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ANALYTICAL INVESTIGATION OF ANCIENT COINS DISCOVERED IN DIBBA

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ABSTRACT

Nineteen ancient coins discovered in Dibba were subjected to physical and analytical investigations to collect numismatic data. The port of Dibba, which lies in the eastern coast of the United Arab Emirates, has been an active trade post for centuries according to the archaeological evidence excavated from different parts of the city. The coins collection includes 14 locally minted coins and 5 foreign coins. They were photographed, weighed, measured and analyzed using X-ray fluorescence spectroscopy. XRF data revealed that the elemental composition of the coins is mostly Copper-Silver alloys, with two pure copper coins. All the local coins are debased imitations of the coinage of Alexander the Great. They show the head of Hercules on the obverse and a seated 'Zeus' on the reverse. Three of foreign coins are issued by King Attambelos IV who was a ruler of the Characene Kingdom, while one coin was of King Abhiraka, a relatively obscure Indo-Scythian king. Based on the known dates for the individual coins, it is evident that the whole coin collection belongs to the 1st century AD (35 AD – 70 AD) which fits well with occupation dates provided by other artifacts discovered at the site. The local coins collection highlights Dibba's relationship with local communities in Mleiha and Ed-dur, while the presence of foreign coins from the Characene Kingdom and the Western Kshatrapa dynasty indicates the importance of Dibba Alhisn as an international trade port during the first century AD.

Keywords: Ancient, Coins, XRF, Composition, Dibba, Attambelos IV, Characene, Abhiraka, Kshaharata.

1. INTRODUCTION

Dibba Alhisn is a large natural harbour on the east coast of the United Arab Emirates (Red dot in Figure 1). It has been an important site of maritime trade and settlement for hundreds of years, and recent excavations support the reputation of the town as a transhipment centre and trade throughout the iron age and into the late pre-Islamic era. An archaeological site, discovered in the present city by accident in 2004, led to a number of excavations which have yielded evidence of a large settlement with layers of occupation and significant finds of trade goods, bitumen, ceramics and glass as well as coins (Jasim & Yousif, 2014).

Coins are one of the most important archaeological artefacts, because they clearly document historical eras and ruling dynasties. Usually, their metallic composition resists the environmental elements. Thus, making them resilient to degradation and preserve their main features. Since coins are issued by governing bodies, they are an excellent source of information pertaining to dates, rulers, prosperity, geographical domain and trade routes. Historically metal coins were first produced during the 6th and 7th centuries BC in Iron Age Anatolia during the reign of king Alyattes. Early coins were minted with different weights and compositions, thus implying variable values which in effect slowed down their development (Metcalf, 2016). Ever since then coins have been produced around the world in their millions, and consequently collected for their monetary or historical values, such that the science of numismatics was devised.

Generally, different analytical techniques are utilized in numismatics for the study of ancient coins. Some techniques employ computer software and image processing algorithms to identify certain features of the coins (Anwar et al., 2015; Huber-Mörk et al., 2011; Kampel et al., 2009; Kampel & Zaharieva, 2008; Kavelar et al., 2014). While other techniques, such as laser ablation and mass quadrupole spectrometry (LAMQS), x-ray fluorescence (XRF), x-ray diffraction (XRD), laser induced breakdown spectroscopy (LIBS), scanning electron microscopy (SEM), optical microscopy, surface profile analysis (SPA), inductively coupled plasma atomic emission spectroscopy (ICP-AES) and inductively coupled plasma mass spectrometry (ICP-MS) and density measurements are utilized in order to perform chemical analysis (Ager et al., 2016; Caridi et al., 2013; Hajivaliei et al., 2008; Ingo et al., 2004; Marussi et al., 2022; Reale et al., 2012; Torrisi et al., 2010; Torrisi et al., 2016). However, due to its many advantages over other techniques, such as minimum sample preparation, non-destructive testing, high sensitivity and in-situ analysis, x-ray fluorescence spectrometry (XRF) remains the most popular technique employed for archaeological studies in general (Attaelmanan, 2012, 2014; Attaelmanan & Mouton, 2014; Attaelmanan et al., 2020; Attaelmanan & Yousif, 2012; Reddy et al., 2012; Yousif & Attaelmanan, 2012), and for archaeometallurgical research in particular (Attaelmanan et al., 2013; Benoist et al., 2015; Goy et al., 2013). Especially for the purpose of studying ancient coins, XRF was the preferred technique of choice. For example, it was deployed to determine the chemical composition of ancient coins (Al-Saaaed, 1999; Moreno-Suárez et al., 2015; Pitarch & Queralt, 2010), to assess the fineness of the ancient silver coins (Kantarelou et al., 2011), to assess the feasibility of different cleaning methods for silver-copper alloys (Moreno-Suárez et al., 2016), to perform forgery detection (Salem & Mohamed, 2019) and to unveil origins, composition, and appearance of ancient Islamic gold coins (Sáez-Hernández et al., 2024).

The objective of our research is to utilize modern analytical methods to study a coin collection discovered in the ancient port of Dibba Alhisn, United Arab Emirates. With the aim of identifying their chemical composition and provenance. XRF analysis will reveal Very important differences in the major and trace elements. These can be related to the geology of the ore and/or the mines from which they are extracted, the technological process of purification, the environment of burial, and the purity of the precious metals, as well as provide additional information for numismatic studies.

Figure 1: Red Dot Shows the Location of Dibba.

2. MATERIALS AND METHODS

A collection of ancient coins was discovered during excavations in the town of Dibba Alhisn archaeological site, Sharjah Emirate, UAE. The collection is made up of 19 coins of different denominations and origins (Table 1). It includes 14 locally minted coins and 5 foreign coins. The local coins appear to be divided into three groups: three silver coins (Figure 2), nine copper-silver alloy coins (Figure 3), and two pure copper coins (Figure 4).

The three silver tetradrachms (Figure 2) were found among the copper coins, one in Level II and two in

Level III. These are very similar to coins found in other archaeological sites in the UAE, at Mleiha and Ed-Dur, and might indeed have been have minted at Mleiha using a coin mold that was discovered at the site. They are debased imitations of the coinage of Alexander the Great and show the head of Hercules on the obverse and a seated 'Zeus' on the reverse (Potts 2012). Their design appears to be based on the Philip III Arrhidaios (357-317 BC) Drachm which was minted in Babylon. However, the Dibba coins differ from the original design in two main features. On the reverse side of the Philip III Arrhidaios coin Zues holds an eagle on his extended arm and in front of him there is a torch, while the Dibba coins' is a variation of the Hagarian kingdom's coins, where the reverse side shows a horse on the extended arm of Zeus and a palm tree in front of him. Four more badly preserved bronze coins were also found in Level III.

The five foreign examples consist of:

1. Three coins (Figure 5) of King Attambelos IV who was a ruler of the Characene Kingdom, an ancient Arab kingdom that existed in the region of modern-day southern Iraq along the northern coast of the Persian Gulf. This kingdom, also known as Mesene, was an important trade center from around the 2nd century BC to the 3rd century AD (Frye, 1984). Its strategic location made it a hub for trade between the Roman Empire, the Parthian Empire, and the Arabian Peninsula, and it was especially known for its control of maritime trade routes.

Attambelos IV was one of several kings in Characene with the name "Attambelos." His rule is dated approximately from 54 to 64 AD (Nodelman, 1960). Like other Characene rulers, Attambelos IV is primarily known from coins bearing his name and likeness, as historical records from Characene are scarce. The kingdom operated as a client state under the Parthian Empire, which meant that although it had some autonomy, it acknowledged Parthian suzerainty.

Characene's rulers are mostly known for their role in facilitating commerce rather than military conquest, and they often maintained diplomatic relations with neighbouring powers. The rule of Attambelos IV fits within a period of relative stability in Characene's history, although the kingdom eventually faced pressure from the expansion of the Sasanian Empire, which ultimately absorbed it by the 3rd century AD.

2. One coin (Figure 6) of King Abhiraka, a relatively obscure ruler, was an Indo-Scythian king and a member of the early Western Kshatrapa dynasty, also known as the Kshaharata dynasty, which reigned in western India during the 1st century BC to early 1st century AD (circa 35 AD). Abhiraka is primarily known through his rare coinage, which provides insights into his rule and place in the regional succession of power. According to Senior the coins of Abhiraka are of copper only, struck in several sizes, and have been found in Kutch in Gujarat, Afghanistan, and Mleiha in the United Arab Emirates (Jhanjh, 2020; Mahalakshmi, 2020; Senior, 2001).
3. A copper coin (Figure 7) lacking clear features (SAA15N).

Figure 2: Three Local Versions of the Silver Greek Tetradrachm.

Figure 3: Nine Local Copper- Silver Coins.

Figure 4: Two Local Pure Copper Coins.

Each coin was individually weighed with a sensitive balance (Model MS204S, Mettler Toledo, Switzerland) that has a resolution of 0.1 mg, and photographed against a reference grid (10 mm/division). Ultimately, the coins were analyzed using an XRF analyzer (Niton™ XL3t GOLDD+, Thermo-Fisher Scientific, USA). It has an X-ray tube with a Silver (Ag) anode excitation source, operating at 50 kV and 200 micro-Ampere and an optimized silicon drift detector (SDD). It has an energy resolution of 180 eV (FWHM) at 5.95 keV Mn K-alpha line, capable of detecting chemical elements from Mg to U very efficiently. Collected spectra were de-convoluted to calculate the element concentrations as mass% of the analyzed sample area, within a 3σ (99.7%) certainty. Elements are categorized as major, minor or trace depending on their concentrations as mass%, where major is 10 – 100%, minor is 0.1 > < 10% and trace is < 0.1%.

SAAN12 SAA13

SAAN20

Figure 5: King Attambelos IV Coins.

SAAN14

Figure 6: King Abhiraka Coin.

SAAN15

Figure 7: Foreign Coin Lacking Distinctive Features.

3. RESULTS AND DISCUSSION

Based on the coins' features and weights (Table 1) it was clear that no two coins are similar. Although the local coins shared the general features of the head of Hercules on the obverse side and a seated 'Zeus' depicted in various versions on the reverse side, their weights and elemental composition were not consistent.

XRF results (Table 2) clearly differentiate the coin collection into three groups. Group one contains 3 silver coins (SAA1N, SAA2N and SAA7N), that actually contain silver (56 – 66%), and copper (24 – 41%) in addition to traces of tin, lead and gold. Figure 8 shows the clear distinction between the copper coins and the silver coins, where only the three coins could be called "silver coins" due to the fact that they contain over 50% silver. The second group is comprised of twelve coins, eleven of them (SAA6N, SAA8N SAA9N, SAA10N, SAA11N, SAA13N, SAA14N, SAA17N, SAA19N, SAA20N and SAA22N), are composed of a mixture of copper (75 – 93%), silver (4 – 17%), tin (1 – 5%) and lead (0.5 – 15%), while a single coin in this group SAA12N contains high concentrations of lead (30.1%), in addition to copper (55%), silver (10.1%) and tin (3.5%). While the third group comprises four, almost pure (>98%), copper coins (SAA15N, SAA16N, SAA18N and SAA21N) that have traces of silver and lead.

XRF analysis also revealed the presence of Ni, Zn, Co, Mn, Cr, Ti, Sb, Cd, Zr, Bi and Se in trace amounts. Nickle, Antimony and Bismuth were detected in more than half the coins while the other traces were sporadic.

Five coins (SAA12, SAA13, SAA14, SAA15 and SAA20) were identified as of foreign origin. The three King Attambelos Coins (SAA12, SAA13 and SAA20), share similar physical features in terms of size and weight, and contain similar quantities of tin and silver but vastly different concentrations of lead and copper. King Abhiraka coin (SAA14) is made from a copper-lead alloy and contains no silver traces. Coin SAA15 is a pure copper coin with indistinguishable features.

The 14 local coins have varied elemental compositions, except for two coins (SAA1 and SAA2) that have approximately similar elemental compositions, diameters, thicknesses, but different weights. Also, the two coins share slightly similar obverse sides showing the head of young Herakles in lion scalp facing right, and reverse sides showing a man representing Zeus sitting with one arm extended forward with a jumping horse standing on it, and the other hand holding a scepter, while in front of him there is a symbol and a young palm tree, and behind him is a symbol of an anchor. However, the two reverse sides face opposite direction. Zeus in SAA1N is facing left while in coin SAA2N he is facing right.

The presence of precious metals in coins generally indicates an elevated monitory value as well as the wealth of the issuing governor. Fifteen of the coins contained silver in concentrations ranging from 1.25% to 66.7%, while seven coins contained gold in minor traces ranging from 0.07% to 0.5%.

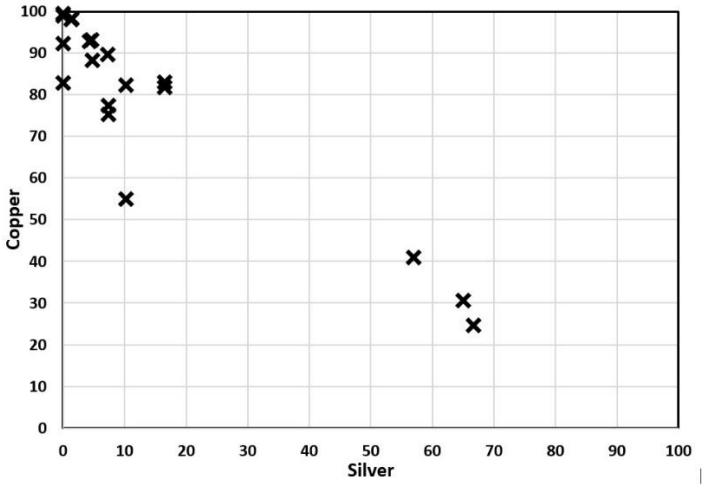

Figure 8: Copper Versus Silver Concentrations

Table 1: Physical Description of the Coins.

SAA1N **Diameter: 2.44 cm** **Thickness: 4.5 mm** **Die rotation: 30°** **Weight: 10.2317 g** **Didrachm**	Obverse: Head of young Hercules in lion scalp facing right with the lion's jaw in the form of a half-circle around the ear. His eye is almond-shaped with a stamp on the cheekbone. Reverse: A man representing Zeus sitting facing left with his right arm extended forward and his left hand holding a scepter. A jumping horse stands on the right hand, while in front of him there is a symbol and a young palm tree, and behind him is a symbol of an anchor. Behind the scepter Aramaic text reading "Abel"
SAA2N **Diameter: 2.52 cm** **Thickness: 4.5 mm** **Die rotation: 30°** **Weight: 6.6 g** **Didrachm**	**Obverse:** Head of young Hercules in lion scalp facing right with the lion's jaw in the form of a half-circle around the ear. His eye is almond-shaped with a stamp on the lion's mane. **Reverse:** A man representing a helmeted Zeus sitting facing right with his left arm extended forward and his right hand holding a scepter. A jumping horse stands on the left hand, while in front of him there is a symbol and a young palm tree, and behind him a symbol of an anchor. Behind the scepter is Aramaic text reading "Abel". Zeus throne is resting on legs that end in a tripod.
SAA3N **Diameter: 1.5 cm** **Thickness: 5 mm** **Die rotation: 30°** **CCW (III-G-3)** **Weight: 1.5 g** **Diobol**	**Obverse:** Head of young Hercules in lion scalp facing right with the lion's jaw in the form of half-circle around the ear. His eye is almond-shaped with a protruded eyeball. **Reverse:** A man representing Zeus sitting facing left with his right arm extended forward and his left hand holding a scepter. A jumping horse stands on the right hand, while in front of him there is a symbol and a young palm tree. Behind the scepter is Aramaic text reading "Abel". **Note:** Zeus is wearing a knight's helmet.
SAA6N **Diameter: 2.5 cm** **Thickness: 4 mm** **Die rotation: 30°** **Weight: 8.5 g**	**Obverse:** The Head of young Hercules wears a lion's skin, and the jaw of the lion takes the shape of a crescent around the ear. **Reverse:** A man sitting representing Zeus facing left and extends his right hand and above this hand it a horse appears naturally raising his right leg. In front of Zeus, there is a sign resembling the number (8) and behind it, there is a trunk of a palm tree, and behind Zeus, there is a symbol of the three-pronged anchor. The Aramaic letters are not clear. Zeus' sitting on his throne, chest muscles are visible, and he wears a helmet resembling a knight's helmet .
SAA8N **Diameter: 2.4 cm** **Thickness: 5 mm** **Die rotation: 30°** **Weight: 9.5 g**	**Obverse:** It is not clear, but some details of the face can be seen, which is Hercules wearing a lion's scalp and a lion's jaw in the shape of a crescent with a small chin protrusion. **Reverse:** A seated man representing Zeus turns to the right, extending his left hand forward with the horse on it, and his right hand back, holding the scepter. Other details are not clear.
SAA9N **Diameter: 2.4 cm** **Thickness: 5 mm** **Die rotation: 30°** **Weight: 15.71 g**	**Obverse:** Hercules wears a lion's scalp with a crescent-shaped jaw open to the bottom of the chin, the lips are two lines and the lion's fangs are slightly protruding above the eye. **Reverse:** A man sitting representing Zeus turns to the right and extends his left hand forward with a horse on it. The right hand is extended behind holding the scepter. In front of him, there is a three-pronged anchor. And behind the back of Zeus, there are three horizontal lines. The body of Zeus was realistically engraved and he wears a helmet, and his neck is clearly extended. There is Aramaic writing behind the scepter, which is almost indistinct, and the Aramaic letter A and B can be seen, but the last letter is not clear, and it may mean (Ab) which means father or (abl). **Note:** The horse was positioned vertically with its legs facing the face of Zeus, and the horse's face facing down towards the hand of Zeus.
SAA10N **Diameter: 2.5 cm** **Thickness: 4 mm** **Die rotation: 30°** **Weight: 13.76 g**	**Obverse:** Hercules is wearing a lion's scalp, where the lion's jaw can be seen taking the shape of a crescent around the place of the ear, while the lips are two lines. **Reverse:** A man sitting representing Zeus facing left and extends his right hand straight there is a horse on this hand in a jumping position while his left hand backward holding a scepter In front of Zeus, there is a symbol resembling the number (8), and behind it, there is a sampling of a palm tree, and behind Zeus' back, there is a three-pronged anchor pointing upwards. The helmet can be seen above the head of Zeus and has some lines that may be the helmet made of wool.

	The Aramaic letters at the back of the scepter, are not clear.
SAA11N **Diameter: 1.4 cm** **Thickness: 4 mm** **Die rotation: 30°** **Weight: 1.5 g**	**Obverse:** The head of Hercules is not clear, but a lion's scalp can be distinguished. **Reverse:** A man sitting, representing Zeus faces to the right, in front of him there is a three-pronged anchor with a palm behind. There are no visible details of the hand and head.
SAA12N **Diameter: 2.5 cm** **Thickness: 5 mm** **Die rotation: 30°** **Weight: 12.75 g**	**Obverse:** A face of a man with a small beard, he is facing to the right, the head is blindfolded, and there is a stamp on the neck. **Reverse:** Hercules with his upper half naked turns to the left sitting on a rock. **Note:** The coin of King Attambelos IV, 54 AD - 64 AD.
SAA13N **Diameter: 2.4 cm** **Thickness: 4 mm** **Die rotation: 30°** **Weight: 12.14 g**	**Obverse:** A face of a bearded man, he is facing to the right, and there is a head tie that is not well clear, as well as there, are two stamps, one on the head and the other on the neck. **Reverse:** Hercules sits facing to the left **Note:** The coin of King Attambelos IV, 54 AD - 64 AD.
SAA14N **Diameter: 2 cm** **Thickness: 4 mm** **Die rotation: 30°** **Weight: 6.12 g**	**Obverse:** Idol Nike facing to the right. **Reverse:** In the middle is the lion and the dharma wheel (dbarmacbaka) on a base and is surrounded by ancient Indian writing (Kharoshti). **Note:** It is a coin of King Abhiraka that dates back to the beginning of the first century AD.
SAA15N **Diameter: 1.5 cm** **Thickness: 2 mm** **Die rotation:** **Weight: 6 g**	**Obverse:** Not clear **Reverse:** Not clear **Note:** Roman copper coin
SAA16N **Diameter: 2.3 cm** **Thickness: 4 mm** **Die rotation: 30°** **Weight: 10.40 g**	**Obverse:** Inconspicuous copper coin in obverse, hairlines can be seen. **Reverse:** A man sitting representing Zeus on his throne, turning to the left, other details are unclear.
SAA17N **Diameter: 2.8 cm** **Thickness: 4 mm** **Die rotation: 30°** **Weight: 28.28 g**	**Obverse:** A distorted face of Hercules wears the scalp of a lion, while the jaw of the lion is in the form of a small crescent that wraps the ear. **Reverse:** A man representing Zeus facing right and extending his left hand in front and a horse stands on it with short legs while the right hand is set back, holding the scepter. In front of Zeus, there is an anchor with three branches and in front of it a palm tree**.**
SAA18N **Diameter: 2.4 cm** **Thickness: 4 mm** **Die rotation: 30°** **Weight: 11.15 g**	**Obverse:** Not clear **Reverse:** A man sitting, representing Zeus turns to the right, the rest of the details are unclear.
SAA19N **Diameter: 2.4 cm** **Thickness: 4 mm** **Die rotation: 30°** **Weight: 12.39 g**	**Obverse:** The head of Hercules wears a lion's scalp and a lion's jaw in the shape of a crescent**.** **Reverse:** A man sitting, representing Zeus facing right, the rest of the details are unclear.
SAA20N **Diameter: 2.4 cm** **Thickness: 5 mm** **Die rotation: 30°** **Weight: 12.06 g**	**Obverse:** The face of King Attambelos IV and there is a horse on his head with a stamp on the neck. **Reverse:** Hercules sitting facing left**.**
SAA21N **Diameter: 2.2 cm** **Thickness: 6 mm** **Die rotation: 30°** **Weight: 15.73 g**	**Obverse:** The head of Hercules wears a lion's scalp and the lion's jaw is a crescent shape and is hollow from the inside with an almond-shaped eye and there is a scar on the cheek. The lips are small dots. **Reverse:** A sitting man representing Zeus facing left, his right arm is extended and the horse stands on it while his left arm is wrapped around the scepter. The palm frond to the left and above the knees there is a three-pronged anchor between the palm and the body of Zeus appears hollow with three points behind Zeus, as well as two Aramaic letters can be seen, the letter A and B means Abel.
SAA22N **Diameter: 2.4 cm** **Thickness: 4 mm** **Die rotation: 30°** **Weight: 8**	**Obverse:** The head of Hercules wearing a lion's scalp and the lion's jaw in the form of a crescent. **Reverse:** A man sitting representing Zeus turns to the right, with a horse standing on his arm, the rest of the details are unclear.

4. CONCLUSIONS

Dibba Alhisn port provided a good anchorage for the maritime trade route for ships arriving from the Roman world and heading to the Arabian Gulf through the Strait of Hormuz, as well as for ships heading east across the Indian Ocean to India, this port also maintained the city's position in its close relations with other contemporary cities through overland trade, as evident by the diversity in discovered artifacts coming from Rome, Egypt, India,

Iran and Mesopotamia. Subsequently, this diversity requires the presence of currency to facilitate the process of trade, which explains the presence of coins of different regions and denominations. Locally issued coins have different categories, and no two coins are alike in features or elemental composition. This is most probably because they were minted at different cities or using different dies while maintaining the basic coins' features. The three silver coins of Alexander the Great, which bears the head of Hercules on the face and the other side sees Zeus sitting on his throne, link Dibba Alhisn to the Hellenistic period at the major United Arab Emirates pre-Islamic cities of Mleiha and Ed-Dur (Jasim & Yousif, 2014).

Three of foreign coins belong to the Characene Kingdom in modern day Iraq, and they bear similar numismatic features and weights, but different elemental compositions, in addition to one Indian King Abhiraka coin and a coin without clear features. The discovery of these coins containing different dominations in the same location indicates that the location was used for trade, most probably a small shop selling commodities. Moreover, the fact that the coins had different origins, local, Iraq and India, highlight the importance of Dibba as an international trade city during the the Iron Age and into the late pre-Islamic era. Most importantly the numismatics data can be used to confirm the date of site occupation. Coins don't perish easily, but their existence in circulation does not last over a hundred years, thus the date of the newest of the coins should coincide with the occupation date of the site. Based on the known dates for the individual coins, it is evident that the whole coin collection belongs to the 1st century AD (35 AD – 70 AD) which fits well with occupation dates provided by other artifacts discovered at the site. Moreover, XRF analysis revealed the varied elemental composition of the coinage collection regardless of the physical appearance, indicating different provenances. Analysis also revealed that some silver looking coins were confirmed to actually be made from a silver-copper alloy, and that the majority of coins contained silver with different concentrations.

Table 2: Element Concentrations (mass%) of the Analyzed Area Together with the Error Expressed as 3σ Which Indicates 99.7% Certainty. The First Five Coins, indicated with (*) Are Foreign and the Rest are Local.

SAMPLE	Cu	Ag	Sn	Au	Pb
SAA1N	30.68±0.22	64.97±0.57	1.51±0.05	0.46±0.02	0.89±0.02
SAA2N	24.72±0.17	66.69±0.54	4.019±0.06	0.50±0.02	1.50±0.02
SAA3N	40.93±0.04	56.92±0.07	0.87±0.03	0.44±0.01	0.55±0.01
SAA6N	81.77±0.03	16.50±0.023	1.21±0.01	0.14±0.01	0.27±0.01
SAA8N	77.36±0.03	7.364±0.02	13.29±0.02	NA	0.83±0.01
SAA9N	92.87±0.02	4.32±0.01	1.98±0.01	NA	0.57±0.01
SAA10N	89.67±0.02	7.30±0.02	2.55±0.01	NA	0.30±0.01
SAA19N	93.21±0.02	4.65±0.01	1.44±0.01	NA	0.47±0.01
SAA11N	88.32±0.03	4.81±0.01	4.94±0.02	0.07±0.01	1.53±0.01
SAA12N*	55.02±0.04	10.15±0.02	3.52±0.02	NA	30.85±0.04
SAA13N*	82.28±0.03	10.20±0.02	2.38±0.01	0.16±0.01	4.65±0.02
SAA14N*	82.82±0.03	NA	1.44±0.01	NA	15.03±0.03
SAA15N*	99.58±0.02	NA	NA	NA	NA
SAA16N	98.39±0.02	1.47±0.01	NA	NA	NA
SAA17N	83.07±0.03	16.46±0.02	0.14±0.01	0.13±0.01	0.15±0.01
SAA18N	98.21±0.02	1.25±0.01	NA	NA	0.24±0.01
SAA20N*	75.37±0.04	7.40±0.02	2.23±0.01	NA	14.76±0.03
SAA21N	99.04±0.02	NA	NA	NA	0.33±0.01
SAA22N	92.40±0.03	NA	1.99±0.01	NA	5.26±0.02

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