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**XRF ANALYSES OF ELECTRUM COINS OF THE 7th — 4th cc. BCE:
COIN HOARD (HOARDS?) OR SEVERAL GROUPS OF COINS***

The subject of the publication is a group of electrum coins of Mysia — Kyzikus, Ionia — Lesbos, Mytilene, Phokaia, and Erythrae. The coins are 83 in number and were found together in a shipment of smuggled traffic. The numismatic term coin hoard, in this case, is not preferable by the authors and the group of coins is called *coin pile*. Given the need to prepare expertise for authenticity, some of the coins were analyzed for their metal composition. Detailed information is represented on the identification of coins and X-ray fluorescence analysis. In a catalog, the coins are arranged for convenience following thematic and chronological order.

Key words: numismatics, electrum coinage, coin hoard, elemental composition of the metal.

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**XRF-АНАЛИЗЫ ЭЛЕКТРОВЫХ МОНЕТ VII—IV вв. ДО Н.Э.:
МОНЕТНЫЙ КЛАД (КЛАДЫ?) ИЛИ НЕСКОЛЬКО ГРУПП МОНЕТ**

Предмет публикации — группа монет из электрума Мисии (Кизик) и Ионии (Лесбос, Митилена, Фокея, Эрифры). Авторы не называют эту *стопку монет* нумизматическим термином «монетный клад». Всего монет 83, и обнаружены они были вместе в партии контрабанды. Учитывая необходимость подготовки экспертизы подлинности, был проанализирован состав металла некоторых монет. Приводится все данные по идентификации и рентгенофлуоресцентному анализу этих весьма редких образцов. Для удобства монеты расположены в каталоге в тематическом и хронологическом порядке.

Ключевые слова: нумизматика, чеканка электра, монетный клад, сплав, элементный состав металла.

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Introduction

On the territory of the Republic of Bulgaria, such finds only from electrum coins are not common. More precisely, a few coin hoard are known only with Kyzikus coins composed of a small number of coins. The authors cannot answer the question of whether these are one or two coin treasures. The reason is the complete lack of information about the origin of the coins and the place of their discovery. The coins were detained by the Bulgarian border services on the Bulgarian-Turkish border.

The coins subject to this publication are probably the result of traffic. The authors did not receive any information about their localization. All coin types and denominations represented in the coin pile are well known. It is not a problem to identify and cite them. In order to have a positive result, the authors divided the work into two parts. The first is to perform numismatic analysis. The second part is X-ray fluorescence analyses and commentary by a specialist chemist and archaeometrist.

In addition to the numismatic methodology, proof of this is the metal composition of the electron, which varies from 9.6 K to 24 K ratio of gold to silver. The conducted expertise and the results give grounds to accept the coins are authentic.

Numismatic analysis by M. Doychinova and I. Prokopov

The total number of electrum coins included in the catalog is 83: Kyzikus — 37 or 38; Lesbos, Mytilene — 26; Phokaia — 10; Erythrae — 3; Uncertain mint. Phocaic standard — 4; Unspecified — 2.

Coin nominals: Staters — 6; Hektes — 52; Hemihektes — 18; Myshemihektes — 5; $\frac{1}{48}$ Staters — 2.

When performing the identification, the authors had to answer two questions. The first is whether the coins were found on the territory of the Republic of Bulgaria? The second is whether it is one, two, or more coin hoards? In order to give an answer to the questions, the authors examined the history of similar finds from the Republic of Bulgaria reflected in publications. The detailed inventory for the collective finds issued in Bulgaria reflects all the finds containing electrum coins (ICHB I).

The review of the collective and individual finds is first focused on the southeastern and southern parts of the Republic of Bulgaria including the Black Sea coast. The following finds were registered in the southeastern region of the border with Turkey:

Region	Number of coins	Nominal	References	Notes
Ahtopol after 2000, Region Burgas	EL 1	hekte Kyzikus	Орачев 2015: No. 23	
Sozopol 2001, Region Burgas	EL hoard?	Kyzikus	ICHB I: 67	
Nessebar area 1988, Region Burgas	EL 20+	stater Kyzikus	IGCH 881	1 coin kept in the Regional Museum Burgas (ICHB I: 53)
Kameno 1943, Region Burgas	EL 1	stater Kyzikus	Карайотов 2011: 23; ICHB I: 48	
Sveti Vlas 1948, Region Burgas (IGCH 689)	EL 3	2 hekte Kyzikus	ICHB I: 63	
		1/3 stater Kroisos		

Electrum coin hoards have also been registered in the southern part of the country bordering Turkey:

Region	Number of coins	Nominal	References	Notes
Ovcharovo-1959, Region Haskovo	EL 1	stater Kyzikus	ICHB I: 690; CCCHBulg. VII: No. 465	One coin of them kept in the Regional Museum
Slavyanovo-1943, Region Haskovo	EL 2	stater Kyzikus	ICHB I: 693; CCCHBulg. VII: No. 466	One coin of them kept in the Regional Museum
Shishmanovo-1900, Region Haskovo	EL 1	stater Kyzikus	ICHB I: 697	
Bolyarovo-1939 (Today a quarter of the town of Haskovo)	EL 2	Stater Kyzikus	ICHB I: 679	
Momchilgrad-1938, Region Kardzali	EL 1	stater Kyzikus	ICHB I: 252	

Collective hoards and single coins were also found in the central part of Southern Bulgaria:

Region	Number of coins	Nominal	References	Notes
Banya-1946, Region Plovdiv	EL 1	stater Kyzikus	ICHB I: 430	Regional museum, Inv. No. 1906
Dabene-1979, Region Plovdiv	EL 9 +	stater Kyzikus, 8 + AR other coins	ICHB I: 437	
Plovdiv area – 1943	2 + : EL	stater Kyzikus	ICHB I: 457	One coin of them kept in the NAIM-BAS Sofia, Inv. No. 586
Starosel-1929, Region Plovdiv	5 + : EL	stater Kyzikus	ICHB I: 463	
Nova Zagora-1943, Region Sliven	EL 1	stater Kyzikus	ICHB I: 550	
Rajena-1929, Region Stara Zagora	EL 1	stater Kyzikus	ICHB I: 634	Kept in History museum in Kazanlak
Stara Zagora-1926	2 + EL	stater Kyzikus	ICHB I: 638	

There is also a non-localized find from Southern Bulgaria:

Region	Number of coins	Nominal	References	Notes
South Bulgaria-1943	EL 2	stater and hekte Kyzikus	ICHB I: 774	NAIM-BAS Sofia, Inv. Nos. 8252, 993

Three finds are reflected in the literature from Western Bulgaria. They are from Sofia district:

Region	Number of coins	Nominal	References	Notes
Jivkovo-1905, Region Sofia (IGCH 714)	EL 41	40 staters, 1 hekte Kyzikus	ICHB I: 587—588	
Muhovo-1936, Region Sofia	EL 3	1 stater Kyzikus; AR 2	ICHB I: 592	
Sofia-1944 (IGCH 713)	EL 1	stater Kyzikus	ICHB I: 599	

Only two finds are known in Northeastern Bulgaria. There is only a single coin on the Black Sea coast:

Region	Number of coins	Nominal	References	Notes
Topoli-1943, Region Varna	EL 1	: stater Kyzikus	ICHB I: 107	

There is one large find on the banks of the Danube River in Bulgaria:

Region	Number of coins	Nominal	References	Notes
Silistra-1905 (IGCH 734)	207+ - EL 7, AR 200+		ICHB I: 534	

The analysis of the electrum coin finds clearly shows activity towards the eastern coast of the Black Sea and the connection with the Sea of Azov. In particular, the area from the town of Olbia to the Taman Peninsula and the Kerch Strait: “Olbia-1966”; “Kerch-1904”; “Taman’ Peninsula-1866-67” and “Taman’ Peninsula-1845” (IGCH 1002, 1011, 1012, 1013). The trace of trade relations marked by electrum coins is obvious. The authors do not intend to comment on the findings outside the delineated area, but they will note that the finds from Bulgaria fall partly in the northern zone of the flow of electrum coins. It is important to emphasize the main conclusion. The analysis clearly shows that in Bulgaria there are no registered coins of Phocaea and Mytilene. The authors assume that the coin pile/hoards? was most likely not found on Bulgarian territory. The question of whether this is one, two, or more finds cannot be answered unequivocally. Examination of the finds with electrum coins shows a rather rare mixing of the coins of Kizik in Moesia with those of the cities of Ionia.

XRF analysis of electrum coins by Boika Zlateva

The analysis of the provided coins was performed with an X-ray fluorescence spectrometer, Bruker S1 Titan. Due to the high content of gold and the chemical properties of it (non-corrosive metal) surface of the coins has not been pre-cleaned. Internal and external (SRM Airubis 3000) calibration of the device is used. The concentration of 44 chemical elements was measured. The table (see Table 1) below shows the concentration (in mass %) for the elements that have concentrations above the lower limit of determination (LOD of the method).

The tested coins are reflected with a laboratory code. Index 1 marks the analysis of the reverse of the coins.

Table 1. Elemental composition of the investigated coins (in mass %).

Lab. Code	Ti	Fe	Cu	Ag	Au	Alloy type
Series A:						
C-100.SOF	0.069±0.008	0.203±0.011	10.74±0.53	44.35±2.21	44.84±1.79	10.9 K Gold
C-100-1.SOF	0.219±0.021	< LOD	10.20±0.50	45.33±2.22	44.06±1.68	10.7 K Gold
C-101.SOF	0.135±0.012	< LOD	1.25±0.05	27.58±1.38	71.04±2.84	17.2 K Gold
C-101-1.SOF	0.384±0.032	< LOD	1.40±0.06	24.57±1.25	73.44±2.88	17.5 K Gold
C-102.SOF	< LOD	< LOD	3.90±0.19	27.52±1.38	68.58±2.60	16.6 K Gold
C-102-1.SOF	< LOD	< LOD	4.29±0.38	27.69±1.39	68.02±2.60	16.2 K Gold
C-103.SOF	< LOD	0.243±0.012	9.88±0.48	50.54±2.53	39.58±1.60	9.6 K Gold
C-103-1.SOF	0.137±0.014	0.231±0.012	9.18±0.45	53.62±2.68	36.76±1.57	9.6 K Gold
C-104.SOF	< LOD	< LOD	1.64±0.07	30.89±1.54	67.47±2.59	16.3 K Gold
Series B:						
C-105.SOF	< LOD	< LOD	4.83±0.40	36.33±1.82	58.60±2.30	14.2 K Gold
C-106.SOF	< LOD	< LOD	3.21±0.15	37.60±1.88	58.96±2.32	14.3 K Gold
C-107.SOF	< LOD	< LOD	2.41±0.11	39.63±1.98	57.96±2.29	13.8 K Gold
C-108.SOF	< LOD	< LOD	5.18±0.25	41.16±2.06	53.66±2.16	13.0 K Gold
C-109.SOF	< LOD	< LOD	4.99±0.25	40.51±2.03	54.50±2.17	13.2 K Gold
Series C:						
C-110.SOF	< LOD	< LOD	1.63±0.08	33.73±1.69	64.63±2.60	15.4 K Gold
C-111.SOF	0.22±0.02	< LOD	1.83±0.07	31.51±1.58	66.44±2.65	15.8 K Gold
C-111.SOF	0.071±0.065	< LOD	2.68±0.22	39.27±1.97	57.64±2.28	13.7 K Gold
C-113.SOF	< LOD	0.264±0.013	2.49±0.12	36.19±1.81	61.32±2.44	14.6 K Gold
C-114.SOF	0.059±0.006	< LOD	3.10±0.14	42.26±2.12	54.58±2.20	13.2 K Gold
Series D:						
C-115.SOF	< LOD	0.229±0.011	7.29±0.35	47.42±2.37	45.29±1.81	11.0 K Gold
C-116.SOF	< LOD	< LOD	7.62±0.36	49.36±2.47	42.76±1.71	10.4 K Gold
C-117.SOF	< LOD	0.395±0.020	7.98±0.39	53.51±2.68	38.51±1.54	-
C-117.SOF	< LOD	0.421±0.021	7.75±0.36	54.05±2.70	37.97±1.52	-
C-118.SOF	< LOD	< LOD	6.70±0.33	52.54±2.63	40.76±1.61	9.9 K Gold
Series E:						
C-119.SOF	< LOD	0.370±0.018	3.81±0.20	36.63±1.85	59.16±2.40	14.3 K Gold
C-120.SOF	< LOD	< LOD	3.76±0.20	37.06±1.85	59.18±2.40	14.1 K Gold
C-121.SOF	< LOD	< LOD	3.14±0.15	38.64±1.94	58.22±2.32	14.1 K Gold
C-122.SOF	2.23±0.02	< LOD	1.11±0.05	29.38±1.46	66.46±2.65	16.1 K Gold
C-123.SOF	0.587±0.061	< LOD	3.18±0.16	34.27±1.71	61.64±2.48	14.9 K Gold
Series F:						
C-124.SOF	< LOD	< LOD	1.01±0.05	37.21±1.85	61.78±2.50	14.7 K Gold
C-125.SOF	< LOD	< LOD	1.66±0.08	39.31±1.96	59.04±2.36	14.3 K Gold
C-126.SOF	< LOD	< LOD	3.96±0.20	36.07±1.80	59.97±2.42	14.5 K Gold
Series G:						
C-127.SOF	< LOD	< LOD	< LOD	0.252±0.01	99.75±4.00	23.8 K Gold
C-128.SOF	< LOD	< LOD	< LOD	0.447±0.02	99.55±3.98	24.0 K Gold

With the exception of sample C-117, the type of alloy was determined. It ranges from 9.6 to 24 K gold.

Electrum is known to consist of gold and silver, often mixed with small amounts of copper, platinum, or other metals. Usually the metals registered in the natural electrum are copper, iron, bismuth and palladium. The name electron can be applied to any natural gold-silver alloy that contain 20—80% gold and 80—20% silver. The artificial electron is called “green gold” or “green silver” depending on which metal predominates in the alloy. The natural electrum found today in Western Anatolia contains 70% to 90% gold. Most examples of ancient electrum are coins that contain lower amounts of gold. Most examples of ancient electrum are coins that contain less gold. Researchers believe that the raw material is further alloyed to maintain profits at a lower quantity of gold (Helmenstine 2020). The early Ionian coins studied have evidence of the addition of silver. It has been found that some of the concentrations of silver are remarkably high for natural levels and certainly contain added copper. The same can be said of the Lydian coins analyzed by Kraay (Kraay 1958: 21—23). The percentages of copper given by Kraay for Ionic and Lydian coins determined through surface analysis by X-ray fluorescence should be considered as minimum values. Paszthory examined two Lydian coins using X-ray fluorescence and wet chemical analysis. (Paszthory 1980). The results show that they contain enough iron and copper, so they must have been made from unrefined electrum with added copper.

The content of silver suggests that it may have been added. The lead content may allow the addition of about one piece of silver to four parts of the electrum accordingly. This means a content of about $\frac{2}{3}$ gold before “dilution”. Such a finding is made for some of these coins written in Lydian letters, WALWEL, which is interpreted as “lion” (Wallace 1988). In both the natural electron alloy and the synthesized metal, the amounts of gold and silver vary considerably. In the electron from which coins were minted in archaic Greece, silver varies from 10 to 30%. An analysis reported by Wallace (Wallace 1987) confirms and round out this hypothesis: “The silver content of early coins varies from approximately 20% to 75%, with most coins having more than 45% silver”.

In the analyzed coins the lowest silver content is shown by coins with numbers C-127 and C-128. It is respectively 0.252 and 0.447% and the gold content is over 99%. In the other cases, silver varies from 24.57% to 54.05%, with an average value of 36.95%.

The C-117 coin has the lowest gold content and the presence of a relatively high copper content — over 7.8 % and the same time has the highest iron content — about 0.4%. This implies the use of unrefined electrum for its production but this conclusion is not certain. It could be rejected or confirmed by analysis by other methods. The obtained values for the elements that are discriminatory — Bi, Pb, Sn, Hg — are below the detection limits of the method.

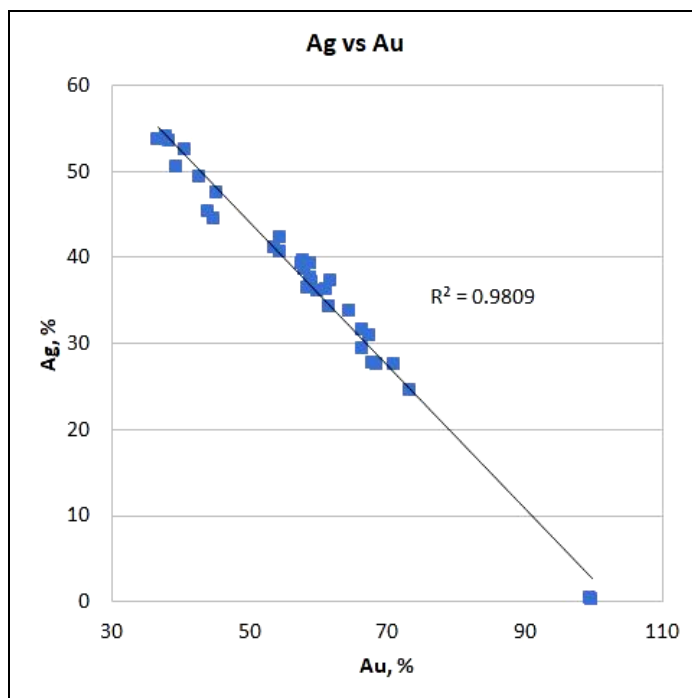


Fig. 1. Two-dimensional distributional of silver and gold.

The average amount of copper is 4.76%, and the content varies from 1.1% to over 10% (Fig. 2).

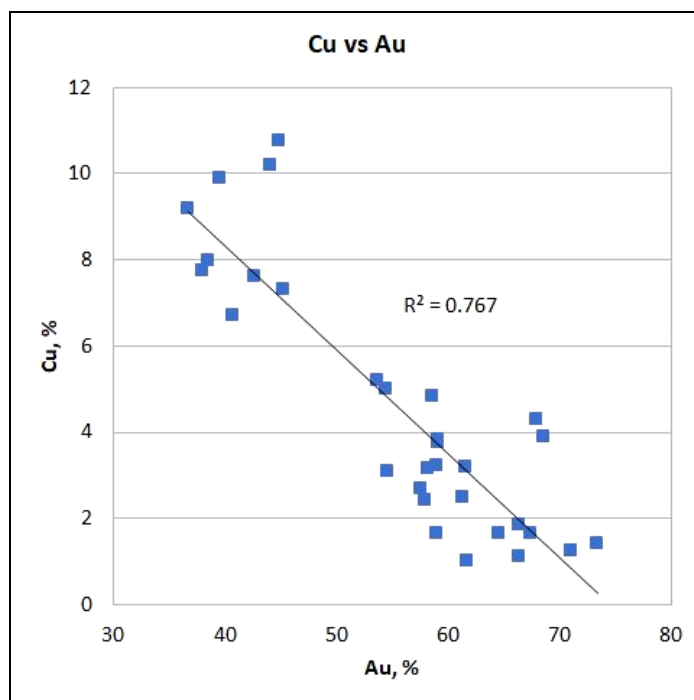


Fig. 2. Two-dimensional distributional of copper and gold.

Looking at the coins in series, it is noticeable that the same series includes coins with different types of alloy. Exceptions are series E, F, and G respectively with a very similar composition of the alloy. This could be an indication of production on one technology and/or in one production center.

Should be noted again the positive correlation between the content of copper and gold — but with a lower correlation coefficient. This fact could be explained by the different periods and places of production of the coins. As well as by the use of unrefined electrum to make some of them.

Conclusion

The performed X-ray fluorescence analysis is suitable for determining the type of alloy used to make electrum coins. The limitations of the method are taken into account: analysis only of the surface layer of the alloy and the high lower limit of determination.

Additional information on the manufacturing technology, as well as the trends in the change in the amount of gold / silver, can be obtained using the information from the numismatic analysis. In order to obtain results, it is necessary to compare the weights of the coins, their dating, as well as a possible place of mining.

CATALOGUE

MYSIA, KYZIKOS (in chronological order). Fig. 3, nos. 1—38.

Kyzikos. Circa 600—550 BCE.

Obv. Fish to left, tunny fish below.

Rev. Quadripartite incuse square.

1. El Hekte 10 mm; No. in a coll.: 3.9.

Hurter & Liewald III 3.

Obv. Head of a tunny fish to right; above and below, small tunnies swimming to left.

Rev. Quadripartite incuse square.

2. El Hemihekte 9 mm; No. in a coll.: 4.3.
3. El Hemihekte 9 mm; No. in a coll.: 4.7.
4. El Hemihekte 10 mm; No. in a coll.: 4.8.

Greenwell 166; Hurter & Liewald III 13.2; SNG France 173; von Fritze I 28.

Obv. Tunny left with wing of griffin above.

Rev. Quadripartite incuse square.

5. El Hemihekte 10 mm; No. in a coll.: 4.10.

Hurter & Liewald III 37.2; von Fritze I 33.

Obv. Head of boar right, holding in its mouth a tunny.

Rev. Quadripartite incuse square.

6. El Hemihekte 9 mm; No. in a coll.: 7.1.

von Fritze I 34 (stater & hemihekte); Hurter & Liewald II 35; SNG Berry 926.

Obv. Head of tunny left; below, headless tunny left.

Rev. Quadripartite incuse square.

7. El Hemihekte 9 mm; No. in a coll.: 7.3.

Hurter & Liewald III 12.2; SNG France 165 (hekte); Rosen 416 = SNG von Aulock 7262.

Kyzikos Circa 550—500 BCE.

Obv. Head of goat with long beard to left; tunny fish upward behind.

Rev. Quadripartite incuse square.

8. EL Stater. 18 mm; No. in a coll.: 2.1.

9. EL Stater. 18 mm; No. in a coll.: 2.2.

von Fritze I 48, pl. I: 49; Rosen pl. XI: 184; SNG France 186.

Obv. Head of Athena to left, wearing Corinthian helmet; tunny fish downward behind.

Rev. Quadripartite incuse square.

10. EL Stater. 18 mm; No. in a coll.: 2.4.

von Fritze I 63; Greenwell 26; SNG France -; Boston MFA 1432 = Warren 1445; Gillet 1058; Jameson 2168; Gulbenkian II 608.

Obv. Winged dog seated to left, head reverted to right; tunny fish to left below.

Rev. Quadripartite incuse square.

11. EL Stater. 18 mm; No. in a coll.: 2.3.

von Fritze I 104; Greenwell 140; Boston MFA 1433; SNG France 245; Weber 5019.

Obv. Head of boar left; to right, tunny upward

Rev. Quadripartite incuse square.

12. EL Stater 17 mm; No. in a coll.: 2.5.

Hurter & Liewald I 45a.

Obv. Satyr in kneeling-running stance to left, holding in his extended right hand a tunny fish by the tail
Rev. Quadripartite incuse square.

13. EL Stater. 18 mm; No. in a coll.: 2.6.

von Fritze I 122; Boston 1461.

Obv. Youthful male head to left, wearing laurel wreath with blossom at his brow; behind to right, tunny fish swimming downwards.

Rev. Quadripartite incuse square.

14. El Hekte 10 mm; No. in a coll.: 3.6.

15. El Hekte 9 mm; No. in a coll.: 3.12.

Boston MFA 1431 = Warren 1498; Greenwell 79; von Fritze I 62.

Kyzikos. Circa 550—450 BCE.

Obv. Satyr kneeling left, holding a tunny fish by the tail in his extended right hand.

Rev. Quadripartite incuse square.

16. El Hekte 9 mm; No. in a coll.: 3.1.

17. El Hekte 10 mm; No. in a coll.: 3.2.

SNG France 270; von Fritze I 122.

Obv. Forepart of ram left; to right, tunny upward.

Rev. Quadripartite incuse square.

18. El Hekte 10 mm; No. in a coll.: 3.3.

19. El Hekte 11 mm; No. in a coll.: 3.13.

Cf. Boston MFA 1420; Jameson 2166; SNG von Aulock 1175.

Obv. Prow to left, the lower hull decorated as a winged forepart of a wolf, the head of which forms the ship's ram; below, tunny left.

Rev. Quadripartite incuse square.

20. El Hekte 10 mm; No. in a coll.: 3.11.

SNG von Aulock 1183.

Obv. Forepart of lion left, [devouring prey]; to right, tunny upward.

Rev. Quadripartite incuse square.

21. El Hemihekte 8 mm; No. in a coll.: 4.1.

22. El Hemihekte 8 mm; No. in a coll.: 4.2.

23. El Hemihekte 8 mm; No. in a coll.: 4.6.

von Fritze I 41; Boston MFA 1416 = Warren 1534; cf. SNG France 181 (hekte).

Obv. Head of Athena to left, wearing crested Attic helmet; below, tunny to left.

Rev. Quadripartite incuse square. SNG France -, cf. 195 (hemihekte). von Fritze I 67.

24. El Hemihekte 8 mm; 8 mm; No. in a coll.: 4.4.

SNG France 195 (hemihekte); von Fritze I 67.

Obv. Ram seated left, with head turned back; below, tunny left.

Rev. Quadripartite incuse square.

25. El Hemihekte 7 mm; No. in a coll.: 4.5.

For nominal stater: von Fritze I 47; Greenwell 131; Boston MFA 1419 = Warren 1555; BMC 14 48; Jameson 2167; Weber 5016.

Obv. Forepart of Pegasos left on tunny left.

Rev. Quadripartite incuse square.

26. El Hemihekte 7 mm; No. in a coll.: 4.14.

von Fritze I 102; cf. Boston MFA 1434–6 (larger denominations); SNG France 243.

Obv. Bearded head of male left, in archaic style, on tunny left.

Rev. Quadripartite incuse square.

27. El Hekte 10 mm; No. in a coll.: 6.4.

von Fritze I 66; Greenwell 78; Boston MFA -; SNG France 194; Jameson 2170.

Kyzikos. Circa 500—450 BCE.

Obv. Lion at bay to left on tunny.

Rev. Quadripartite incuse square.

28. El Hekte 10 mm; No. in a coll.: 3.4.

SNG France 212; von Fritze I 83.

Obv. Forepart of Pegasos left on tunny left.

Rev. Quadripartite incuse square.

29. El Hekte 9 mm; No. in a coll.: 3.7.

30. El Hekte 9 mm; No. in a coll.: 3.8.

SNG France 241; Boston MFA 1435.

Obv. Satyr in kneeling-running stance to left, holding in his extended right hand a tunny fish by the tail. Rev. Quadripartite incuse square.

31. El Hemihekte 8 mm; No. in a coll.: 4.9.

von Fritze I 122; cf. Boston MFA 1461 (stater); SNG von Aulock 7289 (hekte); SNG France 270 (hekte).

Obv. Griffin seated to left, raising right foreleg; below, tunny fish to left.

Rev. Quadripartite incuse square.

32. El Hemihekte 7 mm; No. in a coll.: 4.13.

Cf. von Fritze I 101 (unlisted denomination); cf. Boston MFA 1437—1438 (stater and hekte)

MYSIA, Kyzikos. Circa 550-450 BC

Obv. Head of lion left; to right, tunny upward.

Rev. Quadripartite incuse square.

33. El Myshemihekte 6.5 mm; No. in a coll.: 7.4.

von Fritze I 39; Greenwell 115; Boston MFA 1415 = Warren 1539; SNG France 179—180.

Kyzikos Circa 450 BCE.

Obv. Head of goat left, tunny fish behind.

Rev. Quadripartite incuse square.

34. El Hekte 10 mm; No. in a coll.: 3.10.

von Fritze I 48 (stater); SNG France 186 (stater).

Kyzikos Circa ?

35. El Hemihekte 7 mm; No. in a coll.: 4.11.

von Fritze I 15; Hurter & Liewald 36.

Kyzikos Circa ?

Obv. Forepart of a lion, head turned back.

Rev. Quadripartite incuse square.

36. El Hemihekte 8 mm; No. in a coll.: 4.12.

Kyzikos Circa ?

Obv. Tunny fish right, above ?

Rev. Quadripartite incuse square.

37. El Hemihekte 7 mm; No. in a coll.: 4.15.

Kyzikos or Ionia?

Obv: Forepart of harpy left, holding tunny?

Rev: Quadripartite incuse square.

38. El Hemihekte 8 mm; No. in a coll.: 7.2.

SNG France 207 or von Fritze I 24.

IONIA

Lesbos, Mytilene Circa 521—478 BCE. Fig. 3, nos 39—64.

Obv. Head of roaring lion to right.

Rev. Incuse head of calf to right; rectangular punch behind.

39. El Hekte 11 mm; No. in a coll.: 5.4.

40. El Hekte 11 mm; No. in a coll.: 5.5.

SNG Cop. 301; SNG von Aulock 1685; HGC 6.

Lesbos, Mytilene Circa 454—428/7 BCE.

Obv. Youthful male head to right, wearing tainia.

Rev. Wreathed and bearded male head to right within shallow square incuse.

41. El Hekte 10 mm; No. in a coll.: 5.13.

Bodenstedt 52; SNG Cop. 325; SNG von Aulock 7730; HGC 6, 978.

Obv. Bearded head of the Satyr facing r.
Rev. Rams heads confronted, flower above, all within shallow incuse square.
42. El Hekte 10 mm; No. in a coll.: 6.14.
Bodenstedt 37.

Lesbos, Mytilene. Circa 412—378 BCE.

Obv. Bearded head of Dionysos right, wearing tainia and wreath of ivy in hair, of archaized style.
Rev. Head of Kalathiskos (dance performer) right in linear square within incuse square.
43. El Hekte 11 mm; No. in a coll.: 5.10.
Bodenstedt 76; HGC 6, 1002.

Obv. Head of Athena to right, wearing crested Attic helmet.
Rev. Head of Artemis-Kybele to right, wearing stephane, within linear incuse square.
44. El Hekte 10 mm; No. in a coll.: 5.11.
45. El Hekte 10 mm; No. in a coll.: 5.12.
Bodenstedt 73; HGC 6, 999.

Obv. Laureate head of Apollo to right
Rev. Female head with long hair inside incuse linear square
46. El Hekte 11 mm; No. in a coll.: 5.14.
SNG von Aulock 1713; Bodenstedt 70.

Obv. Head of Io right, wearing tainia.
Rev. Head of Dionysos to right, wearing wreath of ivy and fruit, within linear square within incuse square.
47. El Hekte 11 mm; No. in a coll.: 5.19.
Bodenstedt 77; SNG Cop. 326; SNG von Aulock 1720.

Obv. Forepart of winged lion l.
Rev. Sphinx seated r. in linear square within incuse square.
48. El Hekte 10 mm; No. in a coll.: 6.11.
Bodenstedt 63; HGC 6, 989 corr. (winged lion, not boar); SNG von Aulock 1704; BMC 14 35.

Lesbos, Mytilene. Circa 377—326 BCE.

Obv. Head of Dionysos to right, wearing wreath of ivy and fruit.
Rev. Bald facing head of Silenos with long beard and two animal ears within rectangular incuse.
49. El Hekte 10 mm; No. in a coll.: 5.1.
50. El Hekte 10 mm; No. in a coll.: 5.2.
51. El Hekte 10 mm; No. in a coll.: 5.3.
Bodenstedt 90; SNG Cop. 323—324; SNG von Aulock 1718.

Obv. Veiled head of Demeter to right, wearing wreath of grain ears.
Rev. Tripod tied with fillet; all within linear square within incuse square.
52. El Hekte 9 mm; No. in a coll.: 5.8.
53. El Hekte 10 mm; No. in a coll.: 5.9.
Bodenstedt 91; HGC 6, 1017; SNG von Aulock 1726.

Lesbos, Mytilene. Circa 380/377—326 BCE.

Obv. Head of Athena facing, looking slightly to right, wearing triple-crested Attic helmet.

Rev. Draped bust of Hermes to right, with his petasos hanging behind his neck; all within linear square.

54. El Hekte 10 mm; No. in a coll.: 5.20.

55. El Hekte 10 mm; No. in a coll.: 5.21.

Bodenstedt 86; HGC 6, 1012; SNG von Aulock 1709, 7738.

Obv. Head of Hermes right, wearing petasos.

Rev. Lion standing right in linear square [within shallow incuse square].

56. El Hekte 9 mm; No. in a coll.: 6.7.

Bodenstedt 83; HGC 6, 1009.

Obv. Laureate head of Zeus to right.

Rev. Half-length bust of Nike with spread wings to right, two stars above, all within linear square.

57. El Hekte 10 mm; No. in a coll.: 5.15.

58. El Hekte 10 mm; No. in a coll.: 5.16.

Bodenstedt 101; SNG von Aulock 7741.

Obv. Laureate head of Apollo right; coiled serpent behind neck.

Rev. Head of Artemis right, hair bound in sphendone, in linear square within [incuse square].

59. El Hekte 10 mm; No. in a coll.: 5.17.

60. El Hekte 10 mm; No. in a coll.: 5.18.

Bodenstedt 100B; HGC 6, 1026.

Obv. Head of Kabeiros right, wearing wreathed cap; two stars flanking.

Rev. Head of Persephone right within linear square.

61. El Hekte 10 mm; No. in a coll.: 6.15.

Bodenstedt 99; HGC 6, 1025.

Obv. Half length bust of Maenad, hair in sphendone, right.

Rev. Race torch in linear square within shallow incuse square.

62. El Hekte 10 mm; No. in a coll.: 6.16.

Bodenstedt 92; HGC 6, 1018; SNG Cop. 320; BMC 14 122; Boston MFA 1744; Jameson 1478; *Traité* II 2219; Weber 5643.

Obv. Laureate head of Apollo right.

Rev. Kithara in linear square within incuse square.

63. El Hekte 10 mm; No. in a coll.: 6.17.

Bodenstedt 94; HGC 6, 1020.

Obv. Head of Persephone right, wearing barley-wreath.

Rev. Bull charging left, within linear square frame.

64. El Hekte 9 mm; No. in a coll.: 6.13.

Bodenstedt 88; SNG Lockett 2765; SNG von Aulock -; SNG Cop. 321; HGC 6, 1014.

Phokaia. Circa 625/0—600 BCE. Fig. 3, nos. 65—78.

Obv. Head of griffin with open mouth to right; pellet above.

Rev. Quadripartite incuse square.

65. El Forty-eighth Stater 5 mm; 0.33 g; No. in a coll.: 7.9.

Bodenstedt E1 a; Rosen 317; SNG von Aulock 7789; *Traité* I, 170.

Phokaia. Circa 625—522 BCE.

Obv. Head of boar left; seal below.

Rev. Irregular incuse square.

66. El Hekte 8 mm; No. in a coll.:3.5.

Bodenstadt Em.14; Jameson 1509.f.

Asia Minor, uncertain mint. Phocaic standard 6th c. BCE.

Obv. Swastika in relief on raised square.

Rev. Quadripartite incuse square.

67. El Hekte 8 mm; No. in a coll.:6.5.

Obv. Swastika in relief on raised square.

Rev. Quadripartite incuse square /Incuse punch.

68. El Myshemihekte 6 mm; No. in a coll.:7.5.

69. El Myshemihekte 7 mm; No. in a coll.:7.6.

SNG von Aulock 1778; Rosen -, cf. 319 (hecte).

Obv. Swastika in relief on raised square.

Rev. Incuse punch.

70. El Forty-eighth Stater 5 mm; 0.33 g; No. in a coll.:7.8.

Traité I 238; Traité II.2, 238, pl. 5: 37.

Phocaea. Ca. 477—388 BCE.

Obv. Head of Athena left wearing crested Attic helmet ornamented with crouching griffin; below, small seal left.

Rev. Quadripartite incuse square.

71. El Hekte 8 mm; No. in a coll.:6.18.

Bodenstedt 91; SNG von Aulock 2131—2132.

Phokaia, Ca. 387—326 BCE.

Obv. Laureate female head l., hair in sakkos; below, inverted seal r.

Rev. Quadripartite incuse square.

72. El Hekte 8 mm; No. in a coll.:5.6.

73. El Hekte 8 mm; No. in a coll.:6.9.

BMC 14 63—65; Bodenstedt 102.

Obv. Head of Omphale left, wearing lion skin; club behind neck; below, small seal left.

Rev. Quadripartite incuse square.

74. El Hekte 8 mm; No. in a coll.:6.8.

75. El Hekte 8 mm; No. in a coll.:6.12.

76. El Hekte 8 mm; No. in a coll.:6.19.

Bodenstedt 107; SNG von Aulock 2133; Boston MFA 1917.

Obv. Young female head left; below, small seal left.

Rev. Quadripartite incuse square.

77. El Hekte 8 mm; No. in a coll.:5.7.

Bodenstedt 90.

Obv. Female head to left, wearing a laurel wreath and with her hair in a sakkos; below neck, here off the flan, seal.

Rev. Quadripartite incuse square.

78. El Hekte 8 mm; No. in a coll.:6.10.

BMC 14 63—65; Bodenstedt 102.

Erythrae. Ca. 550—500 BCE. Fig. 3, nos. 79—81.

Obv. Head of Heracles left, wearing lion skin headdress.

Rev. Quadripartite incuse square.

79. El Hekte 8 mm; No. in a coll.:6.1.

80. El Hekte 8 mm; No. in a coll.:6.2.

81. El Hekte 8 mm; No. in a coll.:6.3.

SNG von Aulock, 1942; SNG Kayhan 2002, 737—738.

Unspecified: Fig. 3, nos. 82—83.

Obv. Unclear. According to the angle, it can be a Ketos, a griffin's head or another animal.

Rev. Quadripartite incuse square.

82. El Myshhemihekte 6 mm; No. in a coll.: 7.7.

Obv. Facing gorgoneion, mouth opened and tongue protruding between her teeth.

Rev. Quadripartite incuse square.

83. El Hekte 8 mm; No. in a coll.: 6.6.

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Fig. 3. Photos of coins.



Fig. 3. Photos of coins (continued).



Fig. 3. Photos of coins (continued).