time. There was no reagent gas, and the source temperature was set at 250° c. The MS started at 5.00 minutes with a dampening gas flow of 0.3 ml/min. There were three micro scans for the scan event with a max ion time of 25 ms. This study included the mass range between 50.0 and 700.0. The GC was set at a max temperature of 350° c to ensure that all components reached their gaseous state. The prep-Run timeout was set at 10.00 minutes with an equilibration time of 0.50 minutes. The Initial temperature was set at 40.0° c with the initial time set at 2.00 minutes with only one ramp. The final temperature reached was 350° c and held for 3.00 minutes. The tests conducted for this thesis also used the right split/splitless and carrier methods. Specifically, the tests were splitless with a flow of 15.00 ml/min with a time of 1.00 minutes, a surge pressure of 0.44 psi, and a surge duration of 0.00 minutes. The carrier method was a constant flow with an initial value of 1.50 ml/min and an initial time of 1.00 min. The auxiliary temperature for the MS transfer line was set at 250.0° c.

The gas chromatographer-mass spectrometer produces raw counts of specific elements that are compared to known sources. The identification was primarily done through the Excalibur software provided by the lab with the GC-MS. Each test produced probabilities of the likely compounds that the MS recorded. While some compounds reached 80% accuracy, most compounds only had around 20% accuracy. I did not note trace compounds that had less than 10% accuracy. While the method outlined above has many benefits, this thesis also outlines some limitations as discussed further in Chapter 4.

## Thesis Outline

The ancient Nabataeans have a unique history at the crossroads of major Near Eastern powers, such as the Greeks, Egyptians, and Romans. All those powers contributed to the distinct culture and cultural practices that were manifest in ancient Nabataean material assemblages. Petra served as a center of Nabataean society and the Ad-Deir Plateau hosts several architectural

monuments and features that allow for an in-depth analysis of cultural practices. This thesis focuses on one feature of the Ad-Deir Plateau, Eastern Cistern B (ECB), which served as a part of the larger water catchment system on the Plateau. Local features at ECB, such as the collapsed symposium hall, inscription, and diverse pottery assemblage suggest that the Nabataeans may have hosted a feast there. ECB and those features and others are discussed in greater detail in Chapter 5; however, the ceramic sherds present the unique opportunity to study the ancient contents of those pots through absorbed lipid analysis. Thus, this chapter included an in-depth methodology that describes the system that this thesis used to sample, test, and identify results from the GC-MS. The results of those tests and their subsequent importance within the context of ECB are also discussed in Chapters 2 and 4. The history of the Nabataeans, the context of the ceramic sherds tested for this thesis, and the methodology that I used are both important to understand the rest of this thesis because these topics establish the initial framework in which this study is organized.

# 3 Plant Residues

The following chapter outlines the historical uses of several flowering plants that the ancient Nabataeans may have incorporated into their medicinal practices. These plants were identified via the chemical remains that were found in ancient vessels though gas chromatography- mass spectrometry (GC-MS) from Eastern Cistern B (ECB) on the Ad-Deir Plateau (see Appendix A). This chapter discusses the chemical compounds that demonstrate the presence of specific flora in the Nabataean vessels tested. Each chapter section is titled with the common plant name followed by its scientific name. Additionally, each section has an image of the plant and a rendering of the chemical structure of the compound associated with it. This information is followed by the presentation of appearances of the plant in ancient literary sources with a focus on works from the time of the Nabataeans (i.e., approximately 500 B.C.E to 200 C.E.). These works include Pliny's *Natural History*, Dioscorides' *De Materia Medica*, Celsus' *De Medicina* and other ancient writings that also built upon earlier Greek and Near Eastern sources. These works potentially demonstrate the possible variety of diseases and ailments that occurred among the ancient Nabataeans given the presence of medicinal plants that were used anciently to cure these challenges to human health and wellbeing.

**Foxglove: *Digitalis Sp.***

Figure 3.1. Foxglove or Digitalis. From: https://www.nature-and-garden.com/gardening/foxgloves-planting-care.html accessed April 4, 2023.

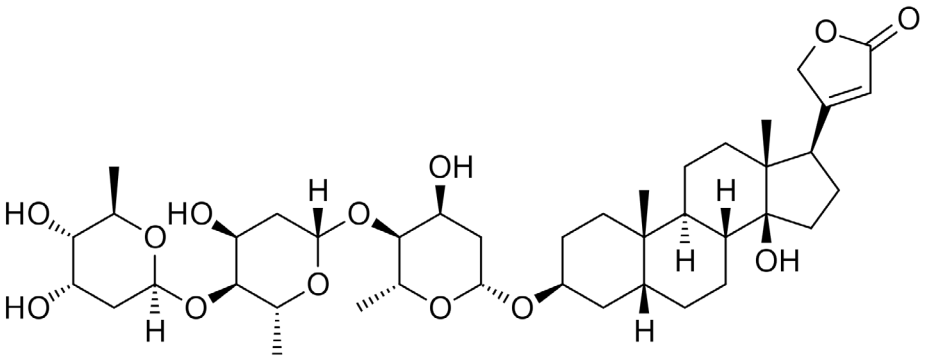



Figure 3.2. Chemical structure of digitoxin. From: https://commons.wikimedia.org/wiki/File:Digitoxin_structure.svg. Accessed April 4, 2023.

Digitoxin is a cardiac glycoside, or a chemical that affects the heart's function. It is naturally derived from species of the Digitalis genus (more commonly known as foxglove) and specifically from the leaves of Digitalis lanata (*woolly foxglove*) and Digitalis purpurea (*common foxglove*) (See Figures 3.1 and 3.2).[1] Digitoxin was found in samples JH0001-JH0006 from Eastern Cistern B on the Ad-Deir Plateau (See Appendix A).[2] Folk medicines in various cultures used foxglove where it grew naturally, for example, 14th century Welsh historical texts indicate that Medieval Celtic populations knew of the medicinal characteristics of foxglove.[3] William Withering, an English botanist, was the first to identify Foxglove's pharmaceutical effects in 1785, which has led the way for foxglove to be used in modern-day medicine.[4] Because the Latin name of the plant was only assigned in the 1500s by Leonhart Fuchs, the identity of foxglove in the ancient sources is disputed among scholars.[5] Some scholars had attributed the Latin names Baccar or Baccaris to foxglove as late as 1898, but this assumption and association is also disputed.[6]

*Baccar* appears in Pliny's *Natural History* in book XXI, section XVI where he described *Baccar* as "used in Unguents."[7] Another possible reference to *Baccar* is in Dioscorides *De Materia Medica* where the *Asaron* plant fits the description given by Pliny where the roots

1 Armelle T. Mbaveng, Rebecca Hamm, and Victor Kuete, "Harmful and Protective Effects of Terpenoids from African Medicinal Plants," in *Toxicological Survey of African Medicinal Plants*, ed. Victor Kuete (Netherlands: Elsevier, 2014), 566.

2 Samples for my study are courtesy of the BYU Ad-Deir Monument and Plateau Project under the direction of Dr. Cynthia Finlayson.

3 Charles Wagner, Jillian De Gezelle, and Slavko Komarnytsky, "Celtic Provenance in Traditional Herbal Medicine of Medieval Wales and Classical Antiquity," *Frontiers in Pharmecology* 11 (2020): 17.

4 William Withering, *An Account of the Foxglove, and Some of Its Medical Uses: With Practical Remarks on Dropsy, and Other Diseases* (London: G. G. J. and J. Robinson, 1785). Later artists and scientists quickly associated foxglove with various Greek and Roman myths. For example, Girolamo Macchietti painted the scene of Jason and Medea preparing a poison for Aetes and in the foreground is foxglove. The painting is part of the *Studiolo* in Palazzo Vecchio, Florence.

5 Leonhart Fuchs, *De Historia Stirpium Commentarii Insignes: Maximis Impensis & Vigiliis Elaborati,* (Apud Ioannem Roigny, 1546), 83.

6 Harry Thurston Peck, *Harper's Dictionary of Classical Literature and Antiquities* (Harper, 1897), 183.

7 Pliny the Elder, *Natural History*, trans. John Bostock and H. T. Riley (Princeton University: H. G. Bohn, 1855), 183. See Book XXI, Chapter 16.

smell like cinnamon.[8] If the *Asaron* is *Baccar* and they both possibly represent some variety of foxglove, then there is the possibility that this plant was used for both its aroma and possible medical uses. Disoscorides wrote that *Asaron* helps with the following: hernia, convulsions, old coughs, difficulty in breathing, and difficulty in urinating. It expels the menstrual flow and taken as a drink with wine it is good for those poisoned by animal bites. The leaves are astringent, and are applied to help inflammation, pains in the head, new ulcers of the eyes, breasts inflamed after childbearing and erysipelas [inflammatory skin disease].[9]

Dioscorides continued by stating that, "The smell induces sleep."[10] This further suggests that the unguents made from this plant could have served a medicinal purpose. It is also interesting that Dioscorides mentioned that this plant could be used in a remedy for dropsy, or the swelling of soft tissues due to the accumulation of excess water, which is one of the modern uses for digitoxin.[11]

Another potential instance of foxglove appearing in ancient literature is in Virgil's, *Eclogues*. Specifically, in *Eclogue* VII, Thyrsis, the Greek shepherd, has within his reply to Corydon the following statement: "Shepherds of Arcady, crown with ivy your rising bard, that Codrus' sides may burst with envy; or, should he praise me unduly, wreathe my brow with foxglove, lest his evil tongue harm the bard that is to be." (*Eclogues* 7.25)[12] Here again the Latin uses *Baccare*, which again could be foxglove. Other possibilities include clary (or clary sage), avens, herb Bennet (colewort), plowman's spikenard (also called *Baccaris montpeliensium*), and *Conyza*

8 Dioscorides Pedanius, *De Materia Medica*, trans. Tess Anne Osbaldeston and Robert P Wood (Johannesburg: IBIDIS, 2000), 13. See Book I, Chapter 9; Pliny the Elder, *Natural History*, 183. John Bostock, who translated *Natural History* in the 1850s disagrees with some early interpretations that *Baccar* is Digitalis based on Pliny's description as having a cinnamon like smell since the root of the foxglove has a poor smell that resembles nothing of cinnamon. Despite the lack of smell, there may have been processes and mixtures that were used to extract a certain smell, however, future experimentation will be needed to make such a determination.

9 Dioscorides Pedanius, *De Materia Medica*, 13. See Book I, Chapter 9.

10 Dioscorides Pedanius, 13. See Book I, Chapter 9.

11 Dioscorides Pedanius, 14, See Book I, Chapter 9; Withering, *An Account of the Foxglove, and Some of Its Medical Uses*, 53.

12 Virgil, *The Bucolics and Eclogues* (Gutenberg Project, 1995), 14. See *Eclogue* VII, verse 25.

*major* (horseweed, butterweed, fleabane) but to some extent the consensus of early translators was that *Baccare* was from the genus *Digitalis,* most likely *Digitalis purpurea*.[13] Nathan Pell, in his analysis of *Baccar* in Virgil's "Eclogues" provides several possible etymological solutions for that word, which included foxglove.[14] Unfortunately, *Baccar* in the context of the *Eclogue* is unclear, but may indicate that foxglove may have had some local importance for at least the Romans in Italy. A likely explanation for the possible appearance of foxglove in Petra is that both the Nabataean medicinal practices and Roman medical sources were drawing from earlier Greek and Near Eastern medicinal practices and folklore that was already widespread through a millennium of trade and conquest.

13 Nathan Pell, "The Meaning of Baccare in Vergils Eclogues," *Self-Published*, n.d., 2-3. This work, although self-published, provides a thorough analysis of the possible meanings of the appearance of *Baccar* in the Eclogue.
14 Pell, 2-3; Harry Thurston Peck, *Harpers Dictionary of Classical Antiquities,* New York: Harper and Brothers, 1898, B.1.

## Oleander: *Nerium oleander*

Figure 3.3. Nerium oleander in Petra, Jordan. Photo by the author.

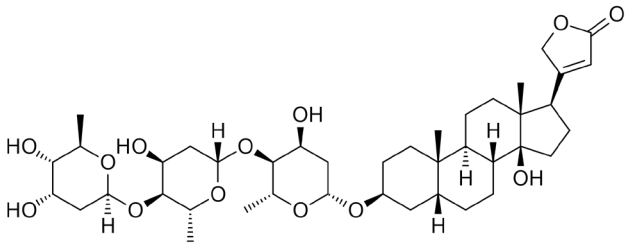



Figure 3.4. Chemical structure of digitoxin. From: https://commons.wikimedia.org/wiki/File:Digitoxin_structure.svg. Accessed April 4, 2023.

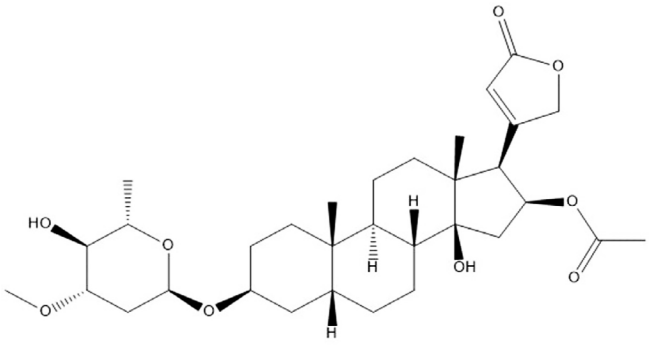



Figure 3.5. Chemical structure of Oleandrin. From: https://www.thestreet.com/phildavis/news/oleandrin-is-a-deadly-plant-poison-not-a-covid-19-cure. Accessed April 4, 2023.

While digitoxin is derived directly from *Digitalis lanata* (woolly foxglove) and *Digitalis purpurea* (common foxglove), studies have demonstrated that digitoxin and digitoxigenin, which are aglycones of digitoxin, are also present in certain oleander shrubs such as the *Nerium oleander*.[15] The toxin that is directly derived from oleander leaves is oleandrin, which has a very similar structure to that of digitoxigenin (See Figures 3.3, 3. 4, and 3.5). Oleander is prevalent throughout the Southern Levant and is well adapted to the arid climate in the region. Additionally, due to its toxicity, the plant thrives without animal destruction. Oleanders also grow well in Petra and are seen in a variety of places all over the ancient city. It is a distinct large bushy plant with pink flowers and evergreen leaves and may grow to between 2 and 6 meters tall.[16]

Oleander does feature in the ancient literature, specifically Pliny's *Natural History* and Dioscorides' medicinal work, *De Materia Medica*.[17] The name, oleander, was first recorded by Discorides, but it was also known as rhododendron and nerium. Pliny suggested that that name rhododendron was not Latin based but possibly came from the Greek rhododaphne or nerium.[18] Olander, or rhododendron, first appears in Book XVI, Chapter 33, where Pliny wrote, "to beasts of burden, goats, and sheep it is poisonous, but for man it is an antidote against the venom of serpents."[19] This plant could have had the same or similar functions for the ancient Nabataeans since they also had various desert snakes that threatened their lives and livelihoods. Dioscorides also mentions rhododendron, or more specifically, nerium and claimed that a "decoction is taken

15 Shahina A. Ghazanfar, *Handbook of Arabian Medicinal Plants* (Florida: CRC Press, 1994), 26; Arturo Anadón, María Rosa Martínez-Larrañaga, and Victor Castellano, "Poisonous Plants of Europe," in *Veterinary Toxicology (Second Edition)*, ed. Ramesh C. Gupta (Boston: Academic Press, 2012), 1080.

16 While these tests may demonstrate the presence of flora, such as oleanders, there is no environmental data from Petra in the Roman Period that can substantiate its existence in that era. What exists in the city today may not have been there two millennia ago.

17 Pliny the Elder, *Natural History*; Dioscorides Pedanius, *De Materia Medica*. See Book XVI, Chapter 33 in *Natural History* and See Book IV, Chapter 82 in *De Materia Medica*.

18 Pliny the Elder, *Natural History*. See Book XXIV, Chapter 53.

19 Pliny the Elder. See Book XVI, Chapter 33 and Book XXIV, Chapter 53.

as a drink with wine against the bites of venomous creatures."[20] Pliny further mentioned oleander again in Chapter 27 of Book XXI and included it (*rhododendron*) in the arrangement of chaplets or garlands.[21] Pliny also argued that rhododendron flowers were the culprit behind certain toxic honeys, but that it could also be mixed with other compounds to produce ointments for skin treatments.[22] The potential dangers of the plant were understood to some extent, and by Pliny's language, it seems that it was observed by pastoralists who witnessed their livestock eating the leaves and then either dying or becoming ill. I do not think it too illogical to assume that the nomadic tribes that constituted the Nabataean Kingdom would have known these facts as well.

Oleanders were also a part of Roman peristyle gardens and were depicted in ancient murals in Italy.[23] Unfortunately, the scholarship regarding the plants utilized in ancient Nabataean gardens is limited.[24] Nevertheless, some have suggested that planters may have been incorporated into the layout of Nabataean shrines.[25] The extensive existence of oleander plants found in Petra today, may indicate that Nabataeans planted these flowers in gardens in antiquity.

20 Dioscorides Pedanius, *De Materia Medica*, 632. See Book IV, Chapter 82.

21 Pliny the Elder, *Natural History*. See Book XXI, Chapter 17. A chaplet is a garland or wreath that is made of flowers and adorns one's head.

22 Pliny the Elder. See Book XXI, Chapter 44 and 45.

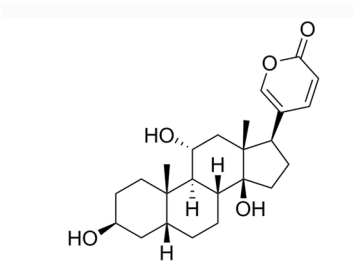
23 Monica Salvadori and Clelia Sbrolli, "Wall Paintings throughout the Ages: The Roman Period - Republic and Early Empire," *Archaeological and Anthropological Sciences* 13 (2021): 25.

24 This is primarily due to the lack of known garden locations. A small garden next to the pool complex adjacent to the Great Temple has demonstrated evidence of plants such as the fig and palm tree, but this is one of the only studies to have incorporated such methods as seed identification. Jennifer Ramsay and Leigh-Ann Bedal, "Garden Variety Seeds? Botanical Remains from the Petra Garden and Pool Complex," *Vegetation History and Archaeobotany* 24, no. 5 (2015): 625.

25 M. Barbara Reeves, "A Nabataean and Roman Shrine with Civic and Military Gods at Humayma, Jordan," *Arabian Archaeology and Epigraphy* 30 (2019): 139.

**Sea Squill*: Urginea maritima***

Figure 3.6. Sea Squill. From: https://www.mygarden.org/plants/7930-giant-sea-squill. Accessed April 4, 2023.




Gamabufotalin (GB)

Figure 3.7. Chemical structure of Gamabufotalin. From: https://www.nature.com/articles/s41598-019-52641-4. Accessed April 4, 2023.

Bufotalin or gamabufotalin are both prominent chemical compounds found in at least thirty-two ceramic sherds from ECB. Bufotalin is an organic compound that acts as a cardiotoxic bufanolide steroid. Samples for my study that contained bufolides (either bufotalin or gamabufotalin), a compound found in Urginea maritima or Sea Squill, are JH0004, JH0014, JH0020-JH0024, JH0028, JH0029, JH0037, JH0039, JH0046, JH0047, JH0050-JH0054, JH0056- JH0058, JH0060-JH0062, JH0064, JH0066-JH0074, JH0081 from Eastern Cistern B (SeeAppendix A). Sea squill naturally grows throughout Petra and is readily seen even on the Ad-Deir Plateau (See Figure 3.6). The Sea Squill's habitat also extends to most of the Mediterranean (i.e., north Africa, Spain, Greece, Italy, Sardinia, Egypt Israel, Lebanon, Syria, and Turkey).[26] The plant itself is bulbous, hence its colloquial name the sea onion. It has leaves that grow in the spring but wither and die in the late summer and fall. The plant does produce a narrow raceme, or single stalk of flowers (See Figure 3.8). Its natural abundance would have made it readily available to nomadic tribes throughout the region and who could have easily harvested it in possible small, cultivated gardens within Petra itself.

Sea squill produces bufotalin, which is a chemical most commonly secreted by certain species of toads but is also found in some plants.[27] While certain medicinal uses of bufolides from toads were known anciently, their uses seem to have been restricted to China and other parts of ancient Asia. While there are some species of toads native to Jordan, such as the Bufo viridis or European green toad, there is little evidence to suggest that it was used culturally among the ancient Nabataeans. However, the frog, toad, or tadpole was an ancient Egyptian symbol associated with long-life and fertility that may have influenced the use of this motif on

26 M. A. Darracq, "Red Squill," in *Encyclopedia of Toxicology (Third Edition)*, ed. Philip Wexler (Oxford: Academic Press, 2014), 63–64.

27 The name bufotalin is connected to the scientific name for toads, whose classificatory family name is bufo.

Nabataean lamps.[28] The *Drimia maritima* and *Urginea maritima* are native plants to the Southern Levant and have been found in Petra, Jordan and may have been harvested by ancient Nabataean agriculturalists (See Figure 3.8).[29]

The Sea Squill (Urginea maritimia) appears in multiple ancient sources from the Mediterranean ranging from ancient Egyptian and Akkadian sources to later Greek manuscripts.[30] The Squill is mentioned in the *Ebers Papyrus* and the Akkadian *Šammu Šikinšu*.[31] This Akkadian document mentions a plant by the name sikillu which translates to onion or bulb, which Dr. Henry Stadhouder argues most likely refers to the sea squill.[32] It is important to note that according to Stadhouder, the squill was used in ritual purification and the dispelling of witchcraft.[33] This may potentially indicate early ancient Near Eastern religious associations with some of the uses of the squill plant. Maddalena Rumor even suggests that the Greeks may have adopted some of the religious or purificatory attributes of the sea squill from the ancient Near East.[34] It is thus possible that the Nabataeans may have also had similar uses for this plant given the provenance of the pottery fragments analyzed in my study in a cistern directly below a rock-cut symposium room. As I discuss in Chapter Four, the possible association of Eastern Cistern B located below a rock-cut symposium room on the cliff above denotes a potential religious context

28 Ahmad M Disi and Zuhair S Amr, "Morphometrics, Distribution and Ecology of the Amphibians in Jordan," *Vertebrate Zoology*, 2010, 16. Despite little evidence for frogs in Nabataean art, there are at least two fragments of ceramic lamps with frogs on them from the ancient Nabataean port, Aila, on the Red Sea that Alexandra Retzleff determined originated in Egypt and were brought over in the Roman period as well as frogs and toads were often seen as symbols of water, life, and fertility in ancient Egypt. See: Alexandra Retzleff, "A Nabataean and Roman Domestic Area at the Red Sea Port of Aila," *Bulletin of the American Schools of Oriental Research*, no. 331 (2003): 61.; J. C. Cooper, *Symbolic and Mythological Animals* (London: Aquarian/Thorsons, 1992), 106–8.

29 Hatem Taifour and Ahmed El-Oqlah, *Jordan Plant Red List*, vol. 1 (Jordan: Royal Botanical Garden, 2014), 552.

30 Cyril P. Bryan and Heinrich Joachim, *The Papyrus Ebers* (London: G. Bles, 1930); A Hollman, "Medicinal Plant Discovery," *British Heart Journal* 67, no. 6 (June 1992): 506.

31 Henry Stadhouders, "The Pharmacopoeial Handbook Šammu Šikinšu -A Translation," *Le Journal Des Médecines Cunéiformes* 19 (2013): 11; Bryan and Joachim, *The Papyrus Ebers*, 506.

32 Stadhouders, "The Pharmacopoeial Handbook Šammu Šikinšu -A Translation," 11.

33 Stadhouders, 4.

34 Maddalena Rumor, "Akkadian Sikillu and Greek Σκίλλα in Their Medical and Magico-Ritual Contexts," in *Patients and Performative Identities: At the Intersection of the Mesopotamian Technical Disciplines and Their Clients*, ed. J. C. Johnson (Winona Lake, IN: Eisenbrauns, 2020), 190.

Figure 3.8. Sea Squill growing in Petra. Photo by the author.

of the cistern and may further substantiate the possibility that sea squill had a similar meaning and use as a purificatory and medical tool among the Nabataeans.

Hippocrates' treatise on medicine is one of the major ancient medical works that discussed squill.[35] Specifically, this plant appears in the emollient, or moisturizer, section of his work and squill appears to have been mixed with other compounds and ingredients:

> Emollient medicines which make the cicatrices fair: Pound the inner mucous part of the *squill* and pitch, with fresh swine's seam, and a little oil, and a little resin, and ceruse. And the grease of a goose, fresh swine's seam, and *squill*, and a little oil. The whitest wax, fresh clean grease, or squill and white oil, and a little resin.

35 Hippocrates, *De Ulceribus,* Section 12.

> Wax, swine's seam (old and fresh), and oil, and verdigris, and *squill* and resin [Italics added].[36]

Hippocrates further mentions squill as burn medication that specifically utilized the bulbous root that was applied to bandages and then were wrapped around the burn wound.[37]

Dioscorides also has a section dedicated to the sea squill or *Skilla* in Book II Chapter 202 of *De Mateira Medica*.[38] He specifically mentions that the sea squill when "put into liquid medicines and aromatic medicines it is good for those in whom we wish to induce movement of urine, for dropsy, a stomach in which the meat swims above, jaundice, griping, those troubled with a cough for a long time, the asthmatic, and those who spit up blood."[39] Dioscorides and Hippocrates both mention that the sea squill could be used as a moisturizer to treat skin as well as viper bites when prepared properly.[40] It is interesting to note that Petra is home to the En Gedi Mole Viper (*Atractaspis engaddensis*), the Arabian Horned Viper (*Cerastes gasperettii gasperettii*), the Palestine Viper (*Daboia palaestinae*), and many other poisonous serpents that would have posed a considerable threat to local inhabitants.[41] Therefore, finding a readily available herbal remedy for bites would have been paramount.[42]

Pliny mentions squill, but not in a medicinal context.[43] Instead, Pliny suggests that the bulb was used to help preserve grapes by inserting the cut vine into the bulb.[44] Celsus also mentioned squill as a remedy for flatulence and other stomach related issues stating, "it is useful also to

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36 Hippocrates, *The Genuine Works of Hippocrates: Translated from the Greek with a Preliminary Discourse and Annotations*, trans. Francis Adams (New York: W. Wood, 1886), 303.
37 Hippocrates, 304.
38 Dioscorides Pedanius, *De Materia Medica*, 336. See Book II, Chapter 202.
39 Dioscorides Pedanius, 339. See Book II, Chapter 202.
40 Dioscorides Pedanius, 339. See Book II, Chapter 202.
41 Ehab Eid et al., "Perceptions and Knowledge Towards Snakes: A Study from Jordan," *Herpetological Conservation and Biology* 16, no. 2 (2021): 345.
42 For further information concerning the species of venomous snakes in southern Jordan see: Zuhair S Amr and Ahmad M Disi, "Venomous Snakes and Snakebites in Jordan," *Toxinology*, 2014, 1–20; Eid et al., "Perceptions and Knowledge Towards Snakes: A Study from Jordan."
43 Pliny the Elder, *Natural History.* See Book 15, Chapter 18.
44 Pliny the Elder, *Natural History*. See Book XV, Chapter 18, however, Bostock views the practice as "absurd."

suck a boiled squill bulb; but for a long while after such attacks of flatulence the patient should abstain from everything that causes it."[45] This is similar to Dioscorides' recommendation that squill be used for stomach issues, however, it certainly seems that Dioscorides was more familiar with its uses than Celsus. It is possible that since Dioscorides was from Cilicia, the plant had more uses in the ancient Near East than the West. However, squill appears in some ancient Greek poems, such as by Theophrastus' poem, *The Superstitious Man,* from the mid-4th century B.C.E. that states, "the offerings at the crossroads, he goes away and washes from head to toe, then calls for priestesses and tells them to purify him with a squill." (*Theophrastus* 16.14-15.) [46] This information possibly relates to Rumor's argument about the religious importance of the plant in ancient Greek and Near Eastern cultures.[47]

Beyond the applications of sea squill by the ancient Romans and Greeks, modern ethnography has also noted its use among the Bedouin of Palestine. Gustaf Dalman, during his expeditions among the Bedouin of Palestine in the early 1900s, noted that they used Sea Squill as a boundary marker for fields.[48] Later ethnographers confirmed this, especially during the sendeterization of the Bedouin in Palestine in the 1980s and 1990s. [49] While these uses are not directly related to medical practices, it may be that this plant took on new meaning and uses over time. For example, the sea squill was noted for its flowering during the Fall, an event that would often mark the coming rainy season.[50] It may be that the original significance for this plant changed and so did its uses.

A word of caution should be made with regard to the appearance of bufotalin and gamabufotalin in my samples. Some of the small traces in these 35 sherds from Eastern Cistern

45 Celsus, *De Medicina*, trans. W. G. Spencer (Loeb Classical Library, 1938). See Book III, Chapter 21.
46 Theophrastus, *Theophrastus: Characters*, trans. James Diggle (Cambridge, United Kingdom: Cambridge University Press, 2004), 110–11.
47 Rumor, "Akkadian Sikillu and Greek Σκίλλα in Their Medical and Magico-Ritual Contexts," 172–73.
48 Gustaf Dalman, *Work and Customs in Palestine*, trans. Nadia Abdulhadi-Sukhtian, vol. 1 (Palestine: Dar Al Nasher, 2013), 99.
49 Gideon M Kressel et al., "Changes in the Land Usage by the Negev Bedouin Since the Mid-19th Century. The Intra-Tribal Perspective," *Nomadic Peoples*, no. 28 (1991): 31. See note 20.
50 Dalman, *Work and Customs in Palestine*, 1:99.

B on the Ad-Deir Plateau in Petra, Jordan, may indicate contamination from the surrounding matrix. Urginea maritima is prolific throughout Petra and on the Ad-Deir Plateau, even near ECB (See Figure 3.6). Therefore, it is possible that a combination of factors released bufolides from sea squill into the soil on the plateau that eventually eroded into Eastern Cistern B and were subsequently absorbed into the ceramic vessels. This may mean that the ancient Nabataeans did not intentionally use sea squill, however, more research will need to be conducted to further validate the use of squill among the ancient Nabataeans

**Crocus*: Colchicum autumnale***


Figure 3.9. Botanical illustration of Crocus. https://commons.wikimedia.org/wiki/File:Illustration_Colchicum_autumnale0.jpg. accessed 11-9-21 Image in the public domain.

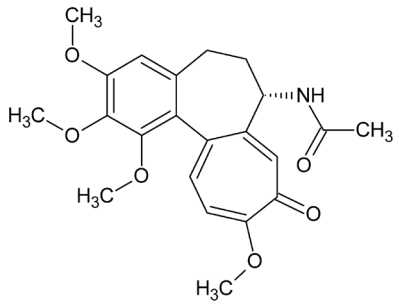


Figure 3.10. Chemical structure of Colchicine. From: https://www.chemodex.com/products/colchicine/. Accessed April 4, 2023.

One chemical that also appeared in nearly every sample was Colchicine (See Appendix A and Figure 3.10).[51] Colchicine is an alkaloid that is the primary ingredient in modern medications to treat gout, familiar Mediterranean fever, and inflammation.[52] It is most abundantly found in the autumn crocus, Colchicum autumnale.[53] Unfortunately, the autumn crocus is not found naturally in Jordan.[54] Nevertheless, it is possible that the ancient Nabataeans had imported the crocus from areas around the northern Mediterranean, which would be in line with Strabo's early assessment that the Nabataeans imported crocus.[55] There are species of crocus that are native to Jordan, which may have also produced the colchicine that the ancient Nabataeans needed for their medicinal practices.[56]

The *Colchicum* genus itself has over 160 species that have natural habitats around the globe. Jordan and the Southern Levant have a number of native *Colchicum* species, such as *C. crocifolium, C. tunicatum, C. steveii, C. triphyllum*, *C. Brachyphyllum,* and others.[57] A recent study that was conducted by Walid Turk and Suleiman Olimat, of Amman University, found that several of the native Colchicum species did have colchicine.[58] Turk and Olimat found that *C. crocifolium* had a Colchicine content of 369.56 ug/ml.[59] They also found that other species, such as *C. steveii* and *C. triphyllum* were close to each other in colchicine content, 249.80 ug/ml and

51 While it is most likely that many of the instances of colchicine are false readings, in samples JH0005, JH0006 and JH0032-JH0074 there are peaks that are identified with as high as 50% accuracy near the same minute marker. For JH0005 and JH0006, both were within one minute of each other (7.82 and 8.48 minutes) and the others were almost all between 10 and 11 minutes. These instances lead me to believe that these are actual instances of colchicine within these samples.

52 Linda S. Jung et al., "Perspectives in Plant Ecology, Evolution and Systematics," *Perspectives in Plant Ecology, Evolution and Systematics* 13, no. 3 (2011): 240.

53 Jung et al., 240.

54 Walid Turk and Suleiman Olimat, "Determination of Colchicine Contents in Different Jordanian Colchicum Spp.," *Jordan Journal of Pharmaceutical Sciences* 8, no. 2 (2015): 119.

55 Strabo, *The Geography of Strabo*, trans. Horace Leonard Jones, vol. VII, Loeb Classical Library (Harvard: Harvard University Press, 1932), 369.

56 Turk and Olimat, "Determination of Colchicine Contents in Different Jordanian Colchicum Spp.," 119.

57 Turk and Olimat, 119–20.

58 Turk and Olimat, 121.

59 Turk and Olimat, 121.

345.36 ug/ml, respectively.[60] Thus, the colchicine that is evident in my samples possibly derived from one of these *Colchicum* species, specifically *C. crocifolium, C. steveii* or *C. triphyllum* and may not have been imported. However, Strabo's notation concerning the Nabataean importation of crocus is still of interest and further study.

The crocus plant appears several times in the ancient literature and was first recorded in the *Ebers Papyrus*.[61] Minoan motifs also demonstrated an early cultural affiliation for the crocus.[62] Unfortunately, the autumn crocus and other similar flowers from the *Colchicum* genus are similar in appearance to flowers of the actual *Crocus* genus. Thus, the challenge for modern scholars is the accurate identification or separation of one from the other in ancient sources. The easiest way is to separate via the ancient medical texts that describe how the crocus plant treat diseases such as gout. For example, if an ancient crocus remedy appears elsewhere, such as in Pliny in a chapter about gardens, then it may perhaps represent the saffron variety of crocus. However, there is still a possibility that a mention of the crocus in a non-medical setting may indicate the medicinal type. In my study, I draw on the few mentions of crocus in different settings to shed light on how the medicinal form of crocus may have been used in ancient times, opening up possibilities for consideration of how it may have been used by the Nabataeans. What also must be kept in mind is that it is entirely possible that *Colchicum* went under a different name. Edward Hartung notes that several ancient authors associated colchicum or colchicon with other names, such as Ephemerum, Hermodactyl, and Surugen.[63] Hermodactyl is derived from earlier sources, specifically Alexander of Tralles (c. 550 C.E.), in his *Therapeutica*, however it does not reappear

60 Turk and Olimat, 121.
61 Bryan and Joachim, *The Papyrus Ebers*, 27.
62 Jo Day, "Crocuses in Context: A Diachronic Survey of the Crocus Motif in the Aegean Bronze Age," *Hesperia: The Journal of the American School of Classical Studies at Athens* 80, no. 3 (2011): 338.
63 Edward Hartung, "History of the Use of Colchicum and Related Medicaments in Gout with Suggestions for Further Research," *Annals of the Rheumatic Diseases* 13, no. 3 (1954): 192-194.

in connection with colchicum in later works.[64] The other two names, Ephemerum and Surugen, appear either in earlier sources or in later Arab chronicles and are further discussed below.

Crocus or Saffron appear in Pliny's *Natural History,* Book XIX, chapter 31, titled "The Roots, Flowers, and Leaves of all these plants. Garden Plants which Lose their Leaves."[65] In this chapter Crocus and other bulbous plants are grouped together, such as onion and even squill, which further suggests that these were items found regularly in ancient Roman gardens.

Dioscorides also mentioned several different crocus variants, such as *Krokos, Krocinon, Knikos* and *Krokomagma*, which translators have interpreted as Croci flores et folia, Crocus sativus, Crocus sativus var officinalis, and Crocus sativus var officinalis.[66] The descriptions tend to indicate that this may be the saffron plant and its oils, and most likely not the colchicum that I found in the samples from Petra. Given all the above possibilities, it seems that in general, crocus was most often mixed with other ingredients to produce ointments for different ailments.

Dioscorides also has a section entitled "Kolchikon" which is Colchicum, most likely *Crocus autumnale.*[67] This section discusses a plant that has "a whitish flower similar to the flower of saffron" which is certainly indicative of crocus' physical likeness.[68] Dioscorides, however, only mentioned that this plant was poisonous and did not indicate any useful medicinal associations with this product.[69] Dioscorides did suggest that this might be Ephemerum and dedicated a chapter to it.[70] He mentions that "Ephemerum has leaves and a stalk similar to the lily but whiter, the flowers white, bitter, and the seed soft."[71] The description of the flower is more in line with

64 See Valerie Knight's thesis on the English translation of Tralles *Theraputica*, specifically Chapter 2.267, 'Catarticum de hermodactilis' to find the etymological association between Hermodactyl and Colchicum. Hartung, 193.; Valerie Knight, "The 'De Podagra' ('On Gout'): A Pre-Garioponteon Treatise Excerpted from the Latin Translation of the Greek 'Therapeutica' by Alexander of Tralles" (University of Manchester, 2015), 29.

65 Pliny the Elder, *Natural History*. See, Book XIX, Chapter 31.

66 Dioscorides Pedanius, *De Materia Medica*, 29–30, (Book I, Chapter 25) 42 (Book I, Chapter 44), 63 (Book I, Chapter 64). Some of these references seem to indicate a plant that is not saffron.

67 Dioscorides Pedanius, 635. See Book IV, Chapter 84.

68 Dioscorides Pedanius, 635. See Book IV, Chapter 84.

69 Dioscorides Pedanius, 635.

70 Dioscorides Pedanius, 636.

71 Dioscorides Pedanius, 636.

the native *C. crocifolium* of the Southern Levant since both have white flowers and Dioscorides' further description of the root as "the thickness of a finger long" perhaps indicating a tuberous bulb further supports this idea that he is referencing colchicum and a species indigenous to the Southern Levant.[72] Dioscorides also mentioned that the root could be, "(used in a mouth rinse) as a remedy for toothache."[73]

Pliny mentioned Ephemeron in Book XXV, Chapter 107 of his *Natural History* and stated that it had a blueish flower.[74] The description of the root, which is like Dioscorides' portrayal, also indicates a bulb (i.e., a single root the width of a finger) that was "an excellent remedy for diseases of the teeth; for which purpose it is cut up in pieces, and boiled in vinegar, the decoction being used warm as a collutory.[75] The root, too, is employed by itself to strengthen the teeth, being inserted for the purpose in those that are hollow or carious."[76] This is remarkably similar to Dioscorides' description and, perhaps, this was a commonly known remedy throughout the Roman Empire, and, by extension, may have been known in Petra as well.

Celsus also mentions crocus in *De Medicina* specifically in Book IV, Chapter 17. Crocus is specifically added with other ingredients, "sixty cucumber seeds stript [sic] of the husk, twelve pine kernels, of aniseed as much as can be taken up by three fingers, and a little crocus, are rubbed up together, and divided between two draughts of honey wine: but if it is merely pain which has to be relieved, thirty of the cucumber seeds, twenty pine kernels, five almonds, and a little crocus are rubbed up together and given in milk" which helped clean the kidneys and cleanse the bowels.[77] Celsus further mentioned crocus in Book V, Chapters 19, 20, and 23 of *De Medicina*. In Chapter 19 he mentioned crocus as a component of a plaster for wounds and

72 Dioscorides Pedanius, 636. Dioscorides also suggested that Emphemerum might be related to *Agrestis iris*, which is a similar bulbous flower.
73 Dioscorides Pedanius, 636.
74 Pliny the Elder, *Natural History*. See Book XXV, Chapter 107.
75 Pliny the Elder. See Book XXV, Chapter 107.
76 Pliny the Elder. See Book XXV, Chapter 107.
77 Celsus, *De Medicina*. See Book IV, Chapter 17.

inflammation which was known as *rhypodes*.[78] Celsus also suggests that crocus could have been used as a remedy for stomach problems and even an antidote to poisonings, specifically from bites.[79] It is important to note that even at this early date (i.e., 1st century C.E.), some anti-inflammatory aspects of the crocus were known even though it was a part of a larger mixture of herbs, oils, and chemicals.[80]

Strabo records in his *Geography* that the Nabataeans imported some things, wholly from other countries, but others not altogether so, especially in the case of those that were native products, as, for example, gold and silver and most of the aromatics, whereas brass and iron, and also purple garb, styrax, *crocus*, costaria, embossed works, paintings, and moulded works were not produced in their country."[81] It is most likely that Strabo was referring to a variety of crocus that is not native to the region since certain varieties of crocus do grow naturally in Petra, Jordan.[82] However, more studies are required on the environment of the ancient Nabataeans to fully assess which plants were native.

*Sea Squill and Crocuses*

Samples JH0001 and JH0027 in my study both exhibited evidence of a similar mixture of plant extracts. Specifically, each exhibited a mixture of bufotalin and colchicine or a combination of squill and crocus. Both crocus and squill were used for stomach issues and it may have been that both were combined to ease a strong stomach or bowel issue.[83] Additionally, as previously discussed, crocus was known to be mixed with other things, and so its addition with squill may

78 Celsus. See Book X, Chapter 19.
79 Celsus. See Book X, Chapters 20 and 23.
80 Celsus. See Book X, Chapter 19, 20, and 23.
81 Strabo, *The Geography of Strabo*, VII:369. Italics added.
82 Turk and Olimat, "Determination of Colchicine Contents in Different Jordanian Colchicum Spp.," 119.
83 Despite the similar mixtures within the vessels, the rim styles do not match. JH0001 is a C.5 and JH0027 is an A.4.5 (see appendix A). This may indicate that the two forms, while different, shared a similar function. Additionally, the main difference is the acuteness of the rim, where in style C.5, the rim comes out to an acute angel while A.4.5 comes to an obtuse angel with a flat edge. Unfortunately, there are not enough sherds from ECB that match those styles to state anything that is statistically significant, but these initial results are promising for further research.

have been a common practice among the ancient Nabataeans for a variety of ailments. It is important to note, though, that there is a natural growth correlation between both the sea squill and crocus in that they appear in the late Summer and early Fall, usually before and after the seasonal rains in Petra. Dalman notes that, "The fact that all these flowers [crocuses and sea squill] develop on parched soil among the dead remains of the summer plants make them appear as a miracle of the divine power of creation."[84] As such, it may be that these two plants that grew from the water that came after the summer heat may have held some religious significance in addition to their healing potential. However, it is important to note that my samples may also be subject to normal soil contaminates, a research challenge that is discussed later in this chapter.

84 Dalman, *Work and Customs in Palestine*, 1:100.

## Myrtle: *Vinca minor*

Figure 3.11. Vinca Minor. Photo by, Ryan Kaldari, Public domain, via Wikimedia Commons.

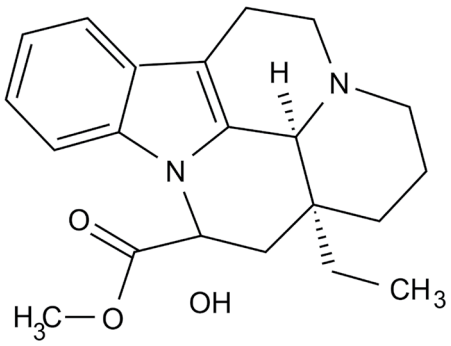


Figure 3.12. Chemical structure of vincamine, illustrated by the author..

In my study samples JH0002, JH0004, JH0005, and possibly in JH0024, JH0054, and JH0063 small traces of vincamine were found. Vincamine is an alkaloid derived from the leaves of the myrtle or *Vinca minor* plant (See Figures 3.11 and 3.12). Vincamine is just one of several alkaloids that are found in myrtle and most have medicinal applications.[85] This plant is native to the forests of Europe and the Caucasus but is not currently found in the Southern Levant due to the environmental incompatibility.[86] Myrtle was cultivated anciently for a variety of purposes, including medicinal. Anciently it had several names, such as vincapervinca, as mentioned by Pliny the Elder and Clematis or *Klematis* by Dioscorides.[87]

*Vinca minor* is attributed to vincapervinca, since only vincapervinca appears in Pliny's *Natural History* in a section concerning flowering plants but in this ancient source had no medicinal association.[88] Clematis, on the other hand, does appear several times with known health benefits. For example, clematis appears in *Natural History,* Book XXIV, Chapter 49 where it says "The leaves of it cleanse leprous sores, and the seed acts as an aperient, taken in doses of one acetabulum, in one hemina of water, or in hydromel," additionally, when mixed with wine it "is wonderfully effectual for arresting diarrhea: beaten up, in doses of one denarius, in five cyathi of oxymel or of warm water, it arrests hemorrhage, and facilitates the after-birth."[89] Pliny further mentioned that, when taken with vinegar, it was an effective against snake bites, the asp in particular.[90] It is clear from Pliny that the myrtle had several uses, which may have been known to the Nabataeans either through more ancient Near Eastern medical sources or through Nabataean trade with both Hellenistic Greek and later Roman markets.

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85 For a larger study of the alkaloids of Vinca minor, see: T. Tulyaganov and A. Nigmatullaev, "Alkaloids of Vinca Minor," *Chemistry of Natural Compounds - CHEM NAT COMPD* 36 (September 1, 2000): 540–540.

86 N. N. Panasenko and L. N. Anishchenko, "Influence of Invasive Plants Parthenocissus Vitacea and Vinca Minor on Biodiversity Indices of Forest Communities," *Contemporary Problems of Ecology* 11, no. 6 (2018): 614.

87 Pliny the Elder, *Natural History*; Dioscorides Pedanius, *De Materia Medica*, 548–51.

88 Pliny the Elder, *Natural History*. See Book XXIV, Chapters 90.

89 Pliny the Elder. See Book XXIV, Chapters 49 and 88.

90 Pliny the Elder. See Book XXIV, Chapters 90.

Clematis appears in Dioscorides as *Klematis.*[91] Dioscorides concurred with Pliny that clematis, when mixed with wine, "lessens excessive discharges of the bowels and dysentery."[92] Disocorides further suggested, like Pliny, that clematis, "Applied in a pessary with milk and rosaceum (or cyprinum) it cures pains of the womb. Chewed, it eases toothache; applied, it helps those bitten by venomous creatures. It is said that a decoction (taken as a drink with vinegar) helps those bitten by snakes."[93] It is worth noting that both sources, *Natural History* and *De Materia Medica* agreed on the uses of myrtle, which may suggest a widespread knowledge of the uses of this plant in the ancient Mediterranean world. The appearance of vincamine within the ceramic vessels from the Ad-Deir Plateau suggests that the Nabataeans also knew of this plant and added it to their local medicinal herbs. Furthermore, it is possible that the populations that had already adopted Hellenized practices and were later absorbed into the Nabataean Kingdom in the second and first centuries B.C.E. were also already using a variety of ancient Greek and local medicines that informed Nabataeans uses of celmatis, or vice versa, and that ancient Near Eastern medicinal practices were known by Hellenistic sources in Egypt, a country that Nabataea traded with heavily.

91 Dioscorides Pedanius, *De Materia Medica*, 548. See Book IV, Chapter 7a.
92 Dioscorides Pedanius, 548. See Book IV, Chapter 7a.
93 Dioscorides Pedanius, 551. See Book IV, Chapter 7a.

## Almonds: *Prunus dulcis*

Figure 3.13. Almond tree in the Southern Levant. From: https://www.reddit.com/r/jordan/comments/fdtlwm/almond_blossom_in_my_home_town/. Accessed April 4, 2023.

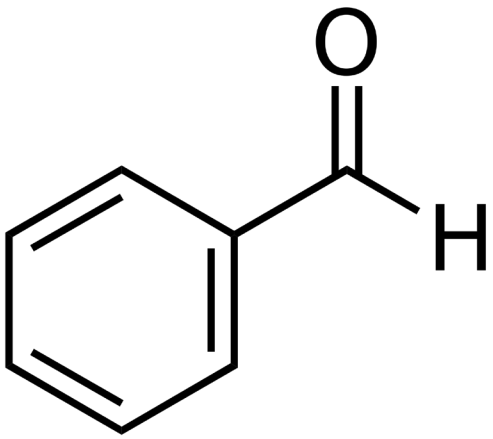


Figure 3.14. Chemical structure of benzaldehyde. From: https://commons.wikimedia.org/wiki/File:Benzaldehyde.svg. Accessed April 4, 2023..

My study samples JH0011-JH0074 all demonstrated the possible residues of benzaldehyde. I have observed certain benzaldehydes in a majority of my samples; however, it is likely that some of these readings represent contamination from unknown sources as well as the local soil. Despite the high probability that the benzaldehydes are contaminates, it is also just as likely that they represent an actual use by the ancient Nabataeans of this product for medicinal practices. Benzaldehydes occur naturally in the seeds of some fruits such as almonds, apricots, apples, cherries, peaches, prunes and plums.[94] Almonds have the highest concentration of benzaldehydes and this tree grows naturally in the Levant (See Figure 3.13 and 3.14).[95] Some flowers in the *Rosacea* family also contain benzaldehyde, such as in the rose and rose hip.[96]

Of the available sources of benzaldehyde, two are still used in the Middle East, primarily the almond and the rose.[97] For example, the oil from almond seeds is used to "treat coughs and to ease difficulty in breathing" and could also be used for herpes and scalp disorders and even enhance sexual potency.[98] Almond oil could also be used in soaps, hair oils, and other daily needs, especially since almond seeds contain a high amount of fatty oils. The rose may also be used for skin disorders, coughs and as a general tonic. In fact, rose and almond oils are still used in local perfumes and in scented products including some foods.[99]

Archaeological evidence suggests that the ancient peoples of Jordan and the Southern Levant have grown almonds since the Early Bronze Age.[100] Pliny mentioned almonds several times and

94 A. H. Hall and B. H. Rumack, "Clinical Toxicology of Cyanide," *Annals of Emergency Medicine* 15, no. 9 (1986)..

95 William R. LaCourse and Ira S. Krull, "Photoelectrochemical Detection of Benzaldehyde in Foodstuffs," *Analytical Chemistry* 59, no. 1 (1987): 49.

96 Sung-Hee Choi, "Essential Oil Components in Herb Teas (Rose and Rosehip)," *Journal of Life Science* 19 (2009): 1334.

97 Shahina A. Ghazanfar, *Handbook of Arabian Medicinal Plants* (Florida: CRC Press, 1994), 184.

98 Ghazanfar, 184.

99 Ghazanfar, 186.

100 For almonds as well as a variety of agricultural products in and around Numeria and edh-Dhra, Jordan, see: David W. McCreery, "Flotation of the Bab Edh-Dhra and Numeria Plant Remains," *Annual of the American Schools of Oriental Research* 46 (1979): 165–69.

wrote that they clear "the complexion, and [give] the face a brighter colour."[101] Almonds were also used for headaches and inebriation when combined with vinegar, rose oil, and water.[102] Pliny goes on to mention several other concoctions that almonds could be a part of to remedy the following ailments:

> Used in combination with amylum and mint, they arrest hemorrhage. They are useful, also, for lethargy and epilepsy, and the head is anointed with them for the cure of epinyctis. In combination with wine, they heal putrid ulcers of an inveterate nature, and, with honey, bites inflicted by dogs. They are employed, also, for the cure of scaly eruptions of the face, the parts affected being fomented first.
>
> Taken in water, or, as is often done, in an electuary, with resin of terebinth, they remove pains in the liver and kidneys; used with raisin wine, they are good for calculus and strangury. Bruised in hydromel, they are useful for cleansing the skin; and taken in an electuary with the addition of a small proportion of elelisphacus, they are good for diseases of the liver, cough, and colic, a piece about the size of a hazelnut being taken in honey. It is said that if five bitter almonds are taken by a person before sitting down to drink, he will be proof against inebriation.[103]

Almonds had a significant contribution to medicinal treatments in this Roman source, especially when mixed with other known medicinal herbs and plants.

Dioscorides added to the corpus of knowledge of almonds by specifically stating the uses of its oils. Dioscroides wrote that the almond, or *Elaion Amygdalinon*, first needed to be

101 Pliny the Elder, *Natural History*. See Book XXIII, Chapter 75.
102 Pliny the Elder. See Book XXIII, Chapter 75. It is worth noting that the rose oil would have also had benzaldehyde, which may possibly indicate a practical use for headache relief.
103 Pliny the Elder. See Book XXIII, Chapter 75.

reduced to its oil.[104] Almond oil could do many things apparently in the ancient world, such as addressing womb pains and constrictions, kidney stones, urination problems, and general inflammation.[105] Like Pliny, Dioscorides then proceeded to give a further list of the variety of things that almond oil could be added to. These included mixing it with honey to be beneficial to the skin, especially when sunburned or with wrinkles.[106] Significantly, Dioscordies mentioned almonds approximately forty times throughout his *Mateira Medicina*, which clearly indicates the almond's many uses throughout parts of the ancient Mediterranean world.[107] Additionally, the rose rock was frequently harvested for the Gum Laudnaum which was also used medicinally and was furthermore traded throughout the Mediterranean world [108]

*Other Vegetables*

Beyond flowering plants and trees, there were some test results from Eastern Cistern B on the Ad-Deir Plateau that demonstrated chemical compounds that originated from some types of edible vegetation. Results from other samples revealed trace amounts of Thiocyanic acid.[109] Thiocyanic acid indicates the presence of Thiocyanate, which is a by product of glycosinolates and cyanide.[110] Glycosionlates are found most commonly in cruciferous vegetables of the *Brassica* family, including cabbage, kale, sprouts, broccoli, brussels sprouts, turnips, and mustard.[111] The *Brassica* family of vegetables were widely known and used in the ancient

104 Dioscorides Pedanius, *De Materia Medica*, 38. See Book I, Chapter 39.
105 Dioscorides Pedanius, 38. See Book I, Chapter 39.
106 Dioscorides Pedanius, 38. See Book I, Chapter 39.
107 Dioscorides Pedanius, *De Materia Medica*. See Book I, Chapter 39 and Chapter 176.
108 David Johnson, "Magic, Medicine and Fraud," *Jordan Journal for History and Archaeology* 14, no. 4 (2021): 240.
109 Samples JH0008, JH0012, JH0013, JH0054, JH0061, JH0063, JH0064, JH0067-JH0071, JH0073-JH0078, JH0080, JH0094, JH0096, JH0099-JH0103, JH0105-JH0107 contained traces of Thiocyanic acid and Isothicyanic acid, see Appendix A.
110 Peter Laurberg et al., "Chapter 28 - The Relationship between Thiocyanate and Iodine," in *Comprehensive Handbook of Iodine*, ed. Victor R. Preedy, Gerard N. Burrow, and Ronald Watson (San Diego: Academic Press, 2009), 275.
111 Laurberg et al., 275.

Mediterranean and the Near East and would have been available to the Nabataeans.[112] Cyanide is also common in foods such as the almond and other pitted fruits, which were known and locally accessible.[113] The presence of cyanide alongside benzaldehyde does support the presence of almonds and possibly almond use among the ancient Nabataeans on the Ad-Deir Plateau for both medicinal and food use.

## Possible Contaminants

Contamination from the handling of sherds, the soil, or other unidentifiable causes are an apparent issue with relation to my research samples. A major part of this research attempted to find common contaminates that I could later exclude from future results. A number of contaminates occurred regularly and are discussed below as well as what they could possibly mean. In some cases, certain chemical compounds have explanations that could indicate the use of ancient rare plants, or they could just as easily be explained by modern interference. Furthermore, I compare pottery samples from another part of the Ad-Deir Plateau to demonstrate certain possible contaminates that are common to the region.

Specifically, in 2019 a small structure was excavated to the south of the Great Circle on the Ad-Deir Plateau that revealed a small kitchen.[114] The kitchen has two small ovens and was buried under a layer of collapsed rubble. Fifteen ceramic samples were tested from the kitchen and oven areas but did not reveal any compounds that could be identified with specific products.[115] However, the samples did show similar contaminants as the sherds from Eastern Cistern B and they helped to demonstrate contaminates that may be similar to the Plateau. These other tests are significant because they help to separate the unique occurrences of aforementioned plants from

112 Lorenzo Maggioni et al., "Domestication, Diversity and Usse of Brassica Oleracea L., Based on Ancient Greek and Latin Texts," *Genetic Resources and Crop Evolution* 65 (2018): 155–56.
113 Nadia Chaouali et al., "Potential Toxic Levels of Cyanide in Almonds (Prunus Amygdalus), Apricot Kernels (Prunus Armeniaca), and Almond Syrup," *ISRN Toxicology* 2013 (2013): 1.
114 Cynthia Finlayson et al. 2019 Ad-Deir Filed Report. 31-33.
115 See Appendix B.

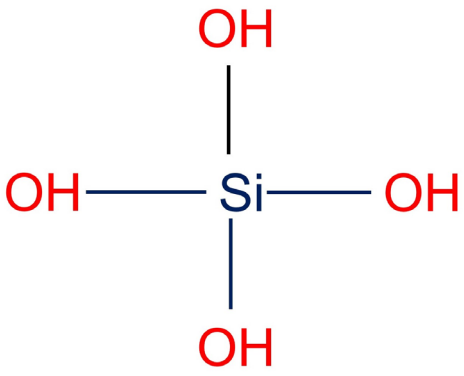


Figure 3.15. Chemical structure of silicic acid. From: https://whatsinsight.org/silicic-acid-formula-properties-uses-and-faqs/. Accessed April 4, 2023.

other common chemical constituents in each sample. The common contaminants found in both the kitchen and the cistern samples are discussed below.

*Plant Hormones*

Silicic acid (found in samples JH0006-JH0009 and JH0014-JH0040, See Figure 3.15), is a common acid found in plants. Specifically, this occurs when plants absorb silica from the soil through their roots, which is important for plant growth.[116] L. Jones and K. Handreck also found that certain grasses have higher concentrations of silica.[117] The presence of silicic acid may thus be indicative of the use of plants, and in particular grasses in the ancient vessels, or also it may be related to the presence of phytoliths from the process of decomposing plants in the soil.[118] Since silicic acid is so common, it is very possible that this is a contaminate within the soil matrix on the Ad-Deir Plateau, which then also left residues on the pottery fragments that

116 S. Berthelsen, A. D. Noble, and A. L. Garside, "Silicon Research Down Under: Past, Present, and Future," in *Studies in Plant Science*, ed. L. E. Datnoff, G. H. Snyder, and G. H. Korndörfer, vol. 8, Silicon in Agriculture (Elsevier, 2001), 241.

117 L. H. P. Jones and K. A. Handreck, "Silica in Soils, Plants, and Animals," in *Advances in Agronomy*, ed. A. G. Norman, vol. 19 (Academic Press, 1967), 112.

118 It should be noted that the relationship between silicic acid and elymoclavine may be significant. In every instance of elymoclavin (samples JH0007-JH0010, JH0025, JH0027, and JH0032-JH0035) which I argue represents the possible use of millet, silicic acid was also present. If the silicic acid originated from a "dryland" grass as Jones and Handreck have demonstrated, then it may also be indicative of millet, a member of the grass family. This should, however, be taken with a note of caution, especially since silicic acid does appear in samples without elymoclavine, which further suggests that it may have been a common soil contaminate.

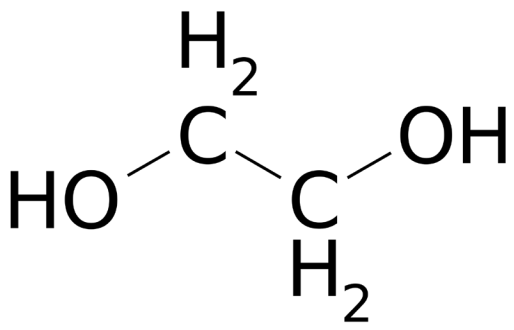


Figure 3.16. Chemical structure of ethylene glycol. From: https://socratic.org/questions/is-ethylene-glycol-molecular-or-ionic. Accessed April 4, 2023.

I tested. All seven samples from the kitchen and oven areas have trace amounts of silicic acid, which demonstrates that this chemical is found on pottery sherds other than in Eastern Cistern B.

Ethylene Glycol, found in 34 pottery fragment samples, and other manufactured chemicals, may have seeped into the cistern from the machines used next to the cistern or even from the products consumed by the work crews (See Figure 3.16).[119] Ethylene glycol in particular, though an organic compound, is primarily used in the manufacture of polyester fibers and antifreeze. However, Ethylene glycol is most often produced when ethene oxidizes with water. Since water was in the cistern throughout its use, it is possible that Ethylene glycol was also the product of the chemical reaction between ethene and water. Ethene and even Ethylene are also natural products of what is called the Methionine or Yang cycle, where Methionine, an amino acid, synthesizes proteins in plant cells to produce Ethylene, which helps regulate plant growth.[120] Most plants produce Ethylene, but flowering plants, and those that eventually bear fruit produce higher amounts of Ethylene so as to induce flowering and ripening. In this way, Ethylene glycol is similar to Gibberellic acid, which was also found in sample JH0001. Ethylene Glycol therefore

119 Samples JH0005, JH0011, JH0012, JH0024, JH0037, JH0039, JH0040, JH0046-JH0048, JH0050, JH0053, JH0055, JH0058, JH0060, JH0062, JH0063, JH0065, JH0067-JH0071, JH0073-JH0078, JH0080-JH0082, JH0100, and JH0104 had trace amounts of Ethylene Glycol Formal.

120 S F Yang and N E Hoffman, "Ethylene Biosynthesis and Its Regulation in Higher Plants," *Annual Review of Plant Physiology* 35, no. 1 (1984): 155–89.

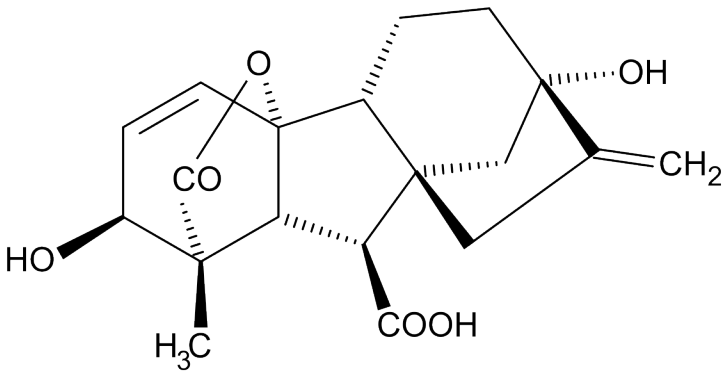


Figure 3.17. Chemical structure of gibberellic acid. From: https://en.wikipedia.org/wiki/Gibberellic_acid. Accessed April 4, 2023.

has two potentialities within my samples. It may be a product of modern machinery that is present on the site, or it could be evidence of flowering plants, which I have also demonstrated were present in most of my samples.

Gibberellic acid is a common plant hormone and was found in a number of samples (See Figure 3.17 and Appendix A). Samples JH0002 and JH0004 both had small traces of gibberellic acid. Specifically, this chemical compound belongs to a group of hormones called gibberellins that help stimulate plant growth and germination.[121] Similar to Ethylene glycol and silicic acid, the appearance of this chemical compound in my samples may indicate one of two things. First it may indicate the presence of plant material in the original use of the vessel, or as a possible contaminate in the soil matrix around the vessel. Having this chemical appear in only a few samples suggests that this was intentionally used. A test was conducted on an unguentarium fragment (sample JH0004) that also demonstrated the presence of gibberellic acid, which helps substantiate the intentional presence of this acid in other samples. Unfortunately, this acid is so common to most plants that it is nearly impossible to narrow down the identification possibilities to just a few plant types, however, since the chemical encourages growth, flowering or fruiting plants are most likely.

121 Amitav Bhattacharya, "Chapter 6 - Effect of High-Temperature Stress on the Metabolism of Plant Growth Regulators," in *Effect of High Temperature on Crop Productivity and Metabolism of Macro Molecules*, ed. Amitav Bhattacharya (Academic Press, 2019), 485.

*Degradation*

Organic compounds naturally decompose through the help of other organic compounds or micro and macro-organisms, especially in soil. Eastern Cistern B, as a wet, dark, open-air environment, certainly had a variety of circumstances that would have degraded most things within the erosion soil that seeped into the confines of the cistern. The major question that relates to my research is whether or not the chemicals detected through GC-MS are directly correlated with their natural counterparts, or whether or not the readings from the identification program cannot successfully identify the degraded samples. For example, the GC-MS detected Prednisolone, which is both the name for a modern pharmaceutical drug and the chemical that is produced in laboratories. Prednisolone was identified by the Excalibur computer program in thirty-eight samples from ECB, but only to a low percentage, usually below 30%. The Excalibur computer identification program matched the mass spectrograph of each result compared to its preset database of known mass spectrographic results. The percentage that the computer program displays for each result represents the likelihood that a particular part of a substance in a sample matches the known data for comparable substances. Thus, the lower the percentage, the lower the likelihood that that substance is represented in the sample. Again, since Prednisolone had a low identification percentage, the samples with it may be an indeterminate substance that the computer has identified resembles Prednisolone to some degree.

Along with such chemicals as prednisolone and dibenzo carbazole, a toxin found in tobacco smoke, compounds such as stearic and palmitic acids have been identified in a number of samples. These chemicals could be considered as a mislabel by the machine or as actual evidence of what was once stored within the original pottery samples. I believe that there is a middle ground where both may occur. The chemical compounds, such as in the case of the Prednisolone and Carbazoles, are most likely degraded forms of previous composites. Whereas the methylated esters may represent the original compound, but the other fatty acids that usually accompany

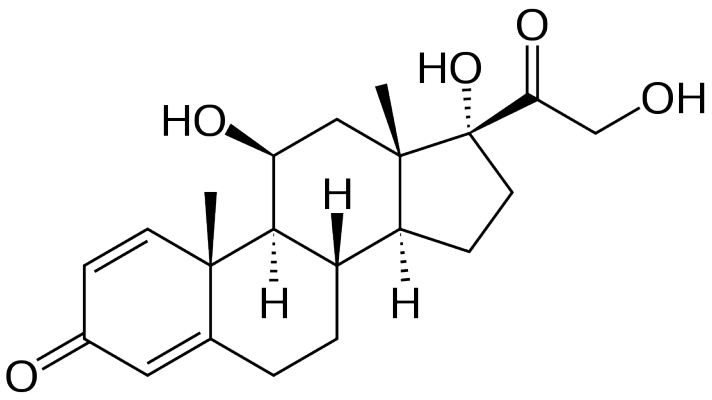


Figure 3.18. Chemical structure of Prednisolone. From: https://en.wikipedia.org/wiki/Prednisolone. Accessed April 4, 2023.

them have fully deteriorated, possibly rendering the final identification indeterminable. Future research will require testing of the individual chemical compounds to determine if there is any error within the GC-MS. For now, the presence of the chemicals discussed below should act as a cautionary warning.

*Prednisolone*

Prednisolone is used to treat conditions such as arthritis, blood problems, immune system disorders, skin, and eye conditions, breathing problems, cancer, and severe allergies (See Figure 3.18).[122] It decreases the immune system's response to various diseases to reduce symptoms such as pain, swelling and allergic-type reactions.[123] The information concerning Prednisolone that is more critical to this study is the fact that it is a man-made substance that does not occur naturally. Its appearance was only calculated with 20% accuracy, and it appeared at several intervals in many of the chromatographs of my research. This suggests that the GC-MS does identify some substance, but with little success.

*Dibenzo Carbazole*

Another prominent compound that was found among my samples was dibenzo carbazole,

122 R. A. C. Hughes et al., "Controlled Trial of Prednisolone in Acute Polyneuropathy," *The Lancet* 312, no. 8093 (1978): 753.
123 Hughes et al., 753.

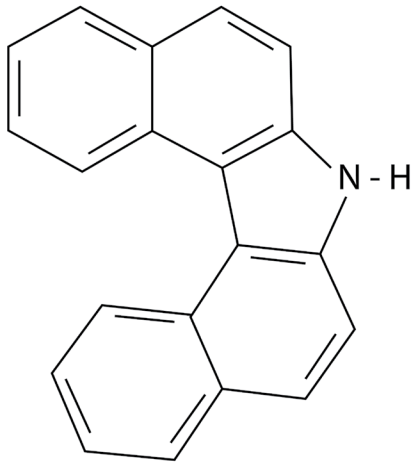


Figure 3.19. Chemical structure of Dibenzo Carbazole. Illustrated by the author.

which appeared in 80 of the samples. dibenzo carbazole or 7H-Dibenzo[c,g]carbazole, is a carcinogen most commonly found in tobacco smoke and tobacco related products.[124] While excavating ECB, several AMPP crew members actively smoked while on site. The presence of dibenzo carbazole in sample JH0027 as well as others (JH0014-29) suggests that either one or more of the crew that smoked may have handled the pottery fragments during excavation and processing, or the carbazole originates from an organic source that was deposited anciently with the pottery. The sherds were washed by non-smoking members of the crew to prevent contamination through smoking, especially since most of the smoking crew only handled the ceramics from ECB for a brief time. An alternative explanation to the presence of Dibenzo Carbazole is that it may mark the presence of a plant from the Solanaceae family. Carbazoles have been found in the roots of these plants, which may have been cultivated for their medicinal purposes.[125] Unfortunately, the plants most often used for any purpose originated in the

124 National Center for Biotechnology Information, "7H-Dibenzo[c,g]Carbazole," PubChem Compound Summary for CID 9134, 7H-Dibenzo[c,g]carbazole, 2021, https://pubchem.ncbi.nlm.nih.gov/compound/9134. Accessed November 15, 2021.
125 Ghazanfar, *Handbook of Arabian Medicinal Plants*, 196.

Americas, such as tomatoes, potatoes, and tobacco, but certain types of eggplants and similar species have been noted as native to the Levant and could have been used for their medicinal benefits.[126] *Solanum melongena*, or eggplant was first domesticated in India around 300 B.C.E, but according to Marie-Christine Daunay and Jules Janick, the plant only made it as far as Persia before it was taken west by the Islamic conquests.[127] It is possible that Nabatean caravans had previously brought eggplant over from India, but no other evidence has been found to support the trade of such a product. Alternatively, *Solanum incannum*, another eggplant-like shrub is native to the Middle East and was also known anciently to the peoples of the Southern Levant (see figure 3.20).[128] Bedouin tribes of Arabia still use the plant today to treat bruises, dyspepsia, earache, hemorrhoids, and for toothaches.[129] Furthermore, all parts of the plant are used, including the leaves, roots, and fruit (berries), which might explain the appearance of carbazoles in the samples.[130] The ancient Nabataeans and other tribes in the Southern Levant and Arabia plausibly recognized the natural abundance of *Solanum incanum* and most likely had a medicinal use for it. Its appearance in a potential religious context or even a possible ritual feasting area may also indicate a religious or feasting association between the uses of the plant and ancient Nabataean ideology and customs associated with plant uses and customs associated with plant uses and consumption.

*Colchicine*

One chemical that has had cause for suspicion as a contaminate within my study is colchicine. In most lab specimens, colchicine appeared in the upper portions of the

126 Ghazanfar, 196. Potatoes, tomatoes, and even tobacco are used today among Bedouin tribes but did not exist in the Old World anciently.
127 Marie-Christine Daunay and Jules Janick, "History and Iconography of Eggplant," *Chronica Horticulturae* 47, no. 3 (2007): 16.
128 Spence-Jones Henry, *The Pulpit Commentary, Volume 4* (Delmarva Publications, Inc., 2015). See commentary on Proverbs 15:19.
129 Ghazanfar, *Handbook of Arabian Medicinal Plants*, 199.
130 Ghazanfar, 199.

Figure 3.20. Solanum incanum. Photo by Philipp Weigell.

chromatographs after nine minutes. Similar to prednisolone, colchicine is a modern anti-inflammatory medication that specifically helps in cases of gout, and both have similar chemical structures.[131] Additionally, the GC-MS could only assign a less than 20% probability of correct identification of this substance to most instances within the samples after 9 minutes, except for the 10–11-minute mark where the probability is likely as high as 50%. This situation is similar to the appearance of prednisone where it would be in the upper portions of the chromatograph and these instances most likely are unidentifiable substances. Whether or not these instances are contaminates will require further testing.

131 B. Dasgeb et al., "Colchicine: An Ancient Drug with Novel Applications," *The British Journal of Dermatology* 178, no. 2 (2018): 350.

*The Kitchen*

In an effort to identify some of the common soil contaminates, I also tested sherds from other areas of the Ad-Deir Plateau, specifically the possible kitchen area to the south of the Great Circle, which demonstrate that there are possible soil taints that affected the ceramic samples at both sites. For example, plant hormones, such silicic acid were found in nearly every sample from the kitchen, which suggests that silicic acid may be a common substance found in all samples but does not reflect the ancient use of plants with silicic acid.

This thesis tested seven samples found in a possible kitchen area designated Element 139. Excavation of the structure demonstrates that two tandoor-styled overs were placed side by side and an early analysis conducted by Josie Newbold found faunal bone and seeds in their burnt contents.[132] The sherds selected for my study were found on top of the northern oven and were part of the collapsed rubble since those sherds most likely originated from the vessels that were stored in the kitchen. While the GC-MS results did not demonstrate any specific marker that may indicate the use of specific plants or animals, they did have common residues that demonstrate that they may be common to the Ad-Deir Plateau. Specifically, each sample from the possible kitchen demonstrate that benzaldehyde, silicic acid, and benz[j]aceanthrylene are contaminates common from the environment that have affected the ceramic sherds on the Ad-Deir Plateau. The information from the kitchen results demonstrates that these substances in the ceramic sherds from Eastern Cistern B are also contaminates. Therefore, the chemical compounds that are found beyond the established contaminates represent the possible ancient uses of those substances.

## Conclusions

Ceramic samples from Eastern Cistern B demonstrate that the Nabataeans used and stored medicinal plants. The plants that could be identified by unique traces of chemical compounds

132 Cynthia Finlayson et al. 2019 Ad-Deir Field Report, 31-33.

were foxglove, oleander, sea squill, crocus, myrtle, almonds, and other edible vegetation. Historical documents, such as Pliny's *Natural History* and Dioscorides' *De Materia Medica* also demonstrate that the plants identified in this study were used in antiquity and especially the ancient Mediterranean world. Older texts, such as the *Ebers Papyrus* and Mesopotamian medical treaties certainly suggest that knowledge of local plants and their medicinal uses, such as the sea squill and crocus, were known by those living in the ancient Near East.

Though my research has identified these plants, contaminants were an important limiting factor. After collecting data from both ECB and the small structure with a kitchen to the south of the Great Circle (both locations on the Ad-Deir Plateau), I found contaminates that were common to the region of ancient Petra. The information of the contaminates allowed me to filter the sherd results from ECB and to firmly identify the contaminates, such as Prednisolone, dibenzo carbazole, ethylene glycol, and even some cases of colchicine. The knowledge of the contaminates will assist future studies on the Ad-Deir Plateau and in Petra.

The medicinal plants identified in this chapter demonstrate that the ancient Nabataeans were well aware of their surrounding flora as demonstrated through the abundant use of local plants. Additionally, the presence of possible flowers, such as foxglove and myrtle, suggest a medical knowledge of plants shared throughout the ancient Mediterranean. However, the appearance of medicinal plants within the context of Eastern Cistern B also possibly suggests the use of medicinal plants in a ritual feast setting as is further discussed in Chapter Five of this study.

# 4 Limitations of the Methodology

While the successful results of identifiable plant residues in ceramics from Eastern Cistern B (ECB) are important, the methodology outlined in Chapter 2 also had limitations. This chapter discusses some of the limitations of using a gas chromatographer-mass spectrometer (GC-MS) that I observed while processing samples from ECB. Though this chapter addresses some issues with using GC-MS it is only meant to illuminate restrictions for future studies.

This chapter is delimitated into two sections. The first discusses the general limitations of GC-MS as observed by others. Specifically, three main issues related to the amount of time one sample takes, the financing involved, and the physical and chemical limitations of working with the ancient material. Significantly, time is one of the biggest issues while using a GC-MS. Scholars need to consider variables such as the time it takes to sample and operate the equipment, as well as the overall time from excavation to results. Financing also carries further variables such as the costs of shipping, sample preparation, and testing. Similarly, the physical and chemical limitations are also discussed at further length in this chapter. My observations of the limits of GC-MS focus on the physical facilities, sampling, and the contamination of samples. Those are further discussed in detail such as the access to equipment, training, as well as human and machine errors. While this chapter might exclude other limitations, it discusses the important issues that others may face when considering and using the methodology discussed in Chapter 2. However, GC-MS also has great benefits for archaeologists and archaeological investigations.

## Time Constraints and Resources

Time is one of the largest factors to consider when deciding to use GC-MS because of the various steps that are necessary to receive a result. One of the first time-consuming things to consider is the length of time from when the ceramic sample (or any sample) is excavated from its context to the result produced by the equipment. Unfortunately, the equipment for a GC-MS (i.e., the actual gas chromatographer and the mass spectrometer) are not available in the field and so there is a necessary wait time from excavation to arrival in the lab. William Middleton and his associates also note that the time involved in sample extraction and processing bars it from use in the field.[1] While such time constraints are not issues for most analyses, the time that the sherds or intended samples are exposed to other environments and conditions may change the actual end results in the lab. Thus, to overcome that limitation, archaeologists should store possible samples in protective containers to limit exposure to contaminates. In some cases, such as in this thesis, the samples had not been kept in containers but had at least been stored in a protected museum environment. The other limiting factors on time include the time spent on sampling and running tests. Sampling is a multistep process that may incorporate various tools, chemicals, and possibly locations. Individuals should consider the time it takes to prepare one or more samples and the various elements involved with the methodologies they choose to use. In the case of the methodology described in Chapter 2, I began sample preparation at the Museum of Peoples and Cultures (MPC) and finished in the Lab on Brigham Young University (BYU) Campus. Eight samples took three hours to prepare and test, which correlates to about 23 minutes per sample. However, that time does not include transportation between each location. The GC-MS also takes a significant amount of time depending on the methodology. My samples ran for about 25 minutes each with warm-up and cool-down times in between. To run eight samples took

1 William D. Middleton et al., "The Study of Archaeological Floors: Methodological Proposal for the Analysis of Anthropogenic Residues by Spot Tests, ICP-OES, and GC-MS," *Journal of Archaeological Method and Theory* 17, no. 3 (September 1, 2010): 190.

between five and six hours. Usually, I would leave the GC-MS to run overnight and come back to check the results the next day. In all, the time constraints limit the speed at which individuals may conduct GC-MS analyses.

## Cost Factors

The cost of GC-MS analyses is an important factor when considering using this technique for absorbed lipid analysis. There are a few basic concerns that limit the number of samples that are processed. Specifically, the costs of shipping, sample preparation, and processing. University labs usually offer services that fall within a range of options depending on the analytical technique. For example, most university labs divide the cost into two parts, the extraction and processing fees. At times there is also a split between in-house versus external customers. For example, the University of Florida has labs that advertise services that identify various compounds ranging from basic biological/environmental samples to algal toxins and microsystems.[2] However, these services also range in price, from $40-$100 for extraction and between $60-$70 for processing.[3] Such costs are necessary to consider since they limit the number of tests possible. I considered in- house processing at BYU which had more manageable costs, such as only $40 per sample to extract and $8 to process.[4] This thesis overcame these obstacles by finding access to a GC-MS at BYU that was free for me to utilize, however, these costs may explain why some studies are limited to only ten or fewer samples and others have several hundred.[5] Beyond the cost of operation, if a team decides to extract the absorbed residues on their own, then they also face the cost of chemicals and other associated materials and equipment. A GC-MS alone may cost

2 "Analytical Services Pricing," University of Florida, 2022. Accessed 4/27/2022. https://toxicology.vetmed.ufl.edu/core-laboratories/analytical-services-pricing/.

3 "Analytical Services Pricing."

4 "Chromatography Facility," BYU College of Life Sciences, 2022. Accessed 4/27/2022. https://ndfs.byu.edu/chromatography-facility.

5 Mayyas and Douglas, "Organic Residues in Iron Age II Pottery Vessels from Jneneh, Jordan"; M. S. Copley et al., "Dairying in Antiquity. II. Evidence from Absorbed Lipid Residues Dating to the British Bronze Age," *Journal of Archaeological Science* 32, no. 4 (April 1, 2005): 505–21.

upwards of $30,000 according to some lab retailers.[6] Such cost-related issues limit the number of samples that studies may feasibly process in a timely manner.

## Physical and Chemical Limitations

Studies involving absorbed residue analysis should consider the physical and chemical limitations of using a GC-MS as well as the cost and time. A basic physical limitation for identifying absorbed lipid analysis in ceramic sherds is the size of the sherd itself. For example, the methodology proposed by Richard Evershed requires a ceramic fragment of at least two grams.[7] While studies may find a result from a sherd that is smaller than two grams, the process of extraction would require destroying the entire sherd. Individuals who decide to use absorbed residue analysis must consider that samples are destroyed in the process and the various permissions required for that process.

There are also chemical limitations to employing absorbed lipid analyses to archaeological materials. For example, Gert Lubec and Leila Afjehi-Sadat wrote, "An ideal matrix… would not generate an interfering chemical background."[8] While Lubec and Afjehi-Sadat referred to the identification of peptides in samples, their assessment is applicable to archaeology since all samples come from a large variety of soil matrices. While a substance may have been present in a ceramic vessel at one point, that substance underwent several physical and chemical processes that ultimately changed its final form. Carole Mathe and her associates faced a similar challenge when they attempted to identify Frankincense among Nabataean burial wrappings.[9] They found

6 See: "Thermo Scientific TRACE 1310 Gas Chromatograph," LabX, 2022. Accessed 4/27/2022. https://www.labx.com/product/thermo-scientific-trace-1310-gas-chromatograph. Middleton and his team also noted that the costs contribute to the fact that using a GC-MS in the field is unlikely. See: Middleton "The Study of Archaeological Floors: Methodological Proposal for the Analysis of Anthropogenic Residues by Spot Tests, ICP-OES, and GC-MS," 190.

7 Mottram et al., "New Chromatographic, Mass Spectrometric and Stable Isotope Approaches to the Classification of Degraded Animal Fats Preserved in Archaeological Pottery," 210–11

8 Gert Lubec and Leila Afjehi-Sadat, "Limitations and Pitfalls in Protein Identification by Mass Spectrometry," *Chem Review* 107, no. 8 (2007): 3570.

9 Carole Mathe et al., "The Study of Nabataean Organic Residues from Madâ'in Sâlih, Ancient Hegra, by Gas

that several results looked like the chemical signature of Frankincense that had undergone oxidation processes because of exposure to the elements and time.[10] In this example, the final product that was analyzed by the GC-MS did not fully resemble a specific substance since the chemical compound had changed over time. Mathe and her colleagues could only suggest what the chemical compounds found by the GC-MS resembled.[11] Thus, there are numerous other physical and chemical processes and conditions that may affect the preservation of absorbed residues within ceramic samples.

While it is important to note the limitations of using a GC-MS, the limits are not fully noted here since to do so would require more space than this thesis allows. It is important to note that there are limits of time in the form of sample preparation and testing. There are also limitations associated with the overall cost of processing samples as well as physical and chemical limitations that depend on the context in which the sherds were found. The following section discusses some of the more nuanced limitations and issues that I observed while preparing samples and performing my tests.

## Physical Facilities

One of the main concerns that this chapter noted previously is the cost of preparing and testing samples through a lab and so to overcome this obstacle I sought out access to a GC-MS through my university. I was fortunate enough to gain access to a lab via BYU's Chemistry Department with the help of Dr. Daniel Austin, however, access to facilities such as labs and equipment is a common issue for individuals who seek to use their university's equipment. For example, the GC-MS that I used is housed in a limited access lab on BYU's campus. Access is only granted to individuals by the lab manager after they have undergone proper lab-safety

Chromatography - Mass Spectrometry," Archaeometry 51 (2009): 626–36.
10 Mathe et al., 632.
11 Mathe et al., 632.

training. Additional chemical safety and handling training were also necessary for permission to work in the lab and with the GC-MS. In my case, I was able to meet with Dr. Austin and he approved my project and provided training and assistance through his graduate student teacher assistants (TA) as well as I had previous chemical training through experience. Once I was given access then I had the freedom to use the lab space and the GC-MS at my leisure, which allowed this thesis to expand the number of samples from a few dozen to 107.

The training was a large component of making this study a success. Beyond the lab and chemical safety training that I had received, I also received basic machine training for the GC-MS. One issue that I faced was that the specific methodology outlined by Richard Evershed and his associates utilized a Carlo Erba Mega Series gas chromatograph interfaced to a Finnigan MAT 4500 mass spectrometer, which I did not have access to.[12] The machine I used was a Thermo Fischer Trace GC Ultra with an auto-sampler, fussed silica column, and attached mass spectrometer that required additional training on the nuances of that machine's operating systems. Fortunately, Abraham De Luiz (one of Dr. Austin's teacher assistants) aided me in that regard.

Additionally, I also had to learn the data analysis associated with reading both mass spectrographs and chromatographs. The ability to read the graphs and data produced by a GC-MS is paramount to making such an analysis a success. Thus, archaeologists who wish to use a GC-MS and understand its data usually employ interdisciplinary specialists to assist them.[13] In my circumstances, I could not employ a specialist, but I was able to learn how to analyze the data I collected.

There are also human and machine conditions that produce further errors. I found that errors could occur when recording notes or samples in my research and sherd logs. If a sample was

12 Mottram et al., "New Chromatographic, Mass Spectrometric and Stable Isotope Approaches to the Classification of Degraded Animal Fats Preserved in Archaeological Pottery," 211.

13 For example, Dr. Bethany Walker and her team employed Andreas Springer who is a specialist in organic residue analysis at the Freie Universität Berlin to assist them with their analysis. See: Walker et al., "Residue Analysis as Evidence of Activity Areas and Phased Abandonment in Medieval Jordanian Village."

mislabeled or some aspect of the information was not recorded correctly in the notes, then the data would be incorrect. I attempted to have some redundancy in my notes by having two or more note- taking sources. For example, I had the main research log that recorded all samples and findings chronologically and in conjunction with the record, I also had a sherd data sheet that recorded all the important information of each sample (See Appendix B). I eliminated as much human-based error by having at least two records for my data.

## Sampling

The sampling strategy that was employed for this thesis, which originated with Evershed, has a few limitations.[14] To briefly reiterate from Chapter 2, my sampling methodology consisted of two main parts. First, once the sherds were selected, photographed, and recorded, a 2g fragment was removed, weighed, and pulverized with a mortar and pestle. The crushed ceramics were then mixed with several chemical compounds to extract the absorbed lipid residues. The largest limitation associated with this methodology is the size of the ceramic fragment available. Since 2g of material is required, this meant that the sample sherd had to have been sufficiently large enough to remove a fragment for testing. For example, the kitchen area (Element 139) had many small fragments of Nabataean fine wares that could have stored such things as olive oil and wine. However, many of these fragments were physically too small for the parameters of my tests. Thus, this study used larger sherds, usually coarse ware sherds, because of the limitation on the size of a sherd that could be sampled. The limitation on size affected the sampling strategy as well. As noted in Chapter 2, I used both a random and judgmental strategy to choose sherds. A random bag of sherds was chosen and from that bag of sherds, I chose ceramic sherds that were large enough for a sample of at least 2g.

14 Mottram et al., "New Chromatographic, Mass Spectrometric and Stable Isotope Approaches to the Classification of Degraded Animal Fats Preserved in Archaeological Pottery."

The thickness of the sample sherds was another limitation closely related to the limitations of size and weight. Nabataean fine wares are unique in the ancient Near East because of their unusual thinness which could reach 1mm. While this study extracted absorbed residues from sherds with 1- or 2-mm thickness, issues may arise if an individual wanted to test just the interior of the sherd after removing the exterior surfaces. Additionally, 2g of a thin Nabataean fine ware may require a larger sacrifice of the surface area of a sherd. Additionally, if a vessel was thin enough, the ancient Nabataeans may have only used them intermittently as a serving vessel and most likely the sherds did not absorb sufficient residues to justify testing. For example, most Nabataean fine wares are plates, some with decoration and very little evidence of use to suggest that ancient populations employed such objects as decoration and not in a utilitarian way (i.e., for the consumption of prepared foods). These are just some of the limitations associated with testing Nabataean and possibly other sherds of unusual thinness.

## Contamination

Another major limitation of using a GC-MS is the high possibility of both human and natural contamination. For example, contamination can start in the field if steps are not taken to prevent them. Field-related contamination could result from washing pottery sherds with water that is already heavy with modern chemicals.[15] Additionally, a large portion of the crew involved with the excavation of the sherds were active smokers and they may have contaminated the samples through their handling of the ceramics.[16] There is also a potential for samples to become contaminated in museum storage. This may occur when museum workers and even researchers handle ceramics with their hands and transfer the residues from themselves to the surface

15 Ethylene Glycol, which is most commonly found in substances, such as antifreeze, was found in several samples in this study and may have possibly been in the unfiltered water used to clean the ceramic sherds after excavation. See Chapter 3 on further contaminates noted in the samples from this study.

16 Dibenzo Carbazole was found in many of the samples and the most common source of it is in cigarette smoke. See Chapter 3 for further details

of the sherds. However, I found that by studying absorbed residues, I could account for the occurrence of compounds that may have transferred from the hand of an individual to the sherd. Contamination may occur if the equipment is not cleaned properly, but individuals conducting the research may overcome these issues through diligence in taking precautions while cleaning and handling objects.

Natural contamination may also occur while sherds are in their soil matrices. For example, silicic acid was found in many samples from both Eastern Cistern B and the kitchen area (Element 139) on the Ad-Deir Plateau. This suggests that plant material that had grown, died, and decayed around the sherds contributed to the absorbed residues noted in this study. Additionally, organic compounds are known to degrade over time and in different conditions. Contamination may occur at any point during the sample preparation and testing process and so individuals should undoubtedly take preventative measures and understand that contamination is a limitation of using a GC-MS.

## Conclusion

Archaeologists may find new data that assists them to interpret the past while using a GC-MS, but there are limitations involved with this scientific process. The time individual samples take to prepare and process, the costs of using or buying a GC-MS restrict the number of tests, and machine limitations are all common issues when using a GC-MS. In the study associated with this thesis, I found that some of the more nuanced limitations included access to a GC-MS, the training involved with the GC-MS and sample preparation, human errors, sampling issues, and contamination at various stages of the process. While these limitations may seem discouraging, future studies may mitigate many of them as mentioned above. Using a GC-MS has provided new insights into the possible ancient pharmacology of the Nabataeans and its possible use in the settings of a ritual feast.

# 5 Ritual Feasting and Healing Practices

The purpose of this chapter is to explain the appearance of medicinal plant products in ceramic vessels from Eastern Cistern B (ECB) on the Ad-Deir Plateau in Petra. ECB is one of seven other cisterns that form a major water-catchment system on the Plateau, but it is unusual in that it contains such rich cultural material. Thus, one of the questions that this chapter seeks to answer is: why was ECB chosen as the final deposit of the ceramic sherds? This chapter argues that the medicinal plants were a part of a ritual feast mentioned in an inscription above ECB.[1] However, this chapter must first define a ritual feast to establish the parameters within which the argument operates.

The first element of ritual feasting is the ritual or performative action accompanied by the event. Ritual, however, is difficult to describe, but this thesis adheres to Talal Asad's definition.[2] Asad notes that "ritual is now regarded as a type of routine behavior that symbolizes or expresses something and, as such, relates differentially to individual consciousness and social organization."[3] Therefore, it is bodily action performed by individuals that conforms them to societal norms. Asad further suggests that the idea of ritual is connected to practice, especially, as espoused by Pierre Bourdieu, that "the concept of *habitus* invites us to analyze the body as

1 Fawzi Zayadine and Suleiman Farajat, "The Petra National Trust Site Projects: Excavation and Clearance at Petra and Beihda," *Annual of the Department of Antiquities of Jordan* 35 (1991): 285.
2 Talal Asad, *Genealogies of Religion: Discipline and Reasons of Power in Christianity and Islam* (JHU Press, 1993), 55.
3 Asad, 57.

an assemblage of embodied aptitudes, not as a medium of symbolic meanings."[4] The production and replication of specific performances enhance the social cohesion of individuals and groups. Rituals are associated with various events and activities to accomplish social goals; therefore, ritual feasts are separated from regular meals via the social solidarity that they help to create. Various scholars have attempted to define feasting through their ethnographic observations from around the world. In particular, individuals such as Michael Dietler, Brian Hayden, and Katheryn Twiss have created their own definitions of ritual feasting.[5] Dietler argues that feasting is "a form of public ritual activity centered on the communal consumption of food and drink."[6] Twiss defines feast as:

> Occasions consciously distinguished from everyday meals, often by a greater number of participants and more food and drink. Feasts may also be marked by the consumption of unusual foods and/or their modes of preparation and discard, the temporal or locational framing of the event, the material culture used, or the performances undertaken. It recognizes, however, that feasts are dialectically related to everyday meals, both in form and in meaning, and are not isolated from quotidian social realities."[7]

Dietler focuses on the accessibility and consumption of the event whereas Twiss equally stresses the accessibility and eating of elements of a feast, but also emphasizes the material culture, performances, and the separation of feasts and everyday meals.[8] The definitions outlined by Dietler, and Twiss provide a structuring principle, whereby archaeologists may begin to interpret

4 Asad, 75; Pierre Bourdieu, *Outline of a Theory of Practice* (Cambridge: Cambridge University Press, 1977).
5 Twiss, "Transformations in an Early Agricultural Society," 418; Dietler, "Theorizing the Feast: Rituals of Consumption, Commensal Politics, And Power in African Contexts," 67; Hayden, "Fabulous Feasts: A Prolegomenon to The Importance of Feasting," 24.
6 Dietler, "Theorizing the Feast: Rituals of Consumption, Commensal Politics, and Power in African Contexts," 67.
7 Twiss, "Transformations in an Early Agricultural Society," 419.
8 Twiss, 419.

local feasting rituals. Thus, this structured principle not only helps archaeologists to identify ritual feasts but also understand their social impact as they appear in the archaeological record.

Hayden goes a step beyond the definitions provided by Dietler and Twiss and discusses the nuances of feasting by identifying three main types of feasts. Hayden categorizes feasts as celebratory-feasts for social bonding, reciprocal aid-feasts for mutual assistance, and commensal-feasts.[9] The commensal feast may be subdivided into subcategories, such as economic, redistribution, and diacritical feasts that are encompassed by economic motivations to control labor and achieve status.[10] While the concept of a division of feast types is tempting, Hayden does state that, "in reality, pure forms of some other feasts may be rare; in many cases feasts may exhibit several or all of the characteristics of the subtypes differing only in the relative emphasis on economic gain, control over labor, and diacritical displays."[11] However, Hayden's definition allows for a more thorough investigation of the motives behind feasts. Additionally, Hayden's outline offers a system to categorize the types of feasts that are observed both anthropologically and archaeologically and is used in this discussion to help define the possible feast at ECB.

In summary, this chapter uses elements from Dietler, Hayden, and Twiss' definitions to understand ritual feasting at ECB. Specifically, a feast is an event that has different levels of consumption when compared to daily meals that are socially constructed with individuals participating in and with each other to accomplish a social goal. This definition is used to set the parameters of Nabataean ritual feasting as currently known in academic scholarship. Specifically, that there are individuals who gather either along family, religious, political, social, or even occupational lines, where there may be elements of the divine as noted in epigraphy, and that there are specific architectural elements associated with areas of feasting. Additionally, curtain

9 Brian Hayden, "Feasting in Prehistoric and Traditional Societies," in *Food and the Status Quest an Interdisciplinary Perspective*, ed. Polly Wiessner and Wulf Schiefenhovel (United States: Berghahn Books, 1996), 128.
10 Hayden, 128. See figure 8.1.
11 Hayden, 129.

assemblages of artifacts may also be associated with these types of group feasting. Furthermore, the areas where those architectural and epigraphic features occur together vary and possibly demonstrate the different social events that may have accompanied those feasts.

## Petra and Ritual Feasting

Ritual feasting is well attested in Petra, Jordan through archaeological and epigraphic surveys of the city. For example, Megan Perry and her associates recently found feasting activity in the form of ceramic and faunal deposits on a carved platform near several shaft tombs on Petra's North Ridge.[12] The combination of the faunal remains and ceramics suggests that a meal was held there in relation to the deceased in the tombs and it is likely that it was a ritual feast. Furthermore, the ancient Nabataeans seem to have leveled off a part of the bedrock which created a flat platform that most likely accommodated a gathering of people, possibly for a feast.[13] As is explained later in this chapter, architectural features often denote a feasting area and so the architecture and the artifact assemblages at a site may denote feasting in Petra and throughout the ancient Nabataean Kingdom.

The most common architectural feature of ritual feasting in Petra was the triclinium. A triclinium is a three-sided bench in either an enclosed room or open to the air, such as the carved stone benches from an enclosed triclinium in Qatar ad-Deir, near the Ad-Deir Plateau (See Figure 5.1). According to Dominque Tarrier's survey, there are at least 120 triclinia in Petra alone, both enclosed and open to the air, however, this number does not reflect countless others that were not included in their study.[14] The word triclinium is borrowed from the ancient Greek since Greek symposia and later Roman meals were also held on three benches aligned against three walls around a singular four-sided table.

12 Megan A. Perry, "Sensing the Dead: Mortuary Ritual and Tomb Visitation at Nabataean Petra," *Syria. Archéologie, Art et Histoire*, no. 94 (2017): 106.
13 Perry, 106.
14 Tarrier, "Banquets Rituels En Palmyrène et En Nabatène," 166; Alpass, *The Religious Life of Nabataea*, 77; Sachet, "Feasting with the Dead," 249.

Figure 5.1. Enclosed triclinium from Qatar Ad-Deir. The photo was taken by the author.

Some triclinia also have niches built into the back wall that some scholars have suggested represent an attachment to a particular deity.[15] Epigraphic sources support such an idea, such as the triclinium at the Obodas Chapel near Jebel en-Nmeir.[16] There, the triclinium is a part of a sanctuary with an idol nice in the back wall.[17] There is also an inscription associated with the triclinium dedicated to the Nabataean god Obodas, demonstrating that the ritual feast that occurred there was dedicated to divinity.[18]

15 Alpass, *The Religious Life of Nabataea*, 77.

16 Laurent Tholbecq, Caroline Durand, and C. Bouchaud, "A Nabataean Rock-Cut Sanctuary in Petra: Second Preliminary Report on the 'Obodas Chapel' Excavation, Jabal Nmayr, (2005-2007)," *Annual of the Department of Antiquities of Jordan* 52 (2008): 235–54; Laila Nehmé, "La Chapelle d'Obodas à Petra: Rapport Préliminaire Sur La Campagne 2001," *Annual of the Department of Antiquities of Jordan* 46 (2002): 243–56.

17 Tholbecq, Durand, and Bouchaud, "A Nabataean Rock-Cut Sanctuary in Petra," 238.

18 Tholbecq, Durand, and Bouchaud, 238.

*Ritual Feasting on the Ad-Deir Plateau*

The Ad-Deir Plateau is home to many instances of possible ritual feasting, mostly in the form of triclinia. In 1908, Gustaf Dalman noted several triclinia on the Ad-Deir Plateau that are situated at the north end of the Plateau.[19] These triclinia, however, appear to be associated with more private settings. Such private devotion or action may reflect the arguments made by John Healey and Laila Nehme where small private triclinia were often dedicated to specific families or occupational groups.[20] Inscriptions indicate that some of those groups were quite diverse, such as companies of scribes or common laborers, whereas other groups were constituted of slaves. There is epigraphic evidence that ritual feasts did occur on the Ad-Deir Plateau from an inscription above ECB and that it may have been associated with a family or friendly gathering.[21]

## A Ritual Feast near Eastern Cistern B

*The Obodas Inscription*

The most compelling piece of evidence of a ritual feast near ECB is the inscription above it. The inscription above ECB states "Let be remembered 'Ubaydu son of Waqiḥel and his associates of the *marzēḥā* [*mrzḥ*ʾ] of Obodat the god" (See Figure 5.2).[22] This is not the only inscription in Petra that associates Obodas with a *mrzḥ*ʾ. As mentioned previously, there is an inscription near a triclinium in the vicinity of Wadi en-Nmēr, Petra on a rock that states "This is the image of Obodat the god with the sons of … made."[23] These two inscriptions place the worship of Obodas, and possibly Obodas I (96 – 85 B.C.E.) , firmly within the practice of the *mrzḥ*ʾ, however, not all triclinia have inscriptions that associate them with various deities.[24]

19 Gustaf Dalman, *Petra und seine Felsheiligtumer* (Leipzig, 1908), 264.

20 Laïla Nehmé, "L'espace cultuel de Pétra à l'époque nabatéenne," *Topoi. Orient-Occident* 7, no. 2 (1997): 1047; John F. Healey, *The Religion of the Nabataeans* (Leiden: Brill, 2001), 166.

21 The inscription is discussed at length later in this chapter.

22 See Dalman 262-274 (his Ed-Dēr section); *RES* 1423; Zayadine and Farajat, "The Petra National Trust Site Projects: Excavation and Clearance at Petra and Beihda," 284; Alpass, *The Religious Life of Nabataea*, 65.

23 Healey, *The Religion of the Nabataeans*, 148.

24 Obodas I defeated the Seleucid ruler, Antiochus XII Dionysus around 86 BCE, when he invaded Nabataea. Some scholars have suggested that Obodas I's success placed him within the pantheon of Nabatean Gods. See: Glen

Figure 5.2. The Nabataean inscription above ECB. The photo was taken by the author.

It is, therefore, important that while some *mrzḥ*ʾ are dedicated to Obodas, some are not. . The inscription from Wadi en-Nmēri also states that the triclinia, or 'chapel' as it was designated by later scholars, was dedicated not only to Obodas, (possibly Obodas I), but also possibly to Aretas (IV) (9 B.C.E. – 40 C.E.) and the royal family.[25] This demonstrates a connection between the royal family and Obodas, which might indicate that the *mrzḥ*ʾ on the Ad-Deir Plateau may have had political connections to the state ruling elite.

Inscriptions from various parts of the Nabataean Kingdom demonstrate the veneration of a deity named Obodas. Healey argues that Obodas was a personal deity in a private cult that had most of its observances in *mrzḥ*ʾ and that this Obodas may be a divinized king.[26] Additionally, Healey suggests that the deification of local royalty may be a Seleucid-Ptolemaic precedent

Bowersock, *Roman Arabia* (Cambridge, MA: Harvard University Press, 1994), 24–25.

25 Healey, *The Religion of the Nabataeans*, 148.

26 Healey, 147.

handed down through the Hellenistic groups living in the Southern Levant.[27] However, the earliest source of the deification of Obodas I originates in the 6th century C.E. from the ancient author Stephanus of Byzantium in his Ethnika, "Uranius in the fourth Arabika [says]: 'Where King Obodas, whom they deify, is buried."[28] It is possible that there was an existing local tradition that influenced the work of Stephanus of Byzantium but there is little evidence to support it. On the Ad-Deir Plateau, there is a niche next to ECB that may have contained a cultic image of Obodas I, however, the only sculptural remains of a deity in anthropomorphic form that the AMPP team has found while excavating ECB is the lower half of a seated female, which most likely originated from the small temple complex near ECB or one of the many rock-cut niches also surrounding ECB.[29] There was a small betyl block recovered in 2017 that may have served as a focal point in the *mrzḥ'*, and was dropped into the cistern after the close of the event.[30] Regardless of the identity of the idol block or sculptural component, both represent religious elements that may have figured in the ritual feast that occurred in the rock-cut room above ECB (See Figure 5.3). The rock-cut room most likely collapsed as a result of an earthquake that affected the area historically. The inscription demonstrates that a feasting event that was dedicated to a deified Obodas, took place near ECB. While the results of my study may suggest that medicinal healing ritual may be associated with Obodas and celebrated through a *mrzḥ'*. This is a potential new aspect of Nabataean symposia that has never previously been discussed.

*Material Evidence of Ritual Feasts*

Ritual feasts are undoubtedly difficult to identify in the material record. Hayden said in 2001, "feasting behaviour has been largely ignored by archaeologists since the inception of the

27 Healey, 147.
28 Healey, 149.
29 Finlayson forthcoming, "Who is the Goddess of Ad-Deir."
30 Cynthia Finlayson, "Ad-Deir Monument and Plateau Project Annual Report" (Petra, Jordan: Brigham Young University, 2017).

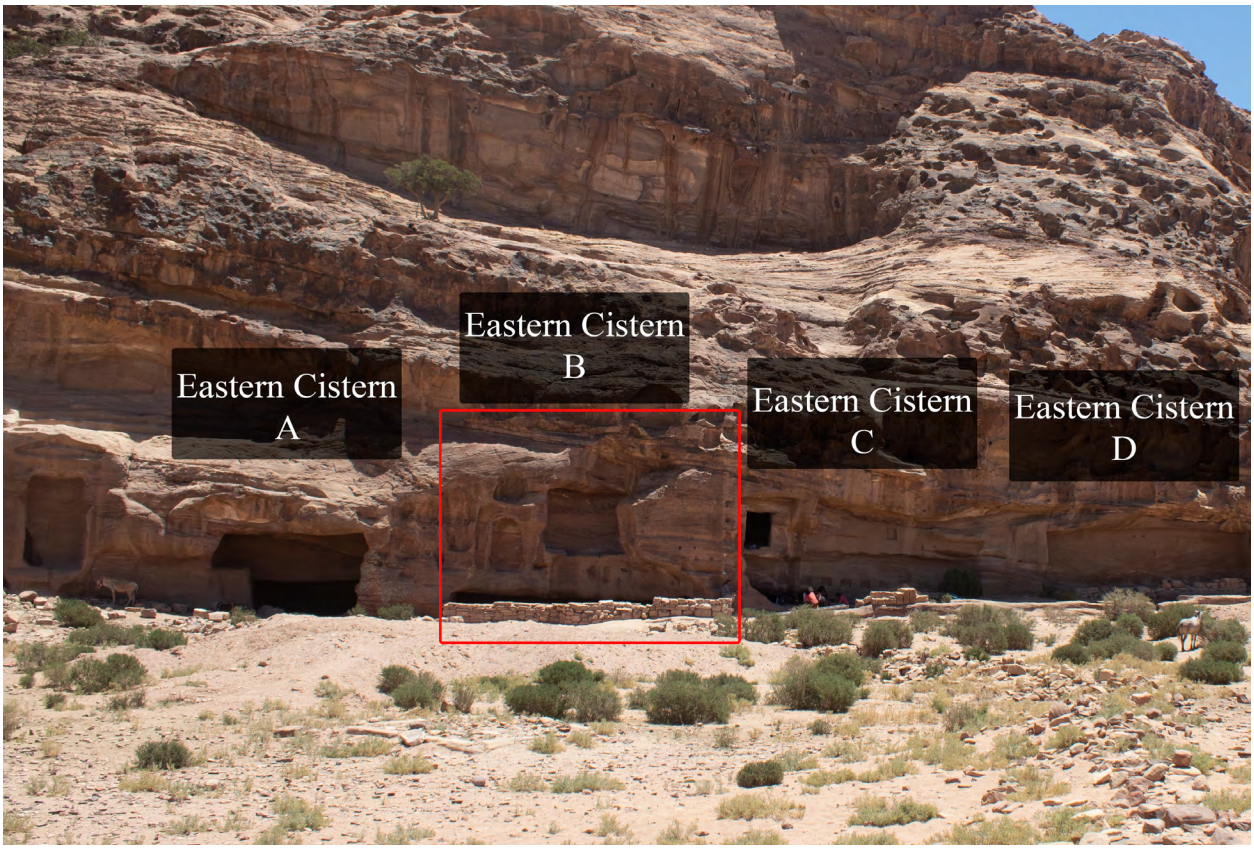


Figure 5.3. Cisterns along the base of Jebel Fatouma with labels and emphasis drawn towards ECB and the rock cut room above it. Photo by the author.

discipline, and by anthropologists for the last two decades. The fact that there is almost no body of archaeological interpretation involving feasts is probably in part due to the limited theoretical attention devoted to the topic in general anthropology."[31] While there may not have been many theoretical writings at the time of Hayden's publication, later studies, such as that by Twiss and others, have begun to identify the material remains of ritual feasts in the archaeological record.[32] The following chapter section thus discusses some of the possible motives behind ritual feasts,

31 Hayden, "Fabulous Feasts: A Prolegomenon to The Importance of Feasting," 23.

32 Twiss, "Transformations in an Early Agricultural Society"; Katheryn Twiss, "Home Is Where the Hearth Is: Food and Identity in the Neolithic Levant," in *The Archaeology of Food and Identity* (Carbondale: Center for Archaeological Investigations, Southern Ilinois University, 2007), 50–68; Ron L. Adams, "Ethnoarchaeology in Indonesia Illuminating the Ancient Past at Çatalhöyük?," *American Antiquity* 70, no. 1 (2005): 181–88; Michael J. Clarke, "Akha Feast an Ethnoarchaeological Approach," in *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, ed. Brian Hayden and Michael Dietler (Tuscaloosa, United States: University of Alabama Press, 2001), 144–67.

as well as some of the trends in material culture that accompany them in the archaeological record. The following chapter section thus discusses some of the possible motives behind ritual feasts, as well as some of the trends in material culture that accompany them in the archaeological record.

Feasts and gifts have a variety of purposes that anthropologists have tied to economic and social gain. Archaeologically, gifts may be evident in prestige items found at feasting sites. Prestige gifts may appear as rare or unique animals that were consumed in the feast, or items that were bought for the express purpose of benefiting the quests, such as the extra bedding described in the Bedouin circumcision feast.[33] Archaeologically, gifts may be hard to determine especially if they were not used or consumed at the original site, but the gifts of rare and unique material that are found in archaeological sites may demonstrate not only that a ritual feast had occurred, but also some of the underlying motives of the individuals who hosted the meal. Thus, it is imperative that this chapter also discusses the material evidence of ritual feasts that are identifiable in the archaeological record.

One study that has succinctly identified some of the unique practices of ancient peoples that indicate ritual feasting within the archaeological record is Twiss's article, *Transformations in an Early Agricultural Society: Feasting in the Southern Levantine Pre-Pottery Neolithic*.[34] While Twiss' article is an argument for the pre-pottery cultures of the Southern Levant, she provides a well-crafted table with associated bibliographic references from other major studies.[35] This table is formatted in a way that shows common aspects of feasting, the ethnographic or ethnohistoric examples, the correlated materials, and the associated references.[36] This table is formatted in a way that shows common aspects of feasting, the ethnographic or ethnohistoric examples, the correlated materials, and the associated references [238] This table is significant for its scope and usability and provides a model used later in this chapter to assess the material evidence from Eastern Cistern B on the Ad-Deir Plateau.

33 Emanuel Marx, "Circumcision Feasts among the Negev Bedouins," *International Journal of Middle East Studies* 4, no. 4 (1973): 417.

34 Twiss, "Transformations in an Early Agricultural Society," 418.

35 Twiss, 420–22.

36 Twiss, 420–22.

The first and foremost aspect of all feasts is the consumption of food. The food may be consumed in large quantities, or the meal could have consisted of rare or unique foods, or even selected parts of a plant or animal. For example, Emmanuel Marx attended several circumcision feasts hosted by various Bedouin tribes of the Negev region in the 1970s and recorded the average sum of a feast as provided by locals, specifically, "Two Bedouins gave me details of their expenses in a feast they had jointly prepared. Each had spent over IL 1,500, an amount equal to an average Bedouin family's annual income."[37] Furthermore, at least half of that sum "went for food, chiefly sheep, wheat flour, coffee, tea and sugar, and firewood, and for hay and barley for the guests' mounts."[38] In such a case, the food for the Bedouin feast was both copious and rare since sheep were not slaughtered on a day-to-day basis. Archaeologically, the remains of such as feast could be identified if the refuse were found with the carcasses of the slaughtered sheep and other food products, such as seeds, that would preserve in the archaeological record. Therefore, the production, consumption, and disposal of food are some things that archaeologists may identify in feasting sites.

Feasting activities usually produce large amounts of waste and often require specialized waste management. Thus, such areas where a feast occurred may be detected archaeologically. Michael J. Clarke found that among the Akha peoples of Southeast Asia, faunal remains of complete animals could be found in smaller feasting areas whereas domestic sites would only have the bones associated with daily consumption.[39] Clarke argues that instances where an entire or nearly complete skeletons of animals in a setting with other feasting-like elements may suggest, archaeologically, that a feast had occurred.[40] Feast waste can extend to other types of objects as well. In the example of the Bedouin feast, mattresses and blankets were purchased for the guests

37 Marx, "Circumcision Feasts among the Negev Bedouins," 417.
38 Marx, 417.
39 Clarke, "Akha Feast an Ethnoarchaeological Approach," 162.
40 Clarke, 162.

who would stay for multiple days for the feast.[41] While mattresses and blankets may not survive in the archaeological record, waste items can be identified and can thus potentially demonstrate ritual feasting.

Containers for cooking, preparing, and serving food are also objects that appear not only within the contexts of a ritual feast, but can also appear in archaeological investigations. Clarke argues that, "Vessels greater than a certain size are really only practical to use when one is cooking for large numbers of people and large volumes of food must be produced."[42] Clarke found that there was even a correlation between the wok sizes used for feasts and those used in domestic or household settings, where woks with a diameter between 10 to 14 inches were common in most Akha households, those with larger (18 to 26 inches and above) were almost entirely used for feasting activities.[43] Additionally, the number of vessels is important since feasts require large numbers of serving vessels that are not common in individual households. Clarke found that the Akha households usually had 15 to 30 various vessels, whereas feasts would require hundreds.[44] Of any material type, ceramics appear most often in the archaeological record. Therefore, large quantities of ceramics in a given location may suggest that a ritual feast occurred nearby.

Beyond the food and objects that remain in the archaeological record from feasts, architecture, when applicable, can also remain. The Korowai long houses are an example of a structure purpose-built for feasts that also represent the fulfillment of a cultural/community expectation of those who have the means to provide feasts.[45] Such dedicated structures are detectable in the archaeological record by the uniqueness of the architecture compared to others

41 Marx, "Circumcision Feasts among the Negev Bedouins," 417.
42 Clarke, "Akha Feast an Ethnoarchaeological Approach," 160.
43 Clarke, 160.
44 Clarke, 160.
45 Rupert Stasch, "The Semiotics of World-Making in Korowai Feast Longhouses," *Language & Communication* 23 (2003): 380.

in the local area as well as the material ensemble found within the building. A recent excavation at Aska in Hagebyhöga Parish, Sweden detected a Viking-age feasting hall within a mound using ground penetrating radar (GPR).[46] The archaeologists associated with the project found that the structure was a feasting hall based on comparable sites from Sweden.[47] The unique architecture of the feasting hall and previous work associating feasting remains with that type of structure found at other sites allowed the archaeologists to identify the Aska mound as a feasting hall. Archaeologists can take this model of investigation and identify feasting architecture based on the uniqueness and location of the buildings within the archaeological record.

In some cases, complex ideas, such as status, wealth, and value can be identified in excavations and sites associated with feasting. In cases among East Polynesians, some foods were considered "prestige" and appeared in feasts, such as dogs or turtles among the Hawaiians.[48] Faunal remains are an important indicator of ritual feasting and are often found at archaeological sites as well as the availability of certain kinds of fauna can therefore demonstrate prestige in a feasting area. Polly Wiessner argues that even the value of objects may be detectable in the archaeological record when associated with ritual feasting sites.[49] Specifically, Wiessner gives four reasons that ritual feasts demonstrate value in objects. First, feasts gather people so that certain permutations of value and meaning can be broadly introduced. Second, during feasting selected items are put in the focus of attention…Third, the special purpose of a feast is instrumental in giving the objects utilized or displayed specific meaning. Fourth, the spirit generated during the communal feasting, song, and dance turn fleeting impressions into lasting

46 Martin Rundkvist and Andreas Viberg, "Geophysical Investigations on the Viking Period Platform Mound at Aska in Hagebyhöga Parish, Sweden," *Archaeological Prospection* 22, no. 2 (2015): 131–32.
47 Rundkvist and Viberg, 136.
48 Helen Leach, "Did East Polynesians Have a Concept of Luxury Foods?," *World Archaeology* 34, no. 3 (2003): 445.
49 Polly Wiessner, "Of Feasting and Value Enga Feasts in a Historical Perspective (Papua New Guinea)," in *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, ed. Brian Hayden and Michael Dietler (Tuscaloosa, United States: University of Alabama Press, 2001), 117–19.

ones.[50] Therefore, archaeologists may be able to identify the value of some objects recovered from their excavations.

*Archaeological Evidence and Feasting Indications from ECB on the Ad-Deir Plateau*

The ceramic assemblage that I chose for this study is significant because it represents a wide range of uses from serving plates and decanters to large storage jars. Specifically, previous studies found at least 235 distinct coarse ware rim types recovered from the 2015 and 2017 excavations of ECB.[51] Questions naturally arise, such as what do these sherds represent? Are they indicative of a cultural phenomenon or are they possibly part of a midden? These questions led me to the discovery that some of those vessels were possibly used to store medicinal plants. However, this study looks beyond just the sherds and at the broader associations within the context of those vessels. This chapter aims to discuss the possibility that a ritual feast occurred at or near Eastern Cistern B (ECB) and that the medicinal plants may have been used in conjunction with that meal.

As previously noted, this chapter is divided into two main sections. The first part of this chapter discussed the theoretical and analytical methods that define what a ritual feast is and how it can be recognized in the archaeological record. This section specifically discusses the various definitions of ritual feasting proposed by archaeologists. It is important to understand how archaeologists have examined the elements that differentiate feasting from normal food consumption and the aspects that make the meal 'ritual.' This section further discusses the material remains from feasts and how those objects may be distinct from day-to-day consumption. For example, whether specialty cookware or dining wares are associated with feasting and if other objects may have direct or indirect connections to meal preparation, such as small or temporary kitchens. Furthermore, this section discusses what feasts accomplish, such

50 Wiessner, 117–19.

51 Jake Hubbert, "Roman Expansion and Nabataean Coarse Wares New Evidence from the Ad-Deir Plateau in Petra, Jordan" (Senior Thesis, Brigham Young University, 2019), 36.

as social solidarity, communal cohesion, and unity. Feasting is discussed in general to establish the overarching framework that structures the basic elements of a ritual feast. Specifically, the reasons behind feasting and the archaeological material that is often associated with ritual consumption. This is done so that the distinctive features of ECB and Nabataean practices may equally contribute to the broader understanding of feasts and their workings.

Understanding the basic principles of a feast also contributes to the understating of the context of ECB since there are elements that might suggest a ritual meal occurred there. To establish that a ritual feast occurred at ECB, the second half of this chapter discusses ritual feasting or *mrzḥ*ʾ among the ancient Nabataeans. Specifically, this section discusses archaeological trends that have led to the identification of feasting spaces among the Nabataeans. The second half argues that evidence from ECB demonstrates that a ritual feast occurred there, and the data suggests that feasting may have been connected to or associated with a healing practice. As previously mentioned, this is a new aspect associated with Nabataean Symposia that has never previously been identified or discussed in Nabataean archaeology. The inscription above ECB mentions a ritual meal dedicated to the Nabataean god Obodas is the prime piece of evidence that indicates a ritual feast occurred nearby.[52] After the discussion of the inscription, this section follows with the material evidence from the cistern, such as the abundance of Nabataean fine and cooking wares, as well as various serving vessels and how some containers demonstrate the variability in size that Clarke has suggested may indicate their use in feasting scenarios.[53] This second half of the chapter concludes with a discussion about the medicinal plant residues discussed in Chapter 3 and how this evidence may demonstrate that a healing event took place near or at or nearby ECB. The evidence discussed throughout this section helps to establish that a ritual feast occurred at ECB and that a healing event may have been associated with this event.

52 Zayadine and Farajat, "The Petra National Trust Site Projects: Excavation and Clearance at Petra and Beihda," 285.

53 Clarke, "Akha Feast an Ethnoarchaeological Approach," 161.

Figure 5.4. View of eastern cisterns A, B, and C. ECB is located in the center and has a modern wall around its entrance to protect livestock and tourists. The rock-cut room is highlighted by a red box. Photo by the author.

Both perspectives allow for a unique look into ritual feasting among the ancient Nabateans.

*Features Around ECB*

Zayadine and Farajat have suggested that the evidence from ECB is indicative of a ritual feast taking place within the Ad-Deir Monument itself, but the distance away from the monument façade and the actual location of ECB at the base of Jebel Fatouma to the north west, make it more likely that the ritual feast took place at or near the cistern Unfortunately, the exact location where the *mrzḥ*ʾ occurred is unknown, but current evidence suggests that it was held in one of the rock-cut rooms within the cliff face above either ECB or Eastern Cistern C (See again Figure 5.3 and 5.4). The small room directly above the ECB (See Figure 5.4), would have been a convenient location directly above ECB to deposit remains (i.e., food and material waste). Excavations in the room above ECB in 2015 found several Nabataean painted fine ware plates and a fragment of a painted cup (See Figures 5.7 and 5.8). These sherds offer a date range from between 50 B.C.E. and 100 C.E., based on Stephen Schmid's chronology, which may correlate to the probable time

frame for the use of the room, which roughly corresponds with the cistern itself.[54] Unfortunately, the room above ECB has significantly eroded away and so there is no current evidence of triclinia that would firmly place the architecture of the room within the realm of Nabataean ritual feasts. However, there is another rock-cut room above Eastern Cistern C (ECC), however, this room has not yet been excavated or explored by the AMPP team. It is possible that the room above ECC was used for the feasting activities mentioned in the inscription above ECB, but future work is required to understand that room and its original function.

## Material Evidence for Ritual Feasting at ECB

*Abundance of Pottery*

One intriguing observation from ECB is that each year the AMPP team retrieves large quantities of ceramics, at times the collective weight of the sherds is as much as 250 kg.[55] These sherds represent a wide range of Nabataean ceramic types, with super fine painted wares to thick coarse wares and even amphorae. Some of these vessels are quickly explained by the fact that ECB was an operating cistern where people would require water storage vessels to retrieve water for home use. Thus, some of these vessels were most likely dropped in by accident over time. However, other ceramic vessels, such as the painted fine wares and cooking jars do not belong within this context. One possibility is that these sherds washed into the cistern over time, however, the AMPP team recovered full plates and other vessels that suggest that they were dropped into the cistern since the erosional drag would have broken the vessels up along the way as it carried them into ECB by a flood event. A more likely explanation is that these vessels were deposited in ECB after some event, in this case, a possible ritual feast above or close to ECB. This would explain the appearance of finely painted plates, cups, bowls, decanters, jars, cooking

54 Stephen G. Schmid, "Nabataean Pottery," in *The World of the Nabataeans*, ed. Konstantinos D. Politis, vol. 2 (Stuttgart: Franz Steiner Verlag, 2007), 312–15.

55 In 2019, 253 kg of ceramics were excavated. See: Cynthia Finlayson, "Ad-Deir Monument and Plateau Project Annual Report" (Petra, Jordan: Brigham Young University, 2019), 42.

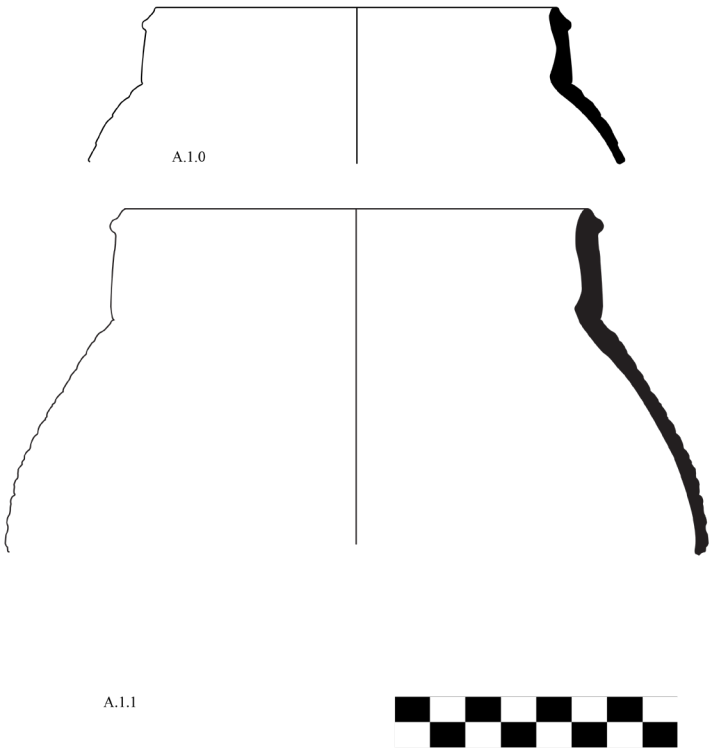


Figure 5.5. Nabataean coarse ware forms A.1.0 and A.1.1. Drawings by the author.

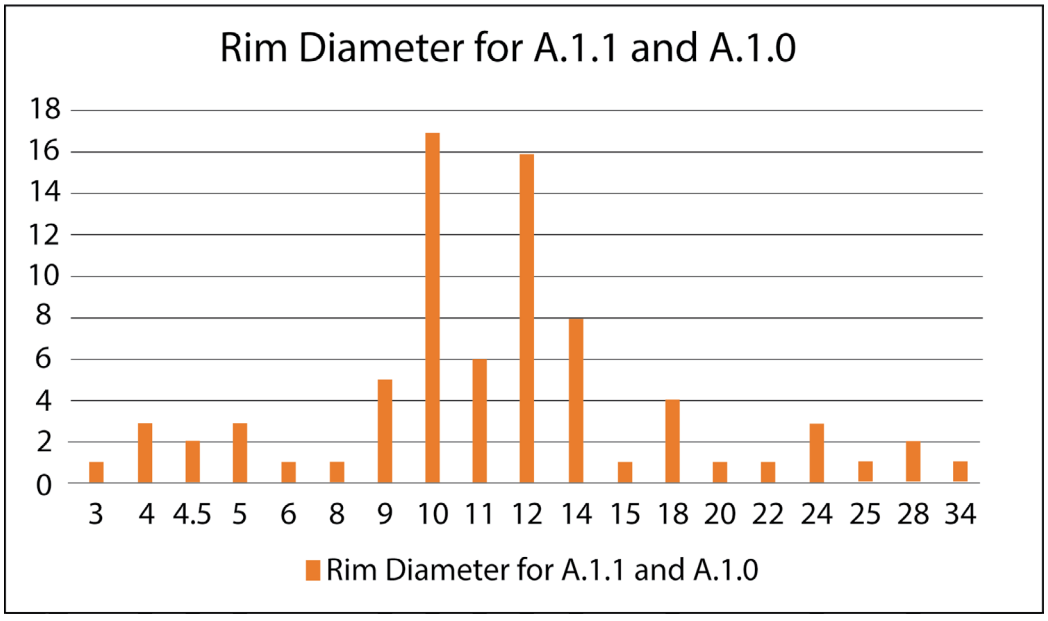


Figure 5.6. Rim diameters for forms A.1.1 and A.1.0..

pots, and large serving vessels. Additionally, this would also explain the abundance of whole or partitially whole vessels surviving within ECB from over 2,000 years.

Like the woks used by the Akha people, where wok size would increase for feasts, some Nabataean coarse ware vessels have varying sizes within the same form that might indicate the larger vessels were used for ritual feasting.[56] Two forms, denoted as A.1.1 and A.1.0 in this study have a similar rim and body designs when compared to each other (See Figure 5.5).[57] Forms A.1.1 and A.1.0 are standard cooking pots according to Nabil Khairy that date from around 50 B.C.E. and that Yvonne Gerber argues actually are perpetuated into the later 2nd and 3rd centuries C.E.[58] According to a sample taken from the 2015 and 2017 field seasons in ECB, my study found that the forms A1.0 and A1.1 represents approximately 7.2% of all identifiable coarse ware vessels recovered from ECB.[262] From the same study, vessels with the A.1.1 and A.1.0 rim and body treatments have an average rim diameter between 10 and 12 cm (see Figure 5.6).[59] However, there are 13 rims that have 18+ cm rim diameters. By implementing the suggestions of Clarke, the rims that have a much larger rim diameter may be specific for feasting, whereas the other containers may have been for more utilitarian use, such as water storage.

There were several casserole dishes recovered from the cistern beyond the form of A.1.1. These forms are simple bowls but have rim diameters as large as 30 cm and these dishes have a similar date range as forms A.1.1 and A.1.0 (i.e., from about 50 B.C.E. to the 2nd century C.E.).[60] The shape and function of the vessel certainly suggest that this bowl was used as a serving dish for possibly a large gathering or ritual feast. While it is possible that these dishes were used in

56 Clarke, "Akha Feast an Ethnoarchaeological Approach," 160.

57 A.1.0 and A.1.1 are comparative to Nabil Khairy's F.6 family of cooking pots, specifically, forms F.6.53 and F.6.63 Nabil I. Khairy, "A Typological Study of the Unpainted Pottery from the Petra Excavations." (Doctoral Dissertation, London, University of London, 1975), 416–17.

58 Khairy, 219; Yvonne Gerber, "Late Roman Coarse Ware from Petra, Jordan: Changes in Typology and Chemical Composition," *Late Roman Coarse Wares, Cooking Wares and Amphora in the Mediterranean BAR International Series* 1340 (2005): 729.

59 Hubbert, "Roman Expansion and Nabataean Coarse Wares New Evidence from the Ad-Deir Plateau in Petra, Jordan," 40.

60 Khairy, "A Typological Study of the Unpainted Pottery from the Petra Excavations." .


Figure 5.7. Nabataean painted fine wares from the room above ECB. Photo courtesy of AMPP.


Figure 5.8. Nabataean painted fine wares from the room above ECB. Photo courtesy of AMPP.

domestic spaces, their appearance at a cistern and in particular in ECB itself suggests that they were used in a feasting setting alongside the other larger preparation and serving vessels.

*Special Pottery*

AS previously mentioned, excavations in the room above ECB in 2015 found several Nabataean painted fine ware plates and a fragment of a painted cup (See Figures 5.7 and 5.8). These sherds date from between 50 B.C.E. to 100 C.E., based on Stephen Schmid's chronology

and possibly into the mid second century C.E. according to Kharieh ‘Amr.[61] Those sherds provide a probable time frame for the use of the room, which roughly corresponds with the cistern itself. Nabataean painted fine wares were also recovered from ECB and in some cases, the AMPP team was successful in reconstructing plates, bowls, and cups. Fine plates do not belong within the context of a cistern but are expected within a more formal dining setting. Modern ethnographic examples demonstrate that some cultures have specialized vessels that accompany feasts.[62] For example, Warren DeBoer found that among the Conibo and Shipibo, denizens of the central and upper Ucayali basin in the Amazon region of eastern Peru, special containers were made for their ritual feasts associated with their puberty rite.[63] Additionally, Dietler found that the people of Alego had specialized drinking vessels for their feasts.[64] Therefore, the Nabataean painted fine wares may have had a special function within the context of a ritual feast or meal.

## Ritual Feasting

Understanding that a ritual feast occurred at ECB helps to illustrate the context in which the medicinal plants from Chapter 3 originated, but there arises a second question; how were the medicinal plants related to a ritual feast and how might they have been used in such a context? This section outlines the possible scenarios in which the ancient Nabataeans may have used the medicinal plants as connected to a ritual feast. First, this section discusses what feasts accomplish and how. I follow the discussion of feasts with the possible roles the medicinal plants played in those ritual actions.

61 Schmid, “Nabataean Pottery,” 312–15; Khairieh ‘Amr, Talal Akasheh, and Mariam Na’es, “Recovery and Reproduction Technology of Nabataean Painted Fine Ware,” 2009, 4–5..

62 Twiss, “Transformations in an Early Agricultural Society,” 421; Dietler, “Theorizing the Feast: Rituals of Consumption, Commensal Politics, and Power in African Contexts,” 96; Warren R. DeBoer, “The Big Drink: Feast and Forum in the Upper Amazon,” in *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, ed. Michael Dietler and Brian Hayden (Tuscaloosa, United States: University of Alabama Press, 2001), 218.

63 DeBoer, “The Big Drink: Feast and Forum in the Upper Amazon,” 217–18.

64 Dietler, “Theorizing the Feast: Rituals of Consumption, Commensal Politics, and Power in African Contexts,” 96–98.

Scholars should consider the major events that often accompany feasting when assessing and categorizing sites. Polly Wiessner notes that "most feasts are held for a specific occasion: to appease ancestors, initiate youth, marry, bury the dead, pay compensation, or assemble a labor force."[65] Ethnographic examples demonstrate that ritual feasts are often connected to other events as demonstrated by the Bedouin of the Negev, where a feast is held in conjunction with the act of circumcision.[66] Feasts in Western society also usually accompany specific events, such as a traditional dinner or feast in association with the Western Christian holiday of Christmas. It is important to remember that feasts and events are not mutually exclusive, but in many instances, one may result from the other.

What Feasts Accomplish

Individuals who participate in an event associated with a feast can often share a similar purpose or motivation for the feast itself. By looking at the theoretical underpinnings of ritual feasts and what they accomplish, then archaeologists may have a better footing to understand what the events associated with feasts also achieve. For example, according to Hayden's typology of ritual feasts, celebratory feasts accomplish social solidarity and bonding, while other feasts bring about economic success or heightened status.[67] While some feasts may ascribe to a specific type as outlined by Hayden, most may be a conglomerate of various types and forms and will thus accomplish different things.[68] But those feasts may have a similar purpose as the event associated with it (i.e., social bonding or solidarity). Each instance of feasting and the various material and social evidence associated with it should therefore be taken into consideration to determine what the original organizers intended with their ritual meal.

One major outcome of ritual feasts is to enhance social ties and solidarity. Deitler wrote, "As

65 Wiessner, "Of Feasting and Value Enga Feasts in a Historical Perspective (Papua New Guinea)," 116.
66 Marx, "Circumcision Feasts among the Negev Bedouins."
67 Hayden, "Feasting in Prehistoric and Traditional Societies," 128.
68 Hayden, "Fabulous Feasts: A Prolegomenon to the Importance of Feasting," 129.

public ritual events, in contrast to daily activity, feasts provide an arena for the highly condensed symbolic representation of social relations."[69] Ritual behavior, even if small, can tie individuals and communities together. For example, a traditional Bedouin circumcision feast usually brought together several families and tribes to celebrate an experience that was shared among them.[70] Such instances where an event may bring together traditionally separate peoples indicate that those events accomplish a deep social cohesion.

Feasts also have inherent political and economic undertones beyond social solidarity. Dietler again wrote, "Feasts are inherently political and that they constitute a fundamental instrument and theater of political relations."[71] Feasts with an inherent economic element may attempt to mobilize labor; create cooperative relationships within a group or, conversely, exclude different groups; create cooperative alliances; invest surplus; create political power and more.[72] One such example of the political motives as represented by feasts comes from E. Paul Durrenberger works on Medieval Iceland in the 9th century C.E. where he once wrote that, "Chieftains from Norway settled Iceland in the 9th century to preserve their anachronistic institution of stratification without a state…their political economy depended on claims of ownership of property."[73] Without the support of a state structure, individual chieftains had to consolidate and promote their power through other means. One such way was the feast where mutual support, gift-giving, and relationships could be fostered.[74] Status and power were thus achieved through ritual feasts for the Viking chieftains of Iceland.

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69 Michael Dietler, "Feasts and Commensal Politics in the Political Economy," in *Food and the Status Quest an Interdisciplinary Perspective*, ed. Polly Wiessner and Wulf Schiefenhovel (United States: Berghahn Books, 1996), 89.

70 Marx, "Circumcision Feasts among the Negev Bedouins," 416–18.

71 Dietler, "Theorizing the Feast: Rituals of Consumption, Commensal Politics, and Power in African Contexts," 66.

72 Hayden, "Fabulous Feasts: A Prolegomenon to the Importance of Feasting," 29–30.

73 E. Paul Durrenberger, "The Political Ecology of Ritual Feasting," in *Dimensions of Ritual Economy*, ed. E. Christian Wells and Patricia A. McAnany, vol. 27, Research in Economic Anthropology (United Kingdom: JAI Press, 2008), 79.

74 Durrenberger, 81.

*The Purpose of Objects within Ritual Feasts*

One of the ways that ritual feasts accomplished social solidarity, gained political power, and raised personal status was through the objects and gifts that were provided during such events. Objects, especially food, are the focal points of ritual feasts, thus any things that are detectable archaeologically may shed light on the various elements of ritual feasting within any given society or culture. In some cases, objects may be given as gifts during the feast. For example, the Jewish feast of Purim has elements of gift giving that accompany the event. Amy Shuman noted that a passage from the book of Esther suggested setting aside a day to remember the good things done unto them and to give a portion of their things to the poor, which orthodox Jews observe today during the feast of Purim.[75] While the association of gift giving with the feast of Purim is driven by theology, other forms of gift giving in feasts have been correlated with the consolidation of power and the pursuit of prestige.

Hayden argues that in the case of competitive feasts, i.e., those that are motivated by economic gain or control, gift giving created a sense of indebtedness between the host and the attendees.[76] Such expenditures by the individual have been viewed by some scholars as an impractical waste, however, others have noted that no gift is ever free, but carry significant social implications such as indebtedness or the creation of a bond between groups or individuals.[77] Feasts are an ideal setting for gift giving because there is already some form of debt created through the intentional sharing of surplus food. But, as Marshall Sahlins quotes an Eskimo saying "gifts make slaves" the gift or act of gift giving socially ensnares individuals.[78] Thus, emphasizing that physical objects within feasting serve an important role in the feast.

75 Amy Shuman, "Food Gifts: Ritual Exchange and the Production of Excess Meaning," *The Journal of American Folklore* 113, no. 450 (2000): 497.

76 Hayden, "Feasting in Prehistoric and Traditional Societies," 132.

77 Marshall Sahlins, *Stone Age Economics* (Chicago IL: Aldine and Atherton, Inc., 1972), 30–31; Hayden, "Feasting in Prehistoric and Traditional Societies," 132; Marcel Mauss, *The Gift* (London: Routledge, 2002), 1.

78 Sahlins, *Stone Age Economics*, 133.

## The Role of Medicinal Plants within Nabataean Ritual Feasts

The final section of this chapter addresses the medicinal plants that were identified in specific ceramic samples from ECB and their possible association with a ritual feast. Furthermore, this portion of the chapter discussed how that information can help archaeologists understand new roles or purposes for Nabataean symposia. There are two main hypotheses that help to explain the appearance of the medicinal plants among the feasting refuse in ECB. The first is that the medicinal concoctions were of some value and were used as gifts during the proceedings of the feast. The second hypothesis is that the medicinal plants were prepared and used in conjunction with the feast and may represent a possible healing or medicinal event that accompanied the ritual meal.

The gift-hypothesis is plausible since the Nabataean economy was based on the collection, production, and distribution of chemical compounds, most notably perfumes.[79] The ancient Nabataeans are most well known for their trade in aromatics, especially frankincense.[80] According to ancient sources, groups in the ancient Near East and the Mediterranean used frankincense for both religious and medicinal uses. For example, Dioscorides mentions several uses for frankincense, such as reducing the inflammation of the eyes, cleaning ulcers, and filling hollow sores.[81] Additionally, myrrh and gum laudanum, were also traded through Petra and both have known medical uses.[82] The Nabataeans traded many substances that have known medicinal uses. Medicinal trade and even production through Petra helped to establish fundamental parts of the economy of the ancient Nabataean Kingdom and so it may be that the medicinal substances found in the ceramic sherds from ECB had significant monetary value. If so, then the presence of

79 Nabil I. Khairy, "Nabataean Piriform Unguentaria," *Bulletin of the American Schools of Oriental Research*, no. 240 (1980): 85.

80 David Johnson, "Magic, Medicine and Fraud," *Jordan Journal for History and Archaeology* 14, no. 4 (2021): 235–36.

81 Dioscorides Pedanius, *De Materia Medica*, trans. Tess Anne Osbaldeston and Robert P Wood (Johannesburg: IBIDIS, 2000), 88. See Book I, Chapter 84.

82 Johnson, "Magic, Medicine and Fraud," 236–37, 240.

medicinal plants among feasting remains may suggest that they were intended as gifts, possibly even from the organizer ‘Ubaydu to their guests.

If gift-giving was one of the objectives of Ubaydu’s feast, then it is possible to suggest that the feast was diacritical in that it was meant to signify Ubaydu’s position or to possibly gain favor or secure loyalty. [83] As mentioned previously, the deified Obodas seems to have been linked with the royal family either by being a deified king or linked in some other way. Additionally, the Ad- Deir Plateau had architectural elements that suggest it was an area for the elite either by its secluded location, monumental architecture, or even its processional-way suggesting that the area was created by or for the ruling and or religious elite. Ancient writers, such as Strabo, mention that the Nabataean king often participated in feasts to demonstrate his “democratic” nature (Strabo 16.4.26).[84] Thus, the medicinal plants may have acted as an agent of material wealth to be conveyed to others to ensure or reward loyalty.

The second hypothesis is that the medicinal plants indicated a healing event and is most readily supported by the ceramics found in association with the rest of the feasting remains. Specifically, if the vessels that contained the medicinal plants were also discarded with the rest of the dining plates, cups, and serving dishes, then that may mean the material in those containers was also consumed in the same event. Thus, the question arises why would ancient groups consume medicinal plants and concoctions in the same event, especially if a part of that event was a ritual feast? This thesis argues that a healing ritual or event was associated with the ritual feast. Somewhat similar to the Bedouin circumcision feast, where the meal followed the ritual act of circumcision, perhaps the Nabataeans gathered at ECB to perform a healing ritual that was then followed by a feast.[85]

83 Hayden, “Feasting in Prehistoric and Traditional Societies,” 132.
84 Strabo, *The Geography of Strabo*, trans. Horace Leonard Jones, vol. VII, Loeb Classical Library (Harvard: Harvard University Press, 1932). See Book XVI, Chapter 4.
85 Marx, “Circumcision Feasts among the Negev Bedouins,” 411.

Unfortunately, the Nabataeans only recorded if a feast was dedicated to a deity or royalty and the social associations (if any) of the individuals involved. From available evidence in Petra, the *mrzḥ*ʾ could be associated with things such as the dead, gods and goddesses, and social organizations. In the case of at least one Nabataean *mrzḥ*ʾ at ECB, the inscription states that the feast was dedicated to Obodas or possibly involved the perceived powers of Obodas in making the healing ritual more effective. [86]

However, individuals who practiced medicine, mainly physicians, are mentioned in inscriptions in the Nabataean Kingdom. Specifically, physicians are noted at religious sites in Petra, such as at the sanctuary of Isis in Wadi Abu Ullayaqah where an inscription mentions a physician, that Jean Roche argues was possibly attending to supplicants within the vicinity of the idol.[87] Perhaps the supplicants mentioned in the inscription above ECB first sought to heal through an attending physician at the local temple to the northeast of ECB or at one of the other shrines on the Ad-Deir Plateau where there is evidence of such plants as the sea squill and crocus that have possible religious connotations (See Chapter 3). The small temple or shrine complex and the associated religious and healing elements noted in and around ECB may support a possible healing or religious-healing event that took place there. Such an event may have been followed by a feast, most likely in celebration of the performance or act, however, such an argument will require further study into the relationship between physicians and feasts at religious sites in Nabataean contexts.

If the main goal of the feast was to accompany a healing event, then it too would fall under Hayden's commensal feast type.[88] Specifically, the feast would be to recognize an event that was important to a wider community and thus would create a deeper sense of social solidarity.[89] This

86 Zayadine and Farajat, "The Petra National Trust Site Projects: Excavation and Clearance at Petra and Beihda," 285; Finlayson, "AMPP Annual Report," 2017.

87 Marie-Jeanne Roche, "A Nabataean Shrine to Isis in Wādī Abū ʿUllayqah, in the South-West of Petra," *Proceedings of the Seminar for Arabian Studies* 42 (2012): 64.

88 Hayden, "Feasting in Prehistoric and Traditional Societies," 128. See figure 8.1.

89 Dietler, "Feasts and Commensal Politics in the Political Economy," 89.

potentially new insight into ancient Nabataean practices needs additional reinforcement through future excavation and testing, but it helps to establish a new theory concerning the relationship between a ritual meal, events that may have been associated with it, and the social benefits of feasting among the Nabataeans.

## Conclusion

Ritual is steeped in practice and established deeply within both the agency and cultural identities of individuals. [90] Ritual feasts are defined by various scholars broadly to include an event where a group of people gather and consume foods that are different from that which are eaten day-to-day. Archaeologists have identified nuances within this definition and have gone further to categorize and organize the types of feasts based on their intended outcomes.[91] Feasts also accomplish tasks such as creating a sense of social solidarity or soliciting labor and even gaining status within a community. This study may now indicate that an additional healing event may be part of the repertoire of symposium events among the Nabataeans.

Ritual feasts are abundant across nearly all peoples since they are highly adaptive to needs and cultural particularities. Nevertheless, ritual feasts can have some common features that appear as material objects. These include large serving vessels, special containers for drinks and food, and even changes in faunal deposits.[92] Architecture is also a key to understanding ritual feasts since in many cultures specific areas were set aside to accommodate large numbers of people.

Such types of evidence are apparent in Petra where triclinia are abundant. Additionally, in some areas, ceramics and faunal deposits suggest that feasting occurred. Such evidence demonstrates that a ritual feast occurred close to ECB. The evidence includes an abundance of cooking, service, and eating vessels of high quality, and the small room above the cistern,

90 Asad, *Genealogies of Religion*, 55.
91 Hayden, "Feasting in Prehistoric and Traditional Societies," 129.
92 Clarke, "Akha Feast an Ethnoarchaeological Approach," 160.

which would have provided a location for a gathering to perform rituals or ceremonies that accompanied a feast, after which, the attendees could dispose of the excess vessels into the cistern below.

It is possible that the ceramic vessels that held the medicinal plants may have had a role within the ritual of the *mrzḥ*'. The ritual feasts were for small, organized groups and at times dedicated to gods or goddesses, which suggest both a social and religious element to these gatherings. There may have been a healing element along with the religious and social elements in which the medicinal plants were consumed either for practical healing effects or for a special healing ceremony. The plant material that was identified in my study does not correlate with hallucinogens, but they may have caused a physical sensation that was to be experienced by the participants, possibly in the act of epiphany or in social solidarity.

Additional research is required to understand the full effects of the chemical concoctions mentioned in this thesis and their exact relationships with the social organizers of the feast that occurred at ECB. It is possible that the medicinal products were of high economic value and were a part of Ubaydu's attempt at creating a social bond between himself and the attendants of the feast. Or it is possible that Ubaydu and the guests involved were seeking healing from a local physician attached to a religious shrine that was later commemorated via the feast and inscription. These ideas will need further support, but they provide a starting point for future studies.

# 6 Conclusion

This thesis has sought to establish a possible healing practice within the context of a ritual feast as demonstrated by the material remains from Eastern Cistern B (ECB) on the Ad-Deir Plateau in Petra, Jordan. Specifically, this thesis was divided into four main chapters that ranged from the history of the Nabataeans in Chapter 2, the list of medicinal plants found in pottery fragments from ECB via absorbed residue analyses in Chapter 3, the limitations of the chosen methodology in Chapter 4, and the discussion of the medicinal plants within the feasting assemblage from ECB in Chapter 5.

Chapter 2 encompassed the history of the Nabataeans, which for this thesis started with the first record of the Nabataeans around 312 B.C.E. by the ancient historian Diodorus (19.94.1-2). Soon after that date, the Nabataeans grew in strength and became a local power within the Southern Levant. However, that power was thwarted in 106 C.E. when the Roman Emperor Trajan annexed the region into the Roman Empire. It was after that date that scholars noted a general decline of power and distinct cultural traits among the ancient Nabataeans.[1] Thus, the study discussed throughout this thesis focused primarily on the height of the Nabataean state's power, i.e., 50 B.C.E to about 100 C.E.

This thesis study also focused on the area that is called the Ad-Deir Plateau which has been under excavation and exploration by the Ad-Deir Monument and Plateau Project (AMPP) of

1 Schmid, "The 'Hellenisation' of the Nabataeans: A New Approach," 418.

Brigham Young University since 2012.[2] The Plateau is situated on the western border of the ancient city of Petra and is isolated from the rest of the city via two main approaches from the north and south. The site itself includes a large array of architectural features, such as temples, altars, shrines, banqueting areas, niches, and water catchment and control systems.[3] ECB is a part of that water system on the Ad-Deir Plateau and is a part of a chain of seven other cisterns. Additionally, ECB is unique because a rock fall, most likely in the 4th century C.E. sealed the context below, which has preserved the Nabataean cultural remains.

This study utilized a method known as absorbed residue analysis, specifically on the ceramics from ECB to understand what they once contained. This methodology entailed the destruction of a small portion of a sherd and using chemical ethers to extract the absorbed organic residues. I used a gas chromatographer-mass spectrometer (GCMS) to then separate and analyze the organic solution. The GCMS produced both chromatographs that detailed the compounds in the sample and mass spectrographs that detailed the nuanced structure of each compound.[4] These results were further interpreted by a computer program that could help to identify the results that were further studied to determine any connection with ancient plant use.

Chapter 3 then outlined the various results from the ceramics from ECB. While some food remains were found, this thesis focuses on the medicinal plants that were identified with the absorbed residue analysis. This study found chemicals, such as colchicine, digitoxin, bufolides, and carbazoles. Most of those chemicals and others have natural sources among plants that were commonly known among ancient writers, such as Pliny or Dioscorides. Chapter 3 was structured in such a way as to present a chemical compound found among the ECB sherds, the plant it may have originated from, and the ancient sources that mention uses for such plants.

2 Finlayson, "AMPP Annual Report," 2014. Though initial investigations began officially in 2012.

3 For general surveys of the Plateau, see: Lindner et al., "New Explorations of the Deir-Plateau (Petra)"; Finlayson, "AMPP Annual Report," 2019; Dalman, *Petra und seine Felsheiligtümer*.

4 See Appendix A for chromatographs of samples.

The prominent chemical compounds that were identified during testing were digitoxin, bufolide or gamabufolide, colchicine, vincamine, and benzaldehyde. Digitoxin has two natural sources, fox glove and oleander. Both were known anciently among the peoples of the Mediterranean; however, oleander is far more prevalent in landscapes of the Southern Levant. Bufolide or gamabufolide naturally occurs in toads as well as a bulbous plant called sea onion. The sea onion grows naturally in Jordan and surrounding areas and there is some ethnographic evidence of the plants being used among Palestinian groups as late as the early 1900s however, this plant was noted as a medical source by Dioscorides.[5] Colchicine occurs naturally in the autumn crocus and while the autumn crocus is not native to Jordan, several subspecies are, and it is possible that those different types were harvested for their medicinal qualities. Vincamine is most commonly found in the small creeping myrtle plant. Myrtle is not native to the Southern Levant but did have known medicinal uses elsewhere, and so the appearance of this chemical may suggest that it may have been a trade good. Finally, benzaldehyde is most commonly associated with pitted nuts and fruits, such as almonds. Almonds in particular have a long cultural history in the Southern Levant, which included medicinal uses.

Several other compounds were also identified that appeared to have been either natural or chemical contaminants. For example, silicic acid was identified in many of the sherds from both ECB and the possible kitchen area also on the Ad-Deir Plateau. Silicic acid is a common plant acid that may have been absorbed into the ceramic fabric while it lay for two millennia in situ. Additionally, chemicals such as carbazoles and prednisolone were also identified and they most likely derive from modern substances. For instance, carbazole was identified in several samples, but the most readily available source of it is tobacco smoke. Several team members smoked on site and it is possible that their smoking contaminated the samples. Identifying the contaminates was a high priority for this study since absorbed residue analysis has not been used

5 Dioscorides Pedanius, *De Materia Medica*, 336. See Book II, Chapter 202.

for archaeological investigation in Petra and for the ancient Nabataean Kingdom up to this point.

Chapter 4 expounded upon the end of Chapter 3 and specifically focused on the limitations of the methodology used for this thesis. Such limitations included the time involved after initial excavation to chemical testing, preparing samples and running them through a gas chromatographer-mass spectrometer (GC-MS). Additionally, the chapter broadly discussed the costs involved and the physical limitations of using a GC-MS in archaeological investigations. This chapter sought to address some of the more nuanced limitations that I observed while conducting my tests. For example, having access to a machine and a lab where I could process samples was a unique situation that is not available to all archaeologists. Additionally, this chapter discussed how I overcame these issues via access to training materials or individuals who assisted me with early analysis via laboratory and personal resources at Brigham Young University. Additionally, as in Chapter 3, I discussed some of the contaminants that may affect future research in Petra, Jordan.

Chapter 5 discussed the residue data in Chapter 3 within the context of a possible feasting deposit discovered in Eastern Cistern B (ECB) on the Ad-Deir Plateau. The ceramic assemblage from ECB was primarily comprised of ceramic sherds of various sizes and ware. For example, 235 distinct coarse ware rim types were identified in ECB between the years 2014 to 2017.[6] There were both fine dining plates and cups found alongside coarse serving vessels, storage jars, and cooking pots. The broad spectrum of vessel types suggests that they may be the result of a feast that had occurred at ECB. Furthermore, an inscription above ECB states that a feast had occurred at or near ECB in memorial to Obodas.[7] These pieces of evidence seem to suggest that a possible ritual feast or mrzḥʾ occurred in close proximity above ECB in the rock-cut room

6 Hubbert, “Roman Expansion and Nabataean Coarse Wares New Evidence from the Ad-Deir Plateau in Petra, Jordan,” 35.

7 Zayadine and Farajat, “The Petra National Trust Site Projects: Excavation and Clearance at Petra and Beihda,” 284.

that exists above the Cistern itself and just below the inscription that mentions Obodas possibly Obodas I (96 – 85 B.C.E).

Once Chapter 5 had established that a feast had occurred at or near ECB, the chapter discussed the possible interpretations of the ritual meal. That section drew heavily from anthropological and archaeological theoretical applications such as those postulated by Brian Hayden and Michael Dietler to discuss the potential social and religious functions of a feast at ECB within Nabataean contexts. Such functions may have included the gathering of support or create solidarity between the organizer and the attendees.[8] Other hypotheses included discussing how the medicinal plants may have been gifts to curry favor or create social indebtedness between individuals or groups. The evidence, however, does seem to indicate that the medicinal plants were consumed during an event in conjunction with the ritual feast and so this research may indicate that the ancient Nabataeans also socialized symposia and ritual healing practices. This is new information regarding ritual symposia and their function in ancient Nabataea.

The research presented here in this thesis demonstrates that a feast occurred at ECB and that there may have been a healing ritual associated with it. Unfortunately, the feast and associated consumption of medicinal plant material at ECB is an isolated event within current Nabataean scholarship. Again, scholars have primarily focused on identifying feasting sites within ancient Nabataean contexts and not on some of the nuances that may have characterized the types of feasts that occurred. Thus, more studies on the unique aspects of feasts throughout the Nabataean Kingdom are needed to determine if the feast at ECB is an isolated event or not. This research also asks a wider question concerning what events were associated with feasts in the ancient Near East that may not have been obvious from previous archaeological excavations. While textual evidence may demonstrate that a feast occurred within a certain region, only more

8 Hayden, "Feasting in Prehistoric and Traditional Societies," 128.; Hayden, "Fabulous Feasts: A Prolegomenon to the Importance of Feasting," 129.; Dietler, "Feasts and Commensal Politics in the Political Economy," 89.

scientific archaeological investigations into the material remains of such locations may provide insights into the types and purposes of the feast as a social event. Thus, my new data and exploratory research represents an initial study that others may improve and expound upon in the future.

## Bibliography


Adams, Ron L. “Ethnoarchaeology in Indonesia Illuminating the Ancient Past at Çatalhöyük?” *American Antiquity* 70, no. 1 (2005): 181–88.

Alpass, Peter. *The Religious Life of Nabataea*. BRILL, 2013.

Amr, Khairieh, Talal Akasheh, and Mariam Na’es. “Recovery and Reproduction Technology of Nabataean Painted Fine Ware,” 2009.

Amr, Zuhair S, and Ahmad M Disi. “Venomous Snakes and Snakebites in Jordan.” *Toxinology*, 2014, 1–20.

Asad, Talal. *Genealogies of Religion: Discipline and Reasons of Power in Christianity and Islam*. JHU Press, 1993.

Berthelsen, S., A. D. Noble, and A. L. Garside. “Silicon Research Down Under: Past, Present, and Future.” In *Studies in Plant Science*, edited by L. E. Datnoff, G. H. Snyder, and G. H. Korndörfer, 8:241–55. Silicon in Agriculture. Elsevier, 2001.

Bhattacharya, Amitav. “Chapter 6 - Effect of High-Temperature Stress on the Metabolism of Plant Growth Regulators.” In *Effect of High Temperature on Crop Productivity and Metabolism of Macro Molecules*, edited by Amitav Bhattacharya, 485–591. Academic Press, 2019.

Bienkowski, Piotr, ed. *Umm Al-Biyara Excavations by Crystal-M. Bennett in Petra 1960-1965*. Levant Supplementary Series 10. Oxford: Oxbow Books, 2011.

Bourdieu, Pierre. *Outline of a Theory of Practice*. Cambridge: Cambridge University Press, 1977

Bowersock, Glen. *Roman Arabia*. Cambridge, MA: Harvard University Press, 1994.

Bryan, Cyril P., and Heinrich Joachim. *The Papyrus Ebers*. London: G. Bles, 1930. https://search.lib.byu.edu/byu/record/cat.456250.item.31197001964557?holding=qzo8jx9m smvjh211.

Burckhardt, John Lewis. *Travel in Syria and the Holy Land*. Echo Library, 2006. Celsus. *De Medicina*. Translated by W. G. Spencer. Loeb Classical Library, 1938.

Chaouali, Nadia, Ines Gana, Amira Dorra, Fathia Khelifi, Anouer Nouioui, Wafa Masri, Ines Belwaer, Hayet Ghorbel, and Abderazzek Hedhili. "Potential Toxic Levels of Cyanide in Almonds (Prunus Amygdalus), Apricot Kernels (Prunus Armeniaca), and Almond Syrup." *ISRN Toxicology* 2013 (2013)

Choi, Sung-Hee. "Essential Oil Components in Herb Teas (Rose and Rosehip)." *Journal of Life Science* 19 (2009): 1333–36.

Clarke, Michael J. "Akha Feast an Ethnoarchaeological Approach." In *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, edited by Brian Hayden and Michael Dietler, 144–67. Tuscaloosa, United States: University of Alabama Press, 2001.

Condamin, J., F. Formenti, M. O. Metais, M. Michel, and P. Blond. "The Application of Gas Chromatography to the Tracing of Oil in Ancient Amphorae." *Archaeometry* 18, no. 2 (1976): 195–201.

Cooper, J. C. *Symbolic and Mythological Animals*. London: Aquarian/Thorsons, 1992.

Copley, M. S., R. Berstan, V. Straker, S. Payne, and R. P. Evershed. “Dairying in Antiquity. II. Evidence from Absorbed Lipid Residues Dating to the British Bronze Age.” *Journal of Archaeological Science* 32, no. 4 (April 1, 2005): 505–21.

Da Riva, Rocio. “The Nabonidus Inscription in Sela (Jordan): Epigraphic Study and Historical Meaning.” *Zeitschrift Für Assyriologie Und Vorderasiatische Archäologie* 110, no. 2 (2020): 176–95.

Dalman, Gustaf. *Petra und seine Felsheiligtümer*. Leipzig: J.C. Hinrichs, 1908.

———. *Petra und seine Felsheiligtumer*. Leipzig, 1908.

———. *Work and Customs in Palestine*. Translated by Nadia Abdulhadi-Sukhtian. Vol. 1. 2. Palestine: Dar Al Nasher, 2013.

Darracq, M. A. “Red Squill.” In *Encyclopedia of Toxicology (Third Edition)*, edited by Philip Wexler, 63–64. Oxford: Academic Press, 2014.

Dasgeb, B., D. Kornreich, K. McGuinn, L. Okon, I. Brownell, and D. L. Sackett. “Colchicine: An Ancient Drug with Novel Applications.” *The British Journal of Dermatology* 178, no. 2 (2018): 350–56.

Daunay, Marie-Christine, and Jules Janick. “History and Iconography of Eggplant.” *Chronica Horticulturae* 47, no. 3 (2007): 16–22.

Day, Jo. “Crocuses in Context: A Diachronic Survey of the Crocus Motif in the Aegean Bronze Age.” *Hesperia: The Journal of the American School of Classical Studies at Athens* 80, no. 3 (2011): 337–79.

DeBoer, Warren R. “The Big Drink: Feast and Forum in the Upper Amazon.” In *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, edited by Michael Dietler and Brian Hayden, 215–39. Tuscaloosa, United States: University of Alabama Press, 2001.

Dietler, Michael. “Feasts and Commensal Politics in the Political Economy.” In *Food and the Status Quest an Interdisciplinary Perspective*, edited by Polly Wiessner and Wulf Schiefenhovel, 87–125. United States: Berghahn Books, 1996.

———. “Theorizing the Feast: Rituals of Consumption, Commensal Politics, and Power in African Contexts.” In *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, edited by Michael Dietler and Brian Hayden, 65–114. Tuscaloosa, United States: University of Alabama Press, 2001.

Dioscorides Pedanius. *De Materia Medica*. Translated by Tess Anne Osbaldeston and Robert P Wood. Johannesburg: IBIDIS, 2000.

Disi, Ahmad M., and Zuhair S. Amr. “Morphometrics, Distribution and Ecology of the Amphibians in Jordan.” *Vertebrate Zoology*, 2010, 16.

Duma, G. “Phosphate Content of Ancient Pots as Indication of Use.” *Current Anthropology* 13, no. 1 (1972): 127–30.

Durrenberger, E. Paul. “The Political Ecology of Ritual Feasting.” In *Dimensions of Ritual Economy*, edited by E. Christian Wells and Patricia A. McAnany, 27:73–89. Research in Economic Anthropology. United Kingdom: JAI Press, 2008.

Eid, Ehab, Malik Al Awaji, Hussein Nasarat, and Aladdin Alhiyasat. “Perceptions and Knowledge Towards Snakes: A Study from Jordan.” *Herpetological Conservation and Biology* 16, no. 2 (2021): 345–54.

Evershed, Richard P. “Biomolecular Archaeology and Lipids.” *World Archaeology* 25, no. 1 (1993): 74–93.

Evershed, Richard P., Carl Heron, and L. John Goad. “Analysis of Organic Residues of Archaeological Origin by High-Temperature Gas Chromatography and Gas Chromatography-Mass Spectrometry.” *Analyst* 115, no. 10 (January 1, 1990): 1339–42.

Finlayson, Cynthia. “Ad-Deir Monument and Plateau Project Annual Report.” Petra, Jordan: Brigham Young University, 2014.

———. “Ad-Deir Monument and Plateau Project Annual Report.” Petra, Jordan: Brigham Young University, 2015.

———. “Ad-Deir Monument and Plateau Project Annual Report.” Petra, Jordan: Brigham Young University, 2017.

———. “Ad-Deir Monument and Plateau Project Annual Report.” Petra, Jordan: Brigham Young University, 2019.

———. “Ad-Deir Monument and Plateau Project Annual Report.” Petra, Jordan: Brigham Young University, 2021.

———. “The Women of Palmyra--Textile Workshops and the Influence of the Silk Trade in Roman Syria.” In *Textile Society of America Symposium Proceedings*. Northampton, Massachusetts, 2002.

Fuchs, Leonhart. *De Historia Stirpium Commentarii Insignes: Maximis Impensis & Vigiliis Elaborati*. Apud Ioannem Roigny, 1546.

Gerber, Yvonne. “Late Roman Coarse Ware from Petra, Jordan: Changes in Typology and Chemical Composition.” *Late Roman Coarse Wares, Cooking Wares and Amphora in the Mediterranean BAR International Series* 1340 (2005): 725–36.

Ghazanfar, Shahina A. *Handbook of Arabian Medicinal Plants*. Florida: CRC Press, 1994. Graf, David F. "Appendix: The Chronology of the Qasr al-Bint Complex." *Journal of Roman Archaeology* 19 (2006): 446–49.

Hall, A. H., and B. H. Rumack. "Clinical Toxicology of Cyanide." *Annals of Emergency Medicine* 15, no. 9 (1986): 1067–74.

Hartung, Edward. "History of the Use of Colchicum and Related Medicaments in Gout with Suggestions for Further Research." *Annals of the Rheumatic Diseases* 13, no. 3 (1954): 190–200.

Hayden, Brian. "Fabulous Feasts: A Prolegomenon to the Importance of Feasting." In *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, edited by Brian Hayden and Michael Dietler, 23–64. Tuscaloosa, United States: University of Alabama Press, 2001.

———. "Feasting in Prehistoric and Traditional Societies." In *Food and the Status Quest an Interdisciplinary Perspective*, edited by Polly Wiessner and Wulf Schiefenhovel, 127–47. United States: Berghahn Books, 1996.

Healey, John F. *The Religion of the Nabataeans*. Leiden: Brill, 2001.

Henry, Spence-Jones. *The Pulpit Commentary, Volume 4*. Delmarva Publications, Inc., 2015.

Hernández, Juan Pablo Sánchez. "Pausanias and Rome's Eastern Trade." *Mnemosyne* 69, no. 6 (2016): 955–77.

Hippocrates. *The Genuine Works of Hippocrates: Translated from the Greek with a Preliminary Discourse and Annotations*. Translated by Francis Adams. New York: W. Wood, 1886.

Hollman, A. “Medicinal Plant Discovery.” *British Heart Journal* 67, no. 6 (June 1992): 506.

Hubbert, Jake. “Roman Expansion and Nabataean Coarse Wares New Evidence from the Ad-Deir Plateau in Petra, Jordan.” Senior Thesis, Brigham Young University, 2019.

Hughes, R. A. C., J. M. Newsom-Davis, G. D. Perkin, and J. M. Pierce. “Controlled Trial of Prednisolone in Acute Polyneuropathy.” *The Lancet* 312, no. 8093 (1978): 750–53.

Johnson, David. “Magic, Medicine and Fraud.” *Jordan Journal for History and Archaeology* 14, no. 4 (2021).

Jones, L. H. P., and K. A. Handreck. “Silica in Soils, Plants, and Animals.” In *Advances in Agronomy*, edited by A. G. Norman, 19:107–49. Academic Press, 1967.

Jung, Linda S., Silvia Winter, Lutz Eckstein, Monika Kriechbaum, Gerhard Karrer, Erik Welk, Martin Elsasser, Tobias W. Donath, and Annette Otte. “Perspectives in Plant Ecology, Evolution and Systematics.” *Perspectives in Plant Ecology, Evolution and Systematics* 13, no. 3 (2011): 227–44.

Khairy, Nabil I. “A Typological Study of the Unpainted Pottery from the Petra Excavations.” Doctoral Dissertation, University of London, 1975.

———. “Nabataean Piriform Unguentaria.” *Bulletin of the American Schools of Oriental Research*, no. 240 (1980): 85–91.

Knight, Valerie. “The ‘De Podagra’ (‘On Gout’): A Pre-Gariopontean Treatise Excerpted from the Latin Translation of the Greek ‘Therapeutica’ by Alexander of Tralles.” University of Manchester, 2015.

Kressel, Gideon M, Joseph Ben-David, Khalil Abu Rabi’a, and Negev Bedouin. “Changes in the Land Usage by the Negev Bedouin Since the Mid-19th Century. The Intra-Tribal Perspective.” *Nomadic Peoples*, no. 28 (1991): 28–55.

LaCourse, William R., and Ira S. Krull. “Photoelectrochemical Detection of Benzaldehyde in Foodstuffs.” *Analytical Chemistry* 59, no. 1 (1987): 49–53.

Laurberg, Peter, Inge Bülow Pedersen, Allan Carlé, Stig Andersen, Nils Knudsen, and Jesper Karmisholt. “Chapter 28 - The Relationship between Thiocyanate and Iodine.” In *Comprehensive Handbook of Iodine*, edited by Victor R. Preedy, Gerard N. Burrow, and Ronald Watson, 275–81. San Diego: Academic Press, 2009.

Leach, Helen. “Did East Polynesians Have a Concept of Luxury Foods?” *World Archaeology* 34, no. 3 (2003): 442–57.

Lindner, Manfred, Elisabeth Gunsam, Ingo Just, Antonie Schmid, and Elisabeth Schreyer. “New Explorations of the Deir-Plateau (Petra).” *Annual of the Department of Antiquities of Jordan* 28 (1984): 163–81.

Lubec, Gert, and Leila Afjehi-Sadat. “Limitations and Pitfalls in Protein Identification by Mass Spectrometry.” *Chem Review* 107, no. 8 (2007): 3568–84.

Maggioni, Lorenzo, Roland von Bothmer, Gert Poulsen, and Elinor Lipman. “Domestication, Diversity and Usse of Brassica Oleracea L., Based on Ancient Greek and Latin Texts.” *Genetic Resources and Crop Evolution* 65 (2018): 137–59.

Marx, Emanuel. “Circumcision Feasts among the Negev Bedouins.” *International Journal of Middle East Studies* 4, no. 4 (1973): 411–27.

Mathe, Carole, P. ARCHIER, Lamis Nehme, and Catherine Vieillescazes. “The Study of Nabataean Organic Residues from Madâ’in Sâlih, Ancient Hegra, by Gas Chromatography- Mass Spectrometry.” *Archaeometry* 51 (2009): 626–36.

Mattingly, David, P. Newson, O. Creighton, R. Tomber, John Grattan, Chris Hunt, David Gilbertson, and F. Pyatt. “The Making of Early States: The Iron Age and Nabatean Periods.” In *Archaeology and Desertification: The Wadi Faynan Landscape Survey, Southern Jordan*, edited by Graeme Barker, David Gilbertson, and David Mattingly, 271–304, 2008.

Mauss, Marcel. *The Gift*. London: Routledge, 2002.

Mayyas, Abdulraouf, S., and Khaled Douglas. “Organic Residues in Iron Age II Pottery Vessels from Jneneh, Jordan.” *Mediterranean Archaeology and Archaeometry* 15 (2015): 31–44.

Mbaveng, Armelle T., Rebecca Hamm, and Victor Kuete. “Harmful and Protective Effects of Terpenoids from African Medicinal Plants.” In *Toxicological Survey of African Medicinal Plants*, edited by Victor Kuete, 557–76. Netherlands: Elsevier, 2014.

McCreery, David W. “Flotation of the Bab Edh-Dhra and Numeria Plant Remains.” *Annual of the American Schools of Oriental Research* 46 (1979): 165–69.

McKenzie, Judith. *The Architecture of Petra*. Oxford: Oxbow Books, 2005. Meshorer, Ya’akov. “Nabataean Coins.” *Qedem* 3 (1975): 1–112.

Middleton, William D., Luis Barba, Alessandra Pecci, James H. Burton, Agustin Ortiz, Laura Salvini, and Roberto Rodriguez Suárez. “The Study of Archaeological Floors: Methodological Proposal for the Analysis of Anthropogenic Residues by Spot Tests, ICP- OES, and GC-MS.” *Journal of Archaeological Method and Theory* 17, no. 3 (2010): 183–208.

Millar, Fergus. “Caravan Cities: The Roman Near East and Long-Distance Trade by Land.” *Bulletin of the Institute of Classical Studies. Supplement*, no. 71 (1998): 119–37.

Montfort, Antoine-Alphonse. *The Dair in Petra*. 1838. Lead pencil.

Morgan, E. D., L. Titus, R. J. Small, and C. Edwards. “Gas Chromatographic Analysis of Fatty Material from a Thule Midden.” *Archaeometry* 26, no. 1 (1984): 43–48.

Mottram, H. R, S. N Dudd, G. J Lawrence, A. W Stott, and R. P Evershed. “New Chromatographic, Mass Spectrometric and Stable Isotope Approaches to the Classification of Degraded Animal Fats Preserved in Archaeological Pottery.” *Journal of Chromatography A* 833, no. 2 (1999): 209–21.

Musil, Alois. *Arabia Petraea*. Wein Austria: A. Hölder, 1907.

National Center for Biotechnology Information. “7H-Dibenzo[c,g]Carbazole.” PubChem Compound Summary for CID 9134, 7H-Dibenzo[c,g]carbazole, 2021. https://pubchem.ncbi.nlm.nih.gov/compound/9134.

Nehmé, Laila. “La Chapelle d’Obodas à Petra: Rapport Préliminaire Sur La Campagne 2001.”*Annual of the Department of Antiquities of Jordan* 46 (2002): 243–56.

Nehmé, Laïla. “L’espace cultuel de Pétra à l’époque nabatéenne.” *Topoi. Orient-Occident* 7, no. 2 (1997): 1023–67.

Panasenko, N. N., and L. N. Anishchenko. “Influence of Invasive Plants Parthenocissus Vitacea and Vinca Minor on Biodiversity Indices of Forest Communities.” *Contemporary Problems of Ecology* 11, no. 6 (2018): 614–23.

Parr, Peter. “The Beginnings of Hellenisation at Petra.” In *Le Rayonnement Des Civilisations Grecque et Romanie Sur Les Cultures Peripherique*, 527–33. Paris: E. De Boccard, 1965.

Patrick, M., A. J. de Koning, and A. B. Smith. “Gas Liquid Chromatographic Analysis of Fatty Acids in Food Residues from Ceramics Found in the Southwestern Cape, South Africa.” *Archaeometry* 27, no. 2 (1985): 231–36.

Peck, Harry Thurston. *Harper’s Dictionary of Classical Literature and Antiquities*. Harper, 1897.

Pell, Nathan. “The Meaning of Baccare in Vergils Eclogues.” *Self-Published*, n.d., 1–36.

Perry, Megan A. “Sensing the Dead: Mortuary Ritual and Tomb Visitation at Nabataean Petra.” *Syria. Archéologie, Art et Histoire*, no. 94 (2017): 99–106.

Pliny the Elder. *Natural History*. Translated by John Bostock and H. T. Riley. Princeton University: H. G. Bohn, 1855.

Ramsay, Jennifer, and Leigh-Ann Bedal. “Garden Variety Seeds? Botanical Remains from the Petra Garden and Pool Complex.” *Vegetation History and Archaeobotany* 24, no. 5 (2015): 621–34.

Reeves, M. Barbara. “A Nabataean and Roman Shrine with Civic and Military Gods at Humayma, Jordan.” *Arabian Archaeology and Epigraphy* 30 (2019): 134–55.

Renel, François, and Andreas Kropp. “The Hellenistic Levels under the Temenos of the Qasr Al-Bint at Petra.” *Annual of the Department of Archaeology of Jordan* 52 (2008).

Renel, François, Michel Mouton, Christian Auge, Caroline Gauthier, Hatte Christine, Antoine Zazzo, and J-F Saliege. “Dating the Early Phases Under the Temenos of the Qasr Al-Bint at Petra The so-Called Hellenistic Levels.” *Supplement to Proceedings of the Seminar for Arabian Studies* 42 (2012): 1–16.

Retsö, Jan. “Nabataean Origins — Once Again.” *Proceedings of the Seminar for Arabian Studies*29 (1999): 115–18.

Retzleff, Alexandra. “A Nabataean and Roman Domestic Area at the Red Sea Port of Aila.” *Bulletin of the American Schools of Oriental Research*, no. 331 (2003): 45–65.

Roberts, David. *El Deir Petra March 8, 1839*. 1839. Lithograph, color. https://www.loc.gov/item/2002717535/.

Roche, Marie-Jeanne. “A Nabataean Shrine to Isis in Wādī Abū ʿUllayqah, in the South-West of Petra.” *Proceedings of the Seminar for Arabian Studies* 42 (2012): 55–71.

Rumor, Maddalena. “Akkadian Sikillu and Greek Σκίλλα in Their Medical and Magico-Ritual Contexts.” In *Patients and Performative Identities: At the Intersection of the Mesopotamian Technical Disciplines and Their Clients*, edited by J. C. Johnson, 169–92. Winona Lake, IN: Eisenbrauns, 2020.

Rundkvist, Martin, and Andreas Viberg. “Geophysical Investigations on the Viking Period Platform Mound at Aska in Hagebyhöga Parish, Sweden.” *Archaeological Prospection* 22, no. 2 (2015): 131–38.

Sachet, Isabelle. “Feasting with the Dead: Funerary Marzeah in Petra.” In *Death and Burial in Arabia and Beyond.*, 249–62. BAR International Series 2107. Oxford: Archaeopress, 2010.

Sahlins, Marshall. *Stone Age Economics*. Chicago IL: Aldine and Atherton, Inc., 1972.

Salvadori, Monica, and Clelia Sbrolli. “Wall Paintings throughout the Ages: The Roman Period - Republic and Early Empire.” *Archaeological and Anthropological Sciences* 13 (2021): 1– 30.

Schmid, Stephan G. “The ‘Hellenisation’ of the Nabataeans: A New Approach.” *Studies in the History and Archaeology of Jordan* 7 (2001): 407–19.

Schmid, Stephen G. “Nabataean Pottery.” In *The World of the Nabataeans*, edited by Konstantinos D. Politis, 2:309–26. Stuttgart: Franz Steiner Verlag, 2007.

Shuman, Amy. “Food Gifts: Ritual Exchange and the Production of Excess Meaning.” *The Journal of American Folklore* 113, no. 450 (2000): 495–508.

Siculus, Diodorus. *The Library of History*. Translated by Charles Henry Oldfather. Vol. X. Loeb Classical Library, 1954.

Sidoroff, Maria-Louise, and Mary Ownby. “Preliminary Petrographic Study of Nabataean Painted and Unpainted Fine Ware Bowls from Mudayna Thamad, Jordan.” In *Studies on the Nabataean Culture II*, edited by Nabil I. Khairy, 198–214. Amman: University of Jordan, 2016.

Stadhouders, Henry. “The Pharmacopoeial Handbook Šammu Šikinšu -A Translation.” *Le Journal Des Médecines Cunéiformes* 19 (2013): 1–21.

Stasch, Rupert. “The Semiotics of World-Making in Korowai Feast Longhouses.” *Language & Communication* 23 (2003).

Strabo. *The Geography of Strabo*. Translated by Horace Leonard Jones. Vol. VII. Loeb Classical Library. Harvard: Harvard University Press, 1932.

Taifour, Hatem, and Ahmed El-Oqlah. *Jordan Plant Red List*. Vol. 1. Jordan: Royal Botanical Garden, 2014.

Tarrier, Dominique. “Banquets Rituels en Palmyrène et en Nabatène.” *ARAM* 7, no. 1 (1995): 165–82.

Teixidor, Javier. *The Pantheon of Palmyra*. Leiden: BRILL, 1979.

Terpstra, Taco. “Roman Trade with the Far East: Evidence for Nabataean Middlemen in Puteoli.” In *Across the Ocean: Nine Essays on Indo-Mediterranean Trade*, edited by Federico De Romanis and Marco Maiuro. BRILL, 2015.

Theophrastus. *Theophrastus: Characters*. Translated by James Diggle. Cambridge, United Kingdom: Cambridge University Press, 2004.

Tholbecq, Laurent, Caroline Durand, and C. Bouchaud. “A Nabataean Rock-Cut Sanctuary in Petra: Second Preliminary Report on the ‘Obodas Chapel’ Excavation, Jabal Nmayr, (2005- 2007).” *Annual of the Department of Antiquities of Jordan* 52 (2008): 235–54.

Thorley, J. “The Silk Trade between China and the Roman Empire at Its Height, ‘Circa’ A. D. 90-130.” *Greece & Rome* 18, no. 1 (1971): 71–80.

Thornton, M. D., E. D. Morgan, and F. Cleoria. “The Composition of Bog Butter.” *Science and Archaeology* 2 (1970): 20–25.

Tulyaganov, T., and A. Nigmatullaev. “Alkaloids of Vinca Minor.” *Chemistry of Natural Compounds - CHEM NAT COMPD* 36 (2000): 540–540. .

Turk, Walid, and Suleiman Olimat. “Determination of Colchicine Contents in Different Jordanian Colchicum Spp.” *Jordan Journal of Pharmaceutical Sciences* 8, no. 2 (2015): 119–22.

Twiss, Katheryn. “Home Is Where the Hearth Is: Food and Identity in the Neolithic Levant.” In *The Archaeology of Food and Identity*, 50–68. Carbondale: Center for Archaeological Investigations, Southern Ilinois University, 2007.

Twiss, Katheryn C. “Transformations in an Early Agricultural Society: Feasting in the Southern Levantine Pre-Pottery Neolithic.” *Journal of Anthropological Archaeology* 27, no. 4 (2008): 418–42.

Virgil. *The Bucolics and Eclogues*. Gutenberg Project, 1995. https://www.gutenberg.org/ebooks/229.

Wagner, Charles, Jillian De Gezelle, and Slavko Komarnytsky. “Celtic Provenance in Traditional Herbal Medicine of Medieval Wales and Classical Antiquity.” *Frontiers in Pharmecology* 11 (2020): 1–19.

Walker, Bethany J., Robert Bates, Silvia Polla, Andreas Springer, and Sabrina Weihe. “Residue Analysis as Evidence of Activity Areas and Phased Abandonment in Medieval Jordanian Village.” *Journal of Islamic Archaeology* 4, no. 2 (2017): 217–48.

Wenning, Robert. “The Nabataeans in History.” *The World of the Nabataeans* 2 (2007): 25–44.

———. “Towards ‘Early Petra’: An Overview of the Early History of the Nabataeans in Its Context.” In *Men on the Rocks: The Formation of Nabataean Petra*, edited by Stephan G. Schmid and Michel Mouton, 7–22. Berlin: Logos, 2013.

Wiessner, Polly. “Of Feasting and Value Enga Feasts in a Historical Perspective (Papua New

Guinea).” In *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*, edited by Brian Hayden and Michael Dietler, 116–43. Tuscaloosa, United States: University of Alabama Press, 2001.

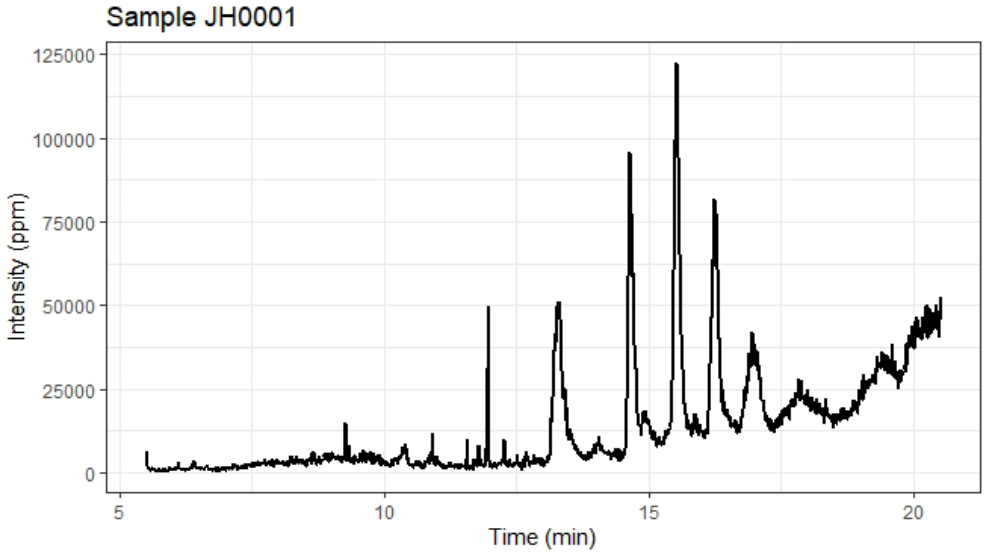
Withering, William. *An Account of the Foxglove, and Some of Its Medical Uses: With Practical Remarks on Dropsy, and Other Diseases*. London: G. G. J. and J. Robinson, 1785.

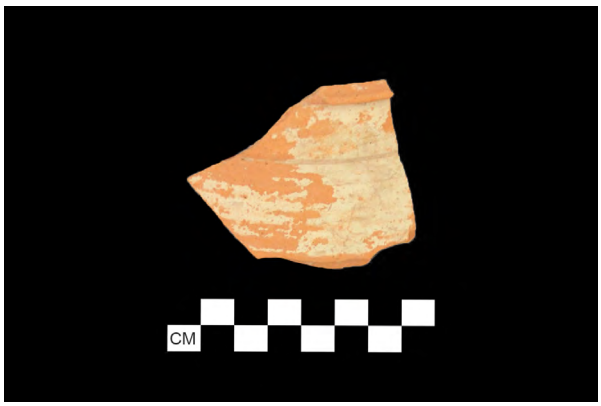
Yang, S F, and N E Hoffman. “Ethylene Biosynthesis and Its Regulation in Higher Plants.” *Annual Review of Plant Physiology* 35, no. 1 (1984): 155–89.

Zayadine, Fawzi, and Suleiman Farajat. “The Petra National Trust Site Projects: Excavation and Clearance at Petra and Beihda.” *Annual of the Department of Antiquities of Jordan* 35 (1991): 275–311.

Zhang, Dong-Mei, Jun-Shan Liu, Patrick Tang, Anita Yiu, Hui-Hui Cao, Lei Jiang, Judy Chan, Hai-Yan Tian, Kwok-Pui Fung, and Wen-Cai Ye. “Bufotalin from Venenum Bufonis Inhibits Growth of Multidrug Resistant HepG2 Cells through G(2)/M Cell Cycle Arrest and Apoptosis.” *European Journal of Pharmacology* 692 (July 25, 2012): 19–28.

# Appendix A

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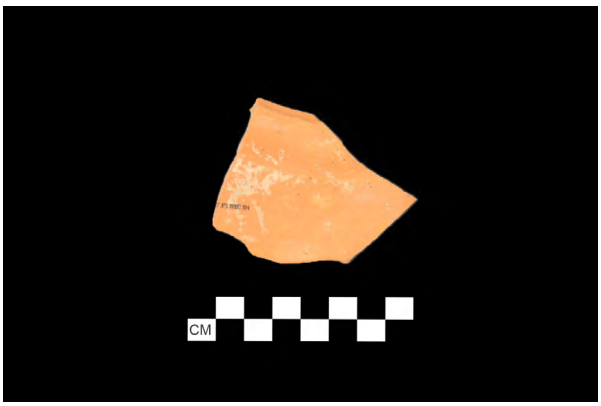
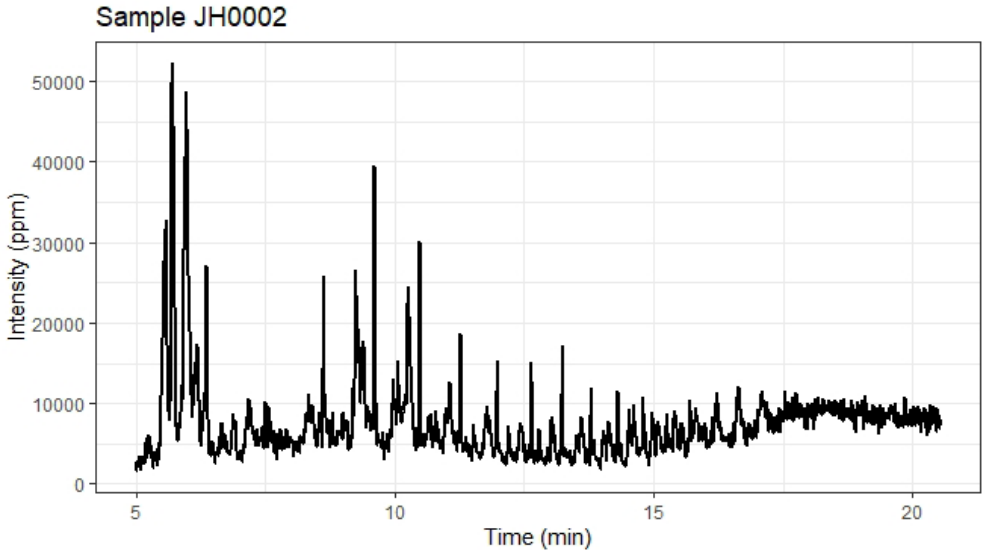



Accession No. 2017.015.00093.004 and Lab No. JH0001 (Reverse)

- Acetamide 46.2% at 5.59 min
- Colchicine from 6.5-9.5 min
- Digitoxin 12.3% at 11 min
- Palmitic acid 15.1% at 11.64 min
- Vitamin D 22.2% at 12.04 min
- Stearic Acid 53.3% at 12.59 min
- Colchicine and prednisone after 12.76 min





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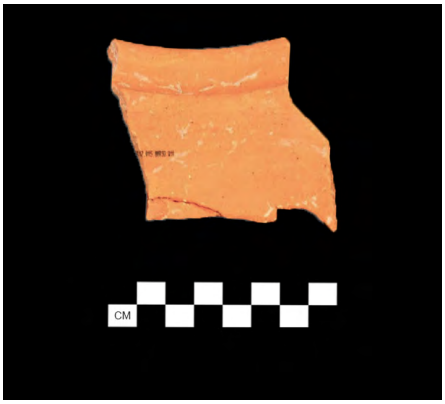
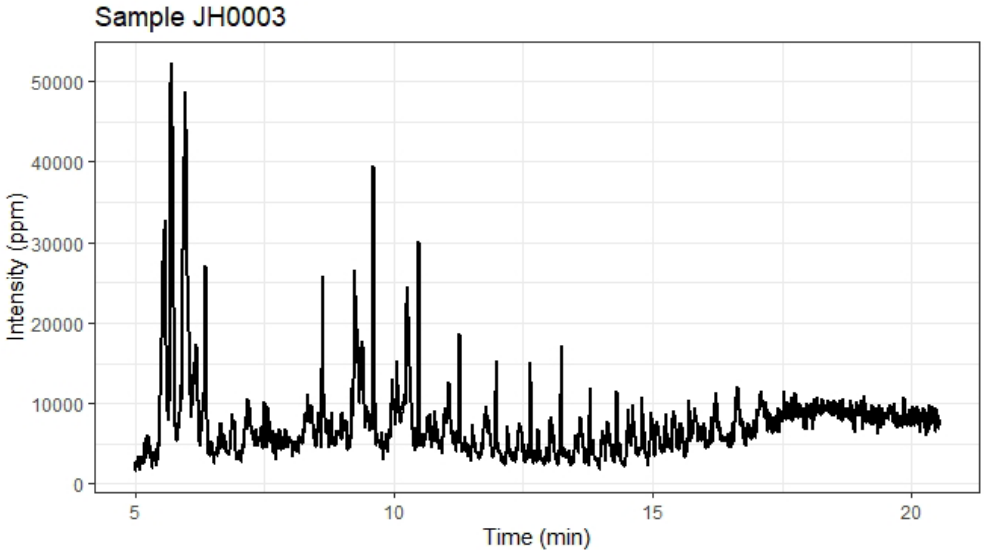



Accession No. 2017.015.00093.011, Lab No. JH0002
(Reverse)

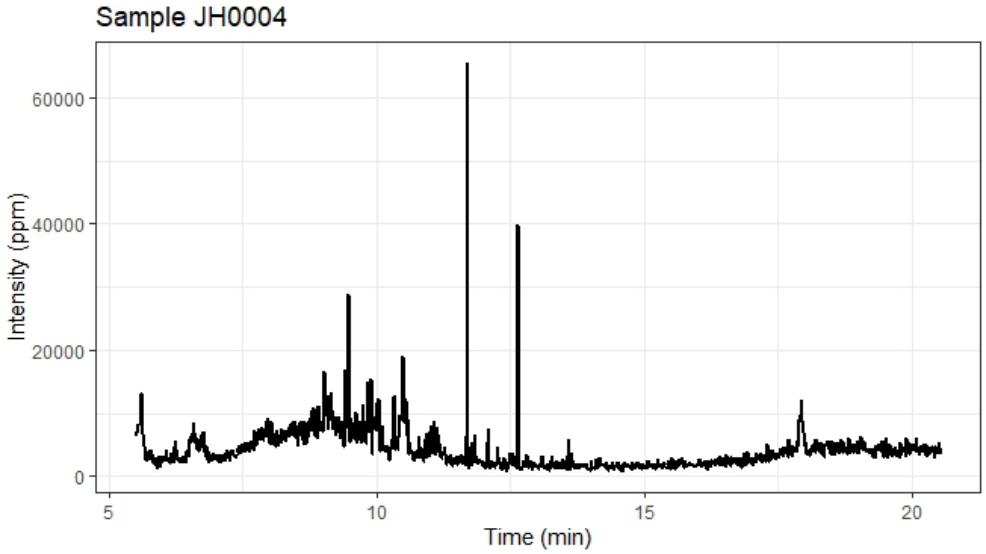
- Acetamide 33.4% at 5.66 min
- Vincamine 15.0% at 6.78 min
- Gibberelic acid 16.4% at 9.41 min
- Digitoin 24.6% at 10.48 min
- Prednisone at 11.05 min
- Palmitic acid 63.0% at 11.69 min
- Retinol acetate 16.1% at 12.05 min
- Stearic acid 75.3% at 12.63 min





Accession No. 2017.015.00093.098, Lab No. JH0003
(Obverse)

- Acetamide 39.5% at 5.60 min
- Dibenzo Carbazole 30.4% at 6.58-5.78 min
- Phenol 47.0% at 9.48 min
- Preg-4-ene-3,20-dione, 11-hyroxy- 52.0% at 10.49 min
- Digitoxin 19.5% at 11.07 min
- Palmitic acid 63.0% at 11.69 min
- Retinol acetate 13.5% at 12.05 min
- Stearic acid 58.5% at 12.64 min
- Dehydrocholic acid 22.6% at 13.58 min
- Colchicine after 14 min

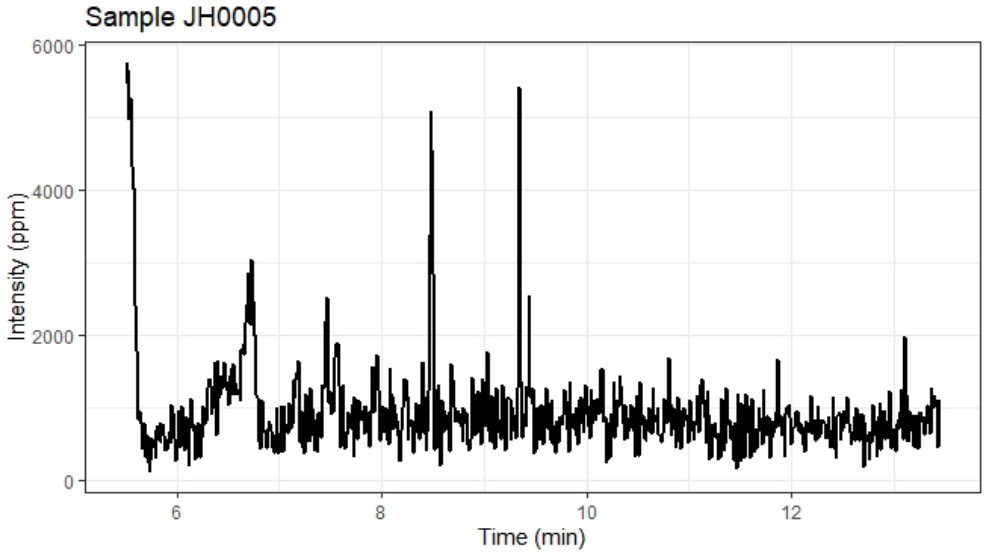




Accession No. 2017.015.00096.000, Lab No. JH0004
(Obverse)


Accession No. 2017.015.00096.000, Lab No. JH0004
(Reverse)

- Colchicine 27.4% at 5.61 min
- Possible vincamine 16.4% at 6.58-78 min (may be dibenzo carbazole)
- Phenol 39.2% at 9.48 min
- Digitoxin 28.6% at 10 min
- Gibberellic acid 18.7% at 10.49 min
- Digitoxin 32.8% at 11.07 min
- Palmitic acid 62.6% at 11.70 min
- Stearic acid 39.5% at 12.64 min
- Dehydrocholic acid 16.9% at 13.58 min
- Possible gamabufotalin spike at 17.95 min at 14.1%
- Colchicine and prednisone after 14 min

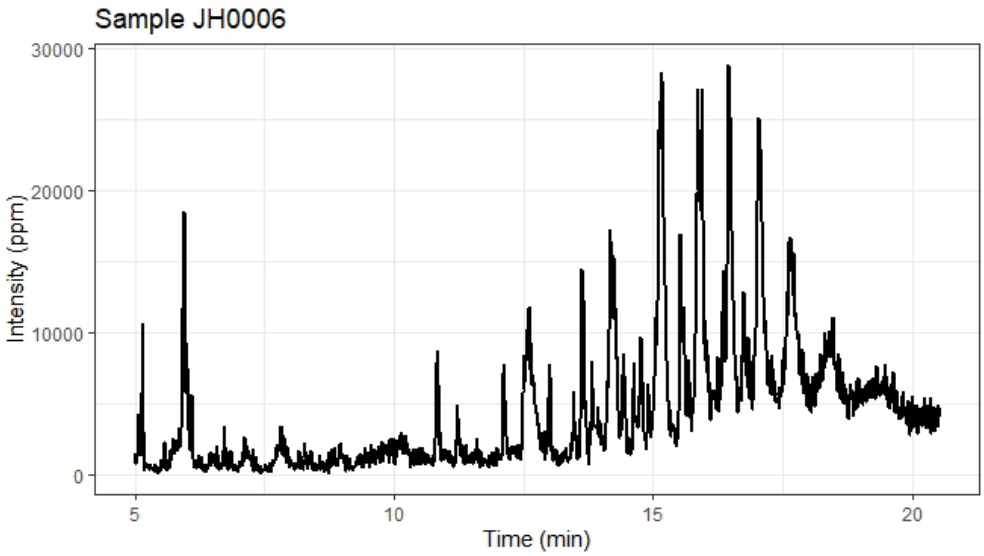


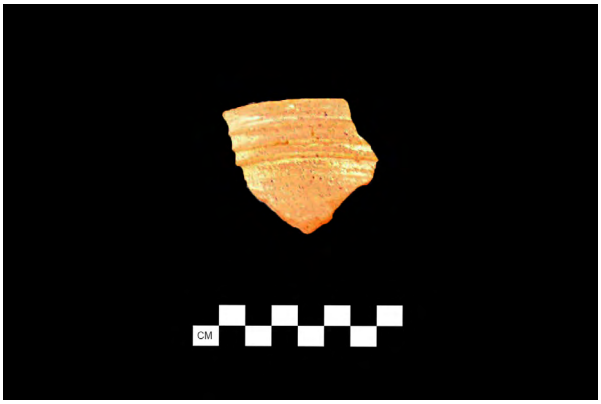


Accession No. 2017.015.00096.002, Lab No. JH0005
(Obverse)


Accession No. 2017.015.00096.002, Lab No. JH0005
(Reverse)

- Vincamine 46.3% at 6.73 min
- Digitoxin 15.6% at 7.18 min
- Phosphoramidic acid 26.9% at 7.47-7.57 min
- Colchicine 45.5% at 8.48 min
- Glycerol formal 76.1% at 9.34 min
- Methylmercuric bromide 42.6% at 9.44 min
- Colchicine, prednisone, and other compounds after 10 min

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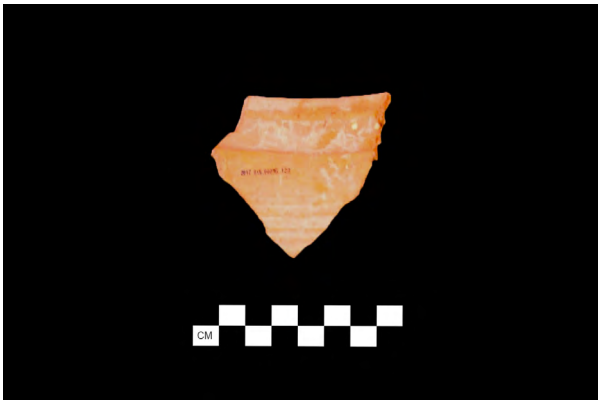
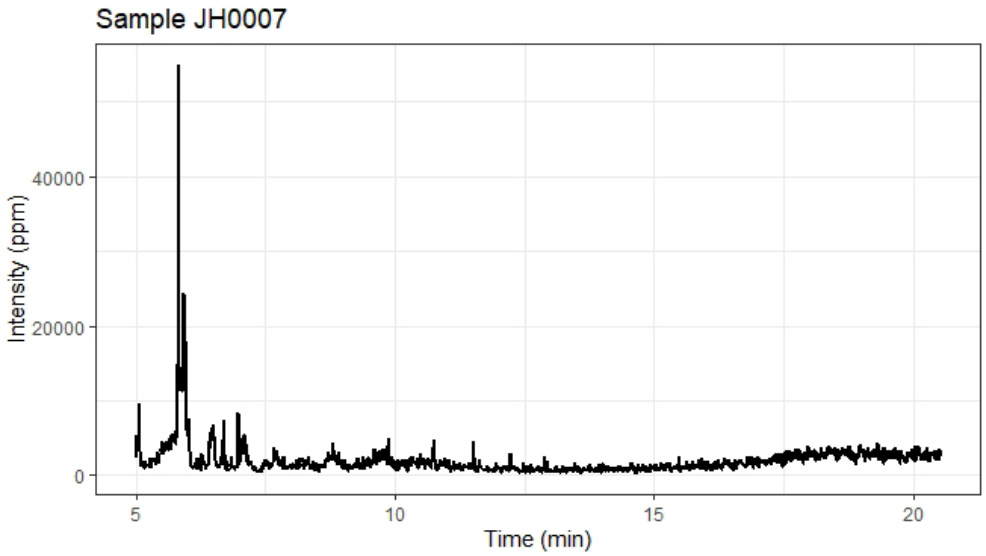



Accession No. 2017.015.00096.123, Lab No. JH0006
(Reverse)

- Silicic acid 50% at 5.14 min
- Benz[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl- 21.4% at 5.95 min
- Acetamide 20.7% at 6.73 min
- Dibenzo Carbazole 63.7% at 7.23 min
- Colchicine 35.2% at 7.82 min
- Digitoxin 13.55 at 10.15 min
- Colchicine 12.0% at 10.84
- Propane 17.2% at 12.12 min
- Colchicine throughout, especially in the upper part of the chromatograph

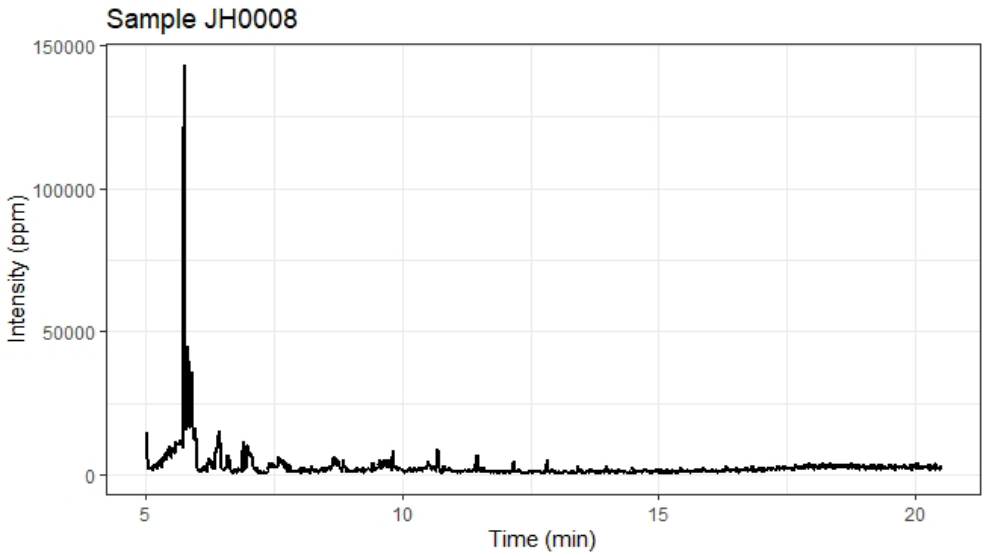




Accession No. 2017.015.00097.006, Lab No. JH0007
(Obverse)


Accession No. 2017.015.00097.006, Lab No. JH0007
(Reverse)

- Silicic acid 68.2% at 5 min
- Benz[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl- 19.9% at 5.82-5.93 min
- Elymoclavin 39.3% at 6.45 min
- Dibenzo Carbazole 47.9% at 6.55, 6.98 min
- Colchicine after 9 min

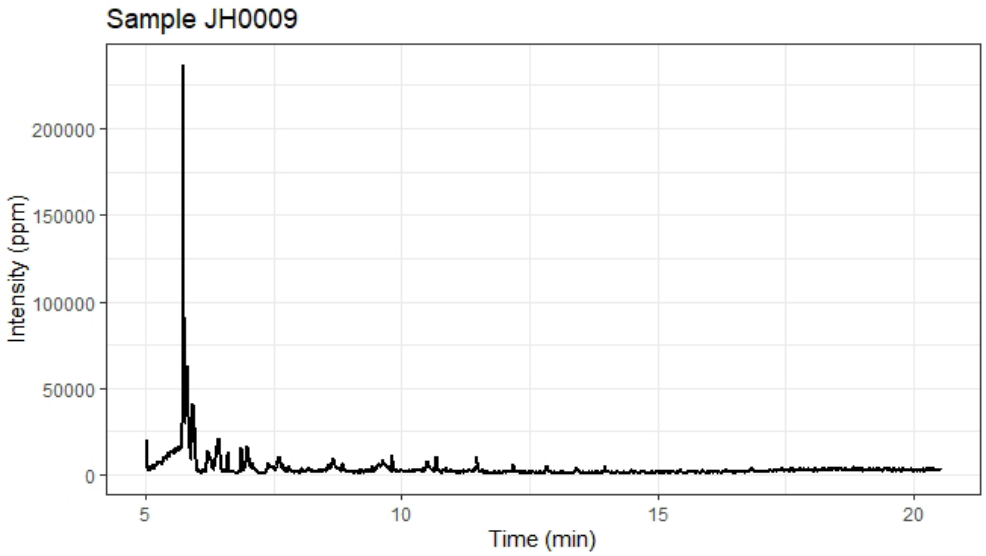




Accession No. 2017.015.00095.118, Lab No. JH0008
(Obverse)


Accession No. 2017.015.00095.118, Lab No. JH0008
(Reverse)

- Silicic acid 78.7% at 5 min
- Acetamide 22.1% at 5.75-5.82 min
- Elymoclavin 40.6% at 6.43 min
- Thiocyanic acid 29.2% at 6.90 min
- Dibenzo Carbazole 47.9% at 6.55, 6.98 min
- Colchicine after 7 min

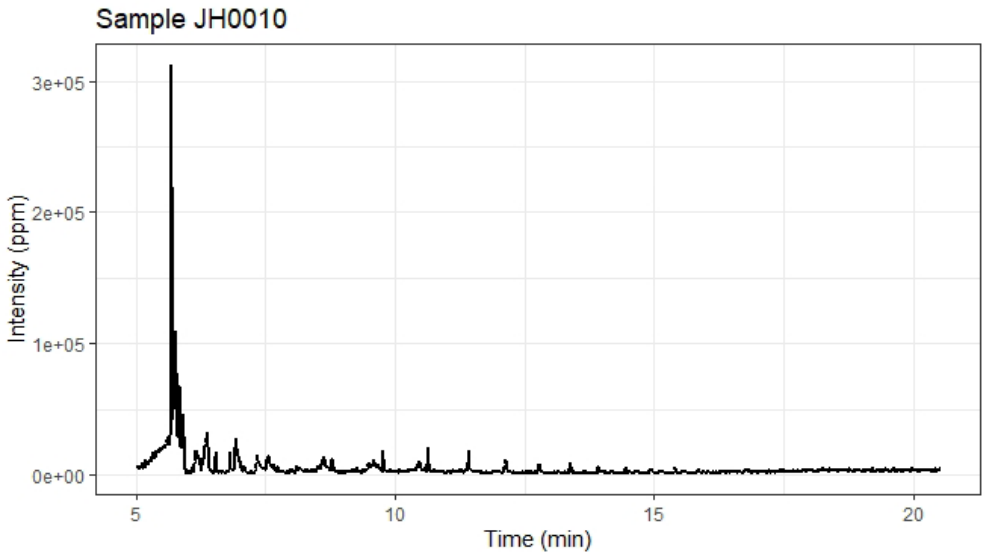


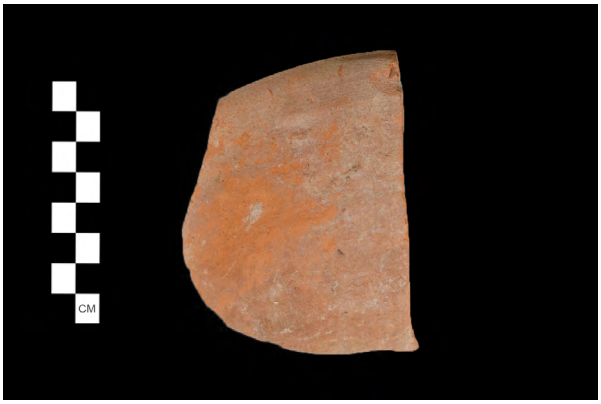


Accession No. 2017.015.00095.119, Lab No. JH0009
(Obverse)


Accession No. 2017.015.00095.119, Lab No. JH0009
(Reverse)

- Silicic acid 67.9% at 5 min
- Benz[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl- 18.4% at 5.74-5.80 min
- Elymoclavin 74.1% at 6.20-6.43 min
- Dibenzo Carbazole 38.6% at 6.98 min
- Acetamide 70.9% at 7.60
- Colchicine after 8 min

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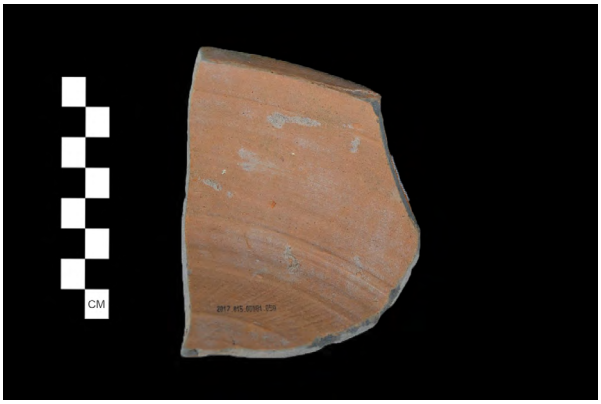
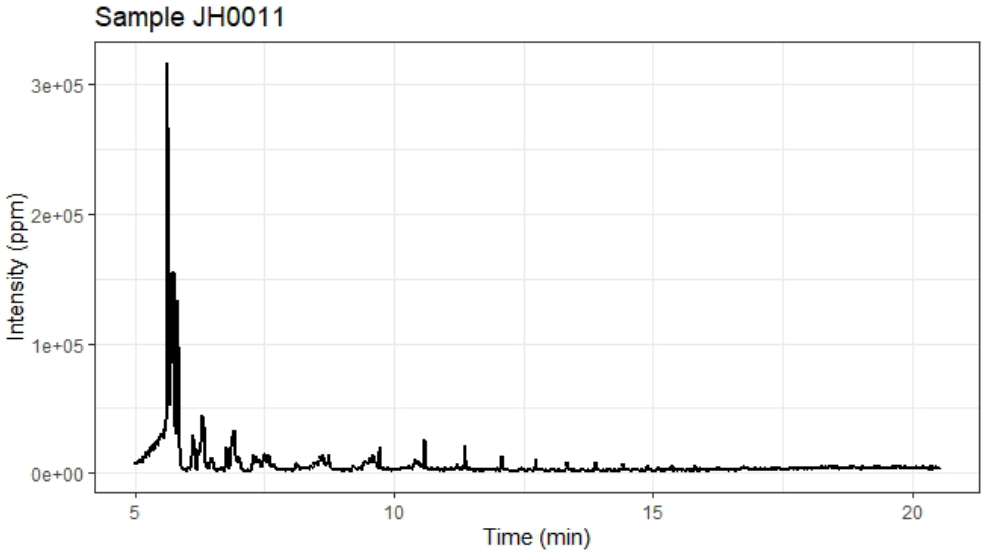



Accession No. 2017.015.00081.050, Lab No. JH0010
(Reverse)

- Acetamide 19.6% at 5.68-5.83 min
- Elymoclavin 71.2% at 6.20-6.43 min
- Dibenzo Carbazole 42.5% at 6.98 min
- Acetamide 69.3% at 7.60
- Colchicine after 8 min





Accession No. 2017.015.00081.051, Lab No. JH0011
(Obverse)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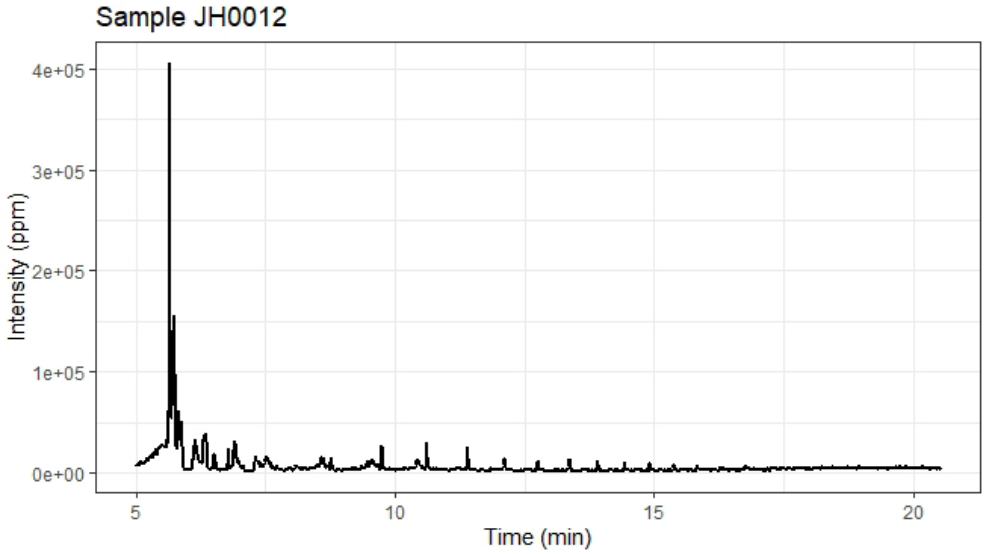
(Reverse)

- Benzaldehyde 94.4% at 5.66 min
- Sulfamoxole 14.0% (Benz[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl- 11.3%) at 7.28 min
- Dibenzo Carbazole 82.1% at 8.19 – 8.45 (possibly Ethylene Glycol at 11%) min
- Isopentyl alcohol, acetate 25.5% at 8.89 min
- Dipropylamine 16.6% at 9.17 min
- Methylmercuric bromide 72.7% at 9.66 min
- Dipehnyl anilinophosphonate 42.9% at 9.8 min
- TPP (triphenyl phosphate) 15.5”% at 10.2 min
- 2-Methylmalonamide 41.2% at 11.01 min
- S-Trithiane 21.8% at 11.8 min
- Colchicine 36.1% at 11.97 min
- Colchicine and other compounds (benzaldehyde and lysergamide) after 12 min

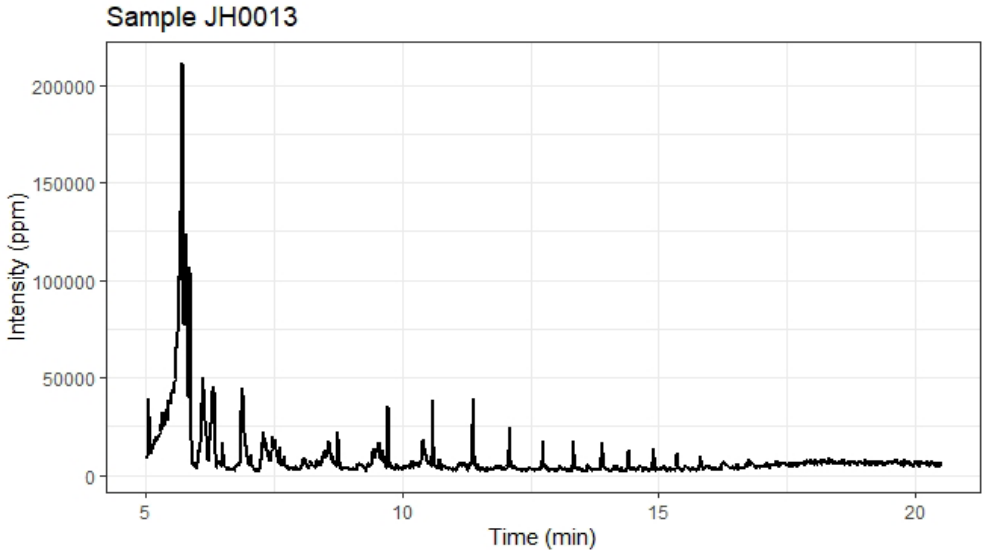




Accession No. 2017.015.00081.003, Lab No. JH0012
(Obverse)


Accession No. 2017.015.00081.003, Lab No. JH0012
(Reverse)

- Benzaldehyde 92.8% at 5.92 min
- Benz[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl- 18.8% at 7.26 min
- Dibenzo Carbazole 70.7% at 8.16 – 8.45 (possibly Sulfamide 33.4%) min
- Ethylene glycol 41.3% at 8.87 min
- Methylmercuric bromide 72.7% at 9.66 min
- Dipehnyl anilinophosphonate 25.3% at 9.15 min
- A-Methoxyethyl acetate 19.1% at 10.15 min
- Pentanoic acid (Valeric acid) 14.1% at 11.00-11.10 min
- Isothiocyanic acid 22.8% at 11.98 min
- Colchicine and other compounds (benzaldehyde and lysergamide) after 12 min

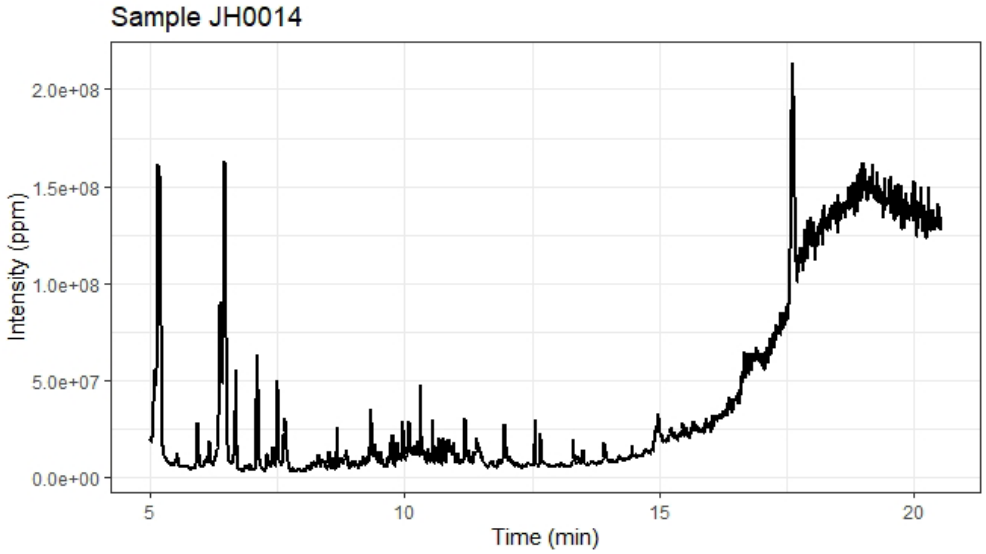




Accession No. 2017.015.00081.005, Lab No. JH0013
(Obverse)


Accession No. 2017.015.00081.005, Lab No. JH0013
(Reverse)

- Benzaldehyde 95.1% at 5.90 min
- Sulfamoxole 15.6% at 7.22 min
- Dibenzo Carbazole 42.1% at 8.45
- Isothiocyanic acid 21.9% at 8.85 min
- Dipehnyl anilinophosphonate 34.1% at 9.13 min
- Butanamide (o-Acetoacetanisidide) 57.2% at 9.65 min
- 2-Heptyl-1,3-dioxolane 50.5% at 10.17 min
- Colchicine 43.5% at 10.99
- Colchicine after 11 min, the highest peak is at 11 min

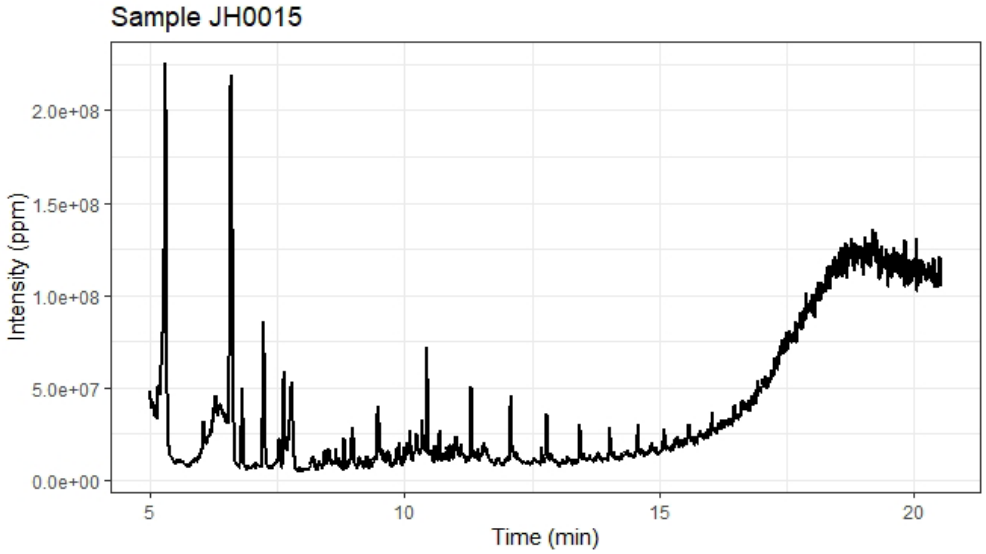




Accession No. 2017.015.00109.049, Lab No. JH0014
(Obverse)


Accession No. 2017.015.00109.049, Lab No. JH0014
(Reverse)

- Benzaldehyde 81.8% at 5.16 min
- Silicic acid 40.7% at 5.54 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 39.3% at 6.38-6.47 min
- Pentachloroethane 97.5% at 6.55 min
- Acetamide 38.73% at 7.10 min
- Avlothane 89.4% at 7.50 min
- Dibenzcarbazole 27.5% at7.6 min
- P-n-Pentylacetophenone 57.6% at 8.52 min
- Colchicine 19.5% at 9.34 min
- Colchicine throughout after 11 min
- Gamabufotalin 15.1 % at 17.62 min (unusually large spike)

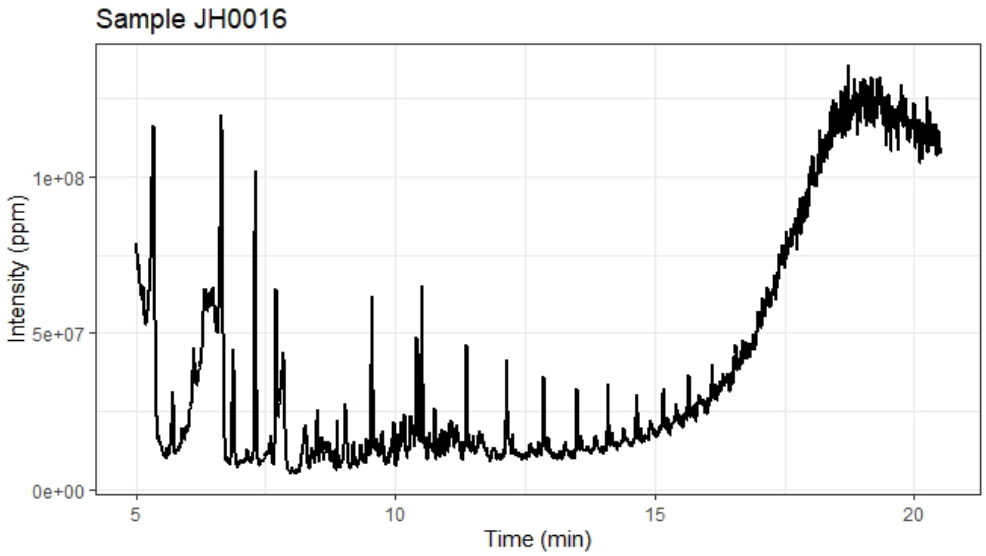




Accession No. 2017.015.00109.049, Lab No. JH0015
(Obverse)

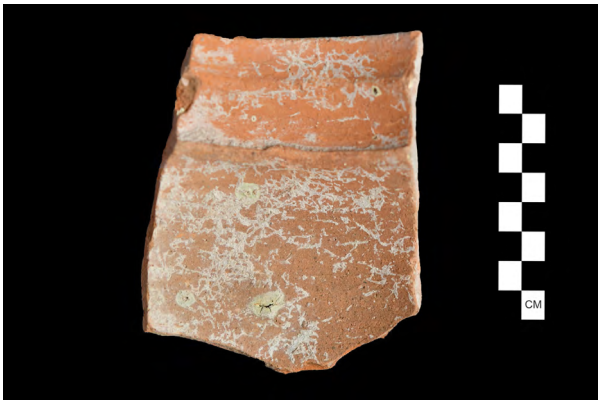

Accession No. 2017.015.00109.049, Lab No. JH0015
(Reverse)

- Benzaldehyde 82.5% at 5.16-5.30 min
- Acetamide 18.4% at 6.00 min (noise)
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 30.9% at 6.59 min
- Pentachloroethane 95.2% at 6.75 min
- Acetamide 42.57% at 7.23 min
- Avlothane 83.85% at 7.62 min
- Dibenzcarbazole 37.7% at7.78 min
- Prednisolone 21-acetate and colchicine throughout after 10 min



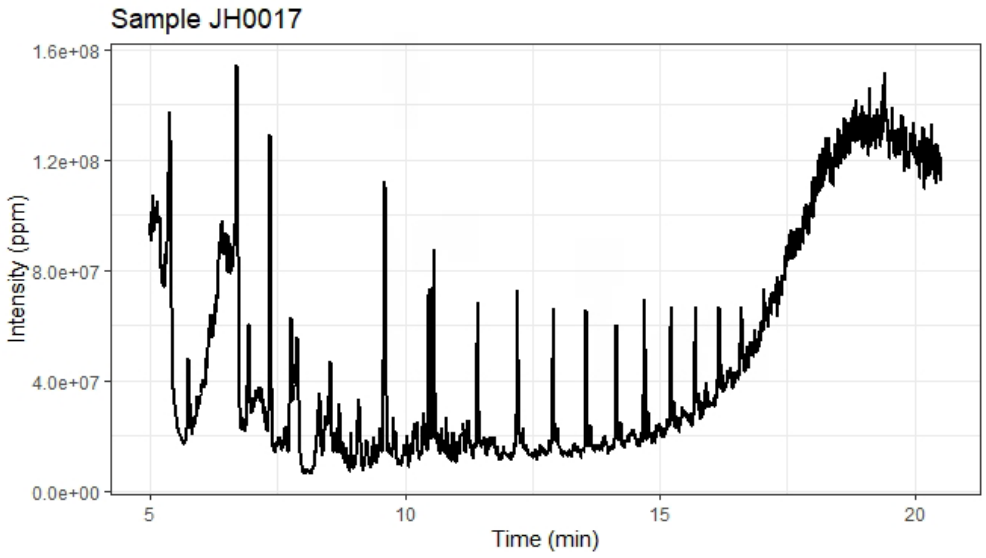


Accession No. 2017.015.00080.000, Lab No. JH0016 (Obverse)




Accession No. 2017.015.00080.000, Lab No. JH0016 (Reverse)

- Benzaldehyde 80.8% at 5.34 min
- Silicic acid 71.52% at 5.54 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 39.7% at 6.38-6.65 min
- Pentachloroethane 95.2% at 6.75 min
- Acetamide 28.28% at 7.30 min
- Avlothane 75.9% at 7.71 min
- Dibenzcarbazole17.9% at7.84 min
- Acetamide 45.7% at 9.04 min
- Prednisolone 21-acetate and colchicine throughout after 10 min

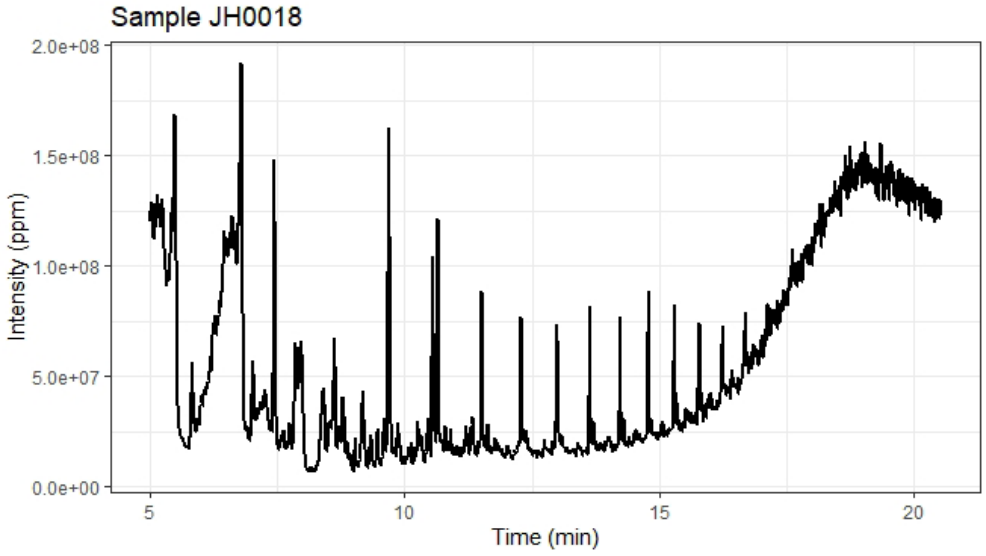




Accession No. 2017.015.00080.018, Lab No. JH0017
(Obverse)


Accession No. 2017.015.00080.018, Lab No. JH0017
(Reverse)

- Benzaldehyde 72.5% at 5.38 min
- Silicic acid 60.6% at 5.75 min
- Colchicine spikes from 9 min on

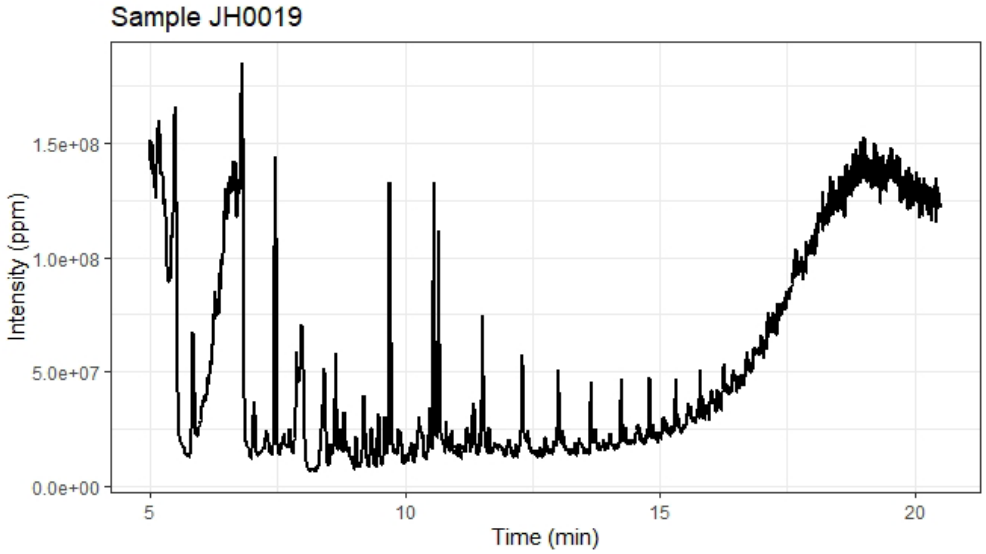




Accession No. 2017.015.00080.025, Lab No. JH0018
(Obverse)


Accession No. 2017.015.00080.025, Lab No. JH0018
(Reverse)

- Benzaldehyde 76.8% at 5.04-5.48 min
- Silicic acid 65.15% at 5.75 min
- Acetamide 28.7% at 6.79 min
- Acetamide 46.7% at 8.62 min
- Colchicine spikes from 9 min on

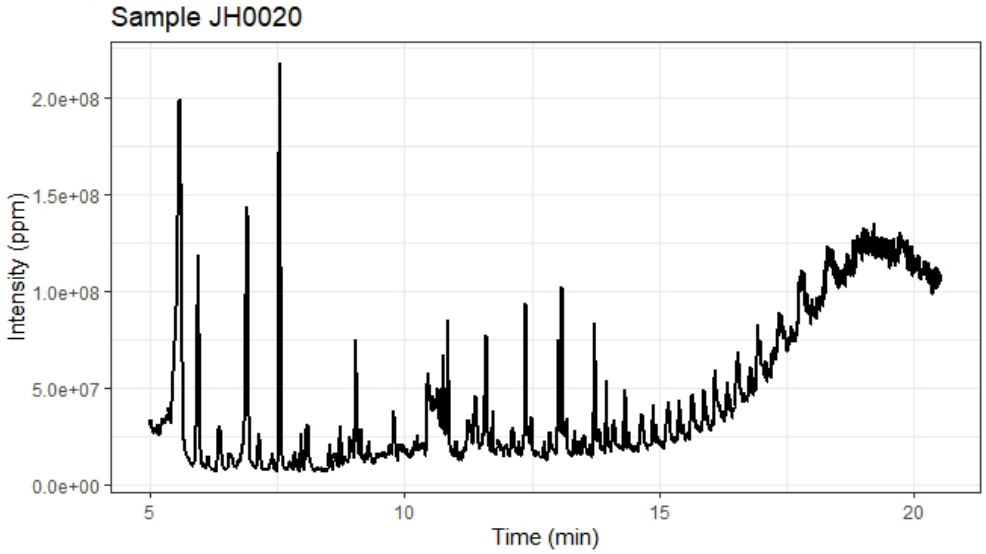




Accession No. 2017.015.00080.037, Lab No. JH0019
(Obverse)


Accession No. 2017.015.00080.037, Lab No. JH0019
(Reverse)

- Benzaldehyde 83.9% at 5.04-5.49 min
- Silicic acid 80.3% at 5.75 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 22.11% at 6.67-6.80 min
- Pentachloroethane 33.1% at 6.95 min
- Acetamide 34.8% at 7.45 min
- Acetamide 40.82% at 8.64 min
- Colchicine spikes from 9 min on

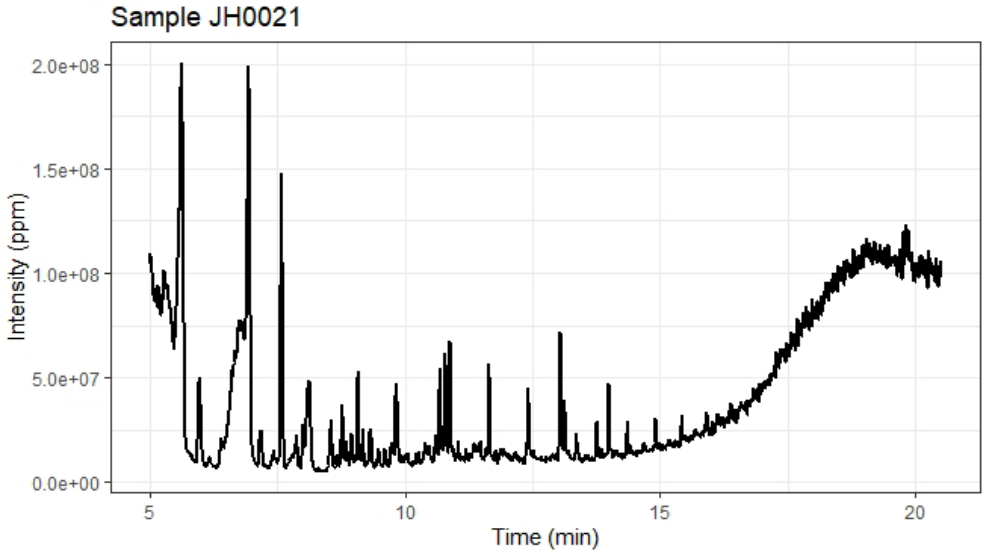




Accession No. 2017.015.00080.009, Lab No. JH0020
(Obverse)


Accession No. 2017.015.00080.009, Lab No. JH0020
(Reverse)

- Benzaldehyde 80.1% at 5.58 min
- Silicic acid 77.9% at 5.94 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 36.4% at 6.92 min
- Pentachloroethane 74.5% at 7.10 min
- Acetamide 29.4% at 7.54 min
- Gamabufotalin 15.52% at 8.12 min
- Colchicine spikes from 9 min on

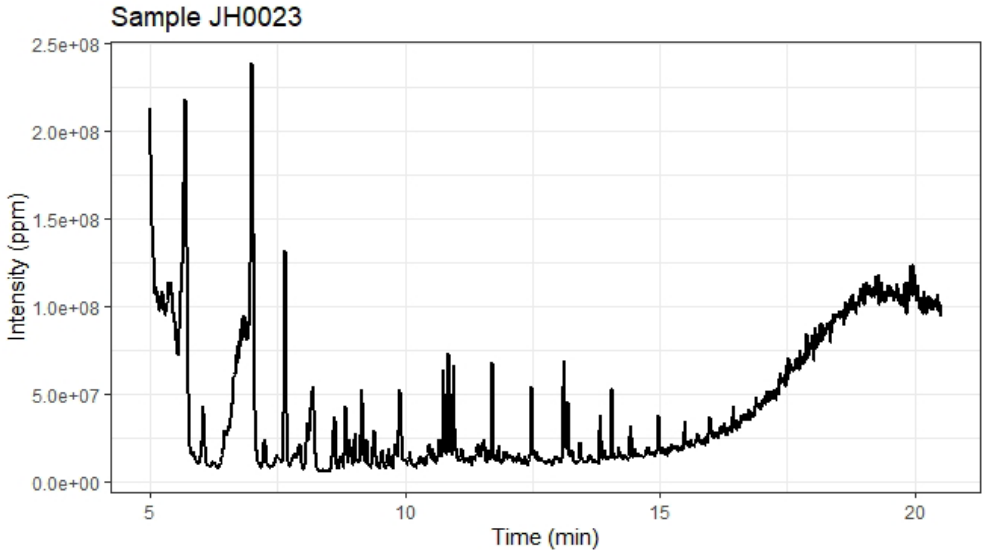




Accession No. 2017.015.00080.024, Lab No. JH0021
(Reverse)


Accession No. 2017.015.00080.024, Lab No. JH0021
(Obverse)

- Benzaldehyde 77.81% at 5.61 min
- Silicic acid 68.5% at 5.94 min
- Acetamide 31.3% at 7.54 min
- Gamabufotalin 25.2% at 13.04 min
- Colchicine spikes from 9 min on

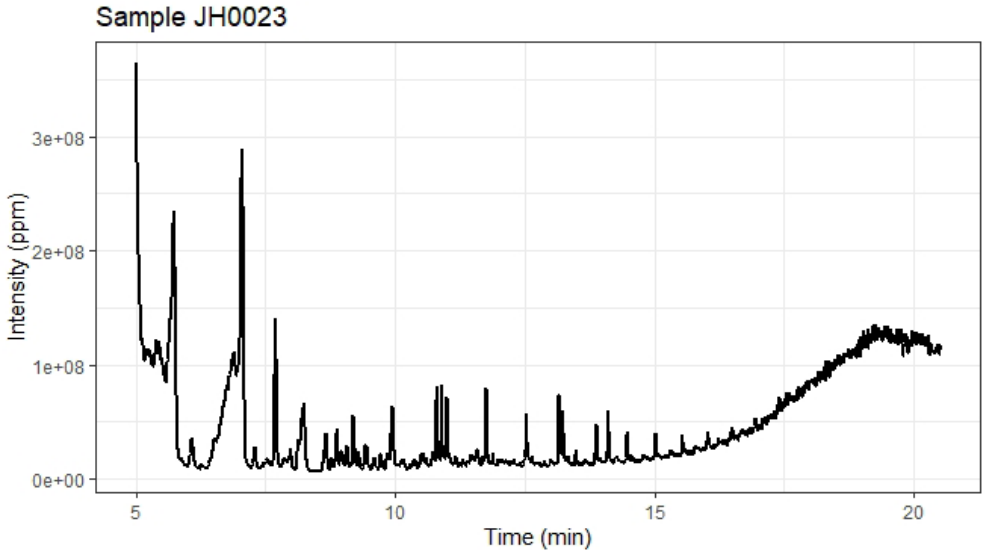




Accession No. 2017.015.00080.017, Lab No. JH0022
(Obverse)


Accession No. 2017.015.0080.017, Lab No. JH0022
(Reverse)

- Benzaldehyde 82.9% at 5.69 min
- Silicic acid 80.9% at 6.05 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 16.6% at 7.0 min
- Pentachloroethane 56.93% at 7.10 min
- Acetamide 28.7% at 7.65 min
- Dibenzo Carbazole 17.5% at 8.19 min
- Gamabufotalin 28.9% at 13.12 min
- Colchicine and prednisolone spikes from 9 min on

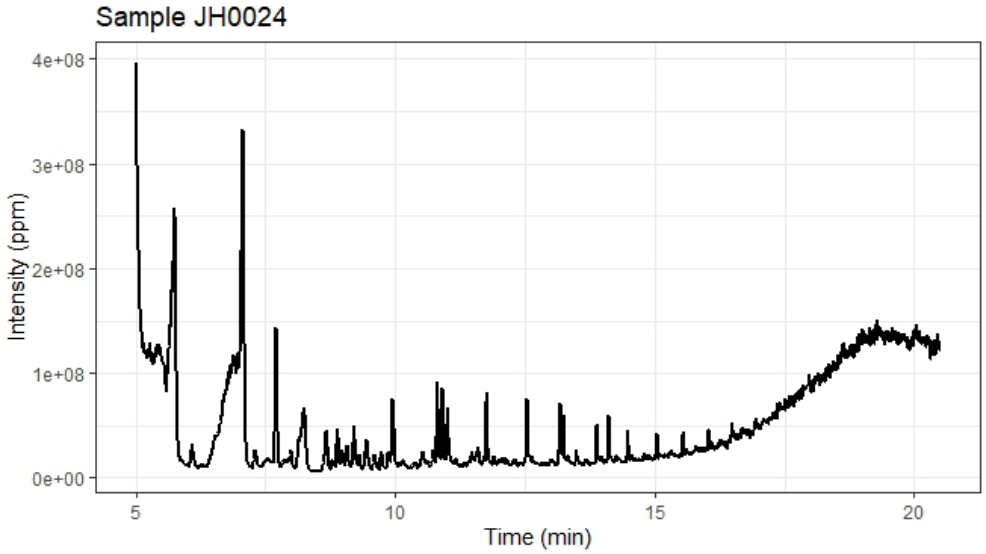




Accession No. 2017.015.0080.015, Lab No. JH0023
(Obverse)


Accession No. 2017.015.0080.015, Lab No. JH0023
(Reverse)

- Chloroform 56.0% at 5 min
- Benzaldehyde 82.9% at 5.74 min
- Silicic acid 80.9% at 6.05 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 17.5% at 7.04 min
- Pentachloroethane 18.9% at 7.10 min
- Acetamide 21.5% at 7.70 min
- Dibenzo Carbazole 30.4% at 8.24 min
- Gamabufotalin 26.3% at 13.17 min
- Colchicine and prednisolone spikes from 9 min on

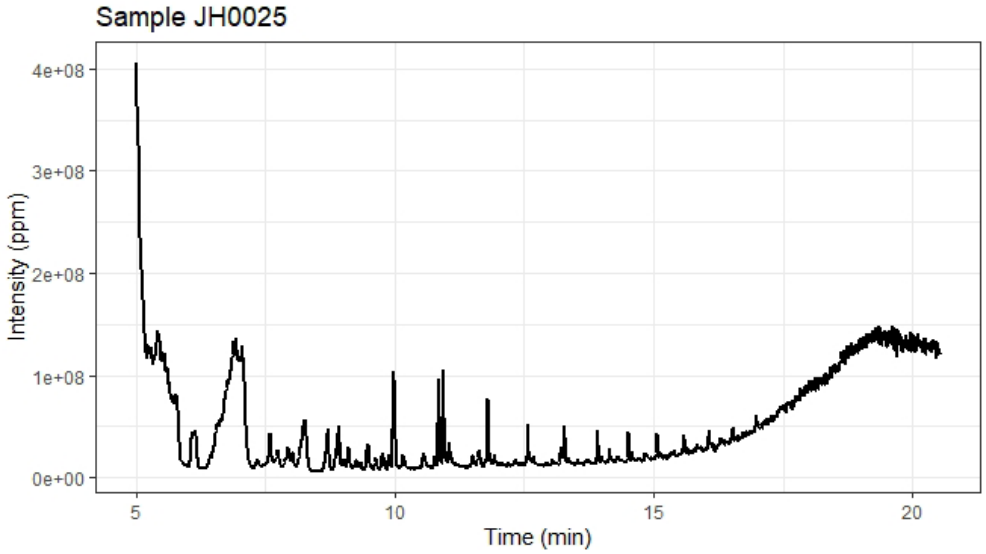


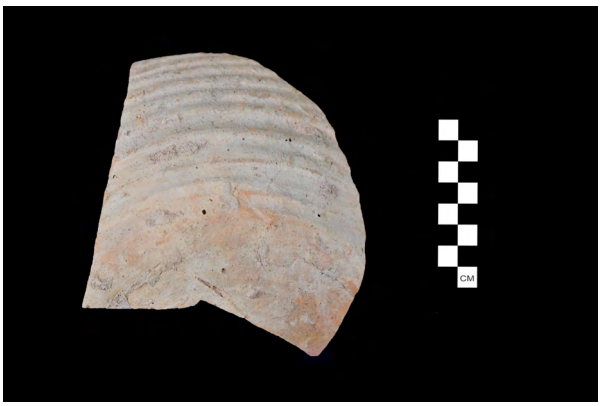


Accession No. 2017.015.00107.004, Lab No. JH0024
(Obverse)


Accession No. 2017.015.00107.004, Lab No. JH0024
(Reverse)

- Chloroform 38.9% at 5 min
- Benzaldehyde 81.0% at 5.74 min
- Silicic acid 86.58% at 6.05 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 18.7% at 7.06 min
- Acetamide 28.3% at 7.71 min
- Ethylene glycol 18.3% at 8.24 (vincamine 11%) at 8.24
- Gamabufotalin 21.1% at 13.18 min
- Colchicine and prednisolone spikes from 9 min on

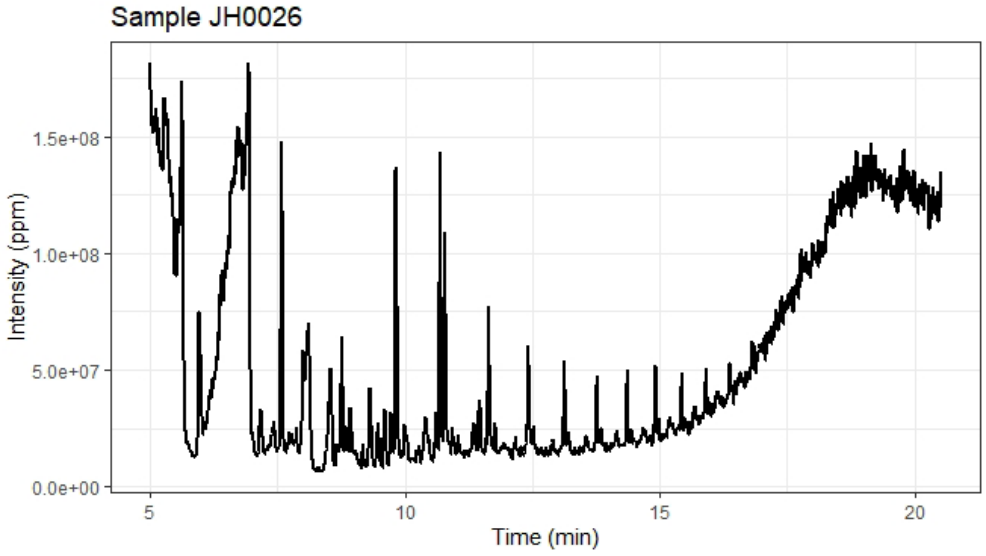


Accession No. 2017.015.00107.005, Lab No. JH0025
(Obverse)

Accession No. 2017.015.00107.005, Lab No. JH0025
(Reverse)

- Tetrachloroethane 26.7% at 5 min
- Benzaldehyde 83.5% at 5.77 min
- Silicic acid 82.4% at 6.05 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 28.3% at 7.04 min
- Elymoclavine 17.3% at 7.5 min
- Dibenzo Carbazole 22.2% at 8.27 min
- Colchicine and prednisolone spikes from 9 min on

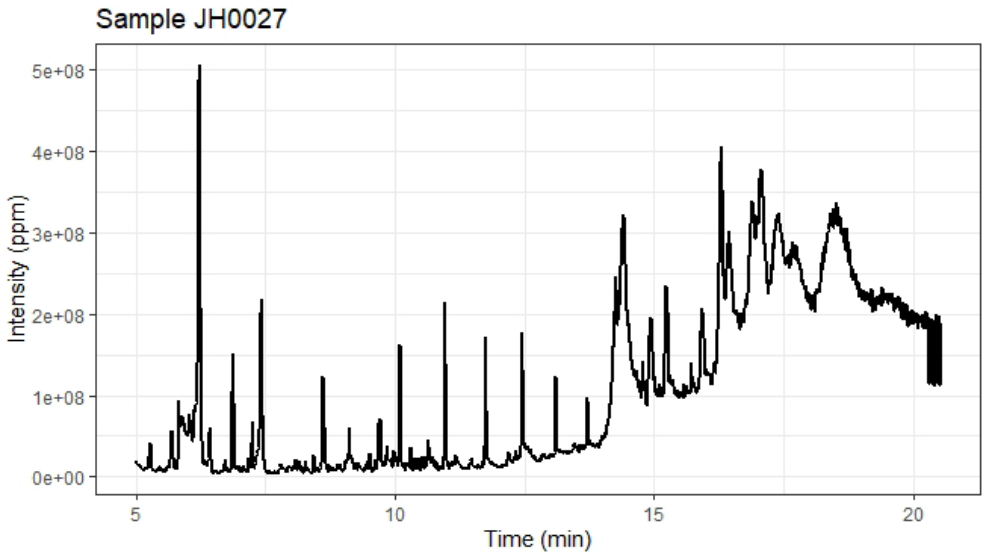




Accession No. 2017.015.00107.026, Lab No. JH0026
(Obverse)


Accession No. 2017.015.00107.026, Lab No. JH0026
(Reverse)

- Benzaldehyde 83.2% at 5.62 min
- Silicic acid 79.5% at 5.95 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 19.1% at 6.92 min
- Pentachloroethane 20.9% at 7.10 min
- Acetamide 20.7% at 7.58 min
- Dibenzo Carbazole 33.6% at 8.27 min
- Colchicine 47% at 8.76 min
- Colchicine and prednisolone spikes from 9 min on

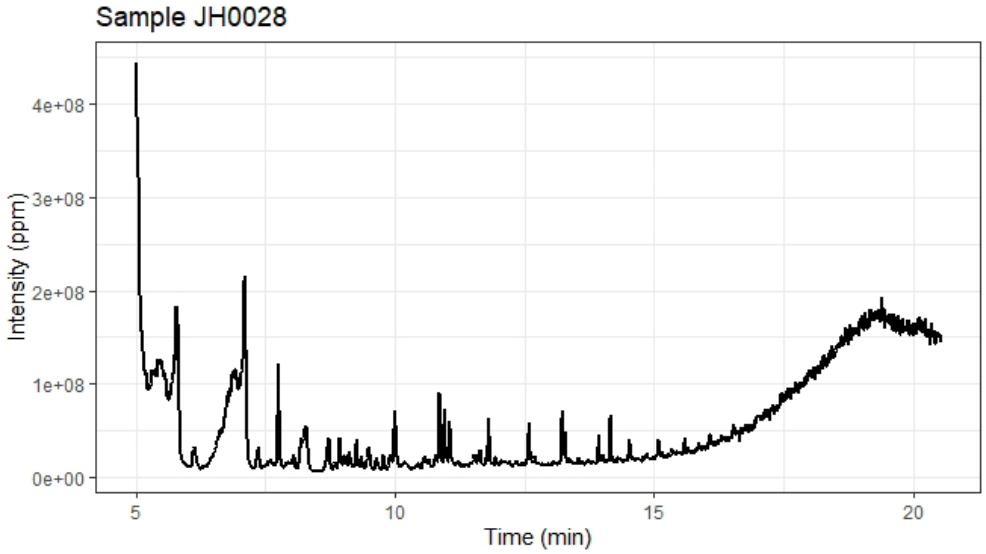




Accession No. 2017.015.00107.007, Lab No. JH0027
(Obverse)


Accession No. 2017.015.00107.007, Lab No. JH0027
(Reverse)

- Benzaldehyde 80.3% at 5.62 min
- Silicic acid 81.7% at 5.95 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 18.1% at 6.92 min
- Elymoclavine 17.1%  (Phenol 26.5%) at 7.10 min
- Acetamide 29.2% at 7.58 min
- Dibenzo Carbazole 18.06% at 8.11 min
- Bofotalin 12.5% at 8.5 (colchicine and gamabufotalin are all about the same)
- Acetamide 55.2% at 8.77 min
- Colchicine spikes after 9 min

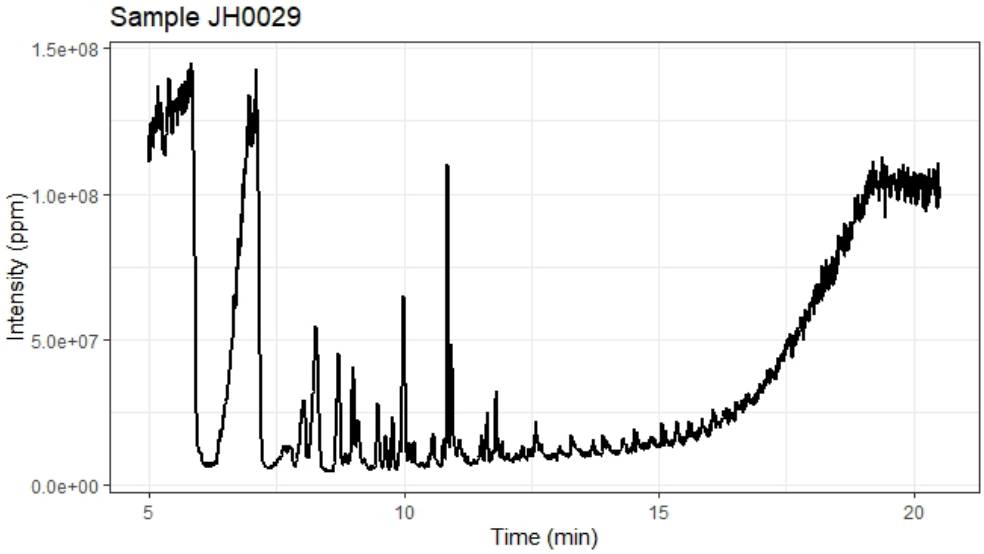




Accession No. 2017.015.00107.042, Lab No. JH0028
(Obverse)


Accession No. 2017.015.00107.042, Lab No. JH0028
(Reverse)

- Chloroform 59% at 5 min
- Benzaldehyde 82.3% at 5.62 min
- Silicic acid 81.8% at 6.10 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 24.2% at 7.11 min
- Pentachloroethane 44.8% at 7.58 min
- Acetamide 26.9% at 7.58 min
- Dibenzo Carbazole 19.6% at 8.28 min
- Gamabufolin 24.6% at 13.23
- Stearic acid 18.6% at 13.9-14min
- Colchicine spikes after 9 min

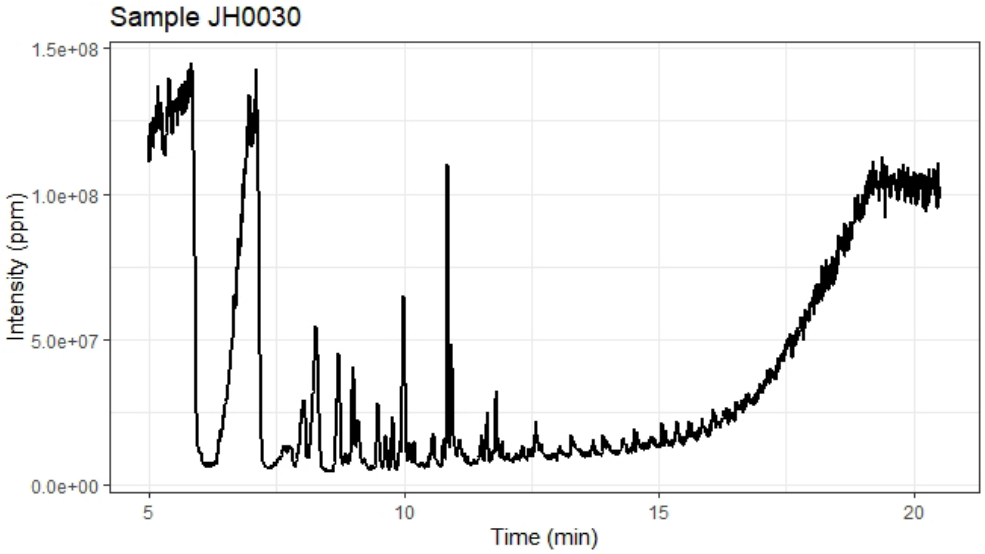




Accession No. 2017.015.00098.134, Lab No. JH0029
(Obverse)


Accession No. 2017.015.00098.134, Lab No. JH0029
(Reverse)

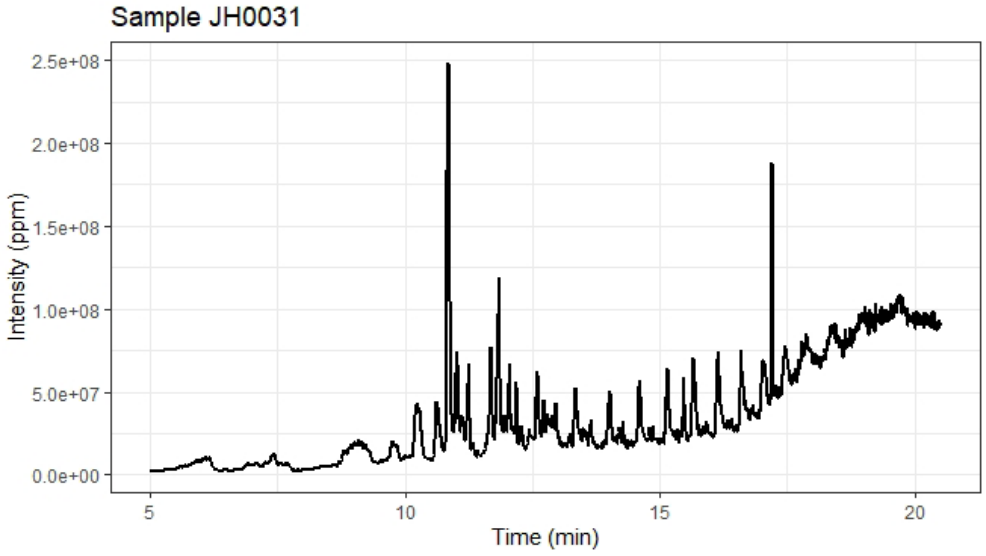
- Benzaldehyde 84.9% at 5.83 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 18.1% at 7.11 min
- Dibenzo Carbazole 68.8% at 8.04 min
- Silicic acid 16.0% at 8.28 min (dibenzo carbazole is at 14.2% as is more likely)
- Gamabufolin 17.9% at 8.72 min (doesn't match)
- Colchicine spikes after 9 min





Accession No. 2017.015.00098.139, Lab No. JH0030
(Obverse)

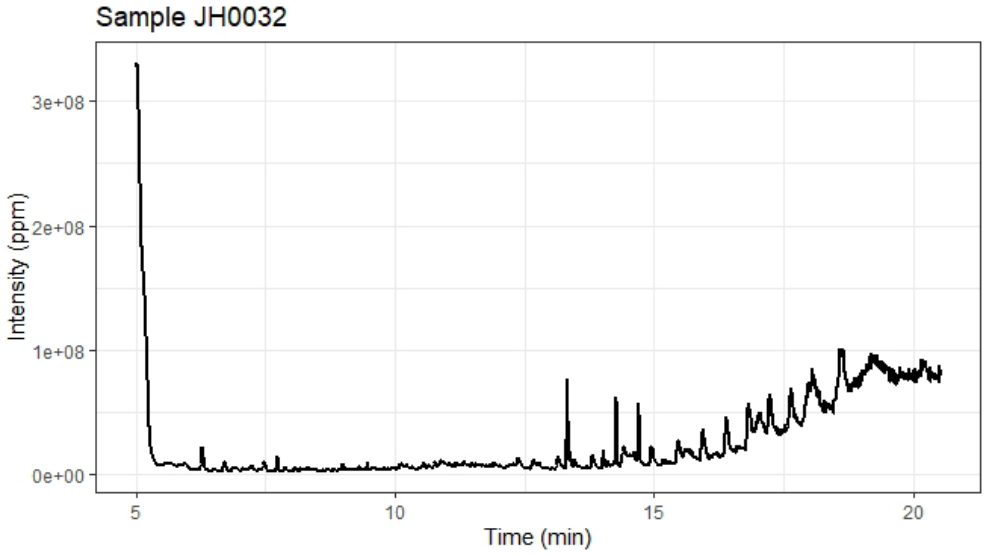

Accession No. 2017.015.00098.139, Lab No. JH0030
(Reverse)





Accession No. 2017.015.00098.065, Lab No. JH0031
(Obverse)


Accession No. 2017.015.00098.065, Lab No. JH0031
(Reverse)

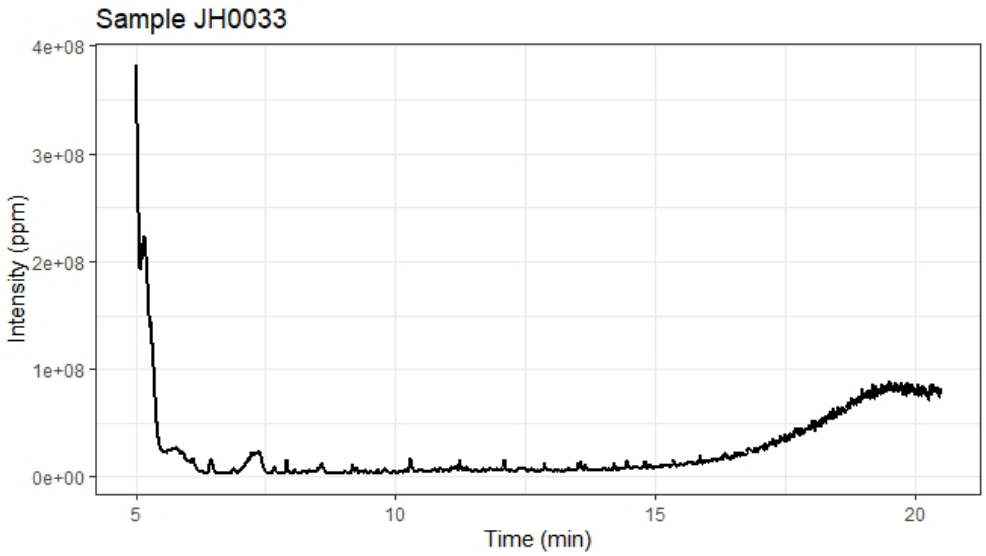




Accession No. 2017.015.00098.112, Lab No. JH0032 (Obverse)


Accession No. 2017.015.00098.112, Lab No. JH0032 (Reverse)

- Chloroform 98.2% at 5 min
- Silicic acid 61.1% at 6.28 min
- Phenol 35.2% (Elymoclavine 33.83%) at 7.72 min
- Palmitic acid 29.3% at 13.33 min
- Stearic acid 24.8 % at 14.25 min
- Eicosanoic acid 18.0% at 14.75 min

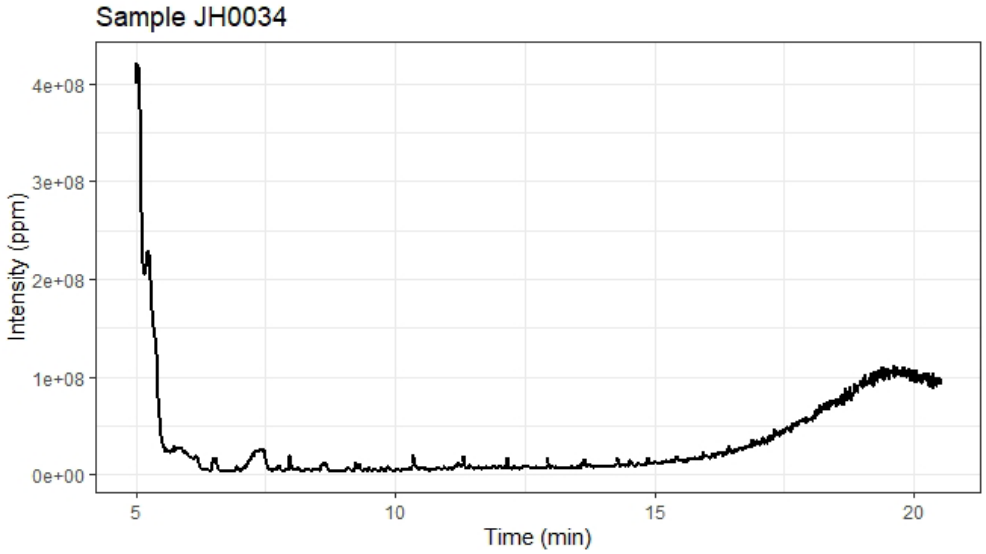




Accession No. 2017.015.00098.196, Lab No. JH0033
(Obverse)


Accession No. 2017.015.00098.196, Lab No. JH0033
(Reverse)

- Chloroform 56.2% at 5 min
- Bromodichloromethane 68.2% at 5.17 min
- Benzaldehyde 79.8% at 5.75 min
- Silicic acid 66.3% at 6.45 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 12.9% at 7.43 min
- Elymoclavin 30.1% at 7.91 min
- Colchicine after 9 min

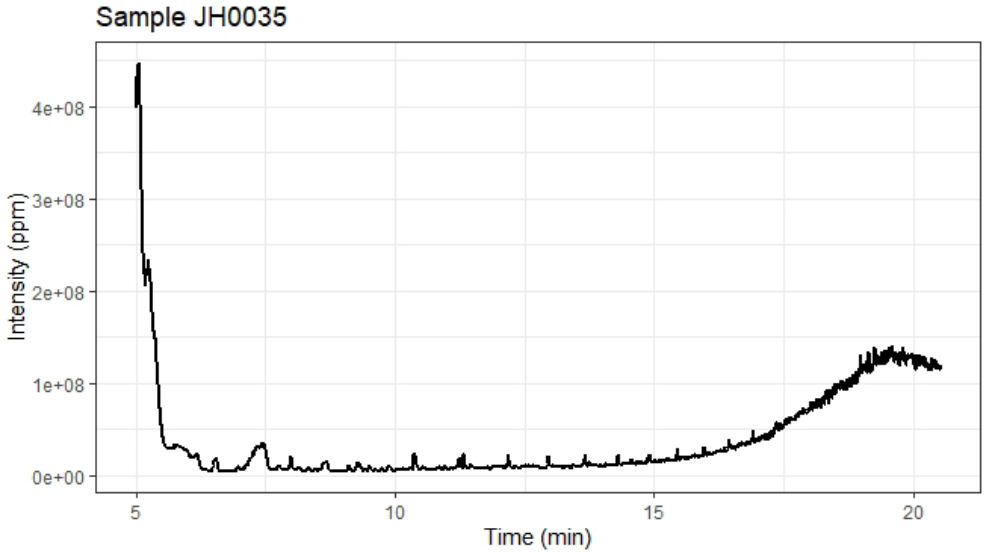


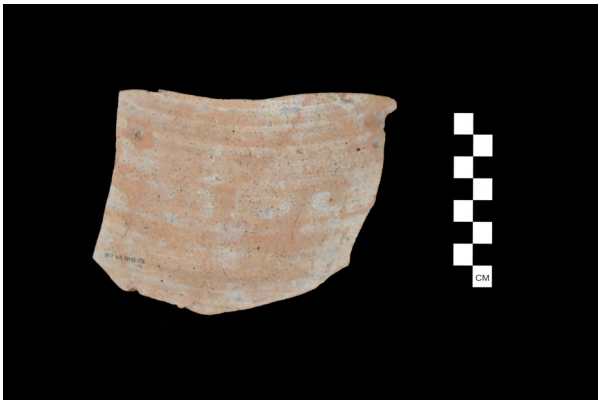


Accession No. 2017.015.00098.085, Lab No. JH0034
(Obverse)


Accession No. 2017.015.00098.085, Lab No. JH0034
(Reverse)

- Chloroform 72.14% at 5-5.24 min
- Benzaldehyde 82.1% at 5.74 min
- Silicic acid 57.0% at 6.50 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 17.0% at 7.38 min
- Petachloroethane 59.5% at 7.75 min
- Elymoclavine 64.75% at 7.98 min
- Colchicine after 9 min (as high as 42%)

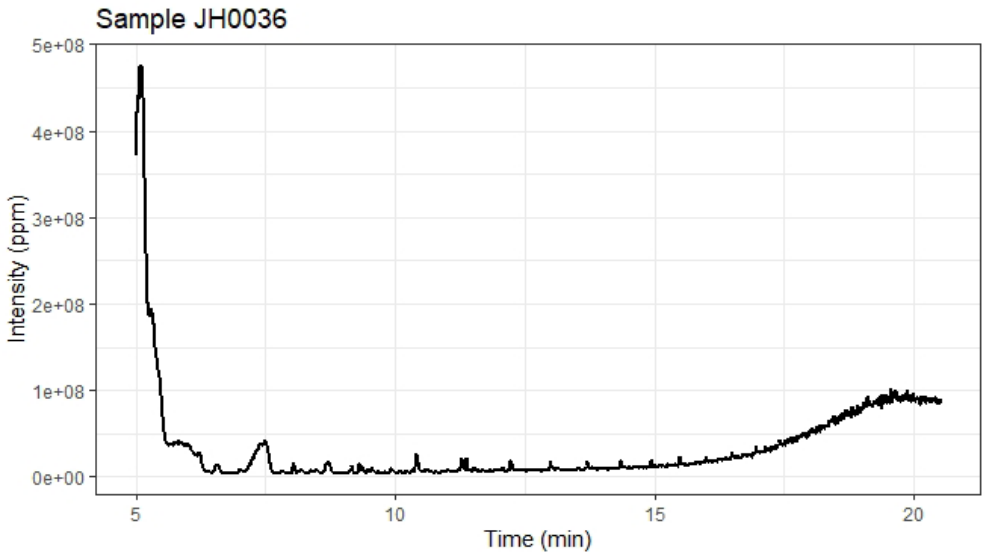


Accession No. 2017.015.00106.075, Lab No. JH0035
(Obverse)

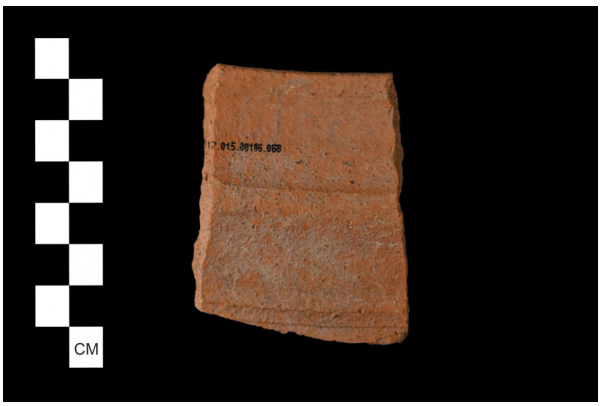
Accession No. 2017.015.00106.075, Lab No. JH0035
(Reverse)

- Chloroform 85.65% at 5-5.24 min
- Benzaldehyde 80.1% at 5.84 min
- Silicic acid 76.8% at 6.50 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 17.35% at 7.50 min
- Petachloroethane 35.3% at 7.75 min
- Elymoclavine 41.53% at 8.00 min
- Colchicine 30.8% at 8.72
- Colchicine after 9 min



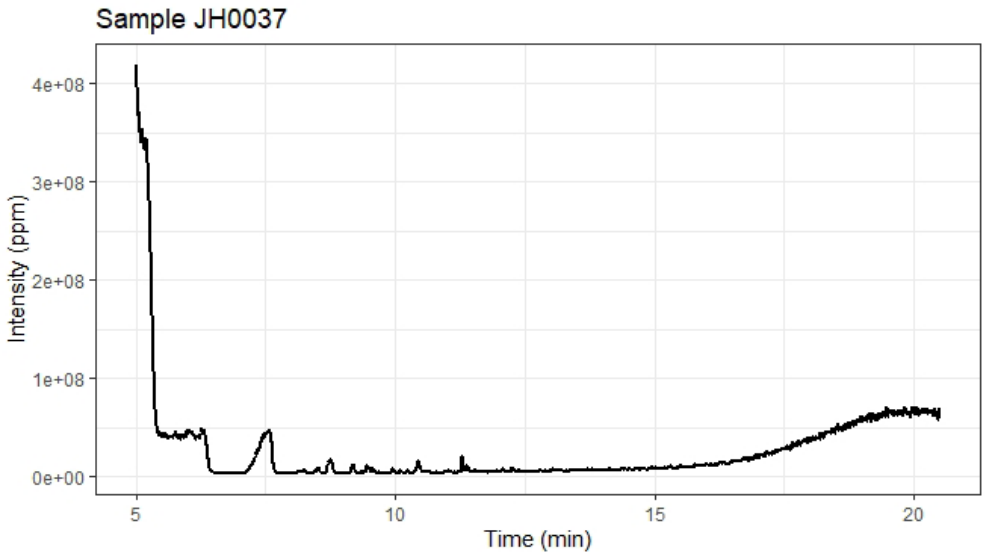


Accession No. 2017.015.00106.068, Lab No. JH0036
(Obverse)




Accession No. 2017.015.00106.068, Lab No. JH0036
(Reverse)

- Chloroform 74.85% at 5.11-5.30 min
- Benzaldehyde 80.1% at 5.76 min
- Silicic acid 74.38% at 6.50 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 17.12% at 7.42 min
- Colchicine 50.1% at 8.72
- Colchicine after 9 min (as high as 50%)

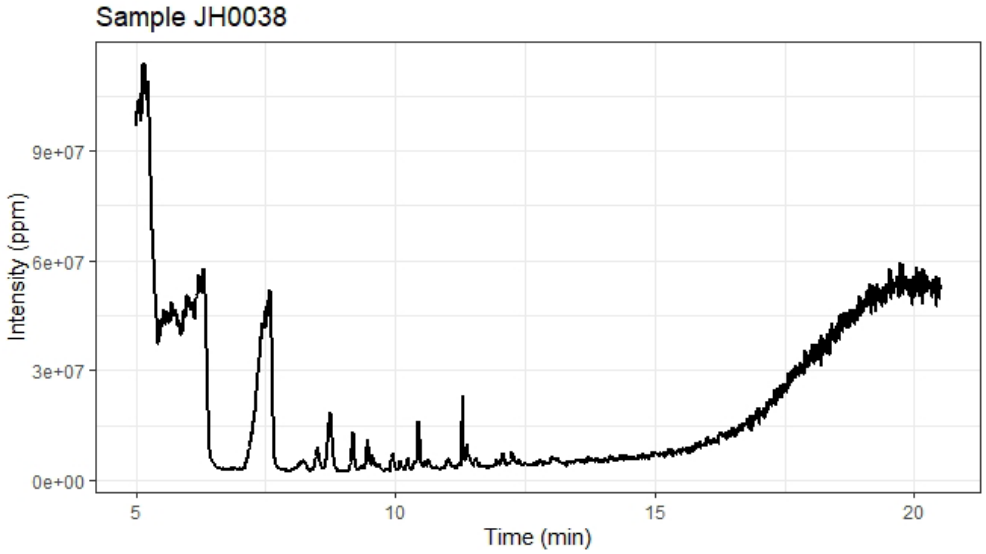




Accession No. 2017.015.00106.081, Lab No. JH0037
(Obverse)


Accession No. 2017.015.00106.081, Lab No. JH0037
(Reverse)

- Chloroform 77.9% at 5.0-5.13 min
- Benzaldehyde 90.4% at 6.32 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 20.7% at 7.59 min
- Dibenzo Carbazole 20.9% at 8.25-8.75 min
- Gamabufotalin 19.1% at 9.25 min
- Ethylene glycol 17.6% at 9.2 min
- Colchicine 39.1% at 8.72
- Colchicine after 9 min

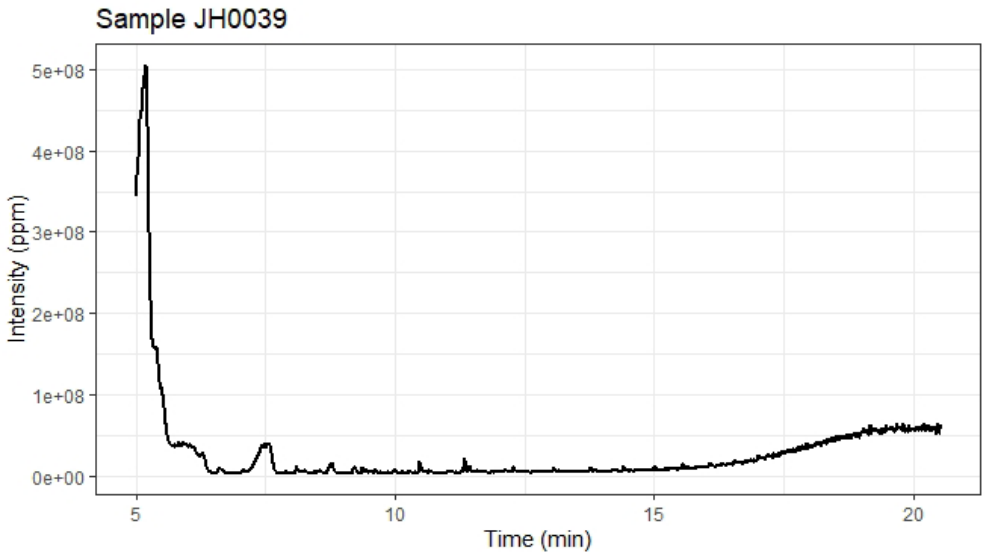


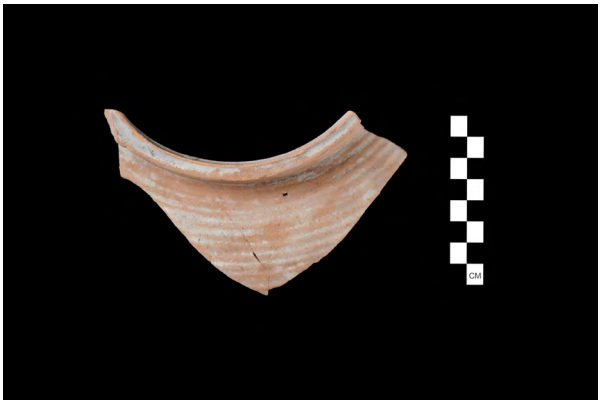


Accession No. 2017.015.00106.082, Lab No. JH0038
(Obverse)


Accession No. 2017.015.00106.082, Lab No. JH0038
(Reverse)

- Chloroform 67.6% at 5.20 min
- Benzaldehyde 86.1% at 5.92 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 14.8% at 7.42 min
- Dibenzo Carbazole 20.7% at 8.76 min
- Colchicine after 9 min

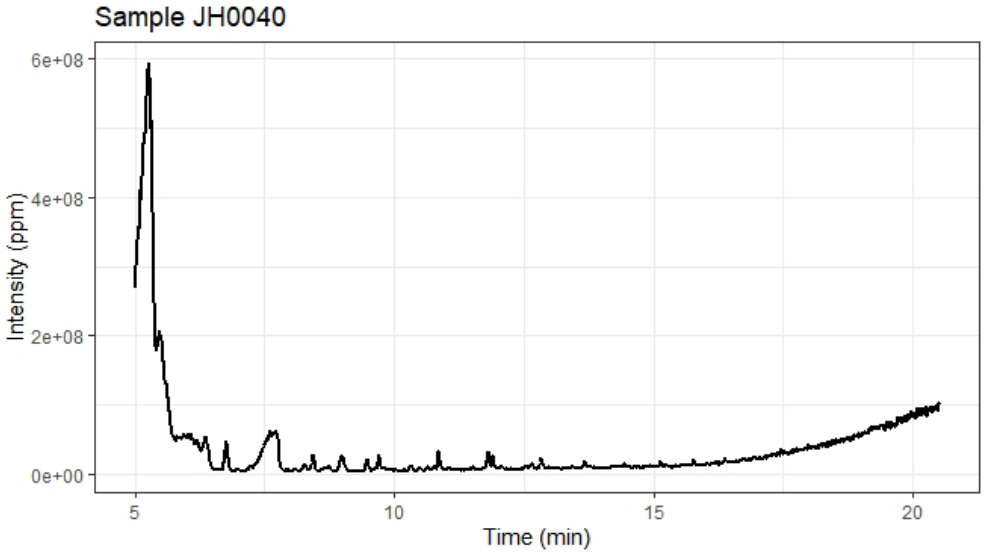


Accession No. 2017.015.00106.075, Lab No. JH0039 (Obverse)

Accession No. 2017.015.00106.075, Lab No. JH0039 (Reverse)

- Chloroform 47.5% at 5.17min
- Benzaldehyde 81.9% at 6.27 min
- Silicic acid 65.3% at 6.5 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 26.6% at 7.5 min
- Ethylene glycol 36.6% at 8.78 min
- Gamabufotalin 16.6% at 9.25 min
- Colchicine and prednisolone after 9 min

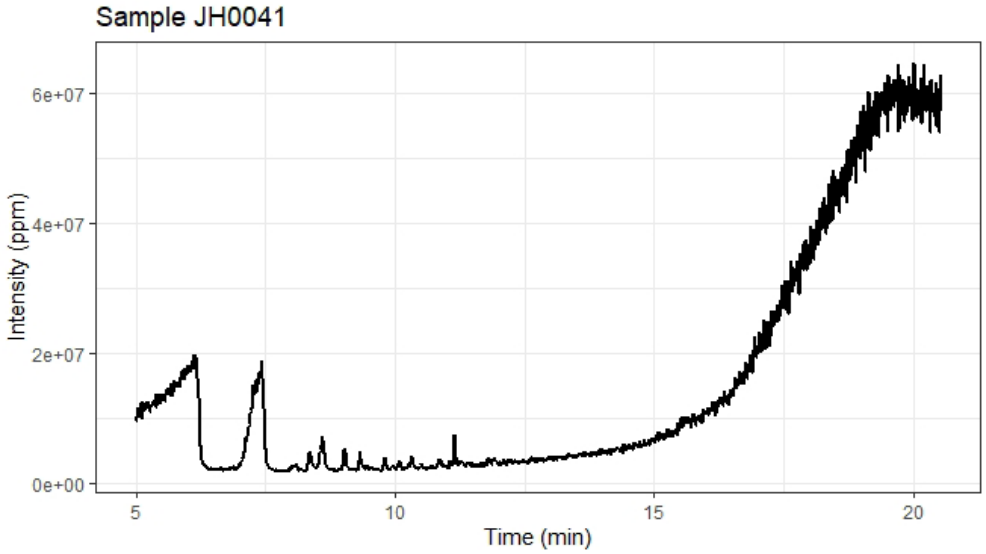




Accession No. 2017.015.00106.083, Lab No. JH0040
(Obverse)


Accession No. 2017.015.00106.083, Lab No. JH0040
(Reverse)

- Chloroform 83.5% at 5.27min
- Bromodichloromethane 58.7% at 5.48 min
- Benzaldehyde 87.4% at 6.27 min
- Silicic acid 69.9% at 6.08 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 17.25% at 7.72 min
- Ethylene glycol 27% at 9.00 min
- Colchicine and prednisolone after 9 min

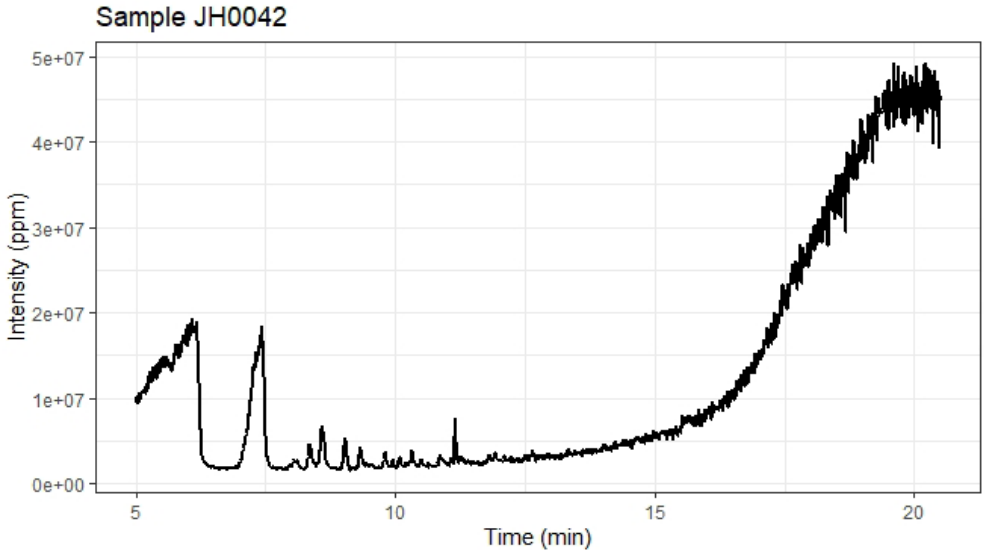




Accession No. 2017.015.00082.008, Lab No. JH0041
(Obverse)


Accession No. 2017.015.00082.008, Lab No. JH0041
(Reverse)

- Benzaldehyde 86.8% at 6.11 min
- Phosphoramidic acid 25.08% at 7 min
- Colchicine 32.2% at 7.43 min
- Ethylene glycol 46.7% at 9.10 min
- Butylamine 16.6% at 9.9 min
- Colchicine 47.8% at 10.84 min
- Colchicine and prednisone after 10 min

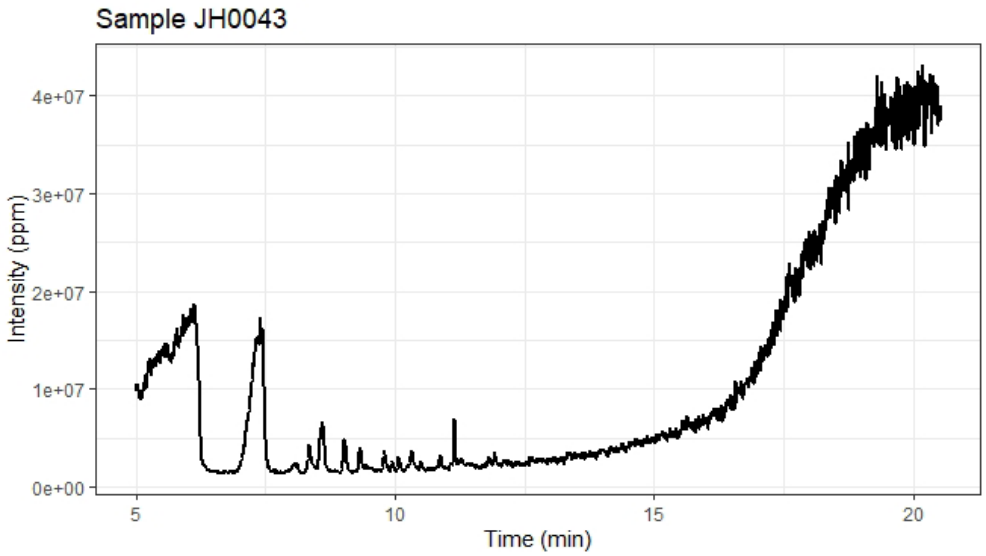




Accession No. 2017.015.00082.000, Lab No. JH0042 (Obverse)


Accession No. 2017.015.00082.000, Lab No. JH0042 (Reverse)

- Benzaldehyde 87.7% at 6.10 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 19.3% at 7.43 min
- Dibenzo carbazole 39.9% at 8.4 min
- Ethylene glycol 19% at 9.02 min
- Butylamine 44.3% at 9.9 min
- Colchicine 39.9% at 11.15 min

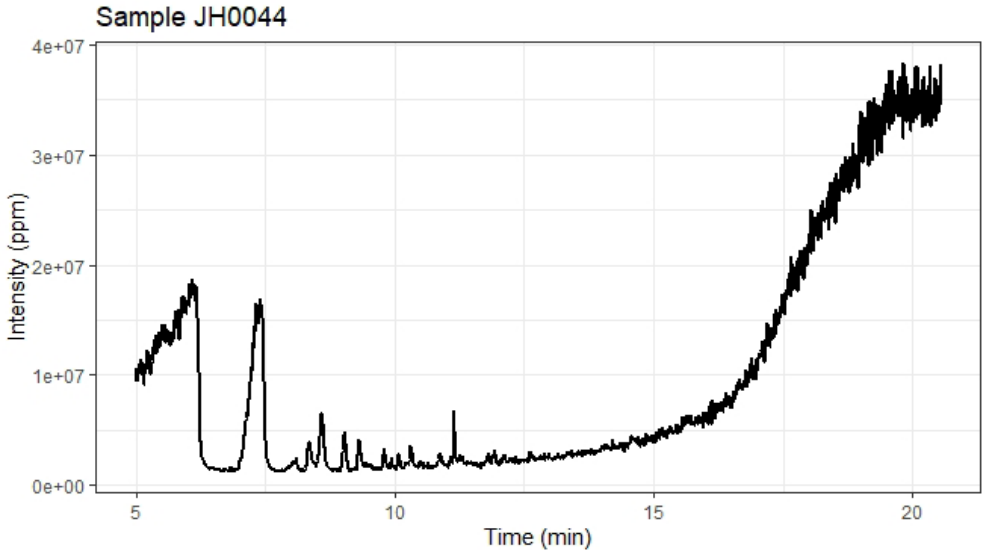




Accession No. 2017.015.00082.002, Lab No. JH0043
(Obverse)


Accession No. 2017.015.00082.002, Lab No. JH0043
(Reverse)

- Benzaldehyde 84.1% at 6.13 min
- Colchicine 16.2% at 7.40 min
- Warfarin 12.4% at 8.10 min
- Dibenzo carbazole 41.5% at 8.35 min
- Bufotalin 11.9% at 9.02 min
- Colchicine between 9.2 and 11.15 min
- Colchicine 42.3% at 11.15 min

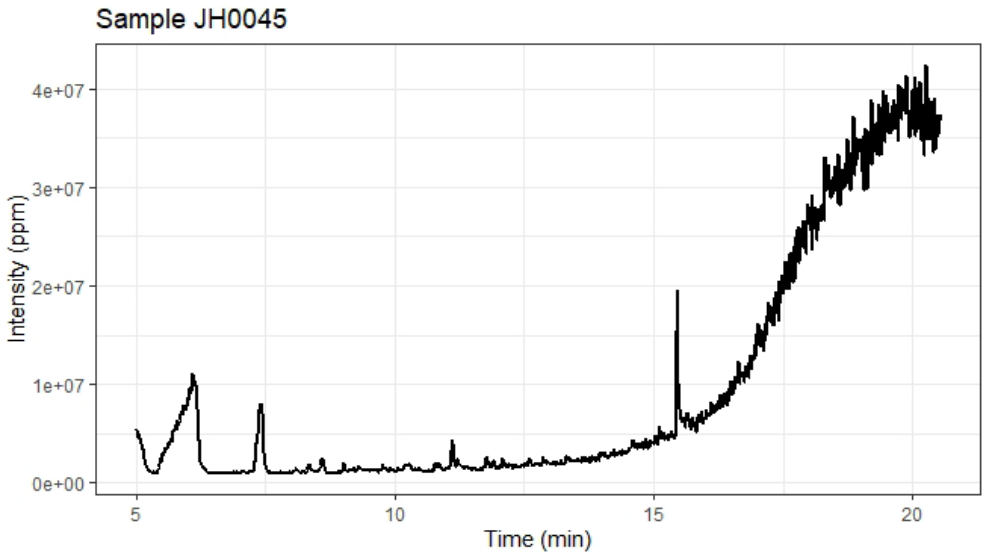




Accession No. 2017.015.00082.001, Lab No. JH0044
(Obverse)


Accession No. 2017.015.00082.001, Lab No. JH0044
(Reverse)

- Benzaldehyde 85.1% at 6.10 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 22.4% at 7.39 min
- Vincamine 13.5% at 8.59 min Dibenzo Carbazole 21.5% at 8.59 min
- Gamabufotalin 13.9% at 9.04 min
- Colchicine between 9.2 and 11.15 min
- Colchicine 40.3% at 11.15 min

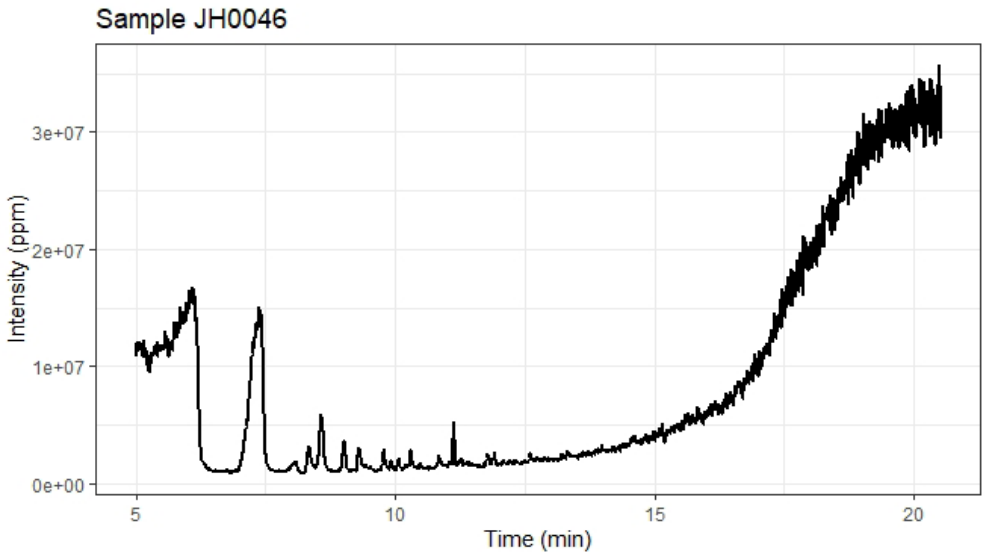


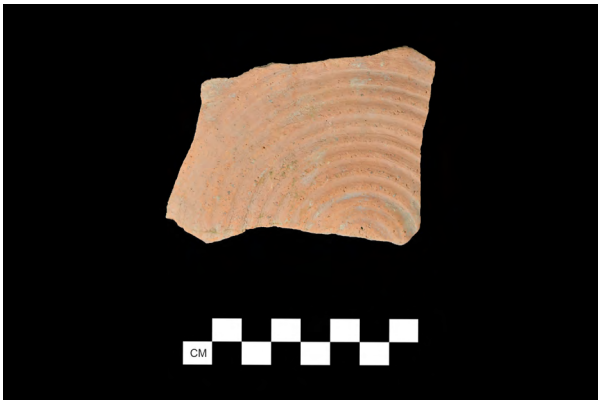


Accession No. 2017.004.00035.000, Lab No. JH0045
(Obverse)


Accession No. 2017.004.00035.000, Lab No. JH0045
(Reverse)

- Chloroform 81.25% at 5.02min
- Benzaldehyde 83.0% at 6.05-6.11 min
- Lysergamide 18.4% at 6.18 min
- Colchicine 12.9% at 7.41 min (larger peak)
- Phthalic acid, butyl cyclohexyl ester 16.2% at 15.45 min
- Colchicine and prednisolone after 8 min

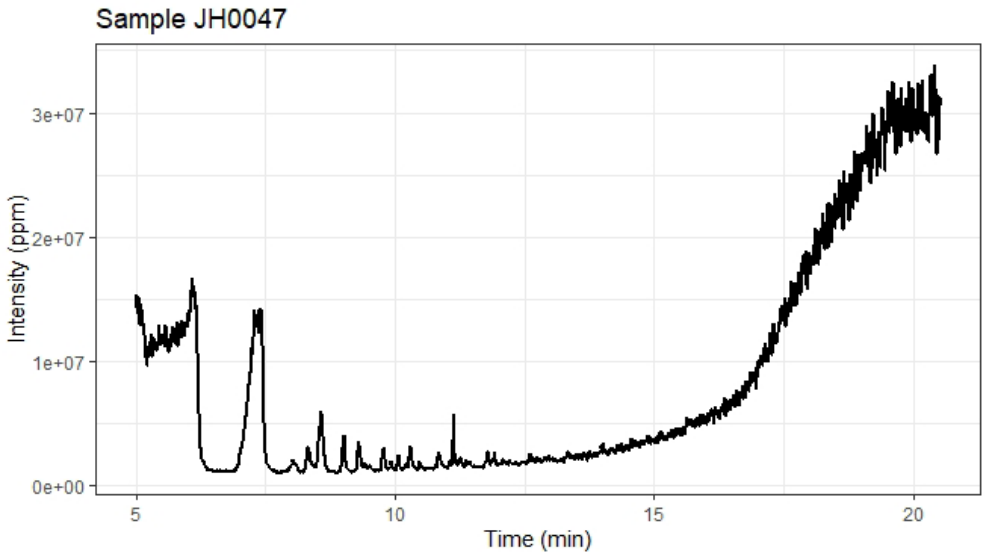



Accession No. 2017.004.00035.000, Lab No. JH0046 (Obverse)


Accession No. 2017.004.00035.000, Lab No. JH0046 (Reverse)

- Benzaldehyde 86.1% at 6.09 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 19.6% at 7.41 min
- Dibenzo Carbazole 49.1% at 8.3-8.57 min
- Gamabufotalin 15.4% at 9.02 min
- Ethylene glycol 45.1% at 9.70 min
- Colchicine and prednisolone after 9 min

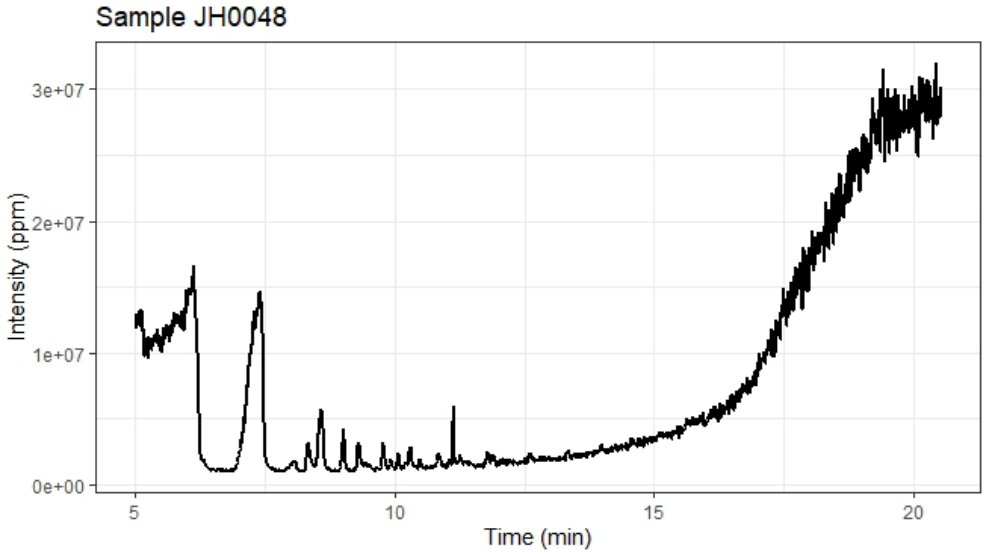




Accession No. 2017.004.00035.000, Lab No. JH0047
(Obverse)


Accession No. 2017.004.00035.000, Lab No. JH0047
(Reverse)

- Benzaldehyde 87.0% at 6.11 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 16.0% at 7.38 min
- Dibenzo Carbazole 25.2% at 8.33-8.57 min
- Gamabufotalin 22.39% at 9.02 min
- Ethylene glycol 42.2% at 9.70 min
- Colchicine and prednisolone after 9 min

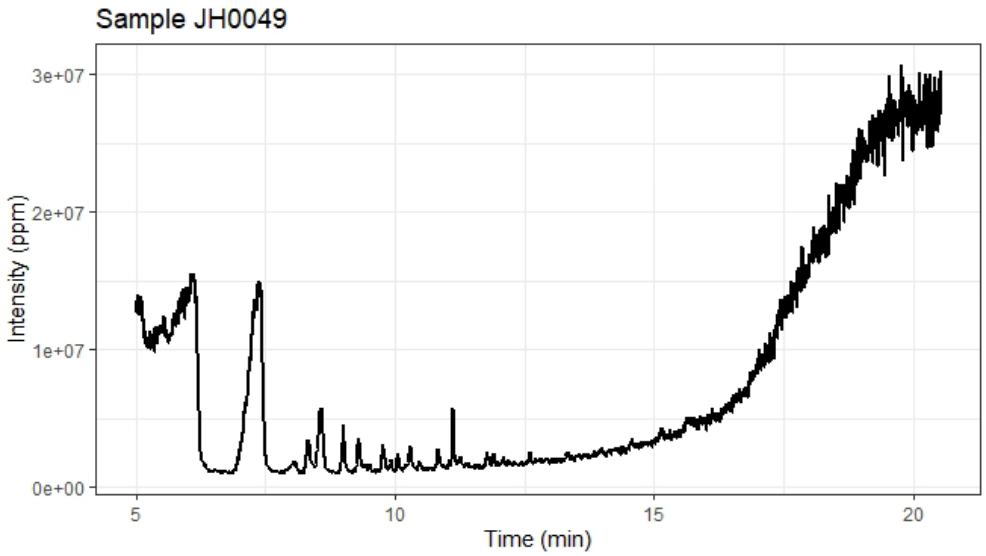




Accession No. 2017.004.00035.000, Lab No. JH0048
(Obverse)


Accession No. 2017.004.00035.000, Lab No. JH0046
(Reverse)

- Benzaldehyde 86.1% at 6.13 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 41.4% at 7.39 min
- Dibenzo Carbazole 73.5% at 8.33 min
- 2-Heptyl-1,3-dioxolane 31.3% at 8.59 min
- Ethylene glycol 67.64% at 9.01 min
- Colchicine and prednisolone after 9 min



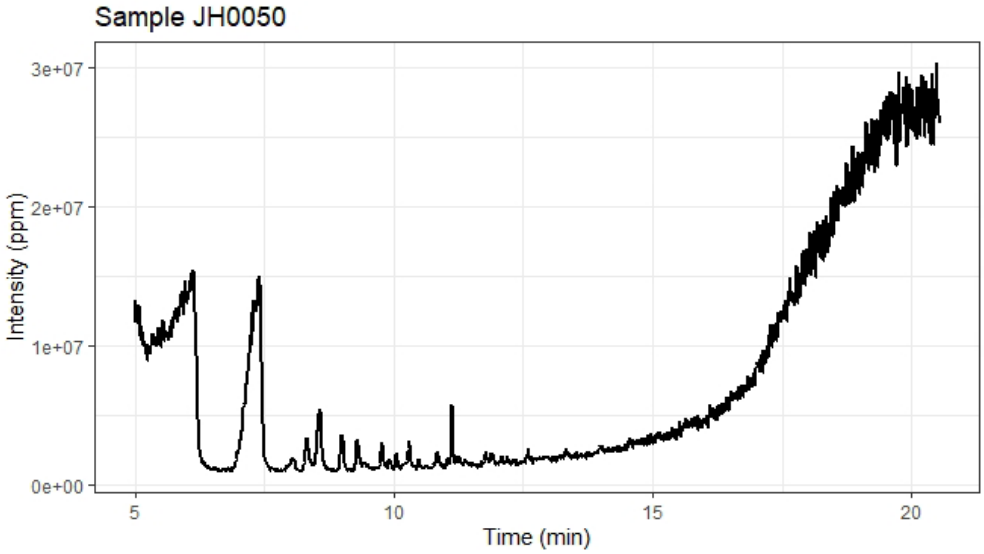


Accession No. 2017.004.00035.000, Lab No. JH0049
(Obverse)


Accession No. 2017.004.00035.000, Lab No. JH0049
(Reverse)

- Benzaldehyde 90.5% at 5.50-6.08 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 21.2% at 7.40 min
- Dibenzo Carbazole 61.1% at 8.33 min
- Acetic acid, sec-butl ester 20.3% at 8.58 min
- 2-Methylmalonamide 24.1% at 9.01 min
- Methanone (Octabenzone) 14.6% at 9.3 min
- Colchicine and prednisolone after 9 min

JH0050

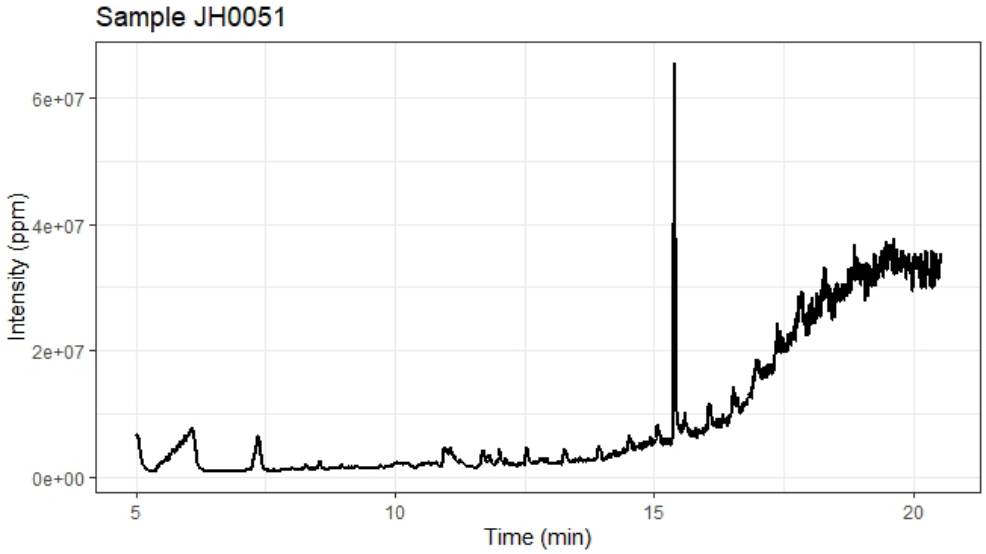




Accession No. 2017.004.00035.000, Lab No. JH0050
(Obverse)


Accession No. 2017.004.00035.000, Lab No. JH0050
(Reverse)

- Benzaldehyde 90.3% at 6.13 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 14.9% at 7.40 min
- Dibenzo Carbazole 36.3% at 8.33 min
- Methylaethylallycarbinol 26.3% (Ethylene glycol 24.1%) at 8.57
- 2-Heptyl-1,3-dioxolane 31.3% at 8.59 min
- Ethylene glycol 67.64% at 9.01 min
- Gamabufotalin 18.1% at 9.02
- Colchicine and prednisolone after 9 min

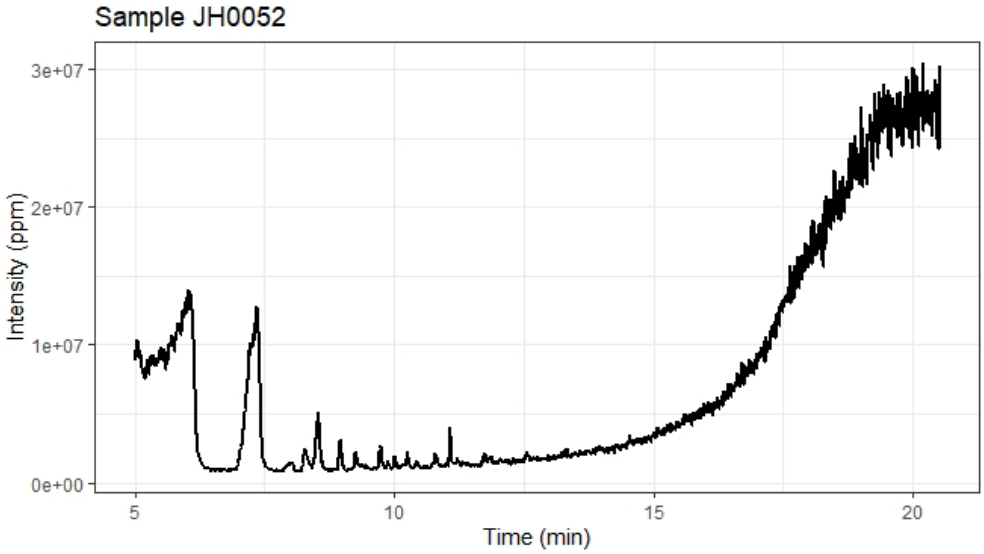




Accession No. 2017.004.00038.000, Lab No. JH0051
(Obverse)


Accession No. 2017.004.00038.000, Lab No. JH0051
(Reverse)

- Benzaldehyde 87.7% at 6.08 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 14.5% at 7.36 min
- Dibenzo Carbazole 28.5% at 8.53 min
- Dibutyl phthalate 29.7 [Phthalic acid, butyl cyclohexyl ester 25.0%] at 15.45 min
- Colchicine and prednisolone after 9 min



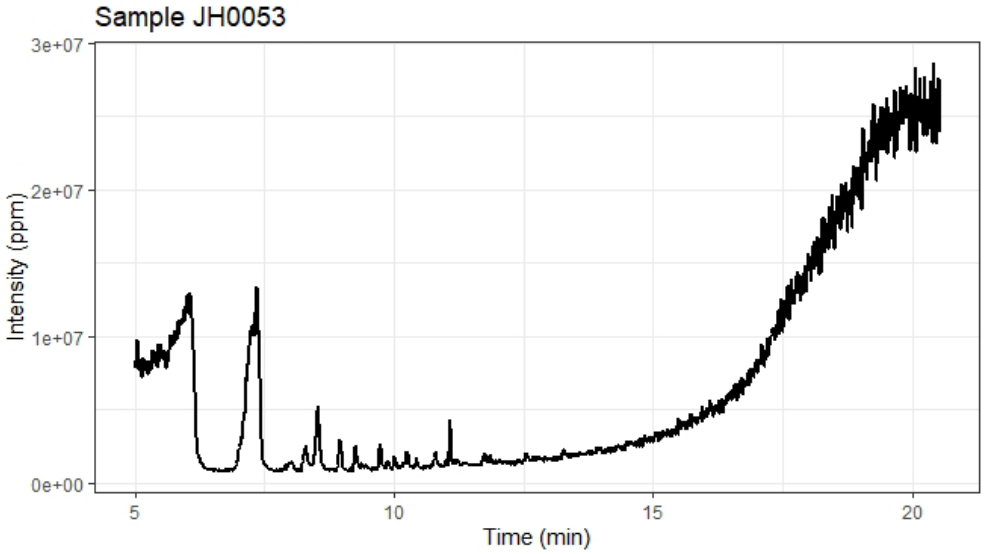


Accession No. 2017.004.00038.000, Lab No. JH0052
(Obverse)


Accession No. 2017.004.00038.000, Lab No. JH0052
(Reverse)

- Benzaldehyde 85.0% at 6.00 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 21.5% at 7.38 min
- Dibenzo Carbazole 14.6% at 8.55 min
- Gamabufotalin 15.48% at 8.97
- Dibutyl phthalate 29.7 [Phthalic acid, butyl cyclohexyl ester 25.0%] at 15.45 min
- Colchicine and prednisolone after 9 min

JH0053

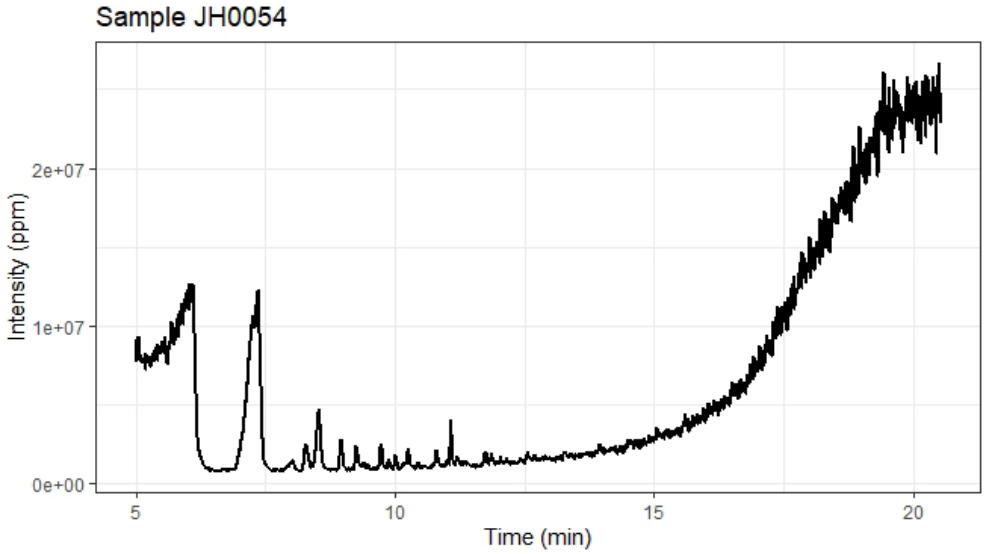


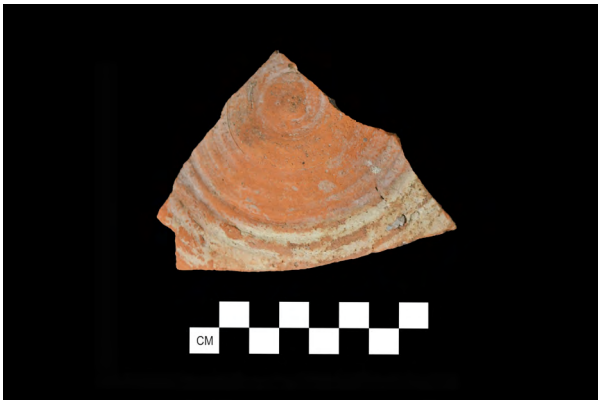


Accession No. 2017.004.00038.000, Lab No. JH0053
(Obverse)


Accession No. 2017.004.00038.000, Lab No. JH0053
(Reverse)

- Benzaldehyde 87.5% at 6.05 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 26.0% at 7.36 min
- Dibenzo Carbazole 22.7% at 8.53
- Gamabufotalin 14.7% at 8.96 min
- Ethylene glycol 33.0% at 9.3 min
- Colchicine and prednisolone after 9 min

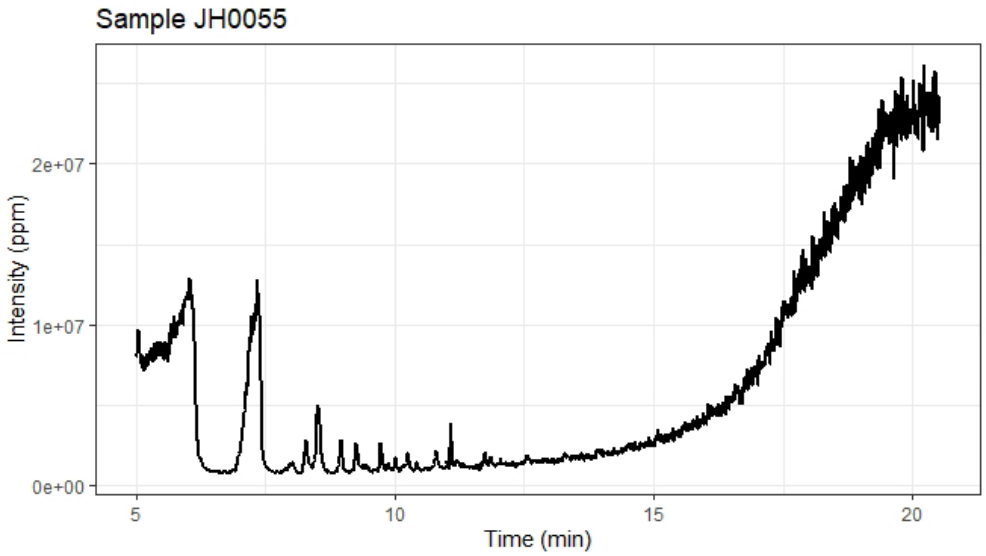



Accession No. 2017.004.00038.000, Lab No. JH0054 (Obverse)


Accession No. 2017.004.00038.000, Lab No. JH0054 (Reverse)

- Benzaldehyde 89.6% at 6.05 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 21.9% at 7.36 min
- Dibenzo Carbazole 20.3% at 8.33
- Vincamine 13.54% (Dibenzo carbazole is also likely 13.01) at 8.53 min
- Gamabufotalin 14.8% at 8.96 min
- Isothiocyanic acid 11.7% at 9.73 min
- Colchicine and prednisolone after 9 min

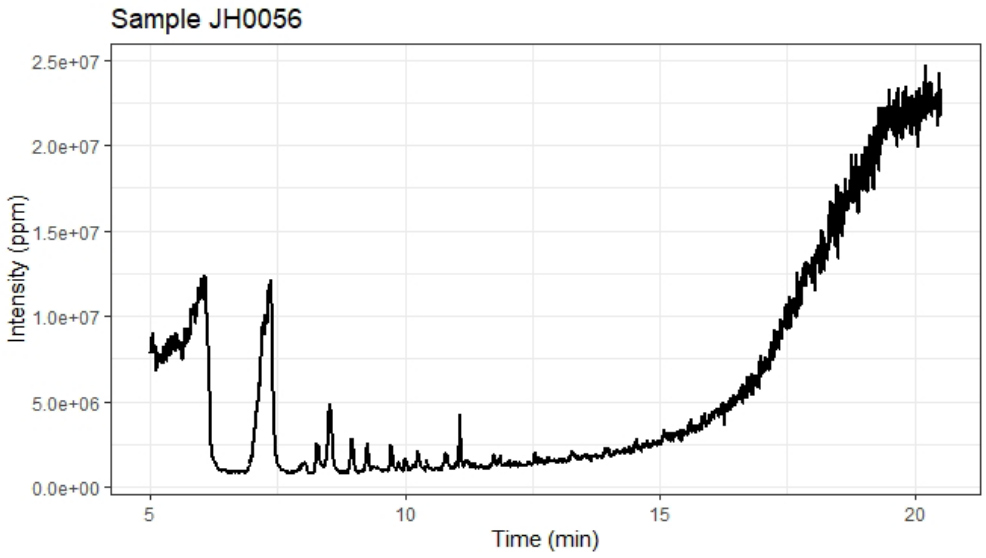




Accession No. 2017.004.00038.000, Lab No. JH0055
(Obverse)


Accession No. 2017.004.00038.000, Lab No. JH0055
(Reverse)

- Benzaldehyde 87.4% at 6.04 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 17.1% at 7.35 min
- Dibenzo Carbazole 53.0% at 8.33
- Ethylene glycol 23.3% at 8.96
- Colchicine and prednisolone after 9 min

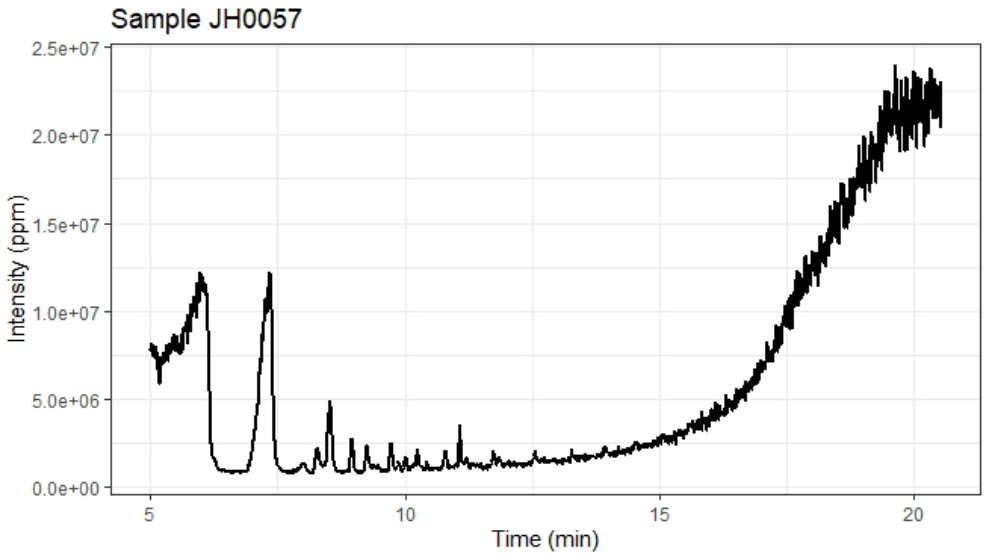


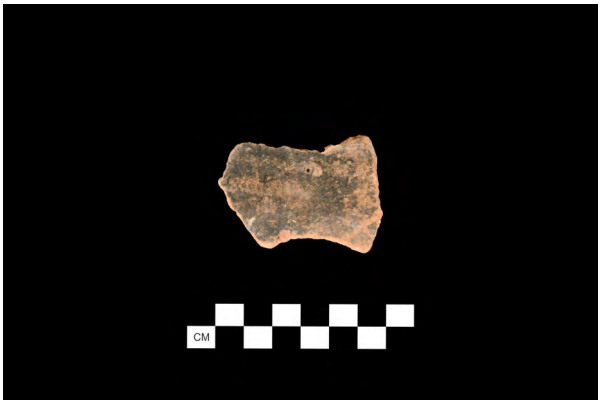


Accession No. 2017.004.00038.000, Lab No. JH0056
(Obverse)


Accession No. 2017.015.00038.000, Lab No. JH0056
(Reverse)

- Benzaldehyde 86.6% at 6.08 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 24.4% at 7.36 min
- Dibenzo Carbazole 21.3% at 8.33-8.52 min
- Gamabufotalin 20.8% at 8.95
- Colchicine and prednisolone after 9 min

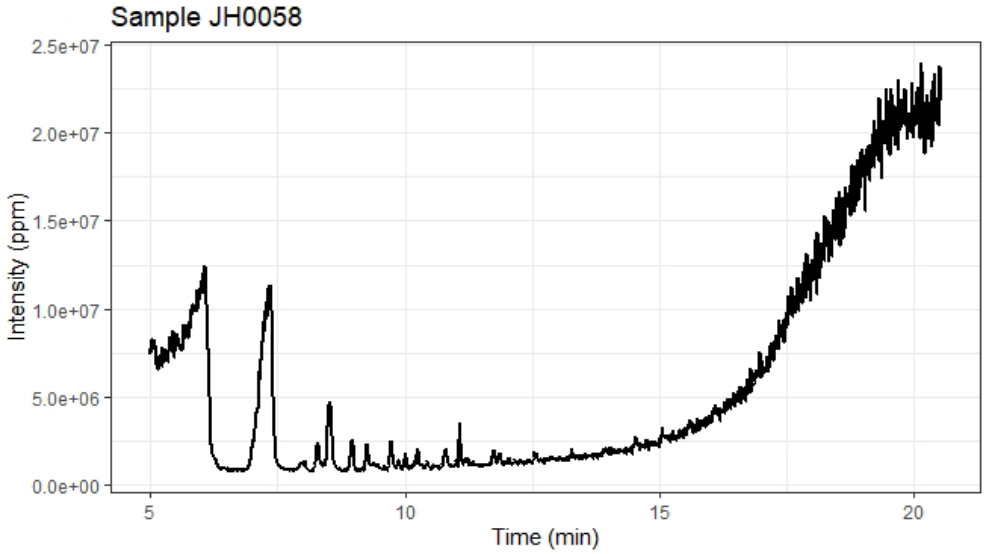



Accession No. 2017.015.00038.000, Lab No. JH0057
(Obverse)


Accession No. 2017.015.00038.000, Lab No. JH0057
(Reverse)

- Benzaldehyde 83.5% at 5.99 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 25.3% at 7.35 min
- Dibenzo Carbazole 18.0% at 8.33, 32.3 at 8.52 min
- Gamabufotalin 20.8% at 8.95
- Colchicine and prednisolone after 9 min

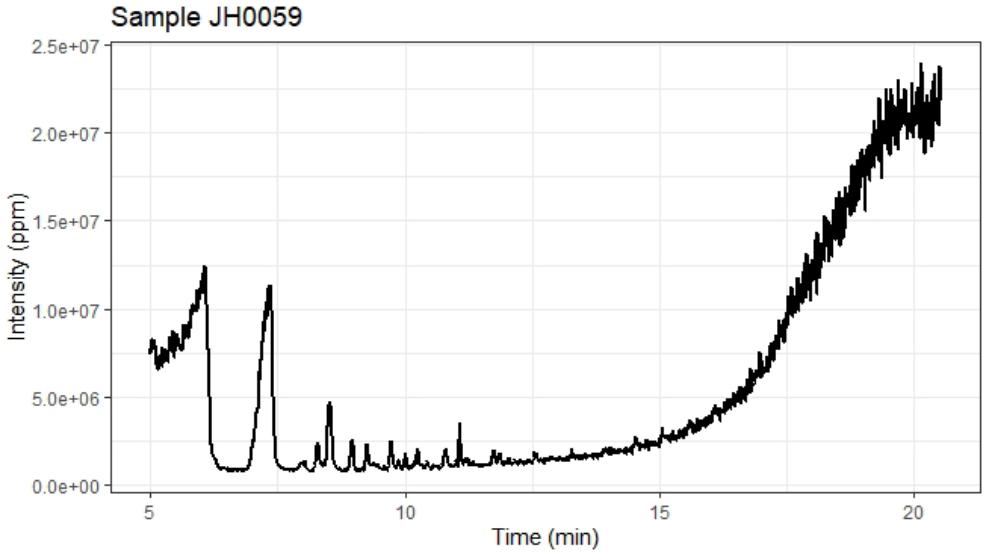




Accession No. 2017.015.00036.000, Lab No. JH0058
(Obverse)


Accession No. 2017.015.00036.000, Lab No. JH0058
(Reverse)

- Benzaldehyde 81.8% at 6.08 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 20.1% at 7.34 min
- Dibenzo Carbazole 39.3% at 8.33
- Ethylene glycol 29.6% at 8.53
- Gamabufotalin 20.8% at 8.95
- Colchicine and prednisolone after 9 min

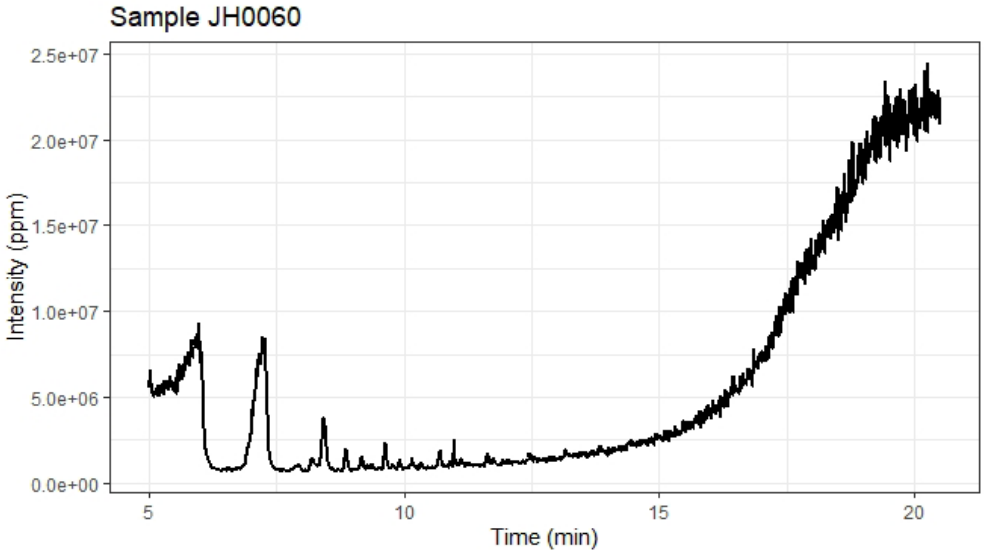




Accession No. 2017.015.00036.000, Lab No. JH0059
(Obverse)


Accession No. 2017.015.00036.000, Lab No. JH0059
(Reverse)

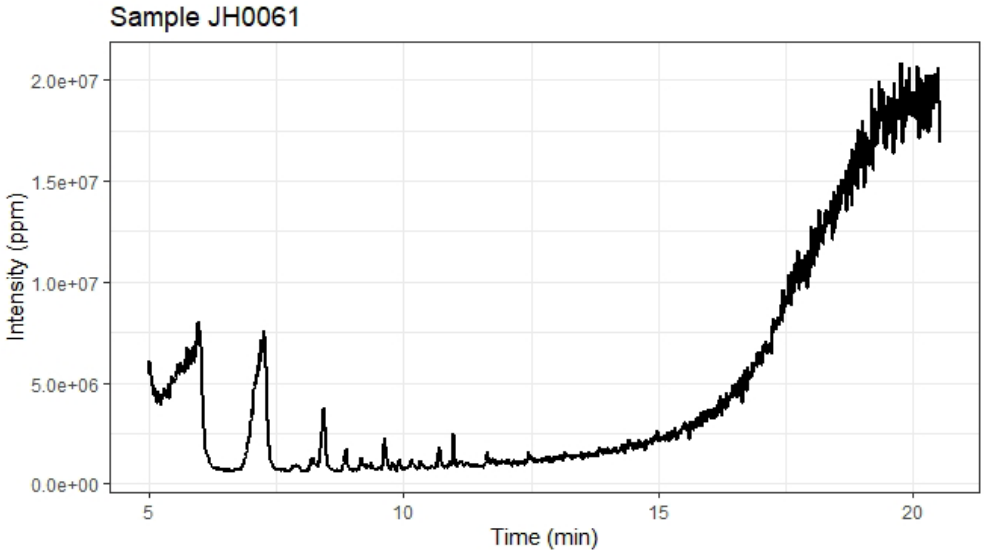
- Benzaldehyde 77.1% at 5.98 min
- Colchicine 27.1% at 7.26 min
- Colchicine 32.4% at 8.44 min
- Dibutyl phthalate 24.9% at 15.28 min
- Colchicine and prednisolone after 7 min





Accession No. 2017.004.00036.000, Lab No. JH0060
(Reverse)

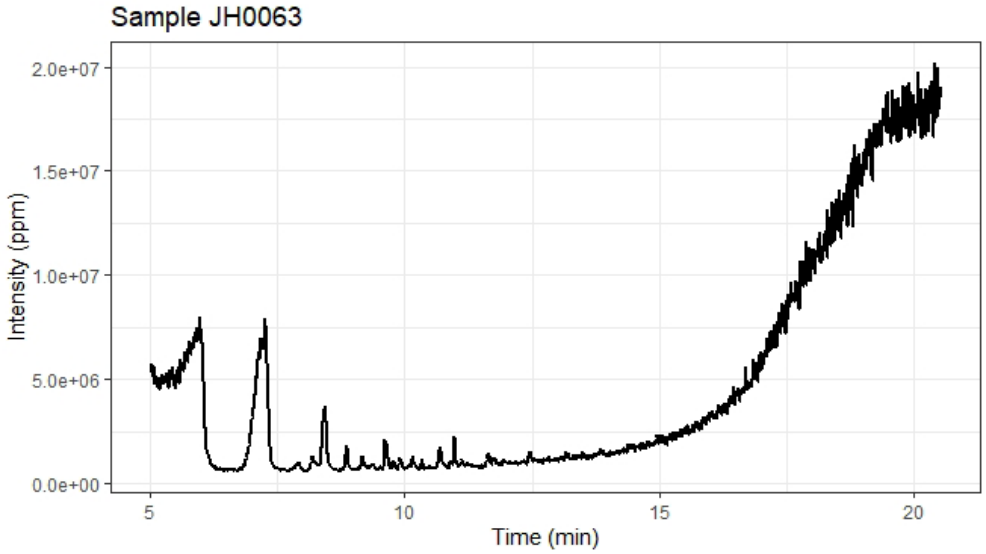
- Benzaldehyde 87.9% at 5.97 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 37.2% at 7.21 min
- Dibenzo Carbazole 22.3% at 8.20
- Ethylene glycol 15.1% at 8.43 min
- Gamabufotalin 16.63% at 8.93 min
- Ethylene glycol 20.9% at 9.43 min
- Colchicine and prednisolone after 10 min





Accession No. 2017.004.00036.000, Lab No. JH0061
(Reverse)

- Benzaldehyde 83.9% at 5.98 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 18.4% at 7.24 min
- Dibenzo Carbazole 20.4% at 8.43
- Gamabufotalin 17.1% at 8.8 min
- Thiocyanic acid 42.4% at 9.63 min
- Colchicine and prednisolone after 9 min

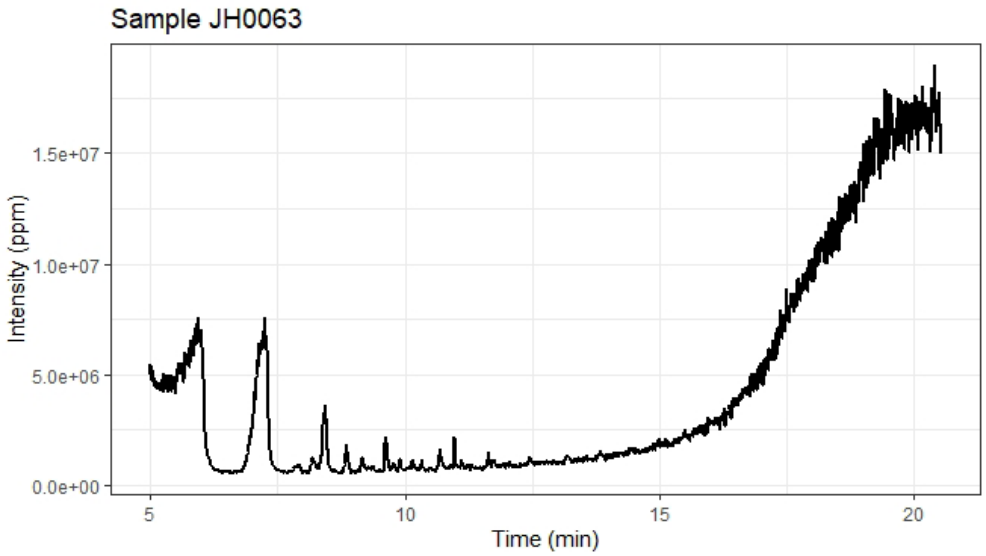




Accession No. 2017.004.00036.000, Lab No. JH0062
(Obverse)


Accession No. 2017.004.00036.000, Lab No. JH0062
(Reverse)

- Benzaldehyde 89.1% at 5.98 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 16.2% at 7.25 min
- Dibenzo Carbazole 20.5% at 8.43
- Gamabufotalin 13.8% at 8.8 min
- Ethylene glycol 34.7% at 9.61 min
- Colchicine and prednisolone after 9 min

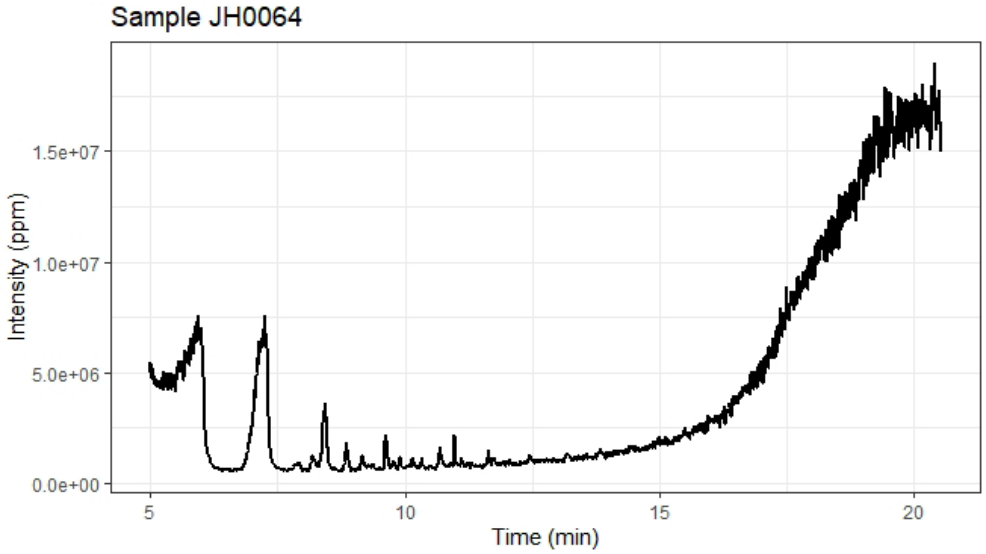




Accession No. 2017.004.00032.000, Lab No. JH0063 (Obverse)


Accession No. 2017.004.00032.000, Lab No. JH0063 (Reverse)

- Benzaldehyde 85.9% at 5.99 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 24.6% at 7.26 min
- Dibenzo Carbazole 20.9% at 8.43 (vincamine is also at this leve at 19.2%)
- Isothiocyanic acid 13.9% at 8.8 min
- Ethylene glycol 50.2% at 9.62 min
- Colchicine and prednisolone after 9 min

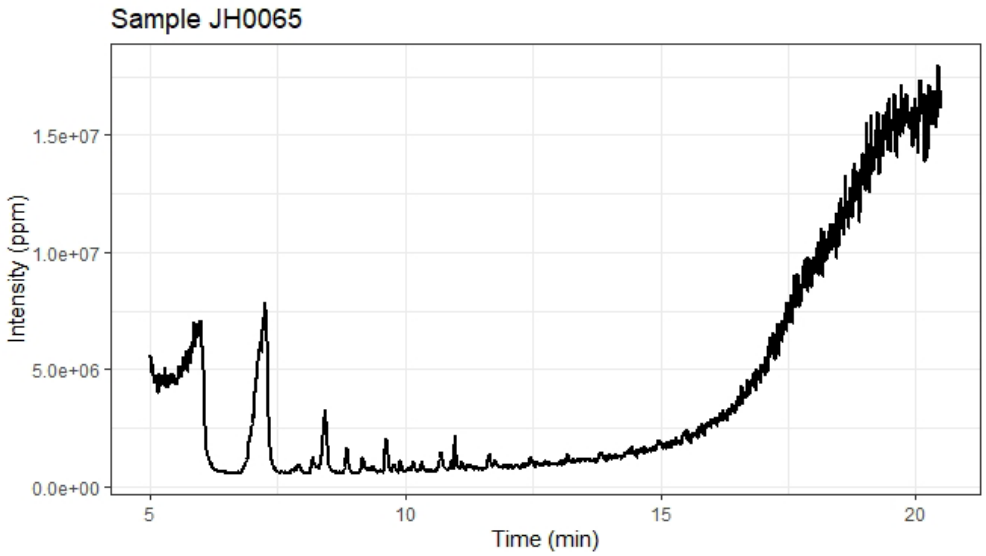




Accession No. 2017.004.00032.000, Lab No. JH0064
(Obverse)


Accession No. 2017.004.0032.000, Lab No. JH0064
(Reverse)

- Benzaldehyde 85.3% at 5.95 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 18.7% at 7.24 min
- Dibenzo Carbazole 21.4% at 8.43
- Isothiocyanic acid 17.7% at 8.8 min
- Bufotalin 9.7% at 9.62 min
- Colchicine and prednisolone after 9 min

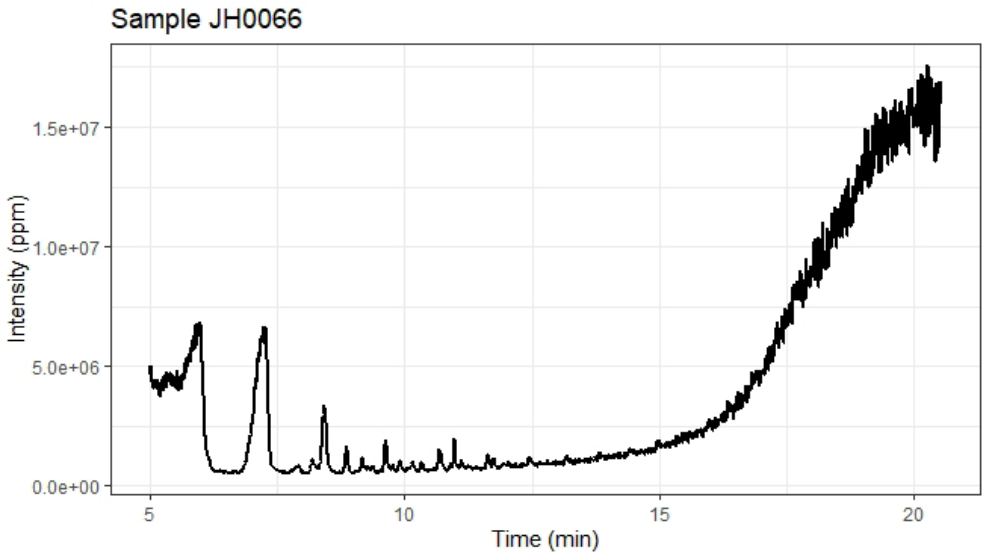


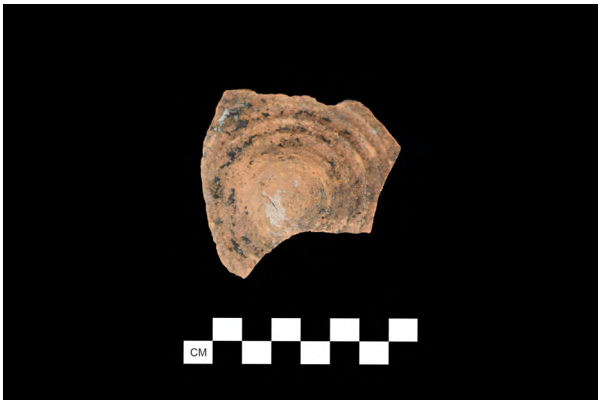


Accession No. 2017.004.0032.000, Lab No. JH0065
(Obverse)


Accession No. 2017.004.0032.000, Lab No. JH0065
(Reverse)

- Benzaldehyde 86.2% at 5.99 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 32.0% at 7.25 min
- Dibenzo Carbazole 26.3% at 8.43
- Ethylene glycol 38.6% at 9.62
- Colchicine and prednisolone after 9 min

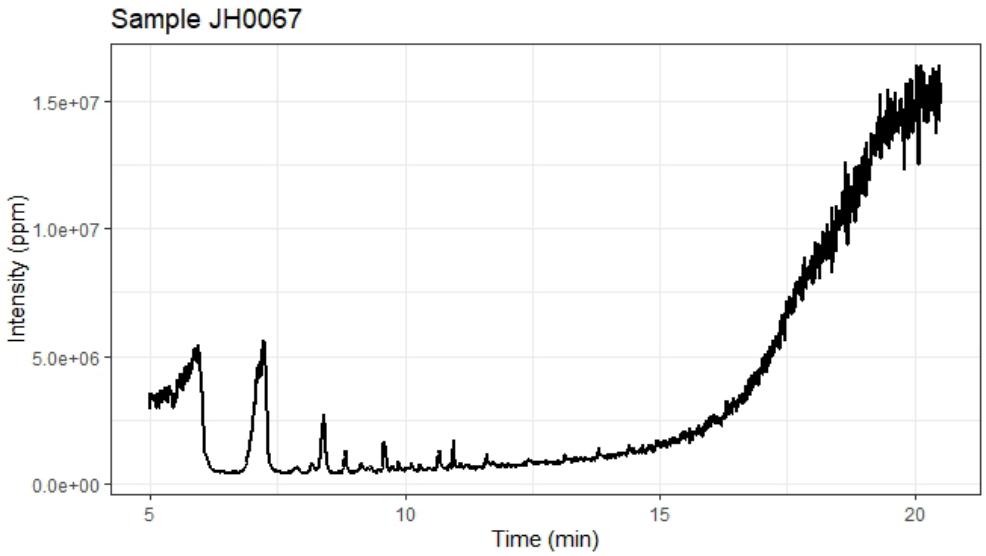



Accession No. 2017.004.0032.000, Lab No. JH0066
(Obverse)


Accession No. 2017.004.0032.000, Lab No. JH0066
(Reverse)

- Benzaldehyde 83.0% at 5.97 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 34.6% at 7.25 min
- Dibenzo Carbazole 19.6% at 8.41
- Gamabufotalin 15.9% at 8.8 min
- Octabenzone 24.3% at 9.62 min
- Colchicine and prednisolone after 9 min

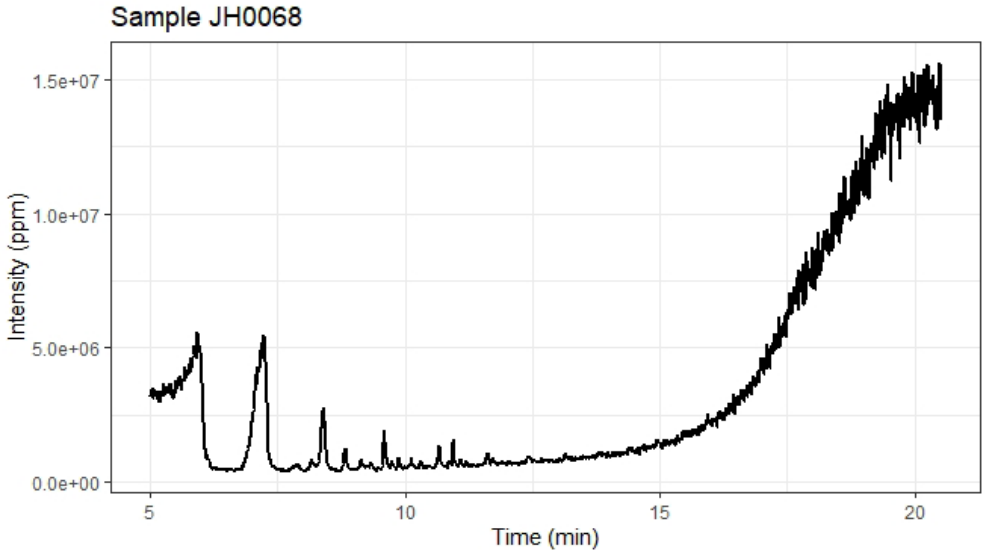




Accession No. 2017.004.0032.000, Lab No. JH0067
(Obverse)


Accession No. 2017.004.0032.000, Lab No. JH0067
(Reverse)

- Benzaldehyde 82.9% at 5.35 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 17.1% at 6.64 min
- Dibenzo Carbazole 29.7% at 7.80 min
- Gamabufotalin 16.2% at 8.25 min
- Ethylene glycol 17.6% at 9.01 min
- Isothiocyanic acid 28.6% at 10.09 min
- Colchicine and prednisolone after 9 min



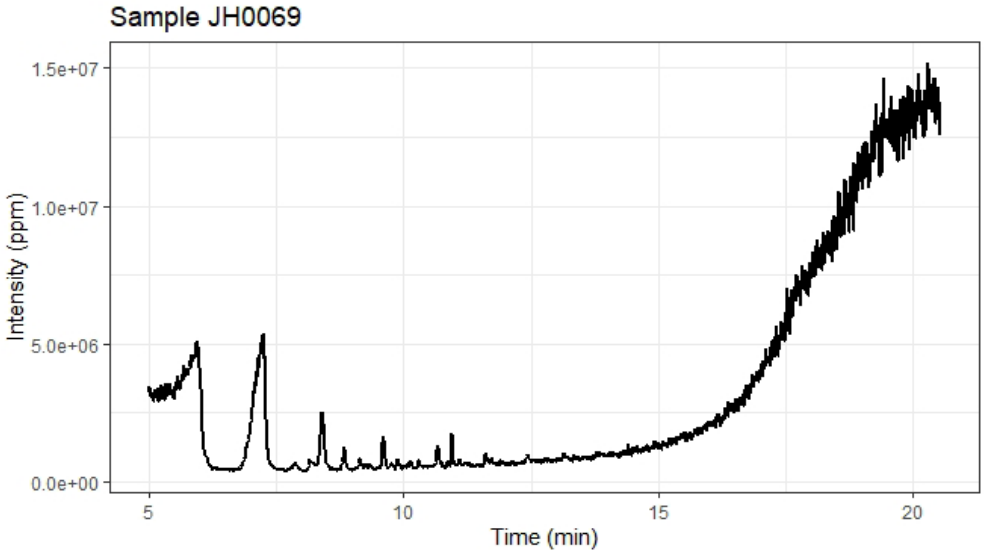


Accession No. 2017.004.0033.000, Lab No. JH0068
(Obverse)


Accession No. 2017.004.0033.000, Lab No. JH0068
(Reverse)

- Benzaldehyde 86.6% at 5.37 min
- Acetamide 12.9% at 6.66 min
- Dibenzo Carbazole 27.3% at 7.81 min
- Gamabufotalin 16.3% at 8.25 min
- Ethylene glycol 26.9% at 9.02 min
- Isothiocyanic acid 28.6% at 10.09 min
- Colchicine and prednisolone after 9 min

JH0069

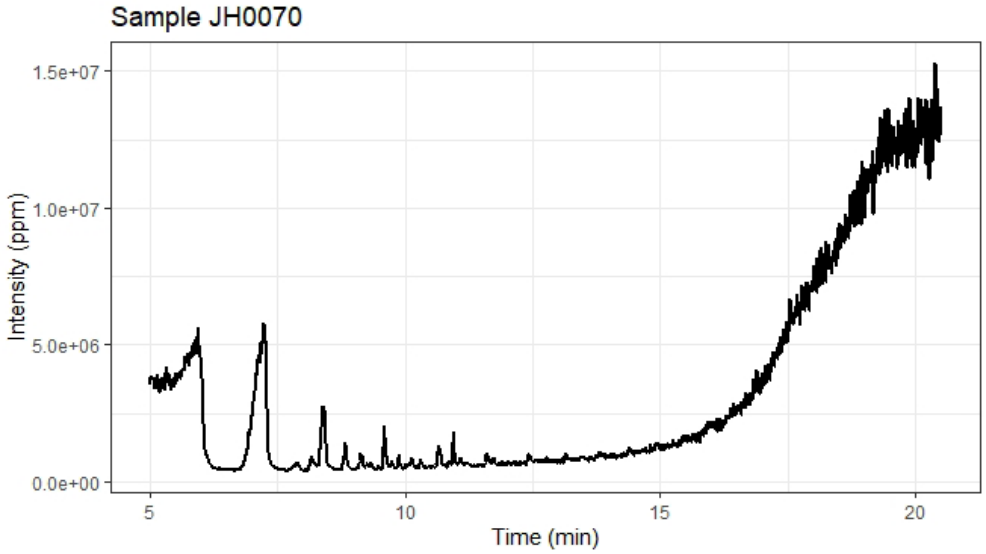




Accession No. 2017.004.0033.000, Lab No. JH0069
(Obverse)


Accession No. 2017.004.0033.000, Lab No. JH0069
(Reverse)

- Benzaldehyde 90.1% at 5.12-5.32 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 13.9% at 6.62 min
- Dibenzo Carbazole 47.74% at 7.56-7.79 min
- Bufotalin (Gamabufotalin 15.52%) 16.2% at 8.25 min
- Ethylene glycol 19.75% at 9.01 min
- Thiocyanic acid 18.5% at 13.25 min
- Colchicine and prednisolone after 9 min

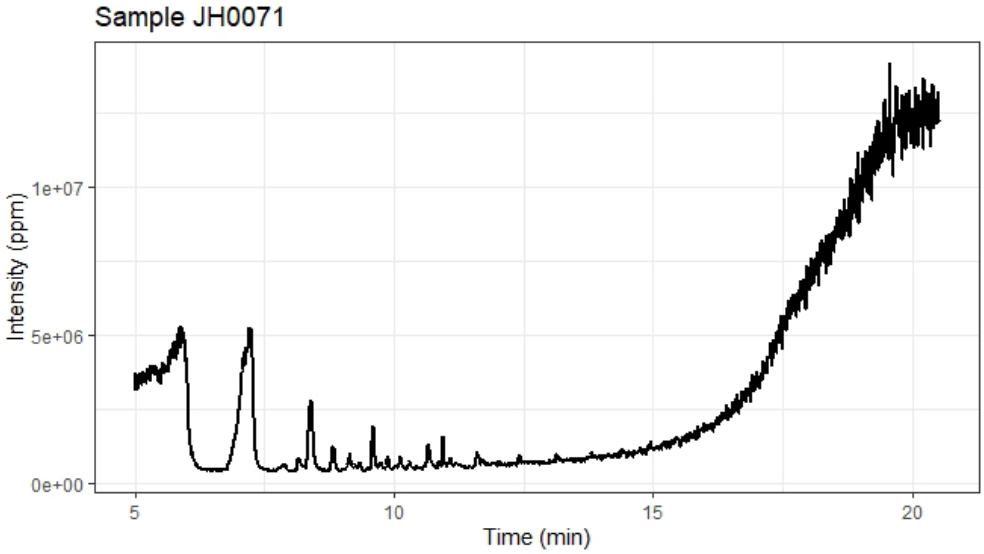




Accession No. 2017.004.0033.000, Lab No. JH0070
(Obverse)


Accession No. 2017.004.0033.000, Lab No. JH0070
(Reverse)

- Benzaldehyde 90.7% at 5.12-5.32 min
- Acetamide 12.2% (Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 12.2%) at 6.62 min
- Warfarin 21.1% at 7.25 min
- Dibenzo Carbazole 29.4% at 7.56-7.79 min
- Thiocyanic acid 23.3% at 9.01 min
- Bufotalin (Gamabufotalin 15.52%) 16.2% at 8.25 min
- Ethylene glycol 18.4% at 9.5 min
- Ethylene glycol 28.5% at 10.25 min
- Thiocyanic acid 43.42% at 12.6 min
- Butylamine 21.8% at 13.8-14 min
- Colchicine, benzhaldehyde, and prednisolone after 9 min

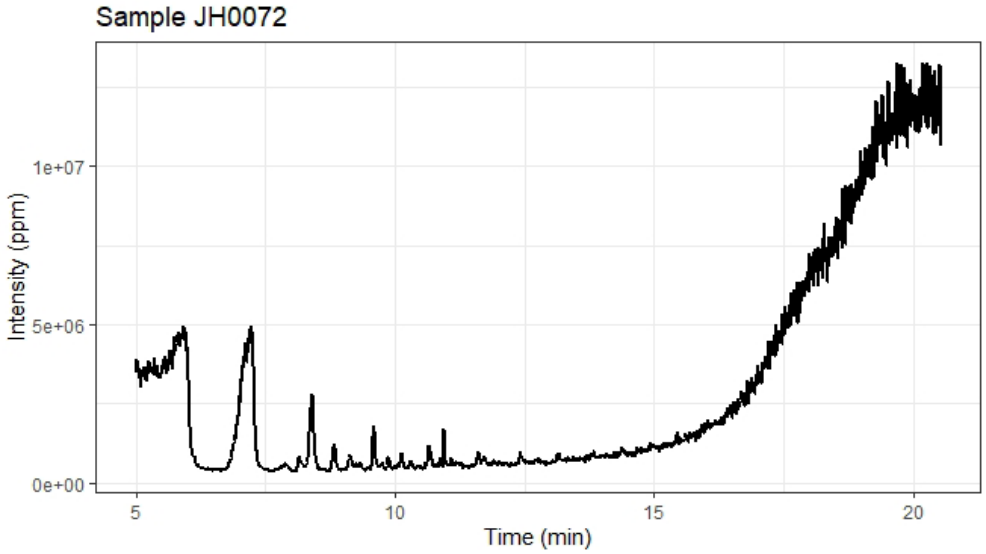


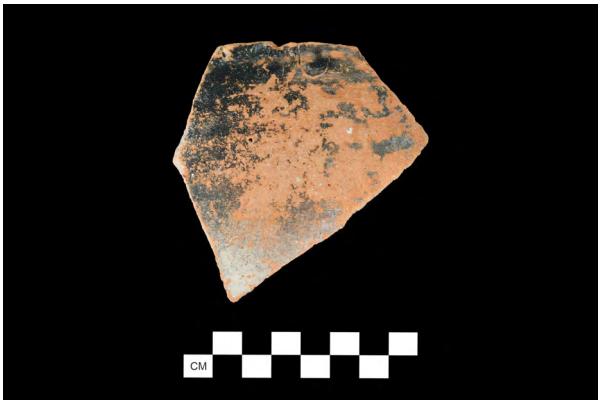


Accession No. 2017.004.00033.000, Lab No. JH0071
(Obverse)


Accession No. 2017.004.00033.000, Lab No. JH0071
(Reverse)

- Benzaldehyde 90.2% at 5.12-5.32 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 14.5% at 6.62 min
- Warfarin 12.7% at 7.25 min
- Dibenzo Carbazole 54.6% at 7.81 min
- Gamabufotalin 12.2% 8.25 min
- Thiocyanic acid 23.3% at 9.01 min
- Bufotalin (Gamabufotalin 15.52%) 16.2% at 8.25 min
- Ethylene glycol 17.6% at 9.01 min
- Ethylene glycol 28.5% at 10.25 min
- Isothiocyanic acid 18% at 13.81 min
- Colchicine, benzhaldehyde, and prednisolone after 9 min

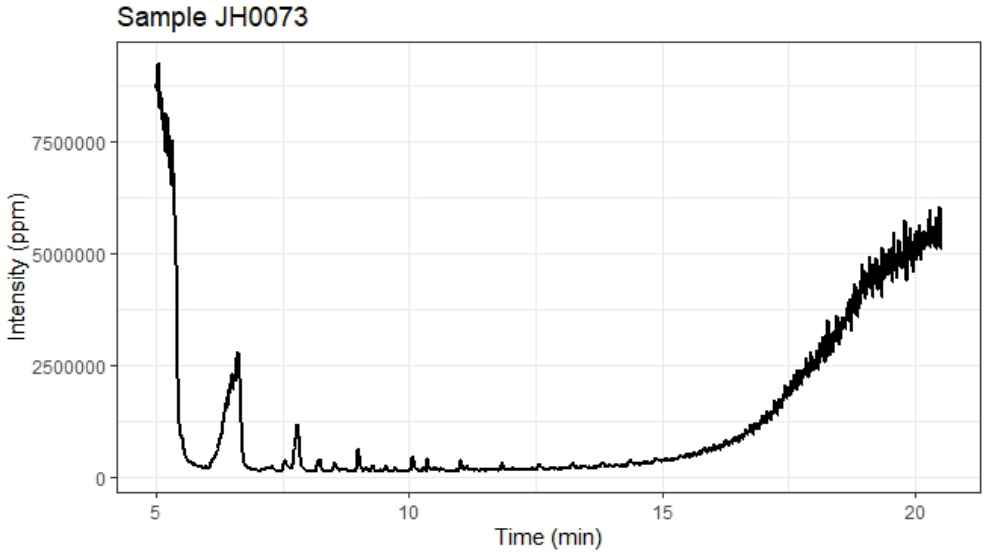



Accession No. 2017.004.0033.000, Lab No. JH0072 (Obverse)


Accession No. 2017.004.0033.000, Lab No. JH0072 (Reverse)

- Benzaldehyde 91.5% at 5.12-5.30 min
- Acetamidel 12.5% at 6.63 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 25.9% (Warfarin 12.6%) at 7.25 min
- Dibenzo Carbazole 37.0% at 7.79 min
- Bufotalin 15.7% (Gamabufotalin 11.7%) at 8.23 min
- Dimethylethlysilane (sliane) 13.8% at 9.00
- Colchicine, benzhaldehyde, and prednisolone after 9 min

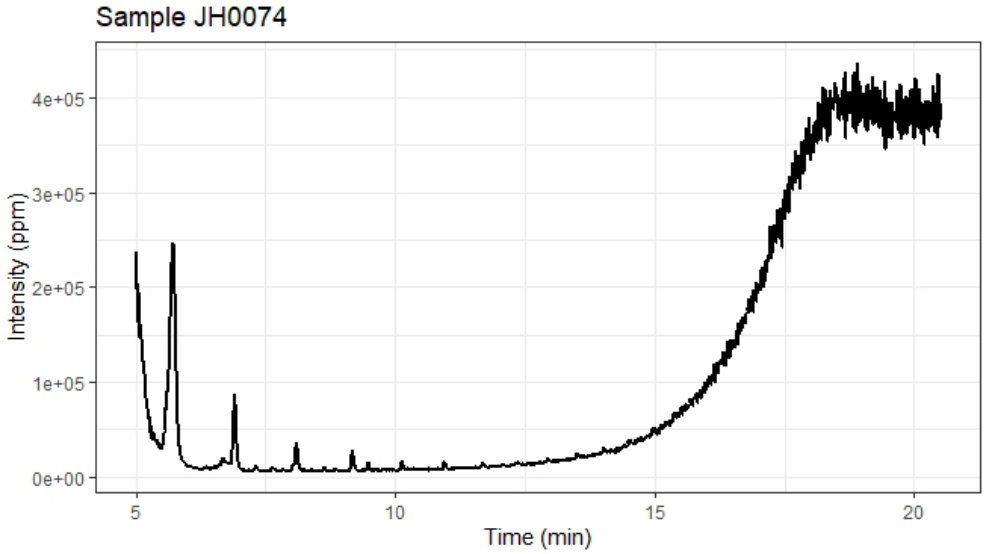




Accession No. 2017.004.00034.000, Lab No. JH0073 (Obverse)


Accession No. 2017.004.00034.000, Lab No. JH0073 (Reverse)

- Benzaldehyde 94.4% at 5.12-5.30 min
- Acetamidel 16.2% at 6.63 min
- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 33.1% (Warfarin 13.1%) at 7.25 min
- Dibenzo Carbazole 39.0% at 7.80 min
- Gamabufotalin 14.2% at 8.23 min
- Ethylene glycol 21.5% at 9.00 min
- Thiocyanic acid 15.1% at 13.25 min
- Dimethylethlysilane (sliane) 13.8% at 9.00
- Colchicine, benzhaldehyde, and prednisolone after 9 min

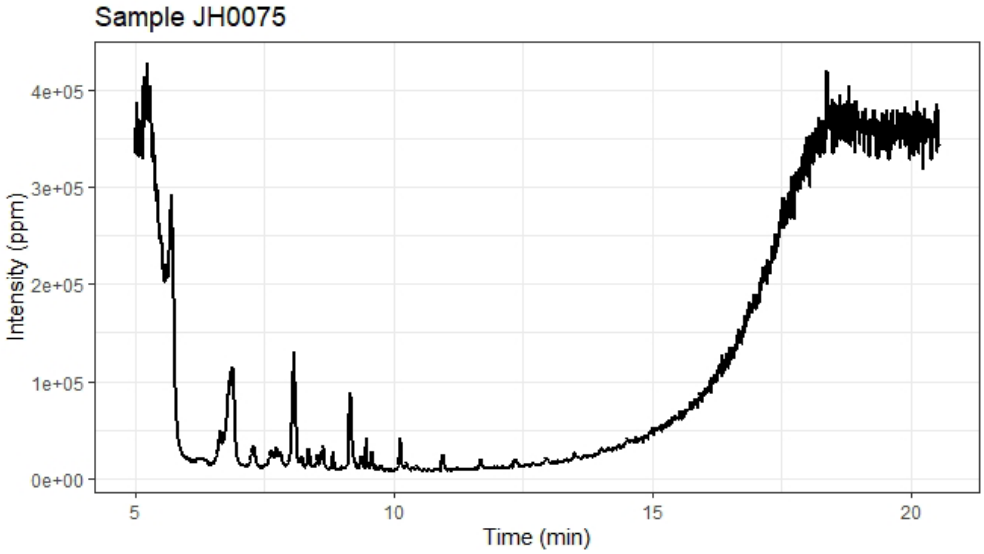




Accession No. 2017.004.00034.000, Lab No. JH0074
(Obverse)


Accession No. 2017.004.00034.000, Lab No. JH0074
(Reverse)

- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 18.5% at 5.72 min
- Dibenzo Carbazole 61.2% at 6.90 min
- Benzaldehyde 23.3 at 7.3 min
- Acetic acid 26.1% at 8.10 min
- Tetramethylsilane 33.8% at 9.17 min
- Isothiocyanic acid 27.8% at 10.13 min
- Gamabufotalin 14.2% at 8.23 min
- Ethylene glycol 21.5% at 9.00 min
- Thiocyanic acid 15.1% at 13.25 min
- Dimethylethlysilane (sliane) 13.8% at 9.00
- Colchicine, benzhaldehyde, and prednisolone after 9 min

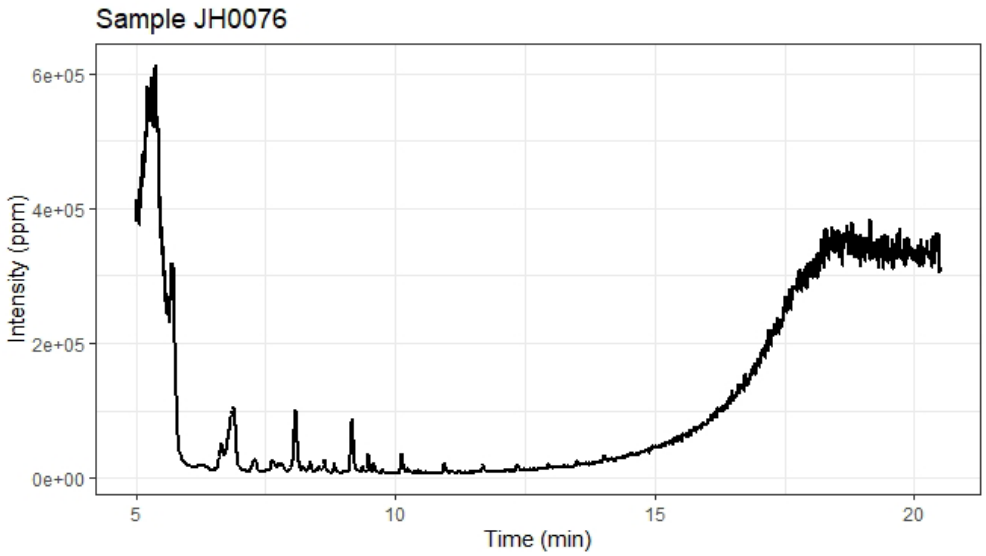


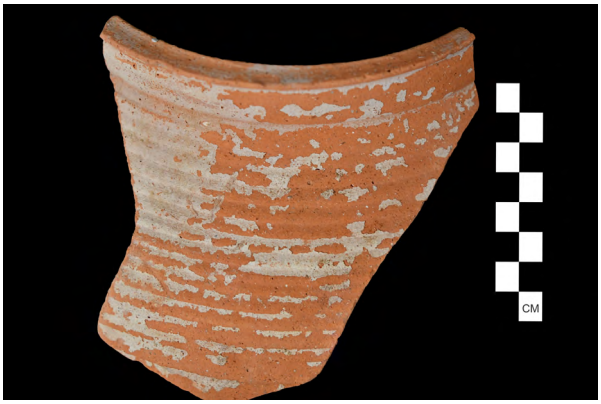


Accession No. 2017.004.0034.000, Lab No. JH0075
(Obverse)


Accession No. 2017.004.0034.000, Lab No. JH0075
(Reverse)

- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 29.4% at 5.71 min
- Dibenzo Carbazole 41.3% at 6.87 min
- Thiocyanic acid 15.0% at 7.29 min
- Ethylene glycol 44.0% at 8.07 min
- Tetramethylsilane 13.8% at 8.63 min
- Thiocyanic acid 24.7% at 9.48 min
- Isothiocyanic acid 48.7% at 10.2 min
- Isothiocyanic acid and benzhaldehyde after 9 min

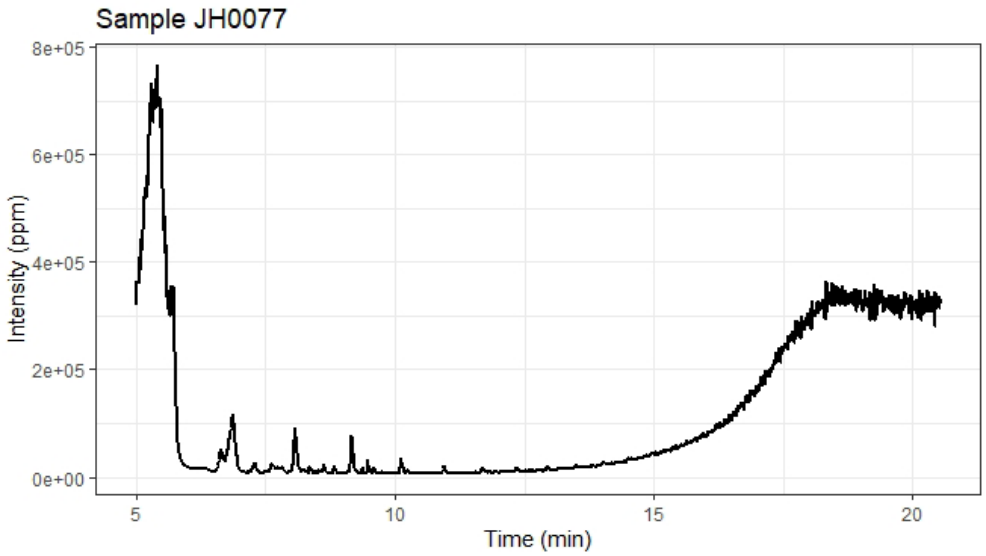



Accession No. 2017.004.0034.000, Lab No. JH0076
(Obverse)


Accession No. 2017.004.0034.000, Lab No. JH0076
(Reverse)

- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 19.4% at 5.71 min
- Dibenzo Carbazole 24.4% at 6.88 min
- Ethylene glycol 16.7% at 7.29 min
- Butyric acid 26.4% at 9.17 min
- Thiocyanic acid 65.2% at 10.95 min
- Isothiocyanic acid and benzhaldehyde after 9 min



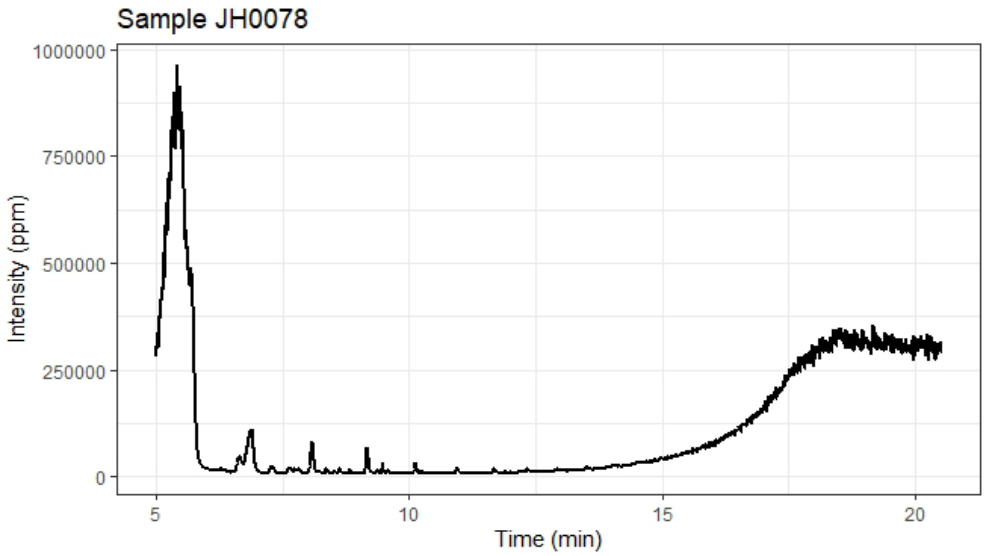


Accession No. 2017.015.00036.151, Lab No. JH0077
(Obverse)


Accession No. 2017.015.00036.151, Lab No. JH0077
(Reverse)

- Acetamide 18.7% at 5.71 min
- Dibenzo Carbazole 31.6% at 6.89 min
- Thiocyanic acid 45.5% at 7.29 min
- Ethylene glycol 17.7% at 8.08min
- Chlorotrimethylsilane 18.9% at 9.17 min
- Ethylene glycol 31.5% at 10.12 min
- 2-Methylmalonodiamide 29.3% at 10.95 min
- benzhaldehyde after 9 min

JH0078

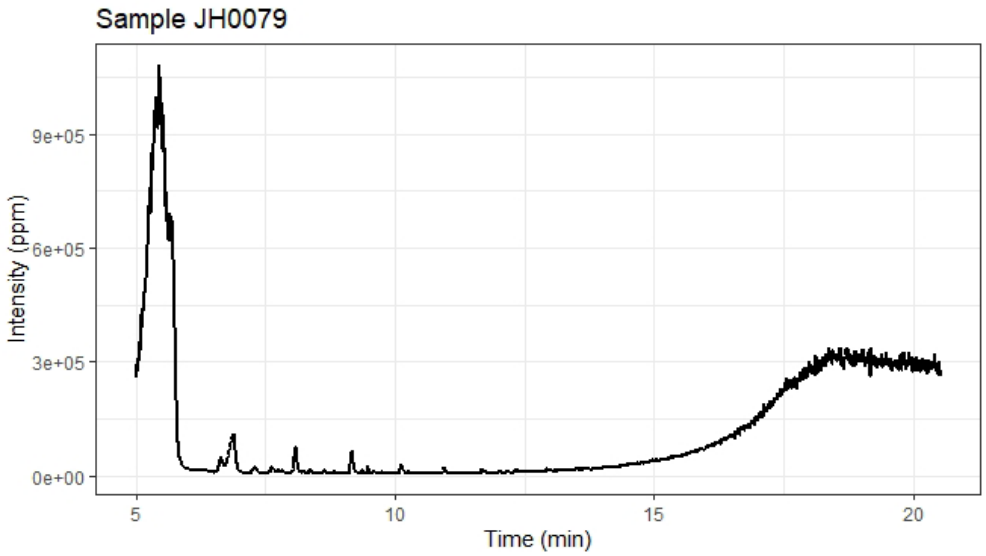




Accession No. 2017.015.00036.002, Lab No. JH0078
(Obverse)


Accession No. 2017.015.00036.002, Lab No. JH0078
(Reverse)

- Acetamide 17.3% at 5.69 min
- Dibenzo Carbazole 30.4% at 6.89 min
- Thiocyanic acid 9% at 7.29 min
- Ethylene glycol 11.2% at 8.08min
- Ethylene glycol 17.9% at 9.17 min
- Thiocyanic acid 17.8% at 9.48 min
- Thiocyanic acid 59.6% at 10.96 min
- benzhaldehyde after 9 min

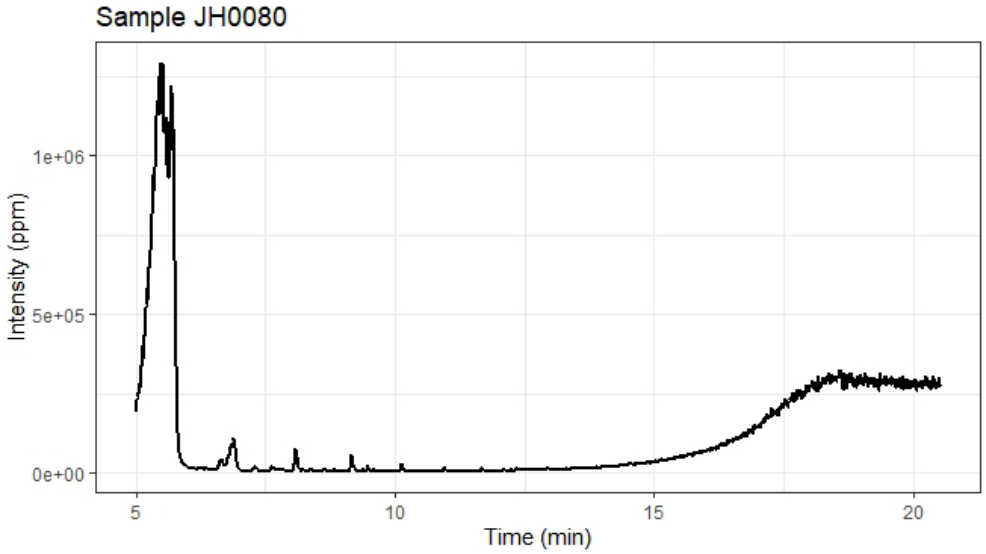




Accession No. 2017.015.00036.001, Lab No. JH0079
(Obverse)


Accession No. 2017.015.00036.001, Lab No. JH0079
(Reverse)

- Acetamide 17.6% at 5.44-5.65 min
- Dibenzo Carbazole 33.6% at 6.89 min
- Acetic acid, ethyl ester 15.0% at 8.08 min
- 2-Heptyl-1,3-dioxolane 23.2% at 9.17 min
- Colchicine and benzhaldehyde after 9 min

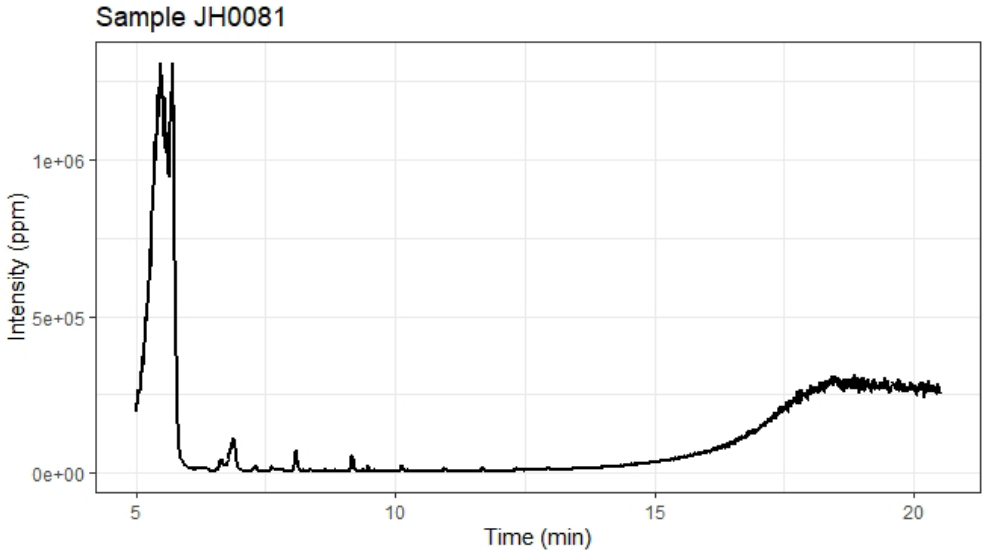




Accession No. 2017.015.00036.150, Lab No. JH0080 (Obverse)


Accession No. 2017.015.00036.150, Lab No. JH0080 (Reverse)

- Acetamide (N-Acetylcolchinol) 24.4% at 5.52-5.68 min
- Dibenzo carbazole 69.5% at 6.64 min
- Acetic acid (n-Butyl acetate) 27.3% (Dibenzo Carbazole 23.1%) at 6.89 min
- Thiocyanic acid 25.7% at 7.30 min
- Ethylene glycol 13% at 8.08 min
- 2-Heptyl-1,3-dioxolane 27.2% at 9.16 min

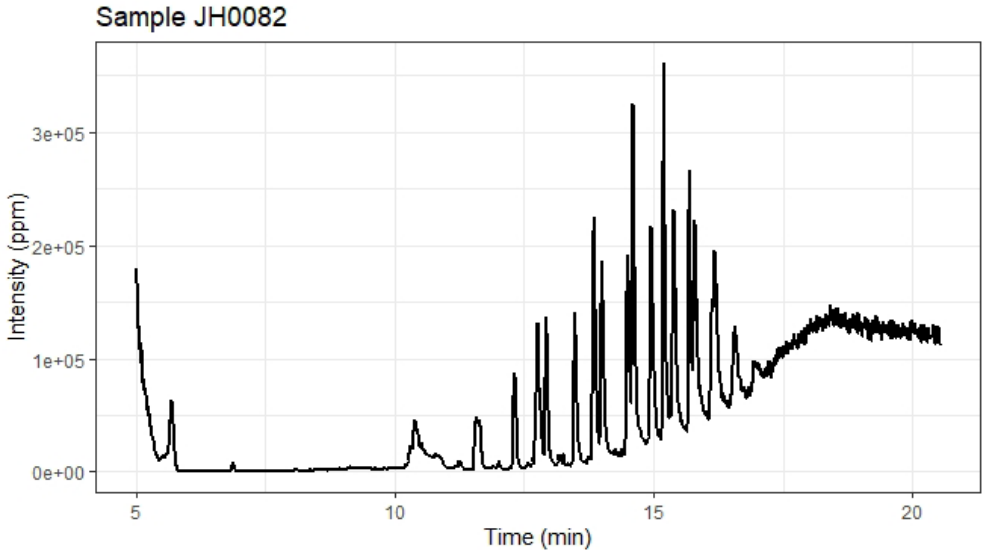




Accession No. 2017.015.00036.013, Lab No. JH0081
(Obverse)


Accession No. 2017.015.00036.013, Lab No. JH0081
(Reverse)

- Acetamide (N-Acetylcolchinol) 17.7% at 5.52-5.68 min
- Dibenzo carbazole 63.2% at 6.64-6.89 min
- Gamabufotalin 8.4% at 7.29 min
- Acetic acid (Ethyl acetate) 10.3% at 8.09
- Colchicine 11% at 9.17 min
- Isobutyric acid (Propanoic acid) 54.6% at 10.13 min
- Colchicine and benzaldehyde after 10 min

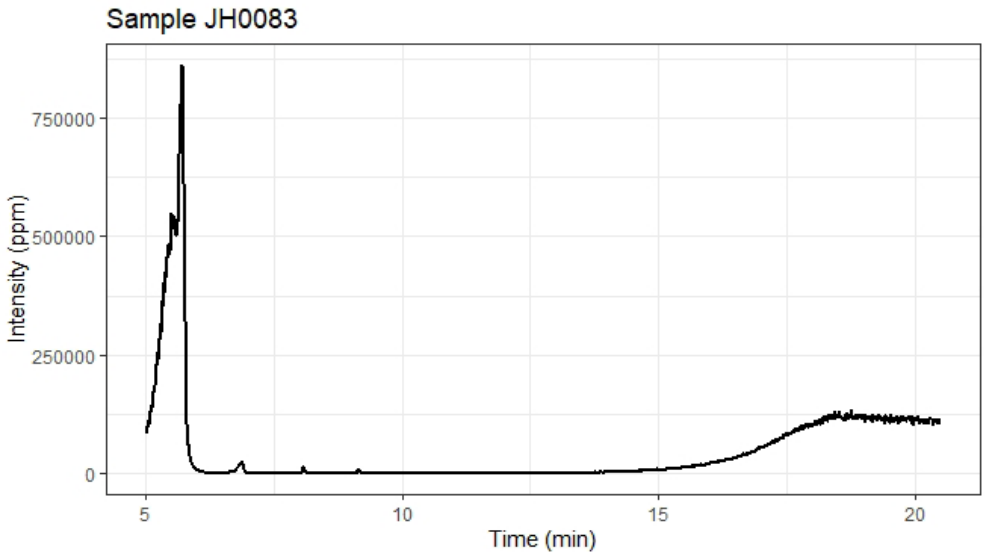




Accession No. 2017.015.00036.028, Lab No. JH0082
(Obverse)


Accession No. 2017.015.00036.028, Lab No. JH0082
(Reverse)

- Ben[j]aceanthrylen-1-ol, 1,2-dihydro-3-methyl 14.6% at 5.69 min
- Ethylene glycol 26.95% (2-Heptyl-1,3-dioxolane 26.95%) at 6.88 min
- 2-Propenoic acid (Acrylic acid butyl ester) 19.0% at 10.40 min
- Formic acid, isopropyl ester 15.8% (2-Bromomethyl- 1,3-dioxolane 17.1%) at 11.58 min
- Cyclobutanecarboxylic acid, 13.8% (2-Bromomethyl- 1,3-dioxolane 16.4%) at 12.31 min
- 2-Heptyl-1,3-dioxolane 37.8% at 12.31 min
- Propionic acid, 3-chloro- 17.5% (2-Heptyl-1,3-dioxolane 20.7%) at 12.76 min
- Acrylic acid butyl ester (2-Propenoic acid) 36.6% at 13.49 min
- Cyclobutanecarboxylic acid, 15.3% (2-Bromomethyl- 1,3-dioxolane 15.9%) at 13.85 min and continues to 15 min

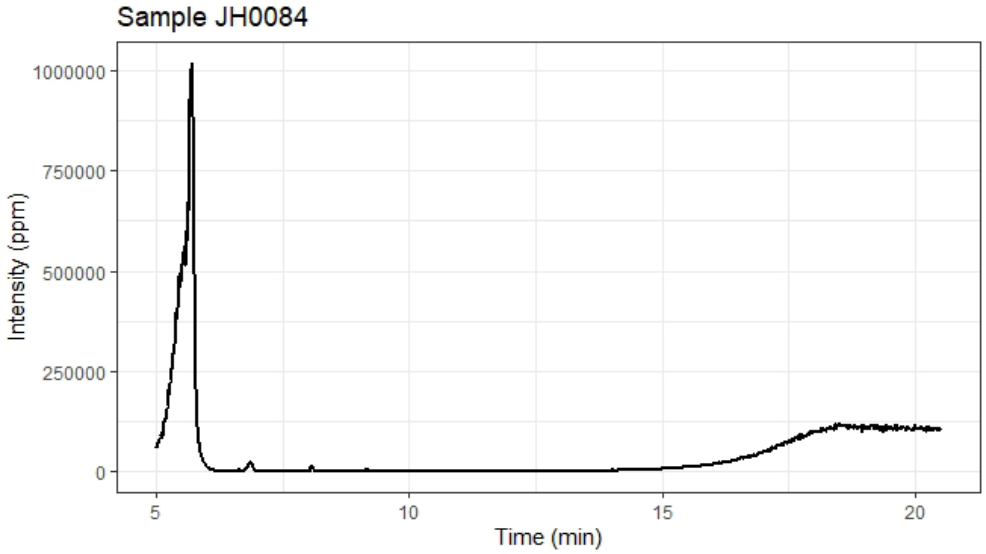




Accession No. 2017.015.00036.010, Lab No. JH0083
(Obverse)


Accession No. 2017.015.00036.010, Lab No. JH0083
(Reverse)

- Acetamide 17.9% at 5.71 min
- Propanoic acid, 3-chloro 25.7% (2-Bromomethyl-1,3-dioxolane 25.7%) at 6.87 min
- Butanoic (Butyric acid) 37.0% at 8.06 min
- Methylmercuric bromide 31.6% at 9.15 min

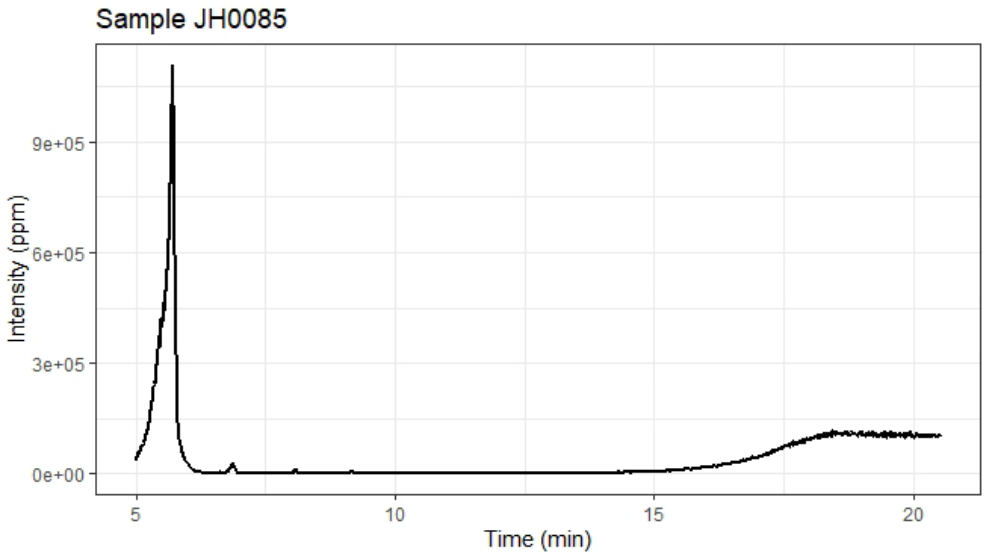




Accession No. 2017.015.00029.002, Lab No. JH0084
(Obverse)


Accession No. 2017.015.00029.002, Lab No. JH0084
(Reverse)

- Acetamide 18.5% at 5.72 min
- Dibenzo Carbazole 45.3% at 6.88 min
- Phosphoramidic acid (Diphenyl anilinophosphonate) 58.5% at 8.06 min
- Arsenic trichloride 66.7% at 9.16 min
- Benzaldehyde after 9 min

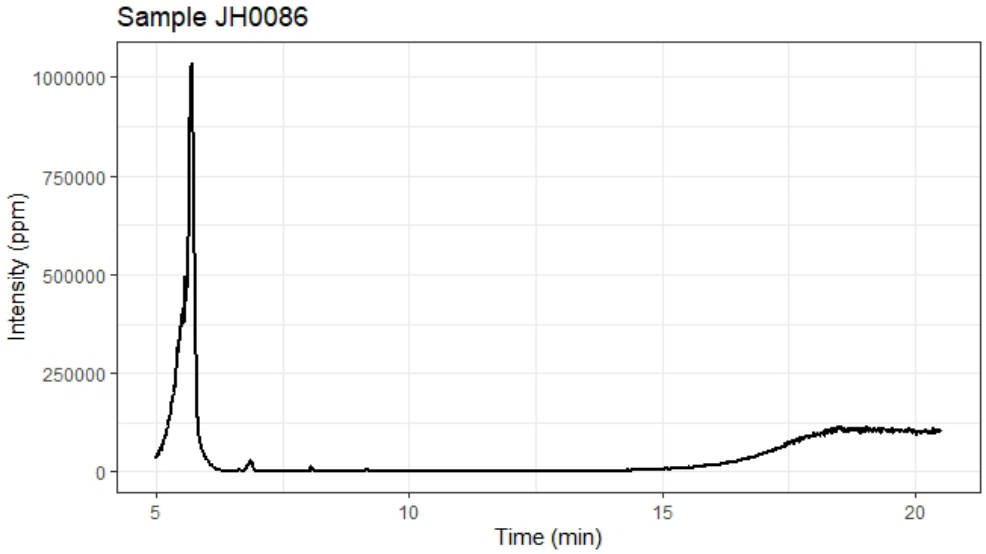


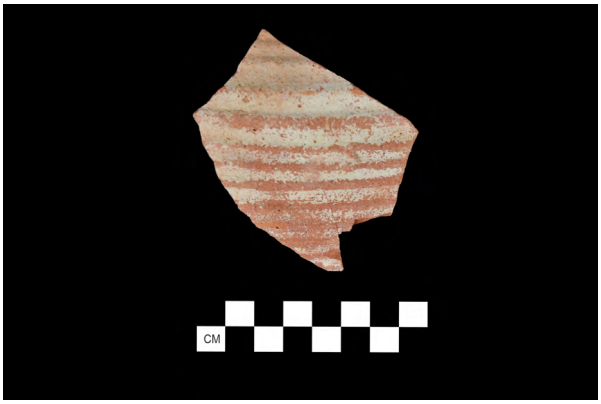


Accession No. 2017.015.00029.056, Lab No. JH0085
(Obverse)


Accession No. 2017.015.00029.056, Lab No. JH0085
(Reverse)

- Acetamide 20.0% at 5.71 min
- Sulfisoxazole Acetyl 18.6% at 6.88 (Dibenzo Carbazole 12.3% at 6.88 min)
- Acetic acid, sec-butyl ester 61.4% at 8.07 min
- Methylmercuric bromide 20.9% at 9.16 min
- Benzaldehyde after 9 min

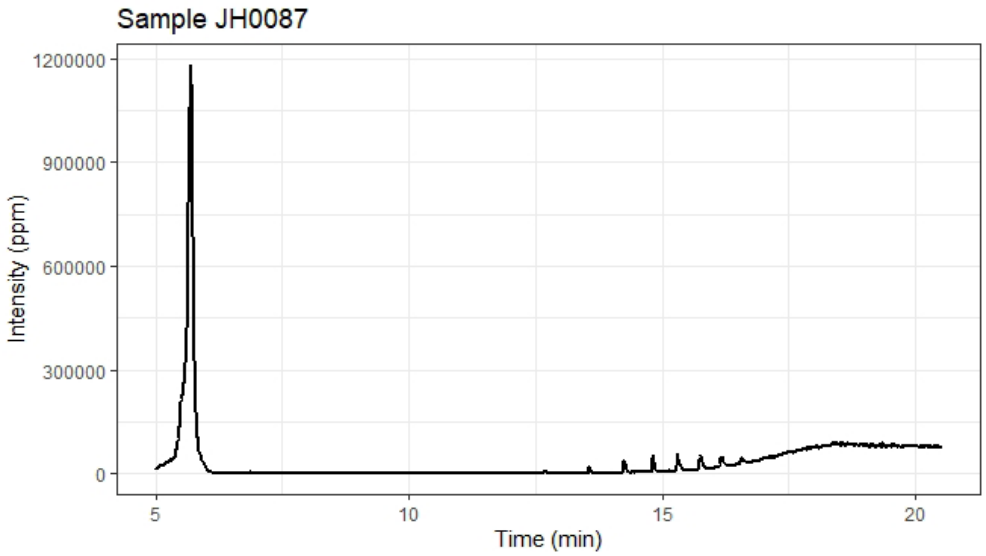


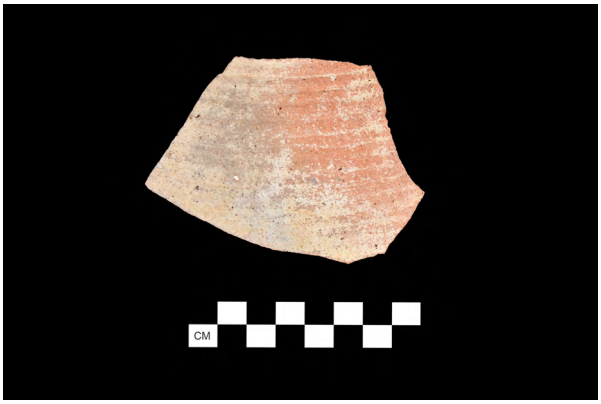




Accession No. 2017.015.00029.003, Lab No. JH0086
(Obverse)


Accession No. 2017.015.00029.003, Lab No. JH0086
(Reverse)

- Acetamide 13.5% at 5.71 min
- Dibenzo Carbazole 42.7% at 6.87 min
- Acetic acid, sec-butyl ester 66.8% at 8.07 min
- Methylmercuric bromide 33.2% at 9.16 min
- Benzaldehyde after 9 min

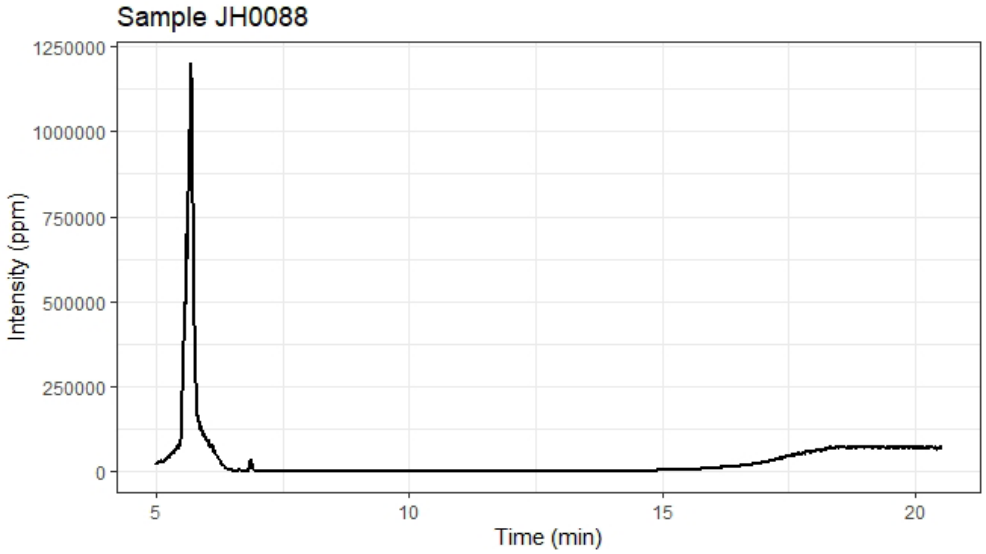



Accession No. 2017.015.00029.023, Lab No. JH0087
(Obverse)


Accession No. 2017.015.00029.023, Lab No. JH0087
(Reverse)

- Acetamide 19.5% at 5.71 min
- Sulfisoxazole Acetyl 14.3% at 6.88 (Dibenzo Carbazole 13.7% at 6.88 min)
- Acetic acid, sec-butyl ester 41.0% at 8.07 min
- Methylmercuric bromide 16.3% at 9.16 min
- Benzaldehyde after 9 min

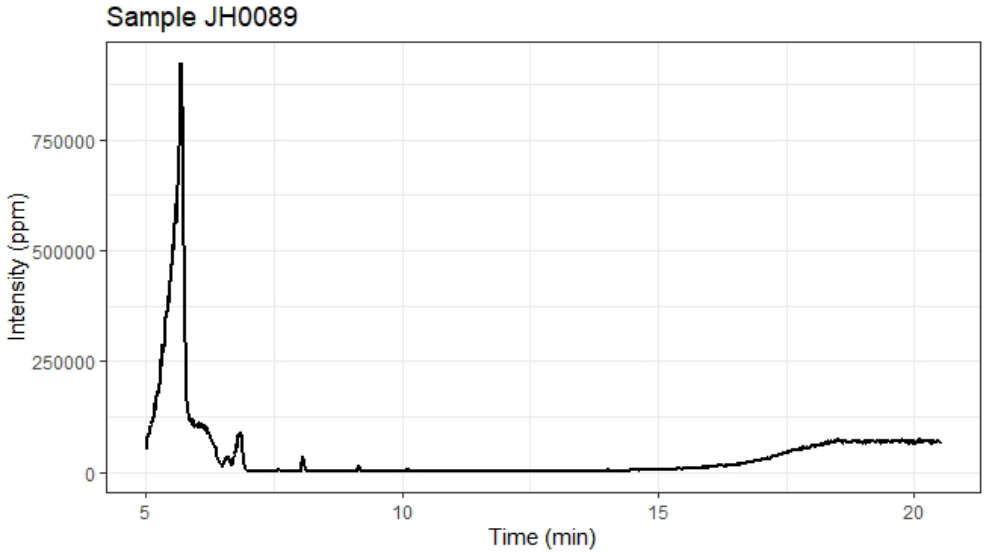


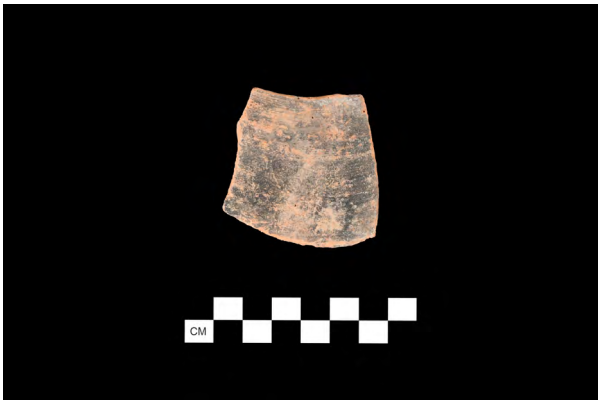


Accession No. 2017.015.00029.144, Lab No. JH0088 (Obverse)


Accession No. 2017.015.00029.144, Lab No. JH0088 (Reverse)

- Acetamide 19.5% (Methylmercuric bromide at 28.1%) at 5.69 min
- Acetic acid, sec-butyl ester 44.7% at 6.87 min (Propionic and dibenzo carbazole have better matches, but are 9.1 and 6.9%)
- Acetic acid, sec-butyl ester 35.6% at 8.08 min (Bufatolin, I think has a better match, but is only at 9.13%)
- Benzaldehyde after 9 min

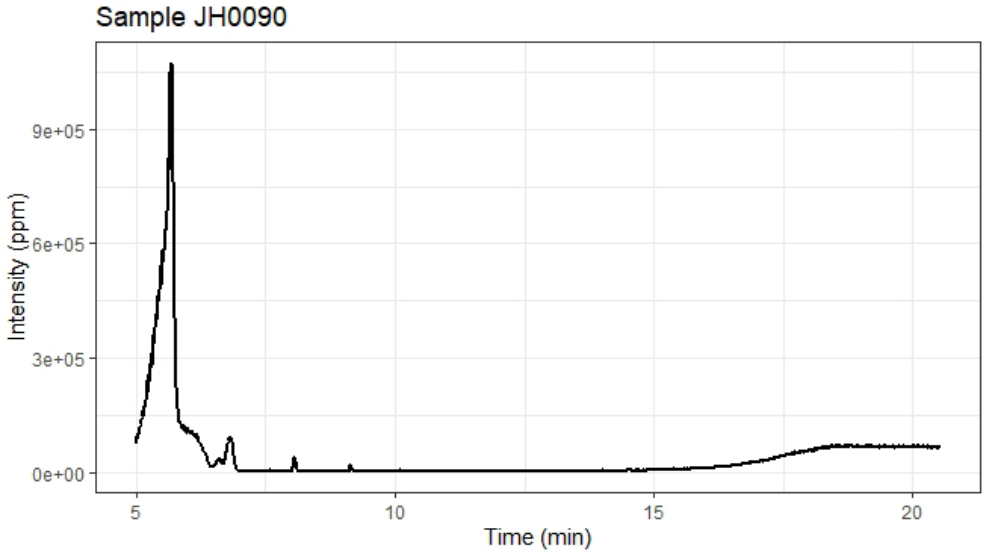



Accession No. 2017.015.00031.010, Lab No. JH0089
(Obverse)


Accession No. 2017.015.00031.010, Lab No. JH0089
(Reverse)

- Acetamide 18.2% (Colchicine 19.8%) at 5.68 min
- Acetic acid, sec-butyl ester 44.6% at 6.84 min (Dibenzo carbazole 28.8%)
- Diphenyl anilinophosphonate (Phosphoramidic acid) 60.4% at 7.60 min
- Propanoic acid (Propionic acid) 3-chloro 18.3% at 8.07 min
- Methylmercuric bromide 43.5% at 9.16 min
- Benzaldehyde after 9 min

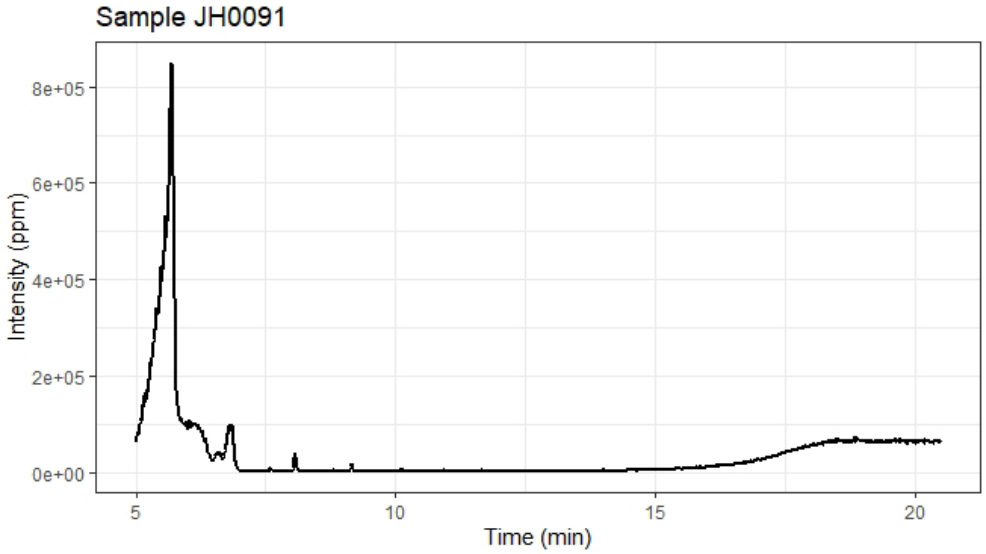


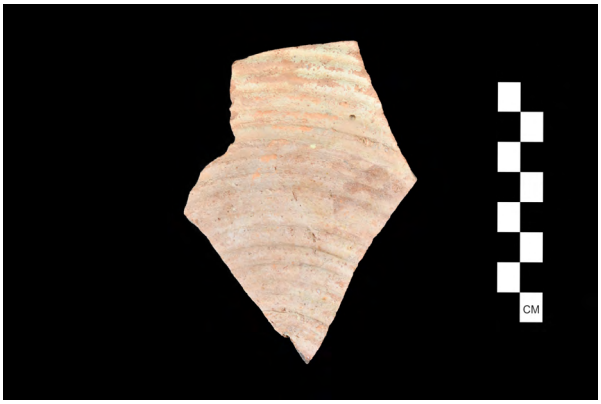


Accession No. 2017.015.00031.014, Lab No. JH0090 (Obverse)


Accession No. 2017.015.00031.014, Lab No. JH0090 (Reverse)

- Acetamide 23.6% at 5.70 min
- Propanoic acid (Propionic acid) 3-chloro 30.9% (Dibenzo carbazole 21.2%) at 6.82 min
- Methylmercuric bromide 43.5% at 8.07 min
- Methylmercuric bromide 44.9% at 9.15 min
- Butane 1,1'-[oxybis(2,1-ethanediyloxy)]bis- Ether, bis(2-butoxyethyl) 60.4 at 10.10 min
- Benzaldehyde after 9 min

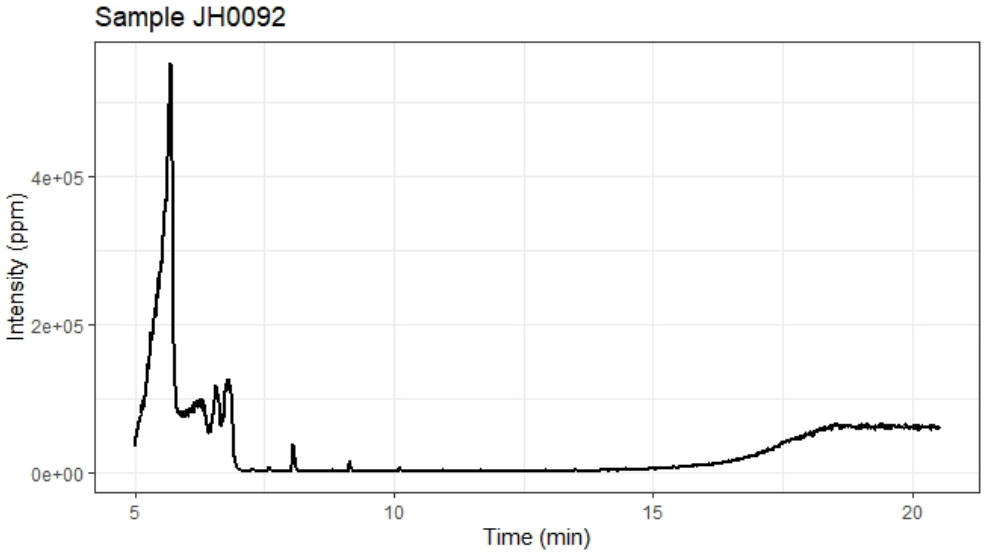


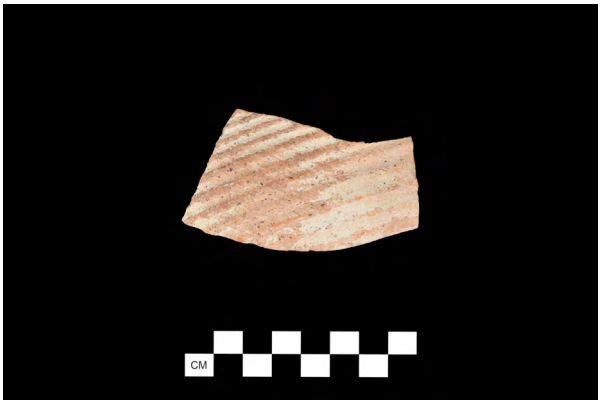




Accession No. 2017.015.00031.060, Lab No. JH0091
(Obverse)


Accession No. 2017.015.00031.060, Lab No. JH0091
(Reverse)

- Acetamide 24.9% at 5.69 min
- Acetic acid, sec-butyl ester 27.0% (Dibenzo Carbazole 26.0%) at 6.84 min
- Diphenyl anilinophosphonate (Phosphoramidic acid) 60.4% at 7.60 min
- Acetic acid, sec-butyl ester 13.5% at 8.07 min
- Dipropylamine 21.1% at 9.16 min
- Methylmercuric bromide 23.2% at 10.11 min
- Benzaldehyde after 9 min

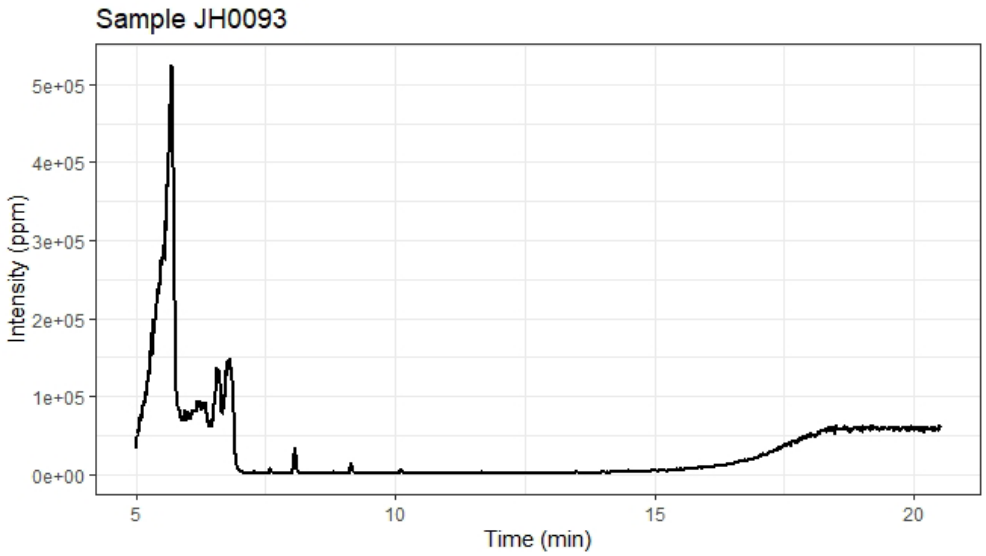



Accession No. 2017.015.00031.005, Lab No. JH0092
(Obverse)


Accession No. 2017.015.00031.005, Lab No. JH0092
(Reverse)

- Acetamide 16.7% (Colchicine 23.4%) at 5.68 min
- Dibenzo Carbazole 26.0% at 6.81 min
- Methylmercuric bromide 30.1% at 9.15 min
- Acrylic acid 40.1% at 8.86 min
- Sulfisoxazole Acetyl 36.1% at 10.11
- Diphenyl anilinophosphonate (Phosphoramidic acid) 58.3% at 7.60 min
- Benzaldehyde after 9 min

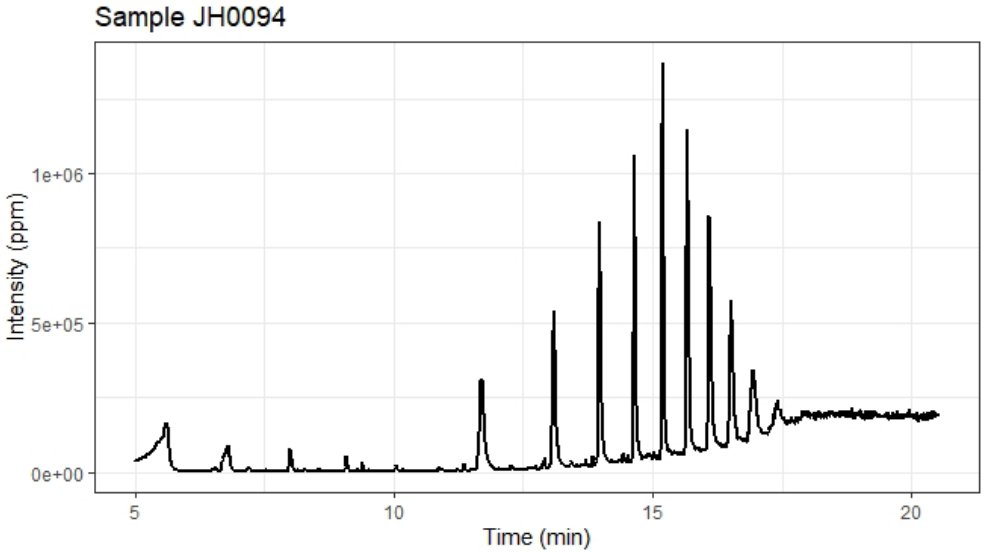


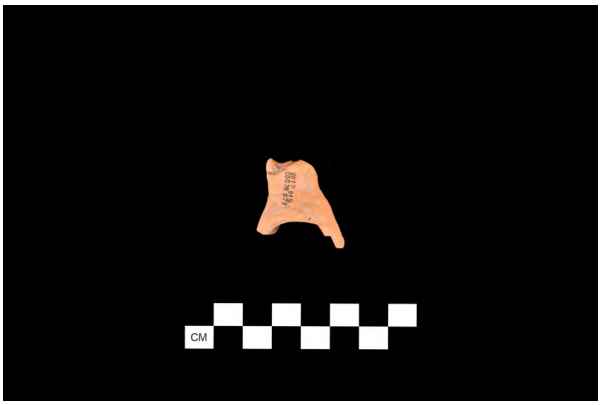


Accession No. 2017.015.00031.051, Lab No. JH0093 (Obverse)

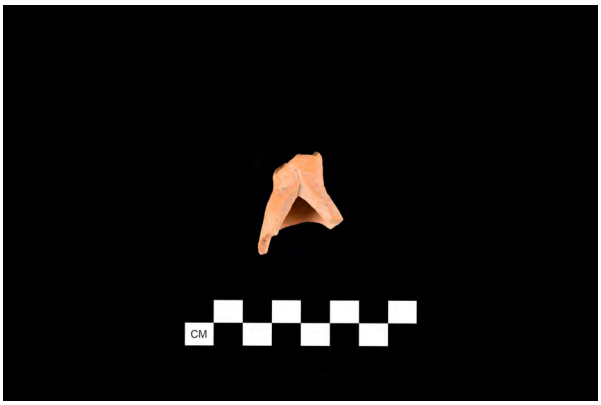

Accession No. 2017.015.00031.051, Lab No. JH0093 (Reverse)

- Acetamide 21.4% (Colchicine 29.5%) at 5.69 min
- Stannane, fluorotriisobutyl- (Triisobutyl tin fluoride) 16.2% at 6.19 min
- Dibenzo Carbazole 68.0% at 6.61 min
- Acetic acid, sec-butyl ester 42.9% at 6.81 min
- Diphenyl anilinophosphonate (Phosphoramidic acid) 37.3% at 7.59 min
- Acetic acid, sec-butyl ester 43.0% at 8.06 min
- Methylmercuric bromide 26.1% at 9.15 min
- 1-Naphtahlenamine, N-phenyl 33.4% at 10.11
- Benzaldehyde after 9 min



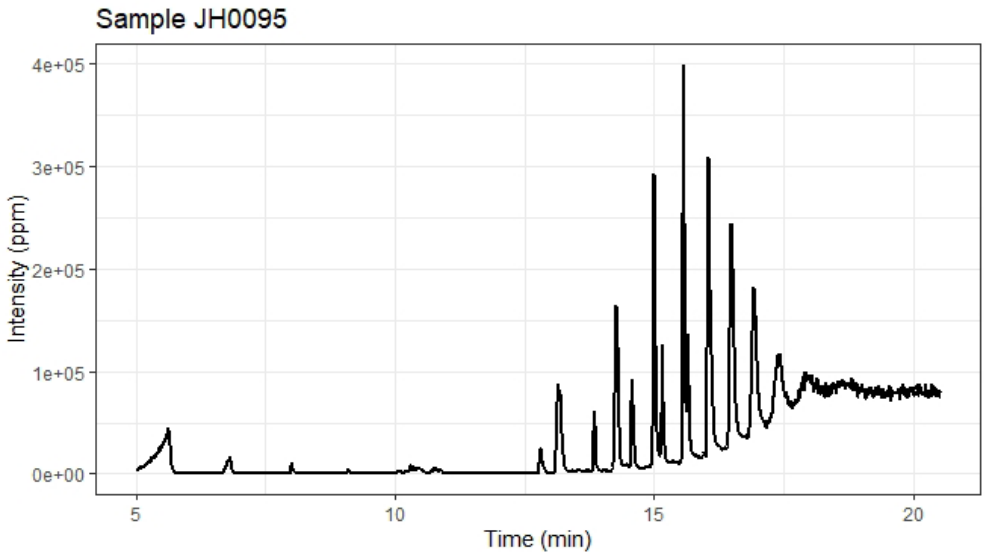




Accession No. 2017.015.00038.077, Lab No. JH0094 (Obverse)




Accession No. 2017.015.00038.077, Lab No. JH0094 (Reverse)

- Diphenyl anilinophosphonate (Phosphoramidic acid) 32.5% at 5.62 min
- 1,3-Dioxolane, 2-(bromomethyl)- 15.9% (Dibenzo carbazole 14.6%) at 6.80 min
- Propanoic acid, 3-chloro (Propionic acid) 27.5% at 8.00 min
- Acetic acid sec-butyl ester 70.0% at 9.08 min
- Colchicine 16.4% at 9.39 min
- 2-Methylmalonamide 31% at 11.71 min
- Isothiocyanic acid 11.9% at 13.09 min
- 2-Methylmalonamide 32.4% at 13.97 min
- Hexacosane 15.3% (n-Eicosane 11.1%) at 14.64 min
- Phenol, m-iodo 16.9% at 15.19 min
- Methylmercuric bromide 14.3% at 15.67 min
- Sulfameter 11.4% at 16.52
- Benzaldehyde after 16.94 min



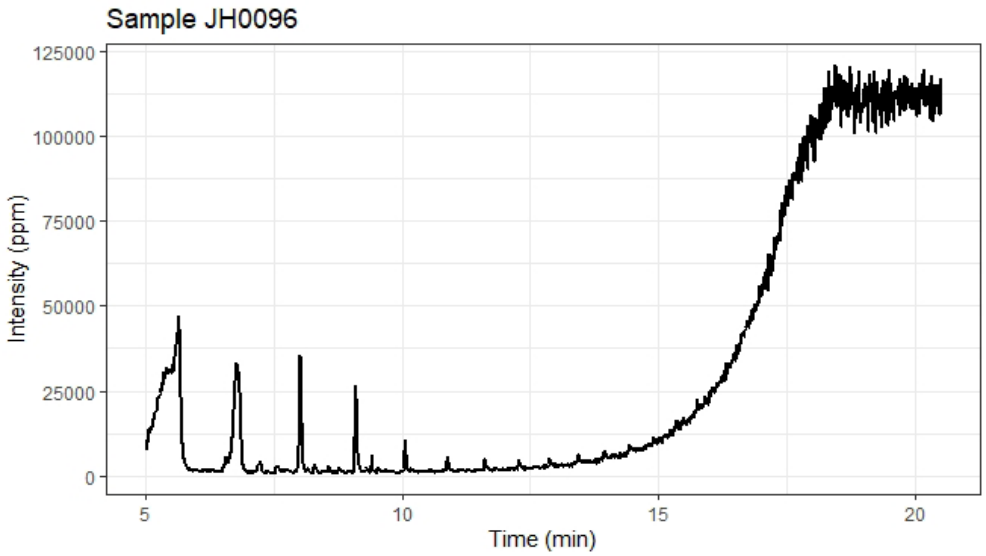


Accession No. 2017.015.00038.075, Lab No. JH0095
(Obverse)


Accession No. 2017.015.00029.056, Lab No. JH0085
(Reverse)

- Anticoagulans 63 (2H,5H-Pyrano[3,2-c][1]benzopyran-5-one, 3,4-dihydro-2-methoxy-2-methyl-4-phenyl) 33.3% at 5.63
- Acetic acid 25.2% at 6.81
- Propane, 2-methoxy-2mehtyl- (Ether, tert-butyl methyl) 41.9% at 8.01 min
- Methylmercuric bromide 40.1% at 9.10 min
- Isobutyric acid (Propanoic acid) 44.1% at 10.31
- Propionic acid, 3-chloro 16.8% at 12.81 min
- 2-Heptyl-1,3-dioxolane 18.3% at 13.16 min
- Propionic acid, 3-chloro 13.7% (2-Heptyl-1,3-dioxolane 13.2%) at 14.27 min
- Methylmercuric bromide 43.9% at 14.55 min

- Silane (Tert-Butyldiphenylchlorosilane) 16.8% at 16.05
- Phenol, m-iodo 8.9% at 16.49 min
- Phenol, m-iodo 8.9% at 16.93 min
- Triisophophyolophosphate (Phosphoric acid, tris(1-methylethyl)ester 17.3% at 17.43 min
- Stannane, fluorotriisobutyl- (Triisobutyl tin fluoride) 16.2% at 6.19 min
- Dibenzo Carbazole 68.0% at 6.61 min
- Acetic acid, sec-butyl ester 42.9% at 6.81 min

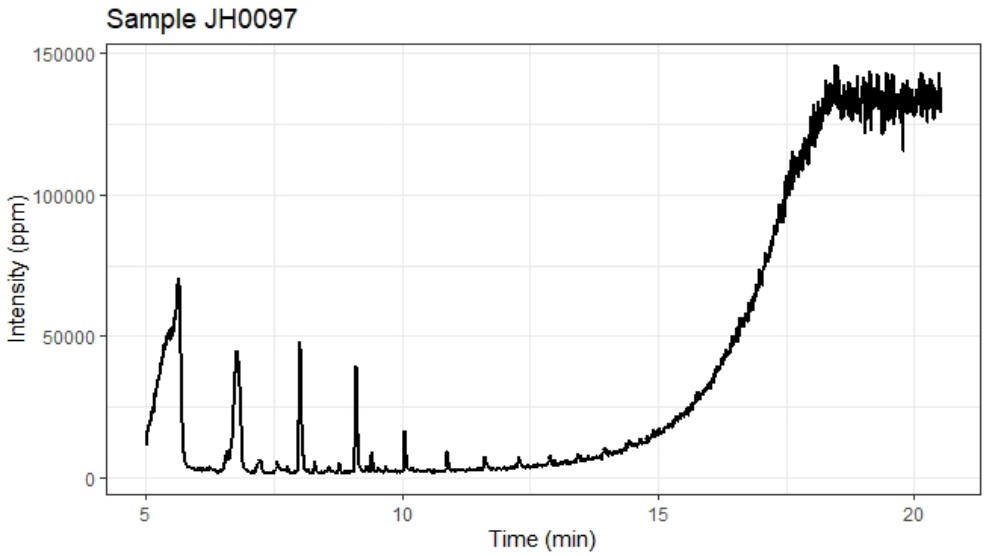




Accession No. 2017.015.00038.079, Lab No. JH0096 (Obverse)


Accession No. 2017.015.00038.079, Lab No. JH0096 (Reverse)

- Anticoagulans 63 (2H,5H-Pyrano[3,2-c][1]benzopyran-5-one, 3,4-dihydro-2-methoxy-2-methyl-4-phenyl) 27.7% at 5.64
- Acetic acid, sec-butyl ester 24.7% at 6.78 min
- Acrylic acid (2-Propenoic acid, oxiranylmethyl ester) 35.5% at 7.23 min
- Tert-Butylacrbinol 21.7% at 8.01 min
- Diphenyl anilinophosphonate (Phosphoramidic acid) 90.5% at 8.29 min
- Methylmercuric bromide 15.0% at 9.10 min
- Isothiocyanic acid 11.4% at 10.06 min
- Benzaldehyde after 9 min

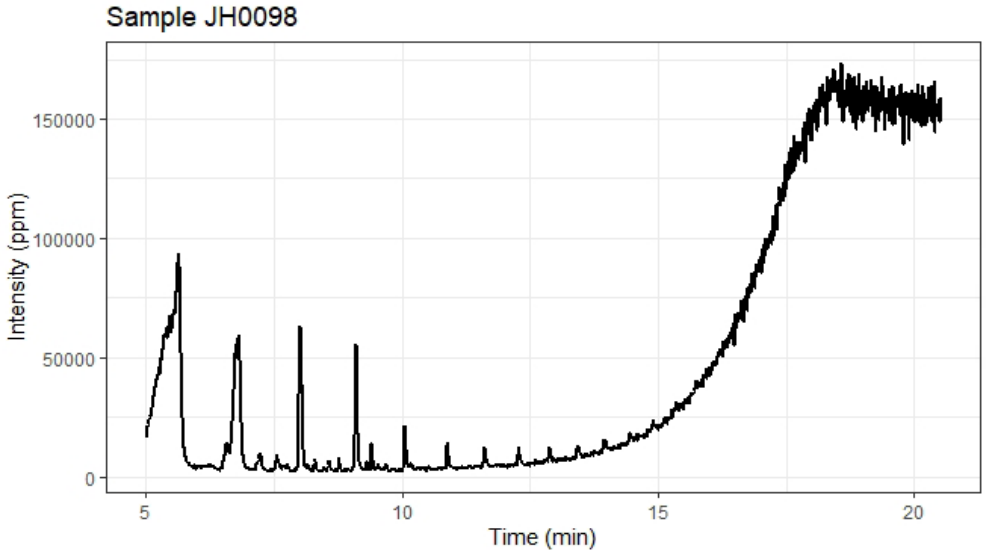


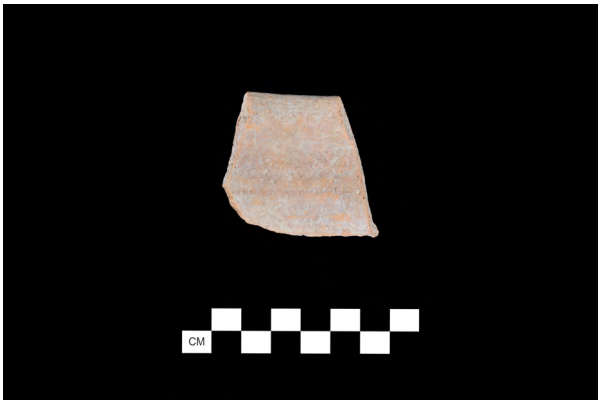


Accession No. 2017.015.00038.079, Lab No. JH0096
(Obverse)


Accession No. 2017.015.00038.079, Lab No. JH0096
(Reverse)

- Methylmercuric bromide 52.6% at 5.64 min
- Acetic acid, sec-butyl ester 18.9% (Dibenzo Carbazole 14.1%) at 6.78 min
- 2-Heptyl-1,3-dioxolane 15.6% (Acetic acid 13.2%) at 8.01 min
- Ethane 16.6% at 9.10 min
- Sulfameter (5-Methoxysulfadizine) 10.9% at 10.89 min
- Benzaldehyde after 11 min

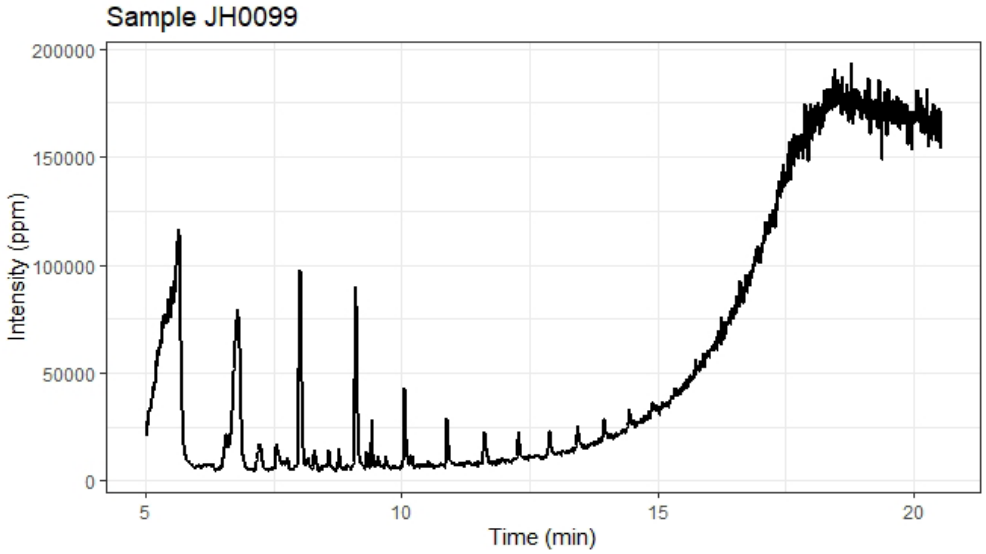



Accession No. 2017.015.00038.061, Lab No. JH0098
(Obverse)


Accession No. 2017.015.00038.061, Lab No. JH0098
(Reverse)

- Methylmercuric bromide 44.9% at 5.64 min
- Dibenzo Carbazole 22.5% (Ethane, 1,1’-oxybis[2-ethoxy-] 22.5%) at 6.81 min
- Butanal (Butyraldehyde) 23.7% (Diethylmethylsilane 22.8%) at 7.24 min
- 1,3-Dioxolane, 2-(bromomethyl)- 18.0% (acetic acid 16.6%) at 8.02 min
- Methylmercuric bromide 16.3% at 9.11 min
- Tetramethylsilane 12.2% at 9.45 min
- 1,3-Dioxolane, 2-(bromomethyl)- 35.0% at 10.06 min
- Benzaldehyde after 11 min

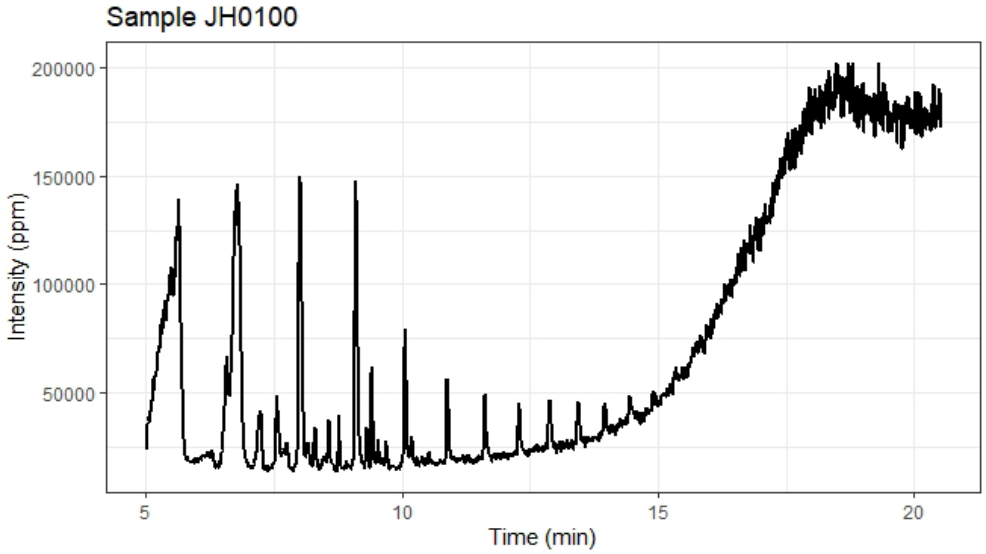




Accession No. 2017.015.00038.026, Lab No. JH0099
(Obverse)


Accession No. 2017.015.00038.026, Lab No. JH0099
(Reverse)

- Methylmercuric bromide 39.3% at 5.65 min
- Dibenzo Carbazole 34.9% (Ethane, 1,1’-oxybis[2-ethoxy-] 23.2%) at 6.80 min
- Isothiocyanic acid 16.9% at 7.57 min
- Propanoic acid (propionic acid, 3-chloro) 13.7% at 8.02 min
- Tetramethylsilane 13.2% at 9.10 min
- Tetramethylsilane 13.2% at 10 min
- Benzaldehyde after 11 min

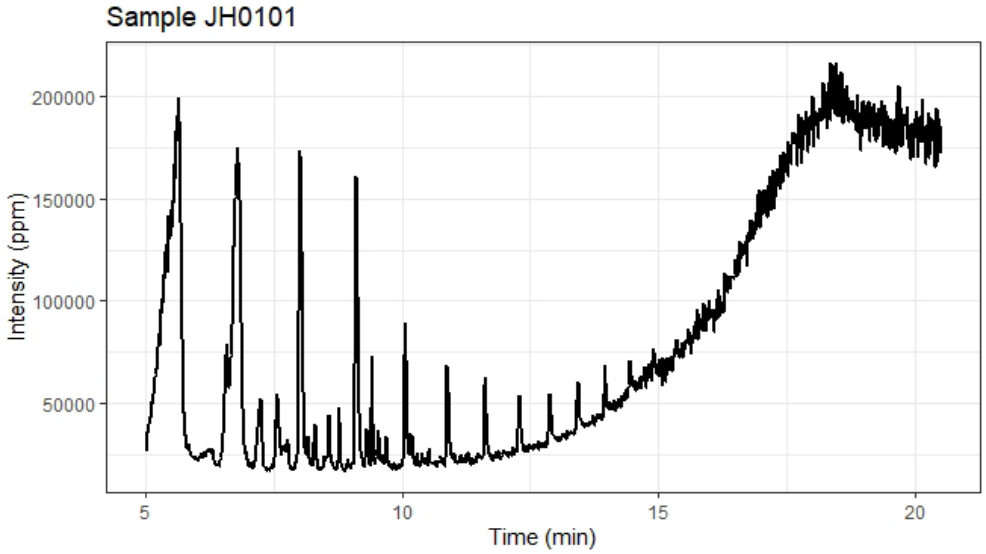




Accession No. 2017.015.00038.018, Lab No. JH0100 (Obverse)


Accession No. 2017.015.00038.018, Lab No. JH0100 (Reverse)

- Methylmercuric bromide 55.9 at 5.63 min
- Ethane, 1,1'-oxybis[2-ethoxy-] 27.6% (Formic acid and dibenzo carbazole at 10.1%) at 6.79 min
- Dibenzo Carbazole 43.1% at 6.79 min
- Chlrorotrimethylsilane 11.3 (Butylamine 11.3%) at 7.20 min
- Chlrorotrimethylsilane 13.3 (Butylamine 16.5%) at 7.56 min
- Butyric acid (Butanoic acid) 12.8% (2-Heptyl-1,3-dioxolane 12.3%) at 8.00 min
- Methylmercuric bromide 24.1 at 9.10 min
- Thyocyanic acid (methyl sulfocyanate) 15.2% at 9.49 min
- Tetramethylsilane 12.3% at 10.06 min
- Benzaldehyde and thiocyanic acid after 11 min

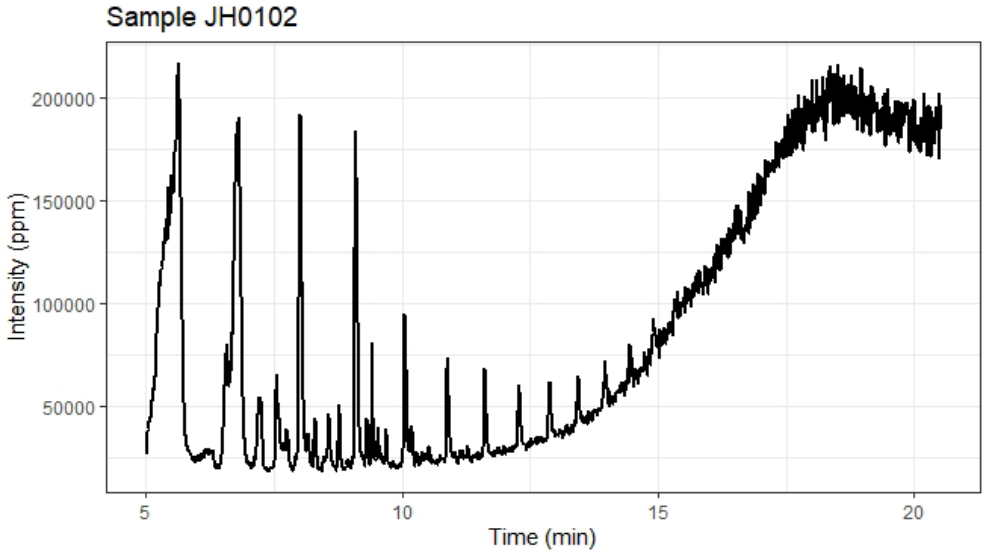




Accession No. 2017.015.00038.043, Lab No. JH0101
(Obverse)


Accession No. 2017.015.00038.043, Lab No. JH0101
(Reverse)

- Methylmercuric bromide 55.9 at 5.63 min
- Ethane, 1,1'-oxybis[2-ethoxy-] 27.6% (Formic acid and dibenzo carbazole at 10.1%) at 6.79 min
- Dibenzo Carbazole 43.1% at 6.79 min
- Chlrorotrimethylsilane 11.3 (Butylamine 11.3%) at 7.20 min
- Chlrorotrimethylsilane 13.3 (Butylamine 16.5%) at 7.56 min
- Butyric acid (Butanoic acid) 12.8% (2-Heptyl-1,3-dioxolane 12.3%) at 8.00 min
- Methylmercuric bromide 24.1 at 9.10 min
- Thyocyanic acid (methyl sulfocyanate) 15.2% at 9.49 min
- Tetramethylsilane 12.3% at 10.06 min
- Benzaldehyde and thiocyanic acid after 11 min

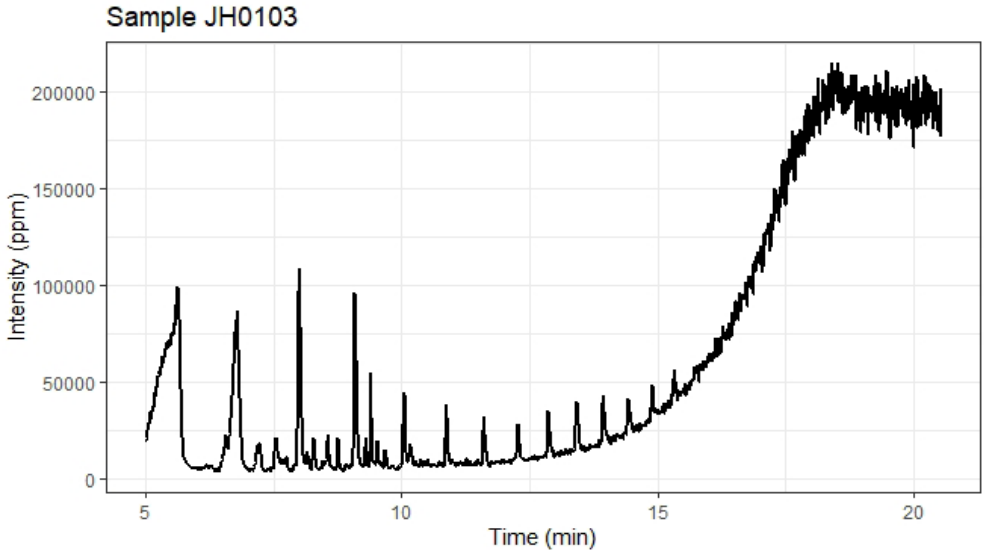




Accession No. 2017.015.00038.037, Lab No. JH0102
(Obverse)


Accession No. 2017.015.00038.037, Lab No. JH0102
(Reverse)

- Methylmercuric bromide 49.3 at 5.65 min
- Acetic acid (Butanoic acid, 2-ethyl-) 12.6% (Dibenzo carbazole 12.1%) at 6.81 min
- Tetramethylsilane 16.3% at 7.20 min
- Thyocyanic acid (methyl sulfocyanate) 15.4% at 7.56 min
- Propanoic acid 3-chloro (Propionic acid) 35.1% at 8.01 min
- Ethane, 1,1'-oxybis[2-ethoxy-] 11.7% at 9.10 min
- 2-Methylmalonamide 11.7% at 10.06 min
- Benzaldehyde and thiocyanic acid after 11 min

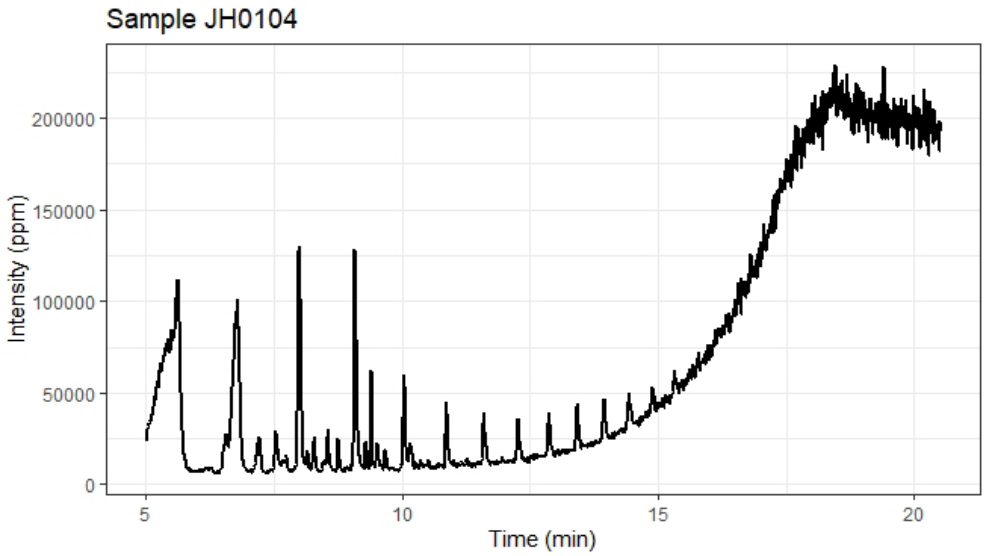




Accession No. 2017.015.00038.063, Lab No. JH0103
(Obverse)


Accession No. 2017.015.00038.063, Lab No. JH0103
(Reverse)

- Diphenyl anilinophosphonate (Phosphoramidic acid) 54.5% at 5.62 min
- Dibenzo carbazole 18.7% at 6.79 min
- Acetic acid (Ethyl acetate) 40.1% at 7.20 min
- Thyocyanic acid (methyl sulfocyanate) 18.8% at 7.54 min
- 1,3-Dioxolane, 2-(bromomethyl)- 32.4% at 8.00 min
- 1,3-Dioxolane, 2-(bromomethyl)- 37.2% at 9.08 min
- Isobutyric acid (propanoic acid, 2-methyl-) 17.0% at 9.40 min
- Isothiocyanic acid 12.7% at 10.05 min
- Benzaldehyde and thiocyanic acid after 11 min

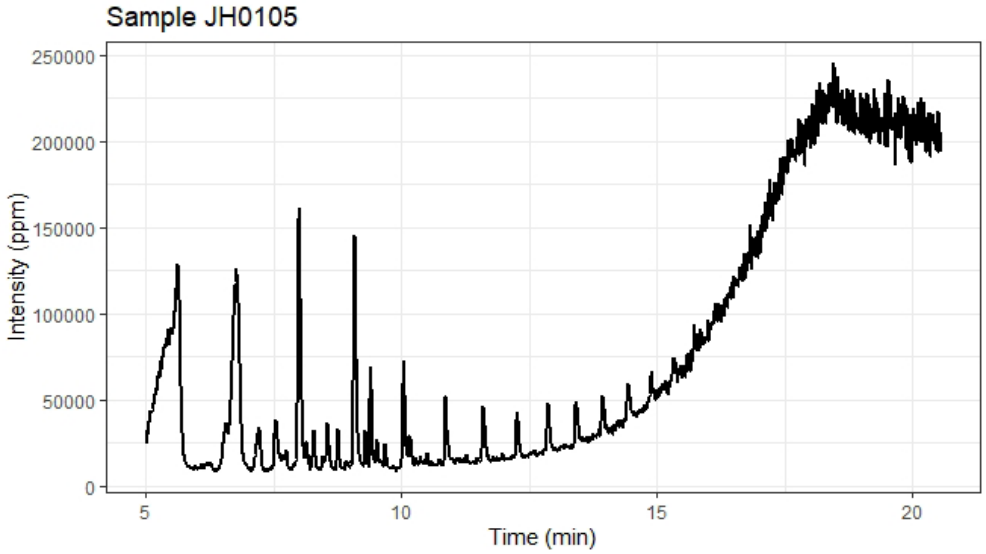




Accession No. 2017.015.00028.111, Lab No. JH0104
(Obverse)


Accession No. 2017.015.00028.111, Lab No. JH0104
(Reverse)

- Methylmercuric bromide 55.7% at 5.63 min
- Dibenzo carbazole 51.1% at 6.79 min
- Acrylic acid. 2-chloroethyl ester 17.3% at 7.20 min
- Thyocyanic acid (methyl sulfocyanate) 22.9% at 7.53 min
- 1,3-Dioxolane, 2-(bromomethyl)- 14.6% at 8.00 min
- 2-Methylmalonamide 13.2% at 8.56 min
- 2-Methylmalonamide 31.9% at 9.08 min
- Tetramethylsilane 19.8% at 9.40 min
- Ethylene glycol 27.6% at 10.05 min
- 2-Methylmalonamide and Benzaldehyde after 11 min

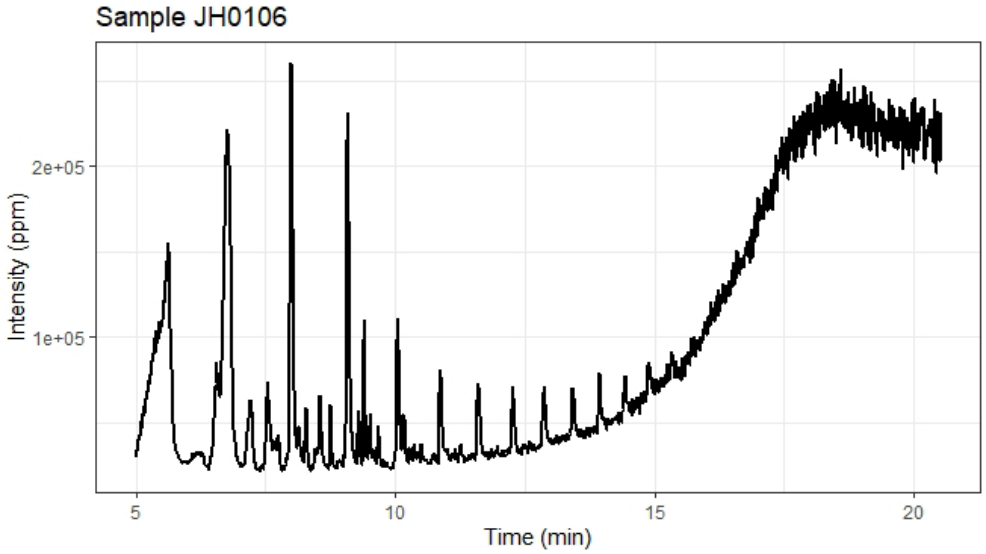


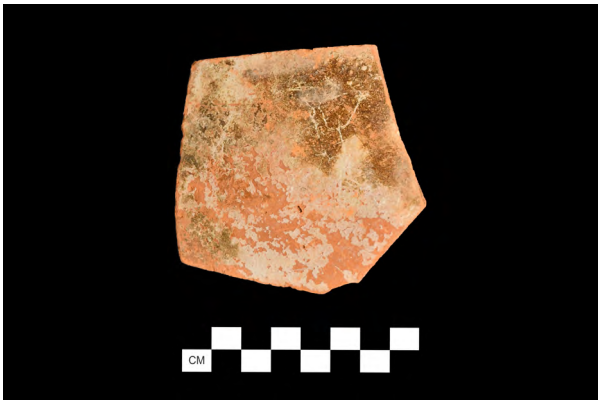


Accession No. 2017.015.00028.100, Lab No. JH0105
(Obverse)

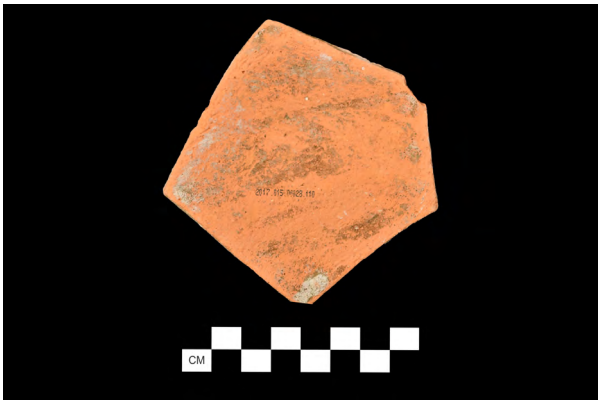

Accession No. 2017.015.00028.100, Lab No. JH0105
(Reverse)

- Diphenyl anilinophosphonate (Phosphoramidic acid) 28.5% at 5.62 min
- Methylmercuric bromide 55.7% at 5.63 min
- Dibenzo carbazole 36.3% at 6.77 min
- Chrolotrimethylsilane 19.6% at 7.20 min
- Thyocyanic acid (methyl sulfocyanate) 19.7% at 7.54 min
- Propionic acid, 3-chloro (Propanoic acid) 34.3% at 8.00 min
- Isothiocyanic acid 37.7% at 8.56 min
- 2-Methylmalonamide 18.8% at 9.09 min
- Thyocyanic acid (methyl sulfocyanate) 12.6% at 10.04 min
- Thicyanic acid and Benzaldehyde after 11 min



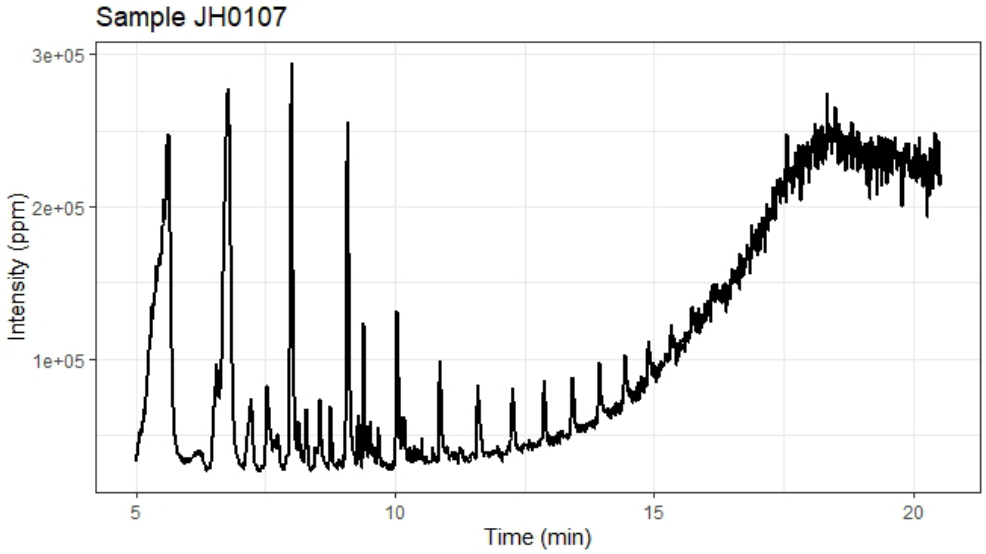




Accession No. 2017.015.00028.110, Lab No. JH0106
(Obverse)




Accession No. 2017.015.00028.110, Lab No. JH0106
(Reverse)

- Methylmercuric bromide 38.9% at 5.63 min
- Dibenzo carbazole 32.8% at 6.76 min
- Butylamine 27.5% at 7.20 min
- Butylamine 28.7% at 7.55 min
- Ethane, 1,1[‘-oxybis[2-ethoxy-] 19.5% at 8.00 min
- Thyocyanic acid (methyl sulfocyanate) 23.7% at 8.55 min
- Diethylmethylsilane 9.7% at 9.09 min
- Thyocyanic acid (methyl sulfocyanate) 39.0%% at 10.87 min
- Dipropylamine 33.7% at 11.60 min
- Thicyanic acid and Benzaldehyde after 11 min



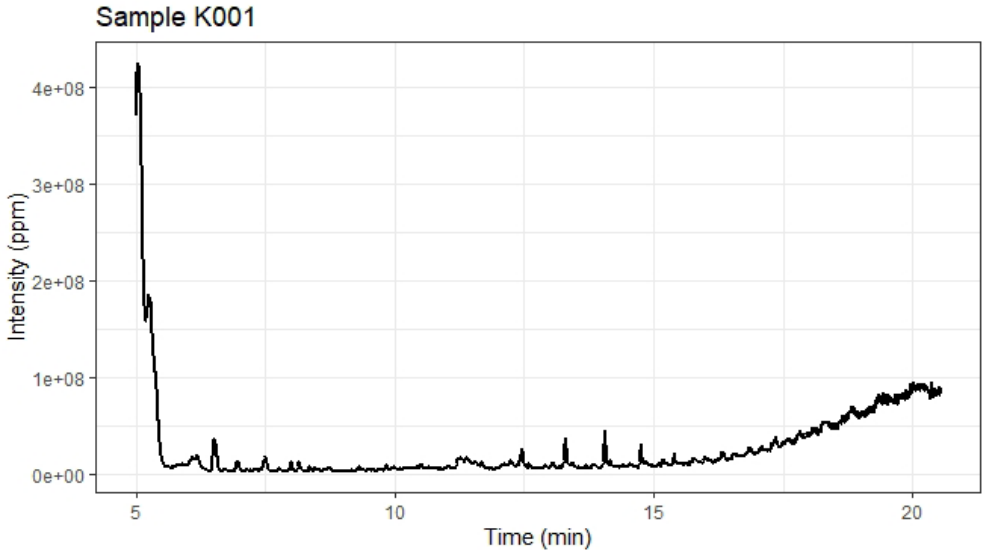


Accession No. 2017.015.00028.115, Lab No. JH0107
(Obverse)


Accession No. 2017.015.00028.115, Lab No. JH0107
(Reverse)

- Methylmercuric bromide 59.7% at 5.64 min
- Dibenzo carbazole 38.7% at 6.78 min
- Thyocyanic acid (methyl sulfocyanate) 12.5% 7.20 min
- Thyocyanic acid (methyl sulfocyanate) 14.4% 7.54 min
- 1,3-Dioxolane, 2-(bromomethyl)- 51.4% at 8.00 min
- Thyocyanic acid (methyl sulfocyanate) 23.7% (Isothiocyanic acid 23.7%) 8.56 min
- Thyocyanic acid (methyl sulfocyanate) 25.3% (Isothiocyanic acid 22.4%) 9.09 min
- Thyocyanic acid (methyl sulfocyanate) 26.8% (Isothiocyanic acid 22.6%) 10.04 min
- Dipropylamine 38.2% at 11.60 min
- Thicyanic acid and Benzaldehyde after 11 min

# Appendix B



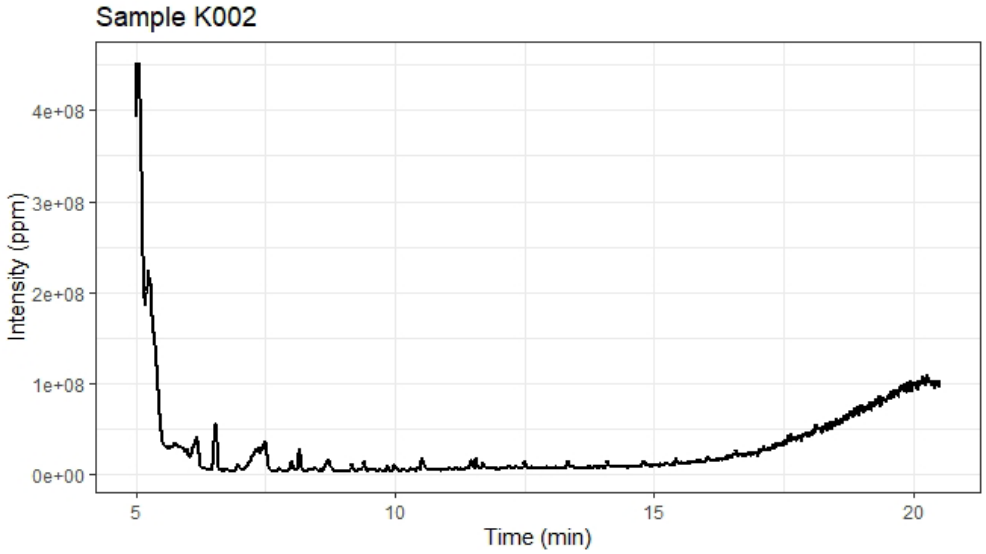


Accession No. 2019.005.00158.001, Lab No. K001
(Obverse)


Accession No. 2019.005.00158.001, Lab No. K001
(Reverse)

- Benzaldehyde 83.6% at 6.19 min
- Silicic acid 56.2% at 6.52 min and 6.97 min
- Colchicine 27.5% at 7.49 min
- Elymoclavin 40.1% at 8 min
- Acetamide 35% at 8.15 min
- Prednisolone and colchicine after 9 min between 16.5 and 40.1%

K002



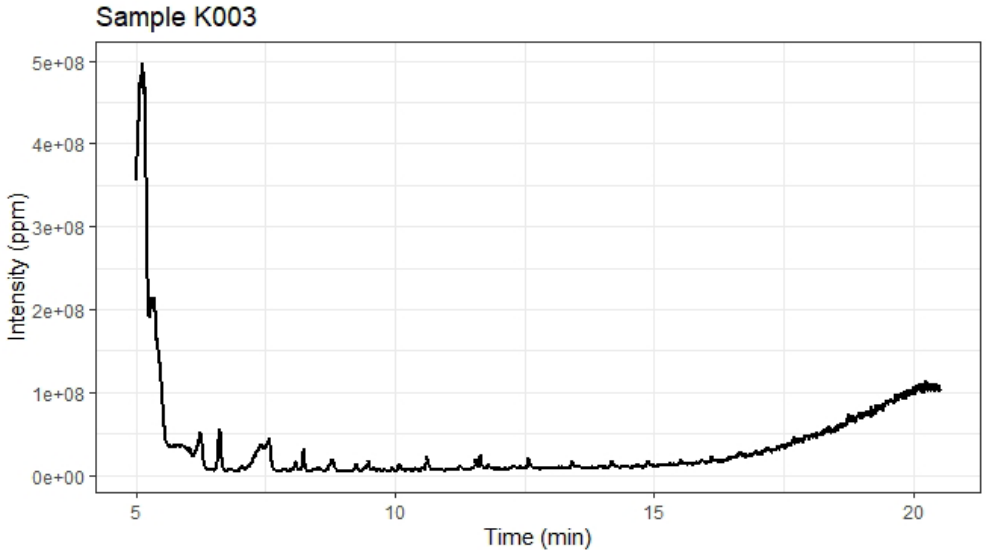


Accession No. 2019.005.00156.001, Lab No. K002
(Obverse)


Accession No. 2019.005.00156.001, Lab No. K002
(Reverse)

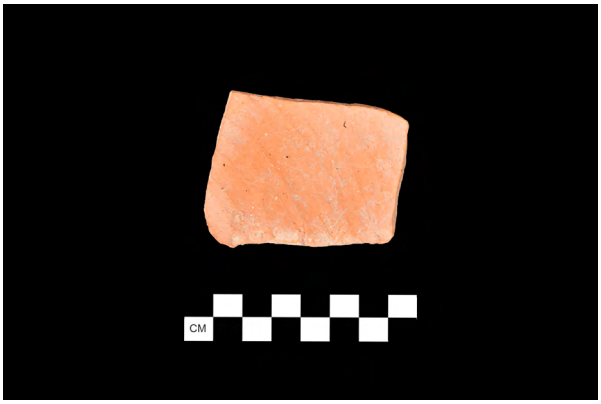
- Benzaldehyde 83.4% at 6.17 min
- Silicic acid 40.4% at 6.55 min
- Acetamide 15.4% at 7.50 min
- Elymoclavin 62.4% at 8 min
- Acetamide 26.5% at 8.15 min
- Prednisolone and colchincine after 9 min

K003



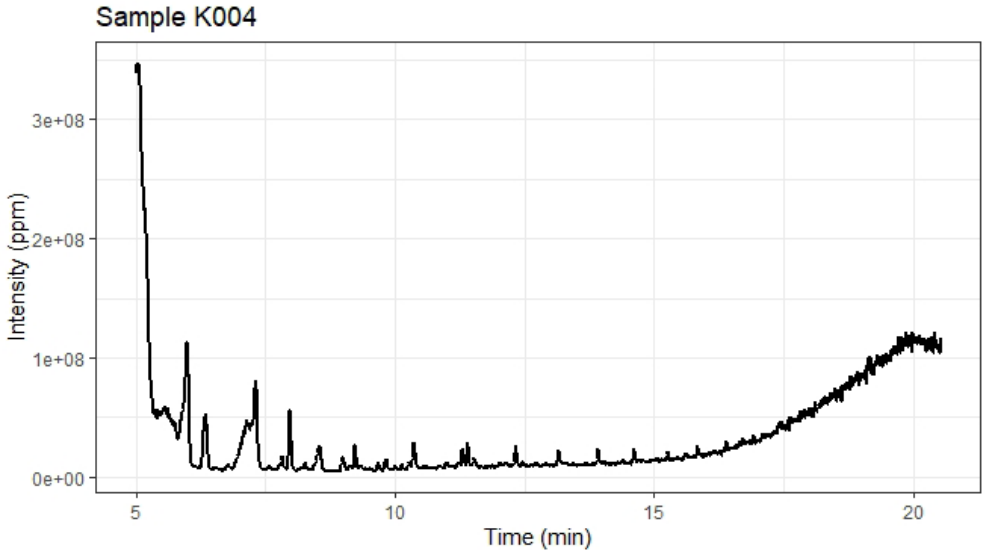


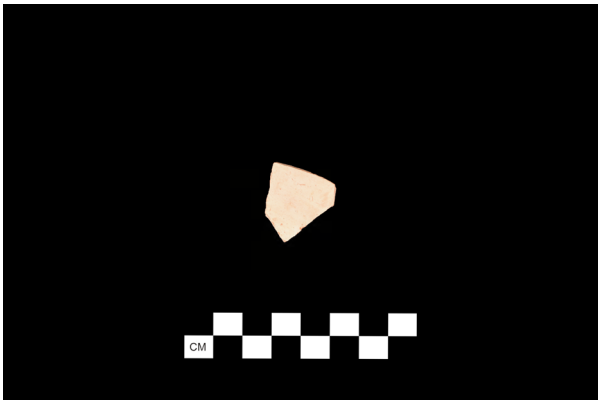
Accession No. 2019.005.00157.001, Lab No. K003
(Obverse)



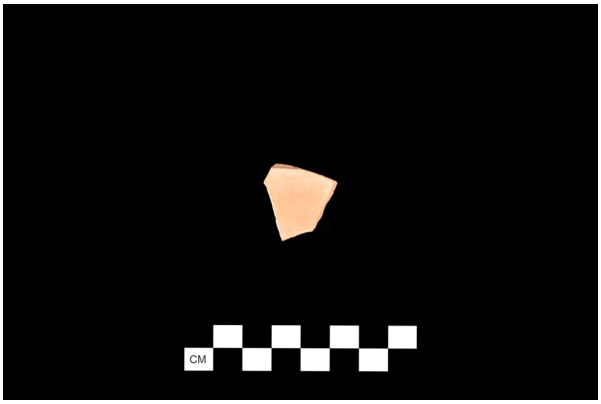

Accession No. 2019.005.00157.001, Lab No. K003
(Reverse)

- Benzaldehyde 85.3% at 6.24 min
- Silicic acid 67.4% at 6.62 min
- Acetamide 15.5% at 7.58 min
- Elymoclavin 50.1% at 8.10 min
- Acetamide 26.5% at 8.15 min
- Prednisolone and colchincine after 9 min



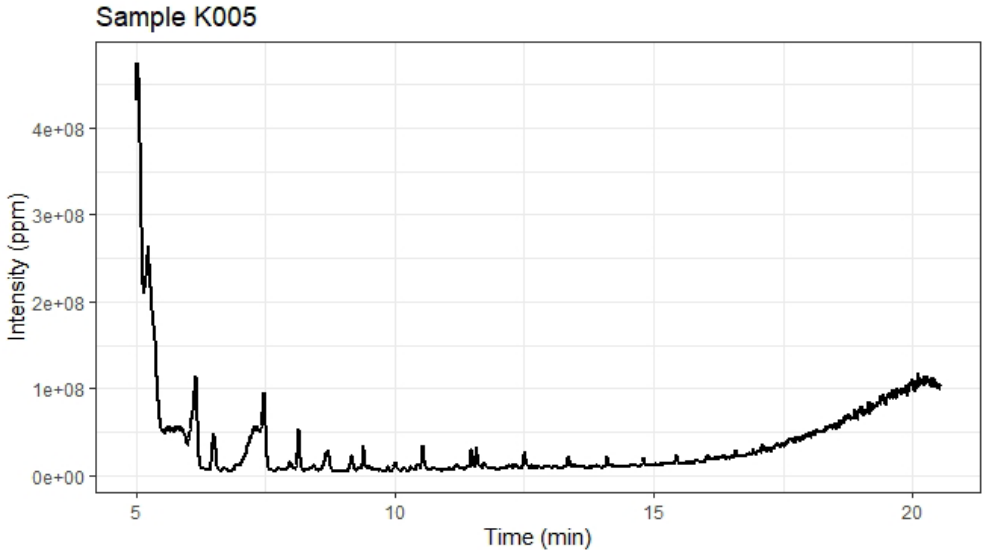



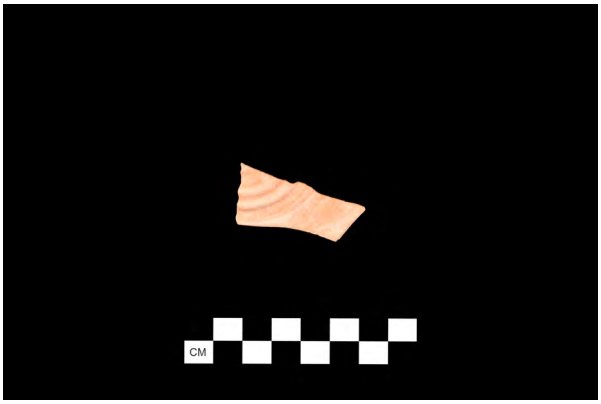

Accession No. 2019.005.00231.001, Lab No. K004
(Obverse)




Accession No. 2019.005.00231.001, Lab No. K004
(Reverse)

- Benzaldehyde 82.2% at 5.99 min
- Silicic acid 64.3% at 6.35 min
- Benz[j]aceanthrylen-1-ol 16.3% at 7.31 min
- Elymoclavin 27.8% at7.90 min and Phenol 31.5% at 7.90 min
- Acetamide 27.4% at 8.00 min
- Dibenzo carbazol 26.7% at 8.54 min
- Prednisolone and colchincine after 9 min between

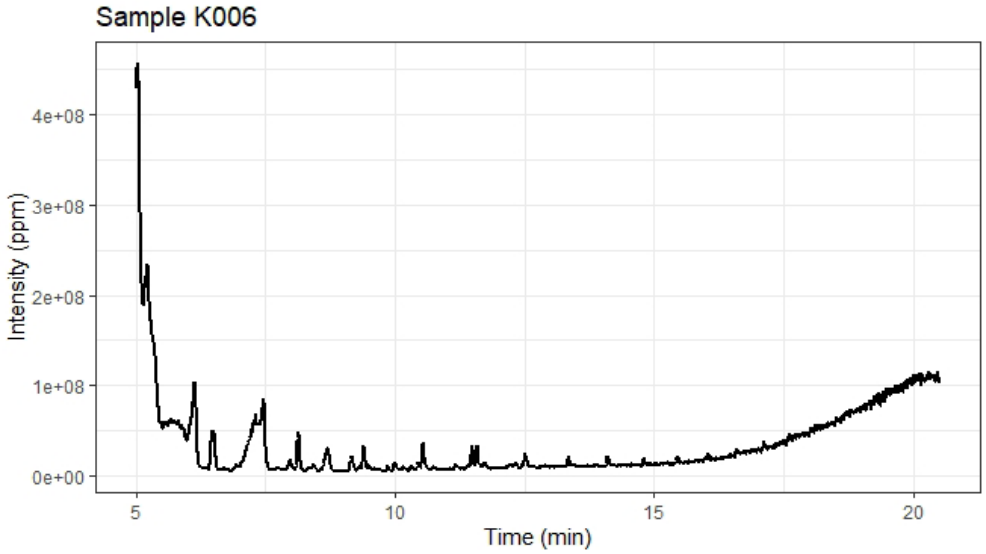


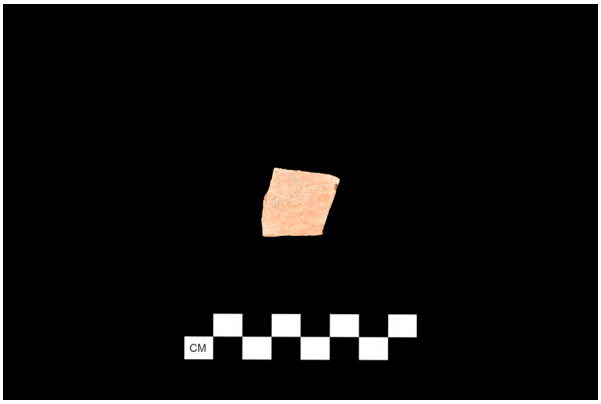




Accession No. 2019.005.00231.001, Lab No. K005
(Obverse)

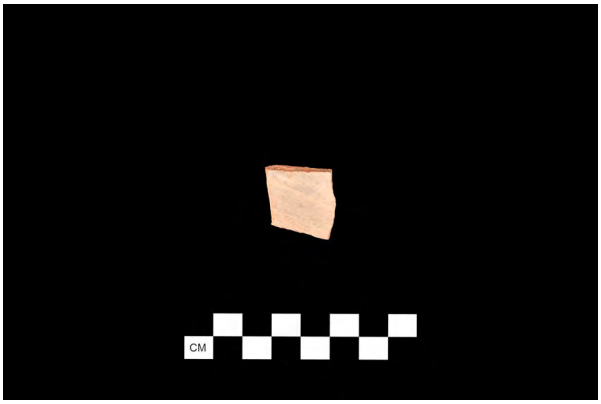

Accession No. 2019.005.00231.001, Lab No. K005
(Reverse)

- Benzaldehyde 86.1% at 6.15 min
- Silicic acid 46.4% at 6.50 min
- Benz[j]aceanthrylen-1-ol 25.9% at 7.48 min
- Elymoclavin 69.3% at 8 min
- Acetamide 22.9% at 8.15 min
- Dibenzo carbazol 28.5% at 8.71 min
- Prednisolone and colchincine after 9 min



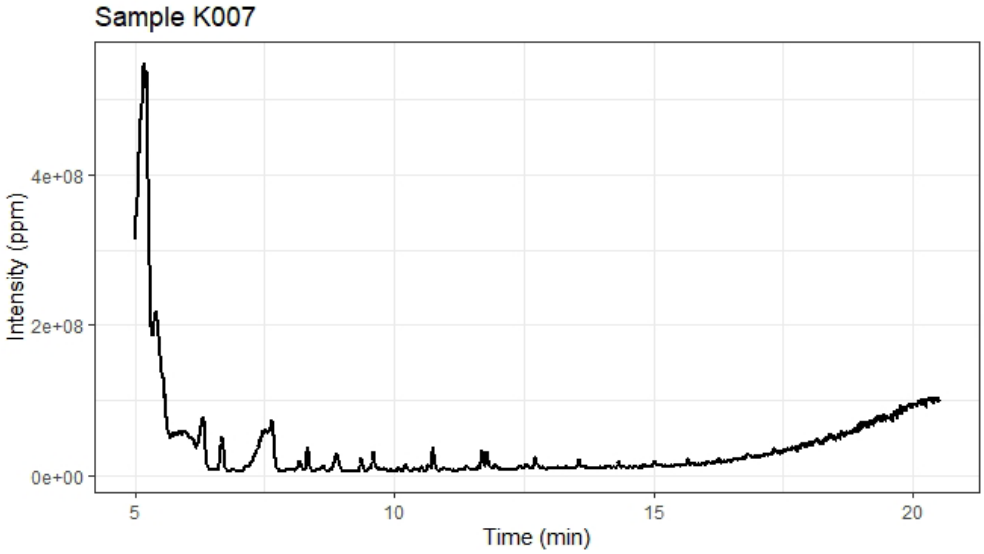



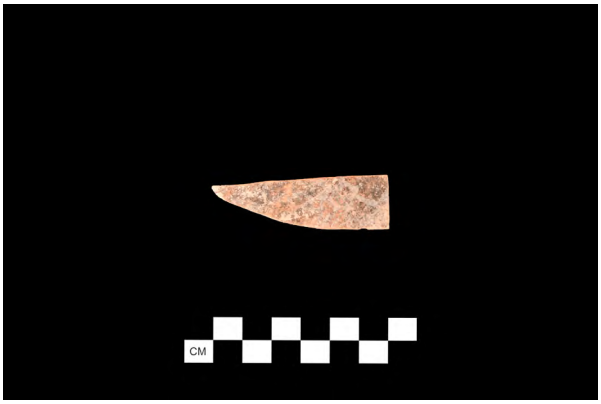

Accession No. 2019.005.00231.001, Lab No. K006
(Obverse)



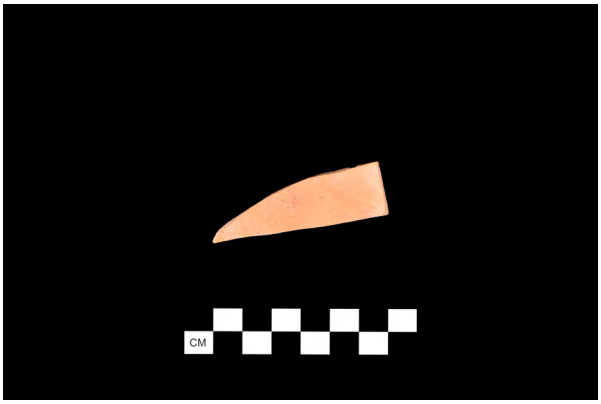

Accession No. 2019.005.00231.001, Lab No. K006
(Reverse)

- Benzaldehyde 87.6% at 6.15 min
- Silicic acid 68.6% at 6.50 min
- Benz[j]aceanthrylen-1-ol 25.3% at 7.49 min
- Elymoclavin 46.9% at 8 min
- Acetamide 24.5% at 8.14 min
- Dibenzo carbazol 31.6% at 8.41 min
- Prednisolone and colchincine after 9 min



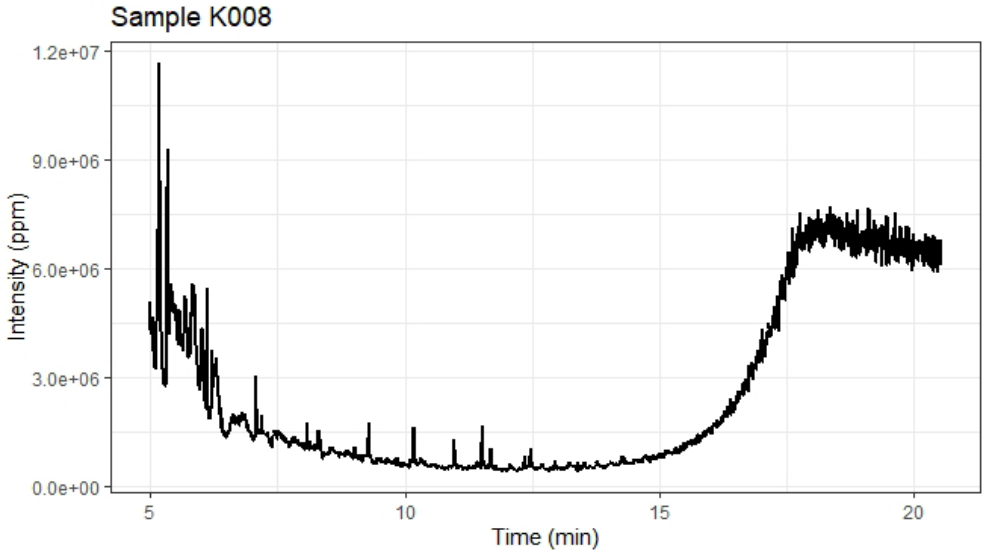



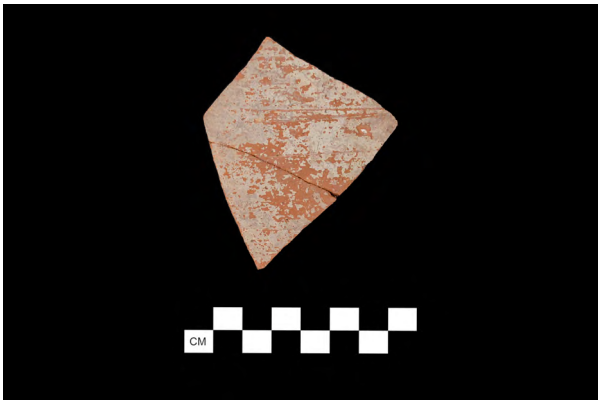

Accession No. 2019.005.00231.001, Lab No. K007
(Obverse)




Accession No. 2019.005.00231.001, Lab No. K007
(Reverse)

- Benzaldehyde 88.23% at 6.32 min
- Silicic acid 57.3% at 6.60 min
- Benz[j]aceanthrylen-1-ol 19.0% at 7.64 min
- Elymoclavin 42.47% at 8 min
- Acetamide 27.1% at 8.34 min
- Dibenzo carbazol 32.7% at 8.71 min
- Prednisolone and colchincine after 9 min

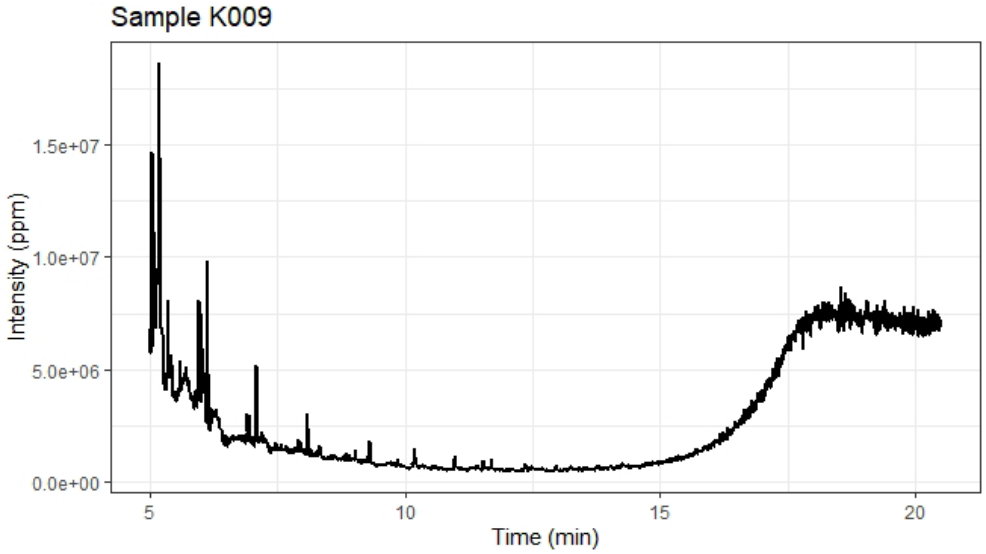



Accession No. 2019.005.00231.001, Lab No. K008
(Obverse)


Accession No. 2019.005.00231.001, Lab No. K008
(Reverse)

- N-acetamide/ethane 9% at 5.17 min
- (Dichloromethyl)methyl ether 9.5% at 5.35 min Ergoline at 8.4% at 5.35 min
- Dibenzo carbazole between 5.42 to 6.38 up to 71%
- Colchicine at 7.07 min at 55%
- 2-Pentanol, 4-methoxy-4-methyl 21.5% at 8.3 min
- Eicosanoic acid (Methyl arachisate) 39.5% at 11.51 min
- Stearic acid  42.5% at 12 min
- Colchicine after 6 min

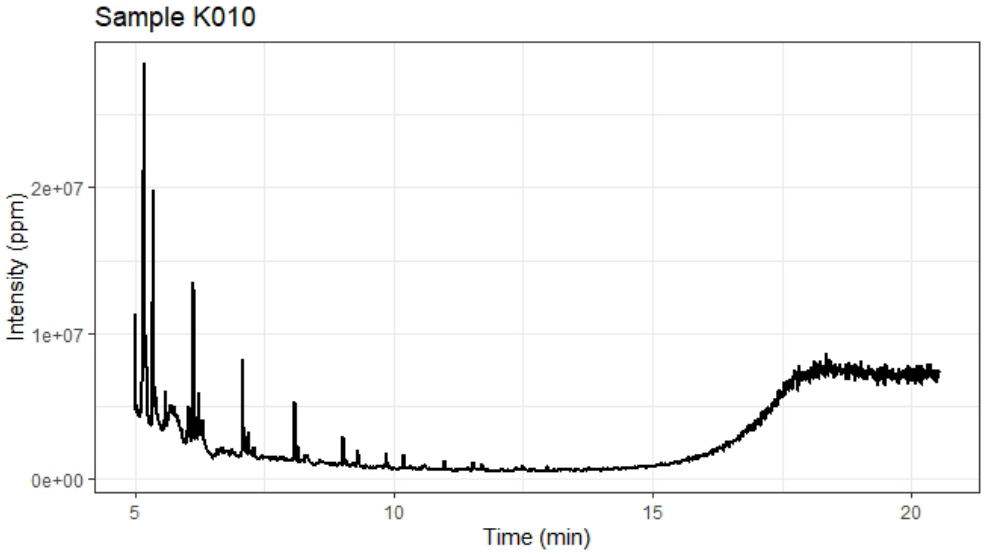




Accession No. 2019.005.00231.001, Lab No. K009
(Obverse)

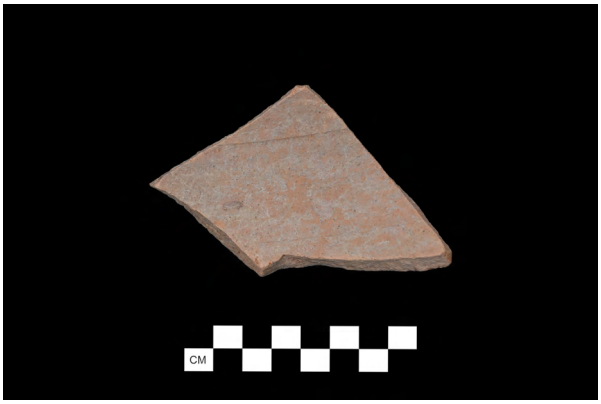

Accession No. 2019.005.00231.001, Lab No. K009
(Reverse)

- Acetamide 20.3% at 6.13 min
- Colchicine 25.9% at 7.08 min
- Colchicine 19.8% at 8.02 min
- Colchicine after 8 min



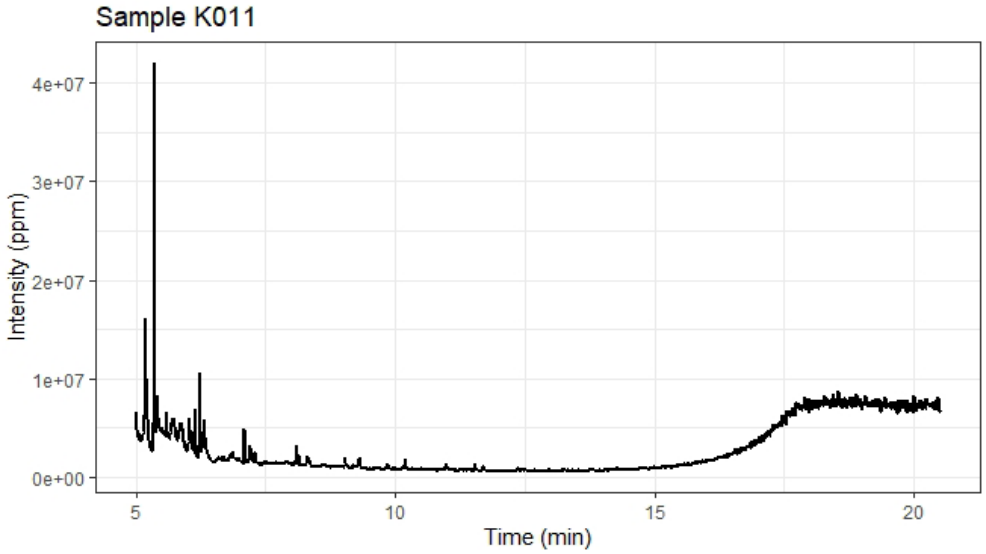


Accession No. 2019.005.00231.001, Lab No. K010
(Obverse)




Accession No. 2019.005.00231.001, Lab No. K010
(Reverse)

- Benz[j]aceanthrylen-1-ol 28.2% at 5.35 min and 33.2% at 6.13 min
- Dibenzocarbazole 20.4% at 7.09 min
- Colchicine after 8 min

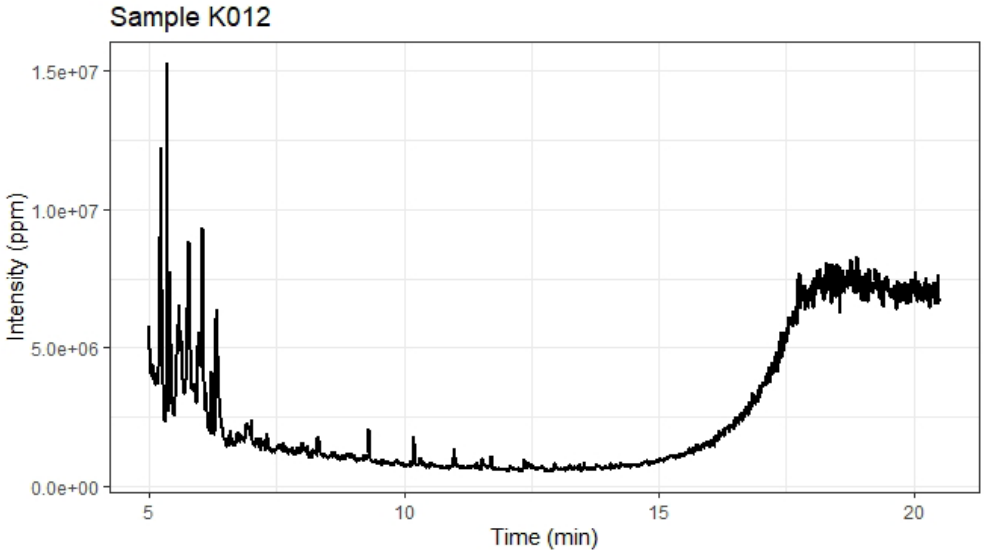




Accession No. 2017.015.00231.001, Lab No. K011
(Obverse)


Accession No. 2019.005.00231.001, Lab No. K011
(Reverse)

- Dibenzo Carbazole 46.9% at 5.36 min
- Ethylene glycol 33.98% at 6.23 min
- Colchicine throughout after 7 min

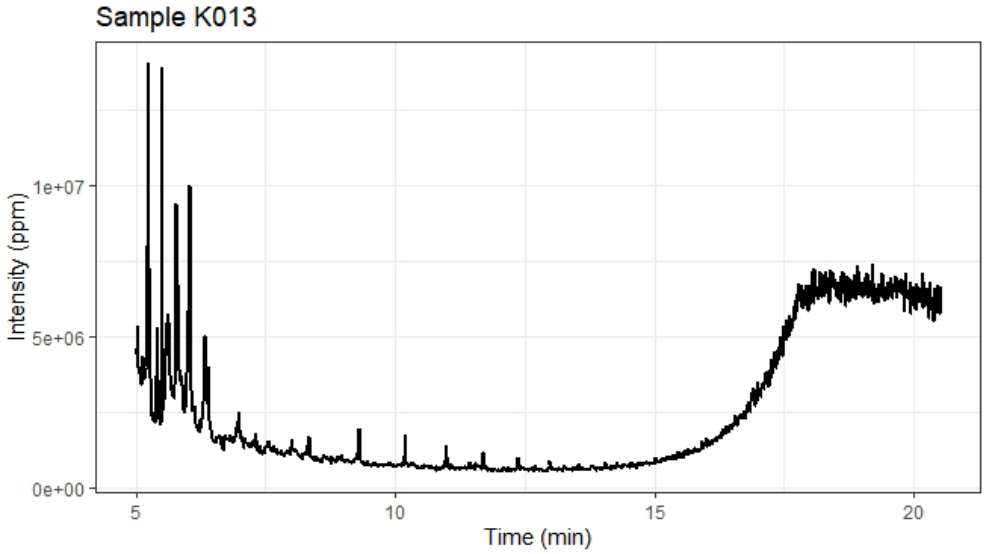




Accession No. 2019.005.00254.001, Lab No. K012
(Obverse)


Accession No. 2019.005.00254.001, Lab No. K012
(Reverse)

- Dibenzo Carbazole 40.6% at 5.35 min
- (Dichloromethyl) methyl ester 38.7% at 5.80 min
- Colchicine after 8 min

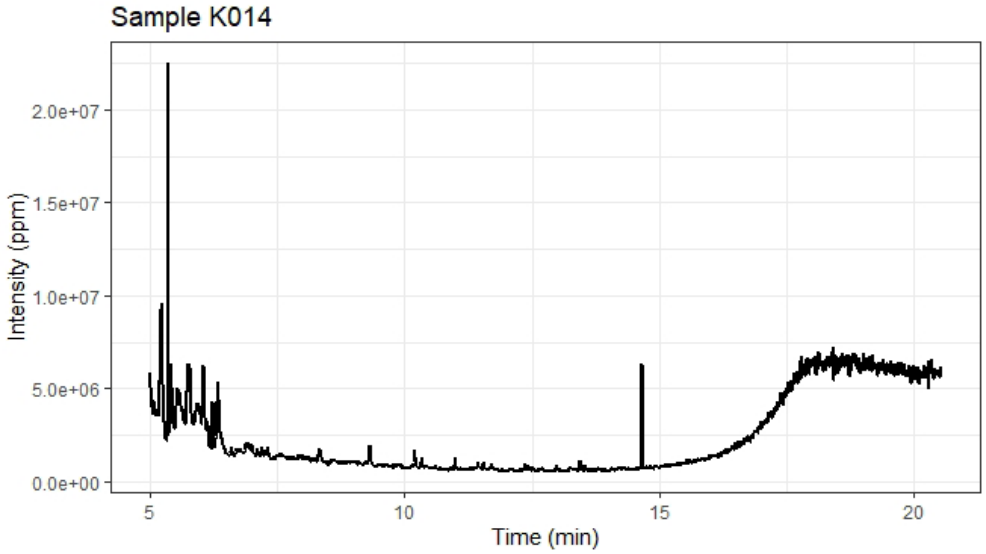




Accession No. 2019.005.00254.001, Lab No. K013
(Obverse)


Accession No. 2019.005.00254.001, Lab No. K013
(Reverse)

- (Dichloromethyl) methyl ester 54.5% at 5.51 min
- Dibenzo Carbazole 52.2% at 6.05 min
- Colchicine after 8 min



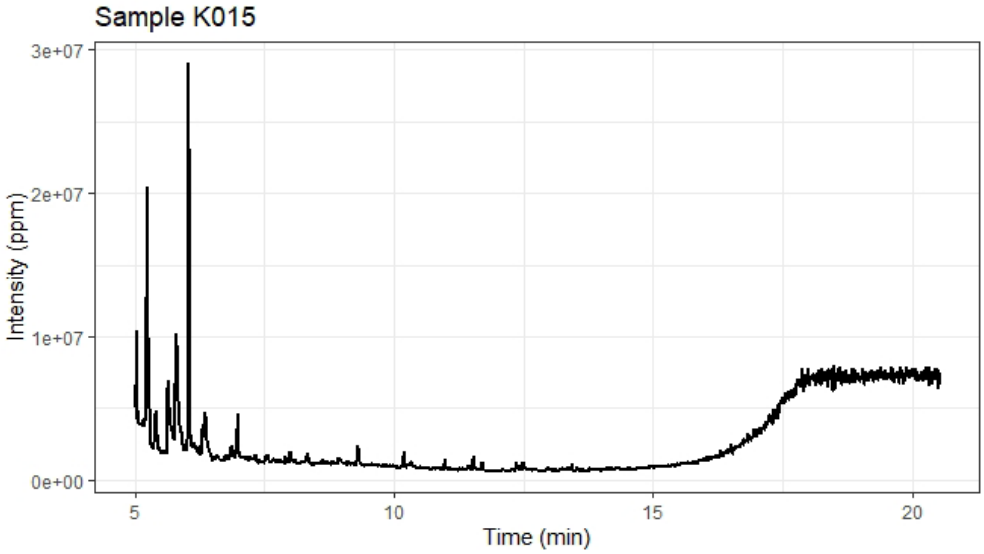


Accession No. 2019.005.00231.002, Lab No. K014 (Obverse)


Accession No. 2019.005.00231.002, Lab No. K014 (Reverse)

- Phosphoramidic acid 40.2% at 5.23 min
- Dibenzo carbazole 40.7% at 5.35 min
- Avicol pesticide 19.7% at 5.74 min
- (Dichloromethyl) methyl ester 72.3% at 14.66 min and possibly Lyssergamide 28.9% at 14.66

K015





Accession No. 2019.005.00231.002, Lab No. K015
(Obverse)


Accession No. 2019.005.00231.002, Lab No. K015
(Reverse)

- Phosphoramidic acid 29.5% at 5.24 min
- Elymoclavin 69.5% at 5.4 min
- Avicol pesticide 19.4% at 5.80 min
- Dibenzo carbazole 75.4% at 6.04 min
- Colchicine and other low probability compounds after 7 min

# Appendix C

Table of sherd infromation from Eastern Cistern B

| Acc. # | Lab # | Date collected | Bag # | Exc. | Site | S.U. | Area | Rim Type | Sherd Type | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 2017.015.00093.004 | JH0001 | 5/21/2017 | 3 of 5 | GBA, CB, JH | ECB | 4 | Central Sector | C.5 | Rim | |
| 2017.015.00093.011 | JH0002 | 5/21/2017 | 3 of 5 | GBA, CB, JH | ECB | 4 | Central Sector | C.8 | Rim | |
| 2017.015.00093.098 | JH0003 | 5/21/2017 | 3 of 5 | GBA, CB, JH | ECB | 4 | Central Sector | C.8 | Rim | |
| 2017.015.00096.000 | JH0004 | 5/16/2017 | 2 of 4 | GBA, CB, JH | ECB | 2017 Erosion collapse | Central Sector | Ung. | Rim | |
| 2017.015.00096.002 | JH0005 | 5/16/2017 | 2 of 4 | GBA, CB, JH | ECB | 2017 Erosion collapse | Central Sector | A.7.2 | Rim | |
| 2017.015.00096.123 | JH0006 | 5/16/2017 | 2 of 4 | GBA, CB, JH | ECB | 2017 Erosion collapse | Central Sector | F.2 | Rim | |
| 2017.015.00097.006 | JH0007 | 5/21/2017 | 4 of 5 | GBA, CB, JH | ECB | 4 | Central Sector | E.4 | Rim | |
| 2017.015.00095.118 | JH0008 | 5/21/2017 | 2 of 5 | GBA, CB, JH | ECB | 4 | Central Sector | A.3.2 | Rim | 1 B.C.E - 20 C.E. |
| 2017.015.00095.119 | JH0009 | 5/21/2017 | 2 of 5 | GBA, CB, JH | ECB | 4 | Central Sector | A.3.2 | Rim | 1 B.C.E - 20 C.E. |
| 2017.015.00081.050 | JH0010 | 5/17/2020 | 2 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | I.1.0 | Rim | |
| 2017.015.00081.051 | JH0011 | 5/17/2020 | 2 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | I.1.0 | Rim | |
| 2017.015.00081.003 | JH0012 | 5/17/2020 | 2 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | A.1.0 | Rim | |
| 2017.015.00081.005 | JH0013 | 5/17/2020 | 2 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | A.1.20 | Rim | |
| 2017.015.00109.049 | JH0014 | 6/6/2020 | 1 of 1 | GBA, CB, JH | ECB | 4 | South Eastern | | Body | |
| 2017.015.00109.049 | JH0015 | 6/6/2020 | 1 of 1 | GBA, CB, JH | ECB | 4 | South Eastern | | Body | |

| Acc. # | Lab # | Date collected | Bag # | Exc. | Site | S.U. | Area | Rim Type | Sherd Type | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 2017.015.00080.000 | JH0016 | 5/17/2020 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Rim | |
| 2017.015.00080.018 | JH0017 | 5/17/2020 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Rim | |
| 2017.015.00080.025 | JH0018 | 5/17/2020 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Body | |
| 2017.015.00080.037 | JH0019 | 5/17/2020 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Base | |
| 2017.015.00080.009 | JH0020 | 5/17/2020 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Body | |
| 2017.015.00080.024 | JH0021 | 5/17/2020 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Body | |
| 2017.015.00080.017 | JH0022 | 5/17/2020 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Body | |
| 2017.015.00080.015 | JH0023 | 5/17/2020 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Unguent. | |
| 2017.015.00107.004 | JH0024 | 5/14/2020 | 1 of 4 | GBA, CB, AS | ECB | 2017 Erosion collapse | Northern Sector | E.4 | Rim | |
| 2017.015.00107.005 | JH0025 | 5/14/2020 | 1 of 4 | GBA, CB, AS | ECB | 2017 Erosion collapse | Northern Sector | | Body | |
| 2017.015.00107.006 | JH0026 | 5/14/2020 | 1 of 4 | GBA, CB, AS | ECB | 2017 Erosion collapse | Northern Sector | | Body | |
| 2017.015.00107.007 | JH0027 | 5/14/2020 | 1 of 4 | GBA, CB, AS | ECB | 2017 Erosion collapse | Northern Sector | A.4.2 | Rim | |
| 2017.015.00107.042 | JH0028 | 5/14/2020 | 1 of 4 | GBA, CB, AS | ECB | 2017 Erosion collapse | Northern Sector | Ung. | Unguent. | |
| 2017.015.00098.134 | JH0029 | 5/16/2020 | 3 of 4 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Base | 75-100 C.E. |
| 2017.015.00098.139 | JH0030 | 5/16/2020 | 3 of 4 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | A.3.4 | Rim | 75-100 C.E. |

| Acc. # | Lab # | Date collected | Bag # | Exc. | Site | S.U. | Area | Rim Type | Sherd Type | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 2017.015.00098.065 | JH0031 | 5/16/2020 | 3 of 4 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Body | 75-100 C.E. |
| 2017.015.00098.112 | JH0032 | 5/16/2020 | 3 of 4 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Body | 75-100 C.E. |
| 2017.015.00098.196 | JH0033 | 5/16/2020 | 3 of 4 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | E.1.6 | Rim | 75-100 C.E. |
| 2017.015.00098.085 | JH0034 | 5/16/2020 | 3 of 4 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Body | 75-100 C.E. |
| 2017.015.00106.075 | JH0035 | 5/11/2020 | 2 of 6 | GBA, CB, AS | ECB | 2017 Erosion collapse | Northern Sector | | Body | 20-100 C.E. |
| 2017.015.00106.068 | JH0036 | 5/11/2020 | 2 of 6 | GBA, CB, AS | ECB | 2017 Erosion collapse | Northern Sector | C.1 | Rim | 20-100 C.E. |
| 2017.015.00106.081 | JH0037 | 5/11/2020 | 2 of 6 | GBA, CB, AS | ECB | 2017 Erosion collapse | Northern Sector | | Rim | 20-100 C.E. |
| 2017.015.00106.082 | JH0038 | 5/11/2020 | 2 of 6 | GBA, CB, AS | ECB | 2017 Erosion collapse | Northern Sector | C.5 | Rim | 20-100 C.E. |
| 2017.015.00106.075 | JH0039 | 5/11/2020 | 2 of 6 | GBA, CB, AS | ECB | 2017 Erosion collapse | Northern Sector | | Body | 20-100 C.E. |
| 2017.015.00106.083 | JH0040 | 5/11/2020 | 2 of 6 | GBA, CB, AS | ECB | 2017 Erosion collapse | Northern Sector | | Body | 20-100 C.E. |
| 2017.015.00082.008 | JH0041 | 5/17/2020 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | A.1.1 | Rim | |
| 2017.015.00082.000 | JH0042 | 5/17/2020 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | A.1.0 | Rim | |
| 2017.015.00082.002 | JH0043 | 5/17/2020 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Body | |
| 2017.015.00082.001 | JH0044 | 5/17/2020 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Central Sector | | Body | |
| 2017.004.00035.000 | JH0045 | 5/10/2016 | 1 of 8 | GBA, CB | ECB | 4 | Pit | A.1.0 | Rim | 50-1 B.C.E |
| 2017.004.00035.000 | JH0046 | 5/10/2016 | 1 of 8 | GBA, CB | ECB | 4 | Pit | | Base | 50-1 B.C.E |
| 2017.004.00035.000 | JH0047 | 5/10/2016 | 1 of 8 | GBA, CB | ECB | 4 | Pit | | Body | 50-1 B.C.E |

| Acc. # | Lab # | Date collected | Bag # | Exc. | Site | S.U. | Area | Rim Type | Sherd Type | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 2017.004.00035.000 | JH0048 | 5/10/2016 | 1 of 8 | GBA, CB | ECB | 4 | Pit | | Body | 50-1 B.C.E |
| 2017.004.00035.000 | JH0049 | 5/10/2016 | 1 of 8 | GBA, CB | ECB | 4 | Pit | | Body | 50-1 B.C.E |
| 2017.004.00035.000 | JH0050 | 5/10/2016 | 1 of 8 | GBA, CB | ECB | 4 | Pit | | Body | 50-1 B.C.E |
| 2017.004.00038.000 | JH0051 | 5/8/2016 | 17 of 45 | GBA, CB | ECB | 4 | Pit | A.5.4 | Rim | |
| 2017.004.00038.000 | JH0052 | 5/8/2016 | 17 of 45 | GBA, CB | ECB | 4 | Pit | A.4.1 | Rim | |
| 2017.004.00038.000 | JH0053 | 5/8/2016 | 17 of 45 | GBA, CB | ECB | 4 | Pit | C.3 | Rim | |
| 2017.004.00038.000 | JH0054 | 5/8/2016 | 17 of 45 | GBA, CB | ECB | 4 | Pit | | Base | |
| 2017.004.00038.000 | JH0055 | 5/8/2016 | 17 of 45 | GBA, CB | ECB | 4 | Pit | | Base | |
| 2017.004.00038.000 | JH0056 | 5/8/2016 | 17 of 45 | GBA, CB | ECB | 4 | Pit | | Body (Burnt ext.) | |
| 2017.004.00038.000 | JH0057 | 5/8/2016 | 17 of 45 | GBA, CB | ECB | 4 | Pit | | Body (Burnt ext.) | |
| 2017.004.00036.000 | JH0058 | 5/8/2016 | 9 of 45 | GBA, CB | ECB | 4 | Pit | A.4.1/2 | Rim | |
| 2017.004.00036.000 | JH0059 | 5/8/2016 | 9 of 45 | GBA, CB | ECB | 4 | Pit | A.5.5 | Rim | |
| 2017.004.00036.000 | JH0060 | 5/8/2016 | 9 of 45 | GBA, CB | ECB | 4 | Pit | | Body (Burnt ext.) | |
| 2017.004.00036.000 | JH0061 | 5/8/2016 | 9 of 45 | GBA, CB | ECB | 4 | Pit | | Base (Burnt ext.) | |
| 2017.004.00036.000 | JH0062 | 5/8/2016 | 9 of 45 | GBA, CB | ECB | 4 | Pit | | body | |
| 2017.004.00032.000 | JH0063 | 5/8/2016 | 34 of 45 | GBA, CB | ECB | 4 | Pit | A.5.4 | Rim | 20-75 C.E. |

| Acc. # | Lab # | Date collected | Bag # | Exc. | Site | S.U. | Area | Rim Type | Sherd Type | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 2017.004.00032.000 | JH0064 | 5/8/2016 | 34 of 45 | GBA, CB | ECB | 4 | Pit | A.5.4 | Rim | 20-75 C.E. |
| 2017.004.00032.000 | JH0065 | 5/8/2016 | 34 of 45 | GBA, CB | ECB | 4 | Pit | A.5.4 | Rim | 20-75 C.E. |
| 2017.004.00032.000 | JH0066 | 5/8/2016 | 34 of 45 | GBA, CB | ECB | 4 | Pit | | Base (Burnt ext.) | |
| 2017.004.00032.000 | JH0067 | 5/8/2016 | 34 of 45 | GBA, CB | ECB | 4 | Pit | | Base | |
| 2017.004.00032.000 | JH0068 | 5/8/2016 | 34 of 45 | GBA, CB | ECB | 4 | Pit | | Base | |
| 2017.004.00033.000 | JH0069 | 5/8/2016 | 38 of 45 | GBA, CB | ECB | 4 | Pit | A.1.1 | Rim | |
| 2017.004.00033.000 | JH0070 | 5/8/2016 | 38 of 45 | GBA, CB | ECB | 4 | Pit | Ung. | Unguent. | |
| 2017.004.00033.000 | JH0071 | 5/8/2016 | 38 of 45 | GBA, CB | ECB | 4 | Pit | | Body (Burnt ext.) | |
| 2017.004.00033.000 | JH0072 | 5/8/2016 | 38 of 45 | GBA, CB | ECB | 4 | Pit | | Body (Burnt ext.) | |
| 2017.004.00034.000 | JH0073 | 5/8/2016 | 42 of 45 | GBA, CB | ECB | 4 | Pit | C.5 | Rim | |
| 2017.004.00034.000 | JH0074 | 5/8/2016 | 42 of 45 | GBA, CB | ECB | 4 | Pit | A.4.7 | Rim | |
| 2017.004.00034.000 | JH0075 | 5/8/2016 | 42 of 45 | GBA, CB | ECB | 4 | Pit | A.5.5 | Rim | |
| 2017.004.00034.000 | JH0076 | 5/8/2016 | 42 of 45 | GBA, CB | ECB | 4 | Pit | A.6.4 | Rim | |
| 2017.015.00036.151 | JH0077 | 5/24/2017 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | A.1.0 | Rim | 20-100 C.E. |

| Acc. # | Lab # | Date collected | Bag # | Exc. | Site | S.U. | Area | Rim Type | Sherd Type | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 2017.015.00036.002 | JH0078 | 5/24/2017 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | A.1.1 | Rim | 20-100 C.E. |
| 2017.015.00036.001 | JH0079 | 5/24/2017 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | A.2.2 | Rim | 20-100 C.E. |
| 2017.015.00036.150 | JH0080 | 5/24/2017 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | H.5.1 | Rim | 20-100 C.E. |
| 2017.015.00036.013 | JH0081 | 5/24/2017 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | | Body (Burnt ext.) | 20-100 C.E. |
| 2017.015.00036.028 | JH0082 | 5/24/2017 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | | Body | 20-100 C.E. |
| 2017.015.00036.010 | JH0083 | 5/24/2017 | 1 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | | Body | 20-100 C.E. |
| 2017.015.00029.002 | JH0084 | 5/30/2917 | 2 of 4 | GBA, CB, JH | ECB | 4 | Southern | A.2.1 | Rim | 100-200 C.E. |
| 2017.015.00029.056 | JH0085 | 5/30/2917 | 2 of 4 | GBA, CB, JH | ECB | 4 | Southern | | Body | 100-200 C.E. |
| 2017.015.00029.003 | JH0086 | 5/30/2917 | 2 of 4 | GBA, CB, JH | ECB | 4 | Southern | | Body | 100-200 C.E. |
| 2017.015.00029.023 | JH0087 | 5/30/2917 | 2 of 4 | GBA, CB, JH | ECB | 4 | Southern | | Body | 100-200 C.E. |
| 2017.015.00029.144 | JH0088 | 5/30/2917 | 2 of 4 | GBA, CB, JH | ECB | 4 | Southern | | Body (yellow ware) | 100-200 C.E. |
| 2017.015.00031.010 | JH0089 | 5/30/2917 | 4 of 4 | GBA, CB, JH | ECB | 4 | Southern | | Body (Burnt ext.) | |
| 2017.015.00031.014 | JH0090 | 5/30/2917 | 4 of 4 | GBA, CB, JH | ECB | 4 | Southern | | Body (Burnt ext.) | |
| 2017.015.00031.060 | JH0091 | 5/30/2917 | 4 of 4 | GBA, CB, JH | ECB | 4 | Southern | | Body | |

| Acc. # | Lab # | Date collected | Bag # | Exc. | Site | S.U. | Area | Rim Type | Sherd Type | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 2017.015.00031.005 | JH0092 | 5/30/2917 | 4 of 4 | GBA, CB, JH | ECB | 4 | Southern | | Body | |
| 2017.015.00031.051 | JH0093 | 5/30/2917 | 4 of 4 | GBA, CB, JH | ECB | 4 | Southern | | Body | |
| 2017.015.00038.077 | JH0094 | 5/24/2017 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | | Unguent. | |
| 2017.015.00038.075 | JH0095 | 5/24/2017 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | H.5.1 | Rim | |
| 2017.015.00038.079 | JH0096 | 5/24/2017 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | | Body | |
| 2017.015.00038.079 | JH0097 | 5/24/2017 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | | Body | |
| 2017.015.00038.061 | JH0098 | 5/24/2017 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | J.1 | Rim | |
| 2017.015.00038.026 | JH0099 | 5/24/2017 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | | | |
| 2017.015.00038.018 | JH0100 | 5/24/2017 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | | | |
| 2017.015.00038.043 | JH0101 | 5/24/2017 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | | | |
| 2017.015.00038.037 | JH0102 | 5/24/2017 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | | | |
| 2017.015.00038.063 | JH0103 | 5/24/2017 | 3 of 3 | GBA, CB, AS | ECB | 2017 Erosion collapse | Southern | | | |
| 2017.015.00028.111 | JH0104 | 5/30/2917 | 1 of 4 | GBA, CB, JH | ECB | 4 | Southern | E.1.6 | Rim | 20-100 C.E. |
| 2017.015.00028.100 | JH0105 | 5/30/2917 | 1 of 4 | GBA, CB, JH | ECB | 4 | Southern | A.7.2 | Rim | 20-100 C.E. |
| 2017.015.00028.110 | JH0106 | 5/30/2917 | 1 of 4 | GBA, CB, JH | ECB | 4 | Southern | | Body | 20-100 C.E. |

| Acc. # | Lab # | Date collected | Bag # | Exc. | Site | S.U. | Area | Rim Type | Sherd Type | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 2017.015.00028.115 | JH0107 | 5/30/2917 | 1 of 4 | GBA, CB, JH | ECB | 4 | Southern | | Body (yellow ware) | 20-100 C.E. |

# Appendix D

Table of sherd information from Element 139

| Acc. # | Lab # | Date Collected | Bag # | Exc. | Site | Room | S.U. | Area (N. & E.) | Other Notes | Rim Type | Sherd Type |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2019.005.00158.001 | K001 | 5/30/2019 | 1 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |
| 2019.005.00156.001 | K002 | 5/30/2019 | 1 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |
| 2019.005.00157.001 | K003 | 5/30/2019 | 1 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | Above Feature 18 (tan-duroven) | | Body |
| 2019.005.00231.001 | K004 | 6/2/2019 | 1 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |
| 2019.005.00231.001 | K005 | 6/2/2019 | 1 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |
| 2019.005.00231.001 | K006 | 6/2/2019 | 1 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |
| 2019.005.00231.001 | K007 | 6/2/2019 | 1 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |
| 2019.005.00254.001 | K008 | 5/30/2019 | 3 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | Pottery cache near feature 17 | | Body |
| 2019.005.00254.001 | K009 | 5/30/2019 | 3 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | Pottery cache near feature 17 | | Body |
| 2019.005.00231.002 | K010 | 6/2/2019 | 2 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |
| 2019.005.00231.002 | K011 | 6/2/2019 | 2 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |

Table of sherd information from Element 139 continued

| Acc. # | Lab # | Date Collected | Bag # | Exc. | Site | Room | S.U. | Area (N. & E.) | Other Notes | Rim Type | Sherd Type |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2019.005.00231.002 | K012 | 6/2/2019 | 2 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |
| 2019.005.00231.002 | K013 | 6/2/2019 | 2 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |
| 2019.005.00231.002 | K014 | 6/2/2019 | 2 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |
| 2019.005.00231.002 | K015 | 6/2/2019 | 2 of 3 | JN | Element 139 | 2B | 2 | 4992 N. 4977 E. | | | Body |