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Thracian horsemen: a provenance study of marble sculptures from Dobrudja, Romania

Mircea Penţia, Robert H. Tykot, Liviu Nedelcu, and Alexandru Barnea

Abstract The "Thracian horseman" representation expresses the idea of a religious myth of the population living during the Hellenistic and Roman periods in the Greek colonies and Roman provinces on the Aegean and western Black Sea shores, including Dobrudja in Romania. The geographical distribution of Thracian horseman monuments is limited to the territory of Thracia and Moesia Inferior. Dobrudja, as part of Moesia Inferior, was quite familiar with the Thracian horseman cult.

Characterization of some Thracian horsemen from the Constanţa Archaeological Museum was carried out by means of $\delta^{13}C$ and $\delta^{18}O$ stable isotope analysis and thin-section petrography. The statistical treatment of the experimental data, using a Gaussian bivariate distribution function, shows the most confident provenance attributions among the quarries represented in a database based on the one initially produced by Herz. The results indicate that most of the Thracian horsemen samples are probably made of marble from Prokonnesos (Marmara). These results are consistent with a previous study of Roman and Byzantine objects from the same region.

INTRODUCTION

The Thracian horseman representation expresses the idea of a religious myth of the population living during the Hellenistic and Roman periods in the Greek colonies and Roman provinces on the Aegean and western Black Sea shores, including Dobrudja (Fig. 1). Known as Scythia in the 1st to 6th centuries AD, modern-day Dobrudja is a territory bounded by the Danube river and the Black Sea.

The geographical distribution of Thracian horsemen monuments is concentrated particularly in the territory of Thracia and Moesia Inferior, but there are discoveries in Roman Dacia and other eastern Roman provinces. Dobrudja, as part of Moesia Inferior, knew the Thracian horseman cult well. Here, the inscriptions contain mostly Greek and Latin epithets of the Thracian hero.

Hampartumian (1979) noted that the geographical and quantitative distribution of the monuments devoted to the Thracian horseman reveals some interesting general conclusions concerning the diffusion and the intensity of the cult of heroes in the ancient provinces of Romania: (1) the absolute preponderance of Moesia Inferior in discoveries of the monuments of the Thracian horsemen; and (2) the finds are concentrated in urban centers. Most of the discoveries have been made in the Graeco-Roman cities of Tomis (Constanţa), Histria, and Callatis (Mangalia), representing 65% of the total finds in Moesia Inferior. The monuments date to the Roman period, especially to the 2nd and 3rd centuries AD.

In an earlier study, 25 Roman and Byzantine marble artifacts in the Tulcea Museum of History and Archaeology were analyzed (Penţia *et al.*, 1999). Among these were six Thracian horsemen from northern Dobrudja. The artifacts investigated in this paper are from the Constanţa Archaeological Museum and come from sites further south along the Black Sea coast (Table 1). Seven other Thracian horsemen marble artifacts (samples 18–24), from the Constanţa Archaeological Museum storeroom, have also been analyzed but are not yet published.

CARBON AND OXYGEN ISOTOPE ANALYSIS OF MARBLE ARTIFACTS

One of the most widely used systems for determining marble provenance is that of stable carbon and oxygen isotope analysis. This involves measuring the ratios $^{13}C/^{12}C$ and $^{18}O/^{16}O$ in samples and expressing the results in terms of relative deviation from a conventional standard, the Pee Dee Belemnite (PDB), a carbonate fossil from South Carolina. This deviation, called δ, is expressed as $\delta^{13}C$ and $\delta^{18}O$, measured in parts per thousand (or per mil, ‰) and calculated as follows:

$$\delta\,(‰) = \frac{R_{\text{sample}} - R_{\text{standard}}}{R_{\text{standard}}} \times 1000 \quad \text{where } R = \frac{^{13}C}{^{12}C} \text{ or } \frac{^{18}O}{^{16}O}$$

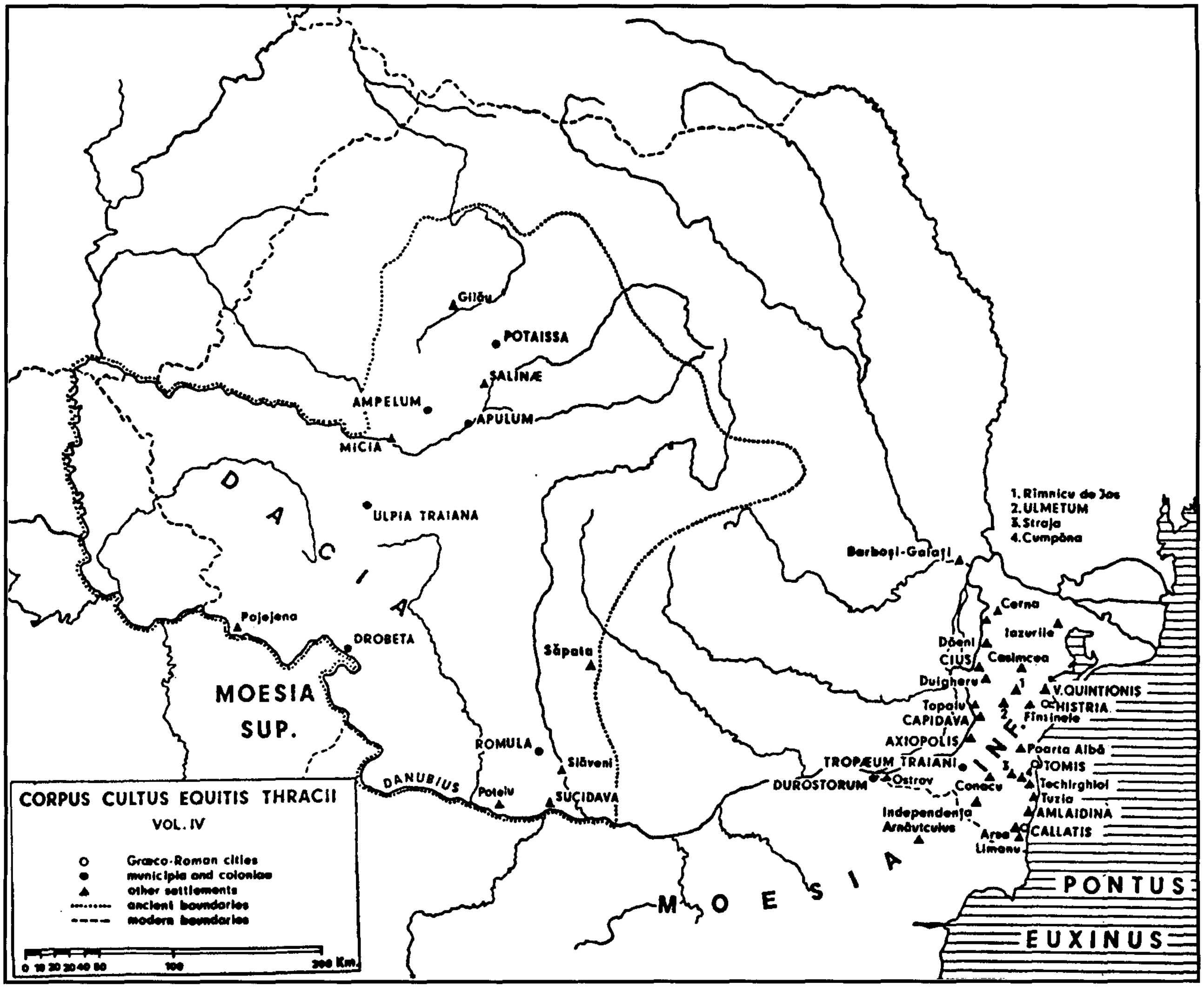

Figure 1 Map showing sites mentioned in the text.

Stable isotope ratios for carbon and oxygen were measured at Harvard University on a VG PRISM II mass spectrometer using a carbonate autosampler equipped with a common acid bath. Analytical precision, based on the repeated analysis of a limestone standard, is 0.1‰ for carbon and 0.2‰ for oxygen.

For a signature to be viable, carbon and oxygen isotopic ratios must be uniform throughout an artifact, relatively uniform in a quarry, but with different values in different quarries. By a statistical treatment of the carbon and oxygen isotopic ratios of the database of some classical Greek and Roman marble quarries (Herz, 1987), it could be possible (Leese, 1988) to locate and to fix the extension of every quarry distribution point ($\delta^{18}O$ and $\delta^{13}C$) in the scatter plot of these values (Penţia, 1995). The statistics also allow the determination of an ellipse contour, containing a constant fraction of the quarry distribution points (δ_C, δ_O) (Penţia, 1995). For example, in Table 2 there are presented some particular values $p(k) = 1 - exp(-k^2/2)$ of the probability that a random sample point (δ_C, δ_O) be within a k^2-ellipse area or, in other words, shows the fractions of all the (δ_C, δ_O) values lying inside the k^2-ellipse. The complementary fraction, expressing the probability that a random sample point (δ_C, δ_O) lies outside the k^2-ellipses of a specific quarry, defines the so-called *Confidence Level* (Aguillar-Benitez *et al.*, 1992):

$$CL(k) = 1 - p(k)$$

PROVENANCE DETERMINATION ACCORDING TO STABLE ISOTOPE ANALYSIS

Based on these considerations we used a quarry assignment probability method for any pair of measured isotopic ratios (δ_C, δ_O) of a marble artifact. The method uses the statistical description of the available quarry data sets (Herz, 1987) and determines the k-value distance to the mean (μ_C, μ_O) of every quarry. The corresponding CL-values represent the probability that the measured k-values belong to each

Table 1 Thracian horsemen from the Constanţa Archaeological Museum analyzed in this paper, with references.

Sample						References			
			Inv.			Scorpan 1967		Hampartumian	
No.	Id.	Short description	no.	Discovery site	Dated	pag.	Fig.	pag.	Cat. no.
1	2S	Rectangular marble plaque	2023	Tomis – Sculpture tesaurus at the old railway station	3rd century AD	17	2	37	18
2	3S	Slightly trapezoidal marble plaque	2020	Tomis – Sculpture tesaurus at the old railway station	1st half 3rd century AD	17	3	39	23
3	4S	Pentagonal marble plaque	2022	Tomis – Sculpture tesaurus at the old railway station	1st half 3rd century AD	19	4	38	22
4	6S	Fragmentary marble stele	5454	Tomis	2nd , 3rd century AD	22	6	37	17
5	14S	Marble stele	5453	Tomis – La Cazarmi	Roman period	35	14	49	39
6	17S	Rectangular marble plaque	2798	Tomis, old railway station	Roman period	39	17	38	20
7	18S	Quasi-square marble plaque	2021	Tomis – Sculpture tesaurus at the old railway station	3rd century AD	42	18	37	19
8	19S	Arched funeral marble stele	34	Tomis	2nd, 3rd century AD	44	19	43	30
9	20S	Rectangular marble plaque	42	Arsa, com. Albeşti, district Constanţa	2nd century AD	47	20	32	5
10	25S	Marble statuette	15763	Tuzla, district Constanţa	2nd century AD	55	25	82	116
11	30S	Marble plate	1939	Tomis	2nd century	37	15	40	28
12	31S	Marble plate	1909	Callatis	2nd century	65	31	69	91
13	32S	Rectangular marble plaque	5451	Limanu, district Constanţa	2nd , 3rd century AD	66	—	67	88
14	34S	Marble plate	7107	Fîntînele	3rd century AD	68	34	57	—
15	38S	Marble plaque	1908	Tomis, blvd. Independenţei 160	2nd century AD	75	38	46	35
16	41S	Marble aedicula	2014	Tomis, old railway station	2nd century	81	41	45	33
17	42S	Marble plate	1995	Unknown	Roman period	83	42	88	133

Table 2 The cumulative probability $p(k) = 1 - \exp(-k^2/2)$, in %, that a random sample point (δ_C, δ_O) of a specific quarry will be within an ellipse area, of semiaxes ($k\sigma_C$, $k\sigma_O$) around the mean (μ_C, μ_O).

k	0.25	0.50	1.00	1.50	2.00	3.00	4.00
$p(k)$	3.08	11.75	39.35	67.53	86.47	98.89	99.97

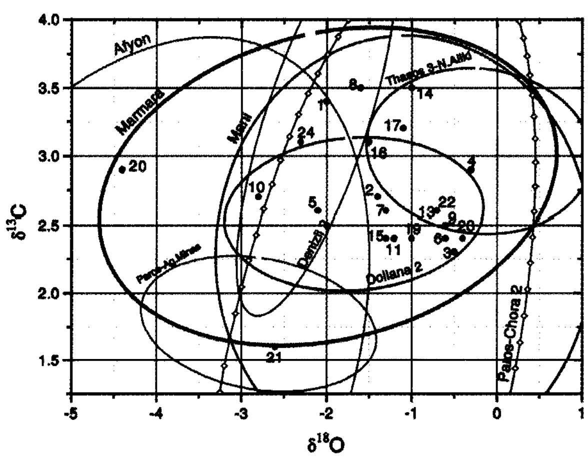

Figure 2 The scatter plot shows the $\delta^{18}O$–$\delta^{13}C$ results, along with the ellipse domains of the most probable quarries of the database which could be assigned to the measured values of our sample artifacts (specified by the corresponding numbers). According to a Gaussian bivariate distribution function, within every ellipse there are 86.5% of the $\delta^{18}O$–$\delta^{13}C$ quarry sample values.

specific quarry, exclusively due to statistical variation. It is important to consider that a *CL*-value less than say 10% generally shows a disagreement which could not be caused by statistical fluctuations, while a large *CL*-value does not necessarily mean a better assignment to the specific quarry but is a consequence of statistical fluctuations. The isotopic results for the Thracian horsemen marble artifacts are presented in Table 3 and Figure 2.

In Figure 2 there are drawn the ellipses (for $k = 2$ or $CL = 13.5\%$) for the possible provenance quarries from the database (Herz, 1987) which could be assigned to our measured ($\delta^{13}C$, $\delta^{18}O$) sample points (see Table 3). The possible origin of the marble could be found within those quarries with a confidence level (*CL*-value) greater than 10%, which was

Table 3 Results of stable isotope analysis of Thracian horsemen marble artifacts from the Constanţa Archaeological Museum.

Sample No.	id.	$\delta^{13}C$ (‰)	$\delta^{18}O$ (‰)	Sample No.	id.	$\delta^{13}C$ (‰)	$\delta^{18}O$ (‰)
1	2S	3.4	−2.0	13	32S	2.6	−0.7
2	3S	2.7	−1.4	14	34S	3.5	−1.0
3	4S	2.3	−0.5	15	38S	2.4	−1.3
4	6S	2.9	−0.3	16	41S	3.1	−1.5
5	14S	2.6	−2.1	17	42S	3.2	−1.1
6	17S	2.4	−0.6	18	1T	2.7	−8.1
7	18S	2.6	−1.3	19	2T	2.4	−1.0
8	19S	3.5	−1.6	20	3T	2.9	−4.4
9	20S	2.5	−0.6	21	4T	1.6	−2.6
10	25S	2.7	−2.8	22	5T	2.6	−0.7
11	30S	2.4	−1.2	23	6T	2.4	−0.4
12	31S	2.7	−8.1	24	7T	3.1	−2.3

Table 4 Probable quarry assignment with Confidence Level greater than 10% for Thracian horsemen samples from the Constanţa Archaeological Museum. Italicized quarries are more probable based on petrographic and archaeological/historical data.

Sample		Possible quarry provenance (Confidence Level)
1	2S	1-Denizli2 (96.5); 2-*Marmara* (54.9); 3-Mani (26.8); 4-*Paros-Chora2* (20.8); 5-Afyon (13.9)
2	3S	1-*Marmara* (88.5); 2-Doliana2 (85.6); 3-Mani (84.1); 4-Iasos (80.0); 5-*Paros-Chora2* (69.1); 6-Carrara-Classical (64.5); 7-Usak (30.7); 8-Collonata (20.1); 9-Denizli (15.1); 10-Afyon (11.5); 11-Miseglia (11.5); 12-Thasos6-Acropolis (11.2); 13-Doliana (10.9)
3	4S	1-Mani (86.5); 2-Thasos5-C.Phanari (66.3); 3-*Paros-Chora2* (59.2); 4-*Marmara* (30.5); 5-Doliana1 (22.1); 6-Car.-Mineralized (18.8); 7-Carrara-Classical (18.8); 8-Doliana2 (16.1)
4	6S	1-Thasos3-N.Aliki (88.8); 2-Thasos1-Aliki (87.5); 3-Denizli1 (79.7); 4-Mani (57.7); 5-*Marmara* (45.4); 6-*Paros-Chora2* (43.7); 7-Car.-Mineralized (43.0); 8-Doliana2 (11.5); 9-Carrara-Classical (11.0)
5	14S	1-*Marmara* (95.5); 2-Doliana2 (85.1); 3-Carrara-Classical (65.9); 4-Mani (61.0); 5-Usak (55.8); 6-*Paros-Chora2* (41.5); 7-Hymettos (39.3); 8-Thasos6-Acropolis (38.5); 9-Denizli (36.9); 10-Iasos (36.0); 11-Doliana1 (34.1); 12-Afyon (23.5); 13-Miseglia (23.5); 14-Mylasa (19.7); 15-Collonata (14.8)
6	17S	1-Mani (89.6); 2-*Paros-Chora2* (64.4); 3-Car.-Mineralized (47.2); 4-*Marmara* (39.8); 5-Carrara-Classical (38.4); 6-Doliana1 (27.6); 7-Thasos5-C.Phanari (24.7); 8-Doliana (24.5)
7	18S	1-Mani (91.0); 2-Doliana2 (88.2); 3-*Marmara* (80.3); 4-*Paros-Chora2* (75.3); 6-Carrara-Classical (74.2); 6-Iasos (64.8); 7-Collonata (33.6); 8-Usak (28.5); 9-Denizli1 (26.7); 10-Doliana (20.2); 11-Thasos6-Acropolis (17.8); 12-Miseglia (16.2)
8	19S	1-*Marmara* (46.3); 2-Denizli2 (41.7); 3-*Paros-Chora2* (30.2); 4-Mani (28.3); 5-Iasos (14.1)
9	20S	1-Mani (87.4); 2-Car.-Mineralized (72.3); 3-*Paros-Chora2* (63.3); 4-*Marmara* (45.8); 5-Doliana2 (33.8);
10	25S	1-*Marmara* (83.3); 2-Mylasa (57.2); 3-Usak (53.7); 4-Afyon (36.1); 5-*Thasos6-Acropolis* (34.7); 6-Denizli2 (31.9); 7-Doliana1 (29.7); 8-Doliana2 (28.7); 9-Mani (26.4); 10-Heracleia (17.6)
11	30S	1-Mani (98.5); 2-*Paros-Chora2* (83.2); 3-Carrara-Classical (74.2); 4-Doliana2 (65.0); 5-*Marmara* (61.8); 6-Iasos (41.2); 7-Thasos5-C.Phanari (40.2); 8-Collonata (35.1); 9-Doliana (33.6); 10-Thasos6-Acropolis (24.6); 11-Miseglia (21.6); 12-Usak (19.1)
12	31S	1-Iznik (82.7); 2-*Naxos-Apollonas* (80.6); 3-*Penteli* (79.2); 4-Doliana1 (76.2); 5-Sardis (70.6); 6-Naxos-Apir/Kin (48.6)
13	32S	1-Mani (87.0); 2-Car.Mineralized (82.9); 3-*Paros-Chora2* (66.4); 4-*Marmara* (55.4); 5-Doliana2 (43.6); 6-Carrara-Classical (37.2); 7-Thasos3-N.Aliki (24.4); 8-Thasos1-Aliki (23.0); 9-Doliana (12.8)
14	34S	1-*Paros-Chora2* (42.3); 2-*Marmara* (41.1); 3-Mani (31.5); 4-Thasos3-N.Aliki (17.6)
15	38S	1-Mani (97.3); 2-*Paros-Chora2* (82.8); 3-Carrara-Classical (81.6); 4-Doliana2 (70.5); 5-*Marmara* (65.2); 6-Iasos (57.7); 7-Collonata (48.2); 8-*Thasos5-C.Phanari* (42.4); 9-Doliana (35.2); 10-Miseglia (27.9); 11-Thasos6-Acropolis (27.5); 12-Usak (22.1); 13-Sounion (18.7); 14-Torana (14.5); 15-Hymettos (13.0)
16	41S	1-*Marmara* (83.1); 2-Mani (55.5); 3-Iasos (52.2); 4-*Paros-Chora2* (48.8); 5-Doliana2 (17.1); 6-Thasos3-N.Aliki (15.0); 7-Carrara-Classical (12.3); 8-Afyon (11.0); 9-Usak (10.1)
17	42S	1-*Marmara* (67.1); 2-*Paros-Chora2* (53.2); 3-Mani (52.0); 4-*Thasos3-N.Aliki* (37.1); 5-Thasos1-Aliki (19.3); 6-Iasos (16.8)
18	1T	1-Iznik (82.7); 2-*Naxos-Apollonas* (80.6); 3-*Penteli* (79.2); 4-Doliana1 (76.2); 5-Sardis (70.6); 6-Naxos-Apir/Kin (48.6)
19	2T	1-Mani (98.6); 2-*Paros-Chora2* (80.7); 3-Carrara-Classical (58.0); 4-*Marmara* (54.6); 5-Doliana2 (52.4); 6-Thasos. 5-C.Phanari (35.2); 7-Doliana (30.5); 8-Thasos6-Acropolis (19.4); 9-Iasos (16.3); 10-Collonata (15.3); 11-Usak (13.9); 12.-Mineralized (13.3); 13-Miseglia (11.7)
20	3T	1-*Afyon* (38.3); 2-*Marmara* (16.7); 3-Doliana1 (14.8)
21	4T	1-Paros-Ag.Minas (79.1); *2-Paros-Chora2* (40.1); 3-Afyon (39.8); 4-Mani (27.5); 5-Hymettos (27.1); 6-Aphrodisias1 (25.1); 7-Ephesos2 (18.4); 8-Miseglia (18.3); 9-Aphrodisias2 (14.7); 10-*Marmara* (13.0)
22	5T	1-Mani (87.0); 2-Car.-Mineralized (82.9); 3-*Paros-Chora2* (66.4); 4-*Marmara* (55.4); 5-Doliana2 (43.6); 6-Carrara-Classical (37.2); 7-Thasos3-N.Aliki (24.4); 8-Thasos-Aliki (23.0); 9-Doliana (12.8)
23	6T	1-Mani (81.3); 2-*Paros-Chora2* (53.0); 3-*Marmara* (32.8); 4-Car.-Mineralized (23.0); 5-Doliana (21.8); 6-Thasos5-C.Phanari (19.9); 7-Doliana2 (18.1); 8-Carrara-Classical (17.7); 9-Thasos1-Aliki (10.5)
24	7T	1-Denizli2 (92.7); 2-*Marmara* (80.5); 3-Mani (32.6); 4-Afyon (21.2); 5-Mylasa (20.2); 6-*Paros-Chora2* (18.4); 7-Doliana2 (10.7)

used in the quarry assignment procedure (Penţia, 1995). The quarries and the corresponding *CL*-values are presented in Table 4. The statistical distribution of the isotopic properties of marbles within a quarry and even within a large artifact is the main source of uncertainty in the provenance determination.

SEARCH FOR PETROGRAPHIC SIMILARITIES

The determination by petrographic criteria of the provenance of marble used for making various artifacts is based on the principle that each marble source has its own identity, determined by a specific combination of petrographic properties. Taking into account color, mineralogic composition, grain size, and various structural aspects, Herz (1985) presented in a synthetic form the petrographic properties of

Table 5 Petrographic characteristics of Thracian horsemen marble artifacts from the Constanţa Archaeological Museum, and petrographic similarities with the available quarry data and stable isotope results.

Sample No.	Sample id.	Accesory minerals[1]	Grain size (mm) Limits[2]	Grain size (mm) MGS[3]	Grain size (mm) Average	Structure and other notes	Petrographic similarities
1	2S	wm, or	0.4–1.7	1.0–1.7	1.0	weak foliated, breccious	Marmara
2	3S		0.4–1.7	0.9–1.7	1.0	massive, mortar texture	Marmara
3	4S	or	0.4–2.0	0.9–2.0	1.2	massive, mortar texture	
4	6S		0.3–1.2	0.8–1.2	0.75	mortar texture, weak breccious	Paros-Chora 2
5	14S		0.3–1.6	0.9–1.6	1.0	foliated, coarse crystals in finer matrix	
7	18S	wm, or	0.5–2.0	0.8–2.0	1.25	mortar texture, weak orientation of crystals	
8	19S	qz, or, ap	0.3–1.1	0.6–1.1	0.7	massive, weak foliated, small dolomite grains (~ 2%)	Paros-Chora 2
9	20S	qz, or	0.45–2.6	0.8–2.6	1.5	mortar, porphyroblastic, coarse crystals in finer matrix	
10	25S	qz, or	0.45–2.0	0.9–2.0	1.2	mortar, breccious texture, small dolomitic grains	Thasos 6
11	30S	wm, qz	0.4–2.2	0.9–2.2	1.3	mortar, breccious texture	
12	31S		0.4–1.65	0.9–1.65	1.0	mortar, breccious milonitic texture	
13	32S	qz	0.4–1.6	0.9–1.6	1.0	massive, weak orientation of crystals	Marmara
14	34S	or	0.4–1.7	0.75–2.4	1.0	massive, weak breccious	Marmara
15	38S		0.15–0.7	0.3–0.7	0.4	massive, small dolomite grains (~ 35%)	Thasos 5
17	42S	or	0.45–2.0	0.8–2.0	1.2	mortar, breccious texture	Thasos 3
18	1T	or, ep, ru	0.3–1.35	0.5–1.35	0.8	foliated texture	Paros-Chora 2
19	2T	or	0.4–1.65	0.8–1.65	1.0	foliated, breccious texture	Marmara
20	3T		0.35–2.4	0.75–2.4	1.4	breccious, weak foliated texture	
21	4T	or	0.5–2.25	1.1–2.25	1.4	foliated, breccious texture	
22	5T	or, ep	0.45–1.35	0.85–1.35	0.9	mortar, breccious texture	Paros-Chora 2
23	6T	or, ep	0.45–1.2	0.8–1.2	0.8	mortar, breccious texture	Paros-Chora 2
24	7T		0.9–1.7	1.15–1.7	1.3	breccious, foliated texture	Marmara

[1] wm-white micas, or-iron ores, ru-rutile, qz-quartz, ep-epidote
[2] Limits of grain size domain
[3] Maximum grain size

12 marble sources used in Greek and Roman antiquity: Pentelikon, Hymettos, Doliana, Agrileza, Apollona (Naxos), Paros, Aliki (Thasos), Marmara (Prokonnesos), Ephesos, Aphrodisias, Dokimeion (Afyon), and Carrara.

Table 5 lists the petrographic properties of the artifacts investigated in this paper. The properties used by Herz (1985) for characterizing the 12 ancient marble sources were used in the examination of the artifacts. When determining provenance by means of petrographic properties, it is presumed that two marble samples with similar petrographic properties are probably from the same source, unless multiple sources have similar petrographic properties. Nevertheless, the accuracy of this method is very dependent on several factors:

1. The petrographic database lacks some ancient marble quarries; it is less complete than the isotopic database;
2. Measuring the variability of petrographic properties within the same artifact requires more thin sections and more sampled material. This is restrictive for small and valuable artifacts and can introduce errors in determining some petrographic properties, due to the impossibility of obtaining enough material for thin sections;
3. There may be significant variation in petrographic properties within each marble quarry;
4. In the case of some small artifacts, the difficulties in determining some petrographic properties such as color, layering, or banding should be taken into account;
5. The accessory mineral content for a quarry may differ from that of selectively quarried blocks, chosen for carving objects because of their high purity;
6. Weathering alteration of the marble artifacts can influence the petrographic determinations (Doehne *et al.*, 1992), because of mineral changes near the surface. For this reason the sampling stage should be approached with special care and fresh marble should be used whenever possible.

QUARRY ASSIGNMENTS AND HISTORICAL OBSERVATIONS ON THE ANALYZED THRACIAN HORSEMEN SCULPTURES

In order to make the quarry assignments for the marble used for the artifacts investigated in this paper, isotopic matches were cross-checked with petrographic data for each quarry. For many artifacts, the provenance quarries suggested by their isotopic signatures agree with the quarries to which the artifacts could also be assigned by petrographic criteria.

First, it must be noted that the isotopic values for the Thracian horsemen are generally not consistent with the Bucova and other quarries in Romania, which have lower carbon isotope ratios (Muller *et al.*, 1997; 1999). Furthermore, these local sources were used for statues, inscriptions, and architectural pieces at the same time that smaller artifacts were generally made of imported marble. According to historical observations, all but one (no. 16) of the first 17 pieces in our study belong to the same epoch and the same iconographic type. Three have votive inscriptions in Greek, and they are not exceptions in the region; the finds show the influence and circulation area of Greek culture.

Our study indicates that the marble used for the Thracian horsemen sculptures found in Dobrudja (Fig. 2; Tables 3, 4, and 5) seems to come mostly from Prokonnesos (modern Marmara) and/or the Paros/Chorodaki 2 quarries (sample nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 14, 16, 19, 21, 22, 23 and 24). In a previous study, four of six horsemen were also attributed to Prokonnesos (Penţia *et al.*, 1999). Many of the horsemen have isotopic ratios consistent with the Doliana 2 quarry, but this marble was used locally in the Peloponnesos and not for export. There are other quarries which also overlap with some of the horsemen samples which similarly may be ruled out on the basis of historical knowledge. Samples 10, 15, and 17, while isotopically consistent with both Prokonnesos and Paros, are petrographically more similar to Thasos, based on grain size and/or the presence of dolomite crystals. Samples 12 and 18 isotopically look like Pentelic or Naxian marble, while sample 20 is isotopically consistent with both Pentelic and Afyon marble although neither are supported by the petrographic data.

The attribution of the bulk of the Thracian horsemen to marble quarries at Prokonnesos and Paros-Chorodaki 2 is supported by evidence from the following centuries in which most sculptural marble, including architectural pieces, have the same provenance. It is a noticeable tradition, and a cultural and spiritual link between the Balkan region, especially its eastern part, and the Aegean Sea and Asia Minor. In fact, the Thracian horseman represents an eastern Greek cult, widespread in the eastern Balkan Peninsula, in the same way that in the western part the Danubian hero cult is prevalent. It is necessary to remind ourselves that the "Thracian" epithet of the horseman or hero is a modern one, based on the finding area, and not due to a possible ethnic relation. Within inscriptions it is named systematically "hero," with the associated Greek name (Hampartumian, 1979).

The chronology of the analyzed pieces shows a tendency towards Prokonnesos, which dominated the market in the 3rd century AD. During this time the horseman cult reached its maximum extension in Moesia Inferior and Roman Dacia (especially the southern part) (Hampartumian, 1979). Before the 3rd century AD this center was in competition with or preceded by Thasos and other quarry sources. It must be pointed out that sculptures 9, 10, 12, 14 and 15 show a distinct iconographic context as compared with the common one of the 3rd century AD. They are among the oldest, as is sculpture 16, but with different characteristics; we have suggested that three of these (10, 12 and 15) may be from sources other than Prokonnesos or Paros. Sculpture 16 iconographically represents a different class, which nevertheless could be added to the Prokonnesos group, from the ascending period of the workshop.

The provenance assignments established in this paper are only probable. The main sources of uncertainty are due to: (1) the overlap of the quarry isotopic fields; (2) uncertainties in and the more subjective nature of petrographic analysis; (3) a lack of information about some quarries, especially in the petrographic database; and (4) statistical distribution of the petrographic and isotopic properties of marbles within a quarry.

In order to determine more accurately the quarries which supplied the marble used for making the respective artifacts, it is necessary to have complete petrographic and isotopic databases that should comprise all the marble occurrences that could have been used in antiquity. Additional analyses will also be necessary to overcome the isotopic and petrographic overlaps between quarry sources. Data which could resolve these issues could be furnished by trace element analysis, paramagnetic resonance spectroscopy, cathodoluminescence, or strontium isotope ratio analysis.

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Scorpan, C. 1967. *Cavalerul trac.* Muzeul Regional de Arheologie Dobrogea – Constanţa.

AUTHORS' ADDRESSES

Alexandru Barnea, University of Bucharest, Department of History, 13 Carol I Blv., Bucharest, Romania
Liviu Nedelcu, Geological Survey of Romania, 1 Caransebeş str., RO-78344 Bucharest, Romania
Mircea Penţia, Institute of Nuclear Physics and Engineering, PO Box MG-6, RO-76900 Bucharest, Romania
Robert H. Tykot, Department of Anthropology, University of South Florida, 4202 East Fowler Avenue, SOC107, Tampa, FL 33620-8100, USA