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APHRODISIAN MARBLE FROM THE GÖKTEPE QUARRIES: THE LITTLE BARBARIANS, ROMAN COPIES FROM THE ATTALID DEDICATION IN ATHENS

by Donato Attanasio, Matthias Bruno, Walter Prochaska and Alì Bahadir Yavuz

The marble of seven under-lifesize sculptures of barbarians, now in the archaeological museums of Naples, Venice and the Vatican, commonly considered to be Roman copies of the Pergamene Lesser Dedication in Athens, comes from the Göktepe marble quarries near Aphrodisias, as is shown by isotopic, electron paramagnetic resonance, trace analyses, and of petrographic data. Since this marble was used mostly by Aphrodisian artists, this finding confirms, on the basis of scientific data, previous hypotheses on the origin of the sculptors who manufactured the statues. Reliable discrimination from similar fine-grained Asiatic marbles, such as Docimium, *is possible primarily on the basis of the composition of the Göktepe marbles, which have unusually low concentrations of manganese and high concentrations of strontium. Present knowledge of the history of the quarries and the distribution of their marbles seems to rule out the possibility that the sculptures date from the late Republican period and supports the opinion, previously proposed on stylistic grounds, that they were manufactured in Rome by Aphrodisian sculptors probably during the first half of the second century* AD.

Il marmo di sette sculture di barbari, di dimensioni inferiori al vero, ora nei musei archeologici di Napoli, Venezia e del Vaticano, in genere considerate copie romane del Piccolo Donario pergameno in Atene, proviene delle cave di marmo di Göktepe vicino Afrodisia come dimostrato dalle analisi delle tracce, isotopiche ed EPR e dei dati petrografici. Poiché questo marmo era usato prevalentemente dagli artisti afrodisiensi, questo risultato conferma, sulla base di dati scientifici, le ipotesi formulate in precedenza sull'origine degli scultori che realizzarono le statue. La possibilità di discriminazione tra i marmi asiatici con grana simile, come il Docimium, è dovuta alla composizione dei marmi di Göktepe, che contengono concentrazioni insolitamente basse di manganese ed elevate di stronzio. L'attuale conoscenza della storia delle cave e la distribuzione dei loro marmi sembra escludere la possibilità di datare le sculture al periodo tardo-repubblicano e supporta l'idea, precedentemente formulata su base stilistica, che esse furono eseguite a Roma da scultori afrodisiensi probabilmente durante la prima metà del II secolo d.C.

INTRODUCTION

This paper continues and extends the work carried out recently on the so-called Larger or Ludovisi Gauls (Attanasio, Bruno and Prochaska, 2011) by reporting on marble provenance studies of seven under-lifesize barbarian sculptures now in the archaeological museums of Naples, Venice and the Vatican.

Since the mid-nineteenth century, when Heinrich Brunn published his pioneering papers (1853; 1870), the Ludovisi Gauls and the so-called Small Gauls or Little Barbarians have aroused enormous interest as the few surviving testimonies of the sculptural Pergamene tradition, besides the Pergamon altar. These sculptures were discovered in Rome at the beginning of the sixteenth century and generally are considered to be Roman copies of the bronze originals that decorated dedicatory monuments erected in Pergamon and Athens by the Attalid kings of Pergamon in the late third or the second century BC. Subsequently a huge amount of scholarship has been devoted to understanding in detail the history and the vicissitudes of the original monuments as well as of the replicas.[1]

Along with stylistic and historical considerations, the marble of the statues, unanimously identified as 'Asiatic', has been one of the key issues in the ample and still-unsettled debate on the dating and the geographic origin of the workshops that produced the marble copies. The term 'Asiatic', however, is ambiguous. Traditionally it has been used to group together several different marble varieties that are clearly not 'Italian' (Luna), nor 'island' (Cycladic and/or Thasian), nor 'mainland Greek' (Pentelicon and Hymettos) marbles. Several scholars have assumed that the term 'Asiatic' may mean that the sculptures of the Gauls were manufactured using *Docimium* marble (Mattei, 1987: 149–50; Marszal, 2000: 203 n. 54). Different provenances, however, have been suggested (Stewart, 2004: 136), such as Proconnesos, on the sea of Marmara, or Denizli, a marble quarried in the Meander valley; and it has been proposed also that some of the sculptures could be made of gypsum alabaster perhaps from Volterra.[2] These hypotheses, mostly based on visual inspection or incomplete analyses, confirm that the term 'Asiatic', although useful for a broad, preliminary marble classification, can be misleading, and certainly does not identify clearly any of the several white marbles quarried in antiquity in Asia Minor.

A decisive study of the marble provenance of the copies has been long-awaited; identification of the marble has not been expected to solve all the problems connected with the Little Gauls, but it could provide valuable information for at least some issues (Ridgway, 1990: 291; Marszal, 2000: 203). Very recently the marble of the Large Gauls has been analyzed in a multi-method scientific provenance study; these four lifesize and over-lifesize sculptures commonly associated with the Attalid Dedication in Pergamon, the Suicidal Gaul in the Museo Nazionale Romano at the Palazzo Altemps, the Dying Gaul in the Capitoline Museums and the so-called head of a Persian and the head of a

[1] For a summary of the studies on the Little Barbarians, see, for example: Ridgway, 1990; Smith, 1991; Stewart, 2004; Gasparri, 2009: cat. nos. 78–81 (by S. Pafumi).

[2] The hypothesis, put forward by Silvano Bertolin, sculptor and restorer at the Munich Glyptothek, refers specifically to the Kneeling Gaul in the Louvre Museum and is reported by Andreae (1998: 116; see also Steingräber, 2000: 250 n. 101). Gypsum alabaster must not be confused with calcitic alabaster, sometimes called onyx marble, which is a kind of travertine commonly used in antiquity and generally originating from Egypt, north Africa or Turkey.

Greek in the Palatine Antiquarium have been firmly identified as marble from the quarries of *Docimium* (Attanasio, Bruno and Prochaska, 2011).

Until recently the archaeometric identification of *Docimium* marble, a fine-grained stone available in white and polychrome (*pavonazzetto*) varieties, has been considered a relatively simple task, although it was conceded that there was some possibility of mis-classification with the well-known Greek Pentelicon marble, but not with other Turkish marble varieties. However, the recent discovery of the Göktepe marble quarries, which also produced high-quality, fine-grained white, as well as black and bichrome, marble, and which were located not far from Aphrodisias (Yavuz *et al.*, 2009), has completely changed this picture, making the reliable identification of fine-grained 'Asiatic' white marbles more challenging. Correct provenancing of the newly-discovered marble relies on its unique trace composition as detected by electron paramagnetic resonance (EPR) spectroscopy, a technique that measures the properties of the marble deriving from its manganese content.[3] On the basis of their low manganese content and other factors, many highly-prized sculptures, mostly made by Aphrodisian artists and widespread from the Hadrianic period onwards, have been shown conclusively to be made of Göktepe marble (Attanasio *et al.*, 2008; Attanasio, Bruno and Yavuz, 2009; Attanasio, Bruno and Yavuz, 2010). The work carried out subsequently on the Ludovisi (Large) Gauls broadened our knowledge of the new site, showing that the marbles quarried in district no. 4 exhibit appreciably higher manganese concentrations than elsewhere at Göktepe and, consequently, cannot be distinguished from *Docimium* simply on the basis of this property. Additional trace data were exploited, and the unusually high strontium content common to all Göktepe samples proved to be another key element for their separation from *Docimium* and their reliable identification.

The analytical peculiarities briefly mentioned above now make it possible to determine the Göktepe provenance of the marbles of the Little Barbarians, thus adding a piece of information important for a better understanding of the sculptures. Our present knowledge of the history of the quarries, in fact, seems to rule out the late Republican dating proposed by several scholars (Palma, 1981: 52; Andreae, 1998: 116)[4] and strongly favours the alternative hypothesis that the sculptures were made during the Hadrianic or the Antonine age (Horn, 1937; Marszal, 2000: 223; Stewart, 2004: 142), when the use of white and black Göktepe marbles became widespread for the manufacture of prestigious sculptures. In addition the opinion, based on stylistic grounds, that the Little Barbarians were made in Rome by an atelier of Aphrodisian sculptors (Palma,

[3] The Göktepe white marbles, especially those from district no. 3, exhibit particularly low values for the manganese concentration, unparalleled by any other fine-grained white marble variety.

[4] The opinion of Andreae may be due at least partly to the hypothesis, already mentioned (n. 2), that some of the sculptures could be made of gypsum alabaster from Volterra. However, this work, as well as the studies carried out on the Louvre Gaul by Philippe and Annie Blanc (private communication), definitely rules out this possibility.

1981: 52; Stewart, 2004: 142) is strongly supported by the close geographic and cultural relationship between Aphrodisias and Göktepe. In this context the fact that the Ludovisi Gauls were made using a different Asiatic marble, *Docimium*, is noteworthy, and will be commented on briefly in our conclusions.

This article starts with a brief summary of the existing literature on the discovery and subsequent dispersal of the sculptures. The following section discusses the most important art historical problems posed by the copies of the Lesser Dedication, also in relation to the original monument. A short description of the recently-discovered Göktepe marble quarries is then provided. Subsequently we focus on the technical aspects of the work, discussing the analytical-statistical approach we adopted and the actual provenance results. Finally we discuss how the marble identification contributes to the general debate, especially in relation to the date and workshops of the Little Barbarians.

THE LITTLE BARBARIANS

Many under-lifesize sculptures of fighting or dying barbarians at Rome are thought to be connected with the so-called Lesser Dedication, a group of bronze sculptures erected by a Pergamene king, either Attalos I or Attalos II, on the Acropolis of Athens in Hellenistic times and briefly described by Pausanias (1.25.2) after he visited the city *c.* AD 170. These lost sculptures represented mythological and historical battles with Giants, Amazons, Persians and Gauls.

The number of under-lifesize Roman sculptures representing barbarians defeated in combat is quite large. Thirty-two were listed in the extensive catalogue published by Palma (1981; 1992), and more have been identified since (Spinola, 1996a). It generally is agreed that ten of these sculptures (Fig. 1) are closely connected with the Lesser Dedication. The other 22 are eclectic Roman elaborations on the theme, only marginally related to the Lesser Dedication. In his original paper, Brunn listed nine of the ten sculptures connected closely with the dedication, the four in Naples (Fig. 2), the three in Venice (Fig. 3), the Kneeling Gaul in Paris and the Kneeling Persian in the Vatican Museums (Fig. 4). A tenth statue connected with the Athenian dedication is thought to be either the Persian in Aix-en-Provence, added by Benndorf (1876: 167), or the Kneeling Persian now in the Torlonia collection, as proposed by Palma (1981: 46, cat. no. 5).

DISCOVERY AND SUBSEQUENT HISTORY

In the late summer of 1514, during some renovation work carried out in a convent probably located in the Campus Martius in Rome, five statues of barbarians were discovered. The number of finds seems to have grown to seven soon afterwards. The sculptures, which were first identified as the Horatii and Curiatii of Roman legend, were bought by Alfonsina Orsini and brought to her residence, the present-day Palazzo Madama. A few months later the statues were seen and

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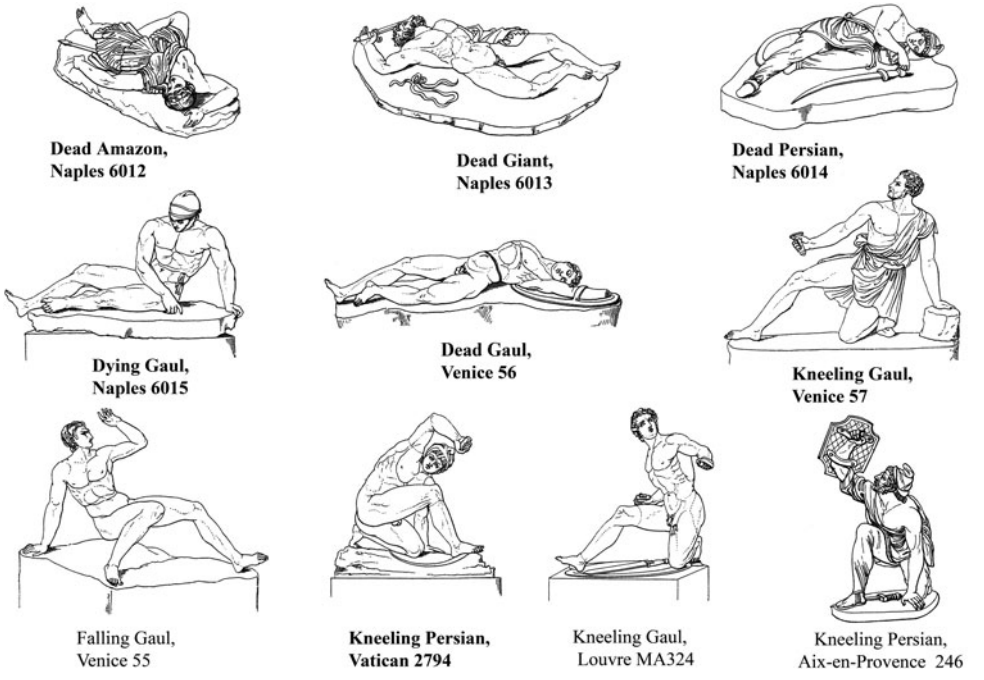

Fig. 1. The drawings of the ten Little Barbarians published by Overbeck (1882: fig. 124). The labels in bold indicate the seven sculptures that have been tested and are discussed in this article.

Fig. 2. The four Little Barbarians in the Museo Archeologico Nazionale, Naples, counter-clockwise from bottom centre: the Dead Amazon (inv. no. 6012), the Dead Persian (inv. no. 6014), the Dying Gaul (inv. no. 6015), and the Dead Giant (inv. no. 6013). *(Photograph by the authors. Reproduced courtesy of the Ministero per i Beni e le Attività Culturali, Soprintendenza Speciale per i Beni Archeologici di Napoli e Pompei.)*

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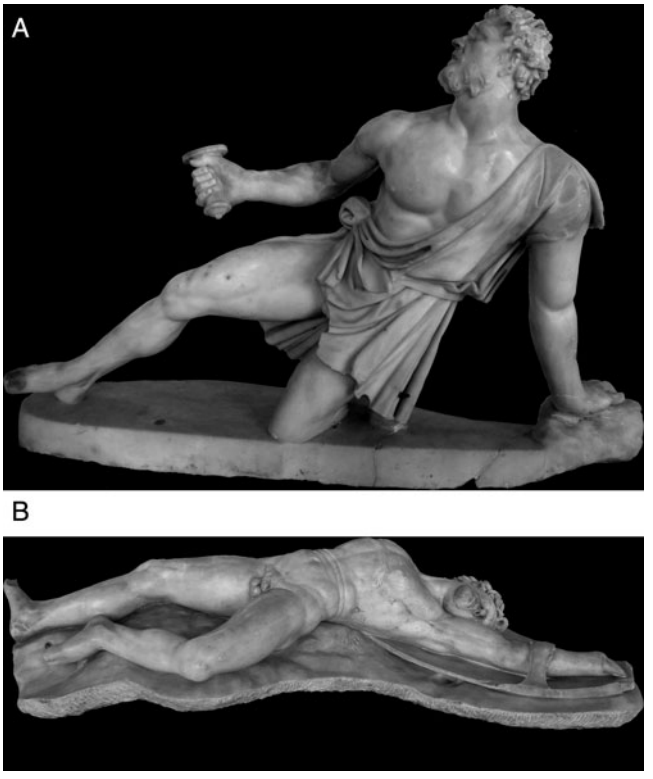

Fig. 3. The Kneeling Gaul (inv. no. 57) and the Dead Gaul (inv. no. 56) from which samples were taken at the Museo Archeologico Nazionale, Venice. *(Reproduced courtesy of the Museo Archeologico Nazionale di Venezia.)*

described by the French traveller Claude Bellièvre. Five of the sculptures can be identified securely as the four barbarians now in Naples and the Kneeling Gaul in Paris. A sixth could be the Vatican Kneeling Persian, as suggested by Stewart (2004: 86, 88), despite the fact that its subsequent history is not known fully. It has not been possible to identify the seventh sculpture described by Bellièvre as 'the sole survivor and victor'. This figure soon thereafter was donated by Alfonsina Orsini to Pope Leo X.

In 1537 the Palazzo Madama was inherited by Margaret of Austria, second wife of Ottavio Farnese. At the end of the eighteenth century the group of barbarians, now reduced to four because the Paris Gaul and the Vatican Persian had already followed a different route, shared the fate of the rest of the Farnese collection, ending up in Naples. The Paris Gaul, which had been bought by Scipione Borghese, was brought to Paris by Napoleon in 1808. The history of the Vatican Persian is less clear. It reappeared in 1638 in the inventory of the Giustiniani collection and then found its way to the Vatican more than a century later, when the family started to sell off its antiquities.

Information on the discovery of the three barbarians now in Venice is less clear. It is known that two of them, the Falling Gaul and the Kneeling Gaul,

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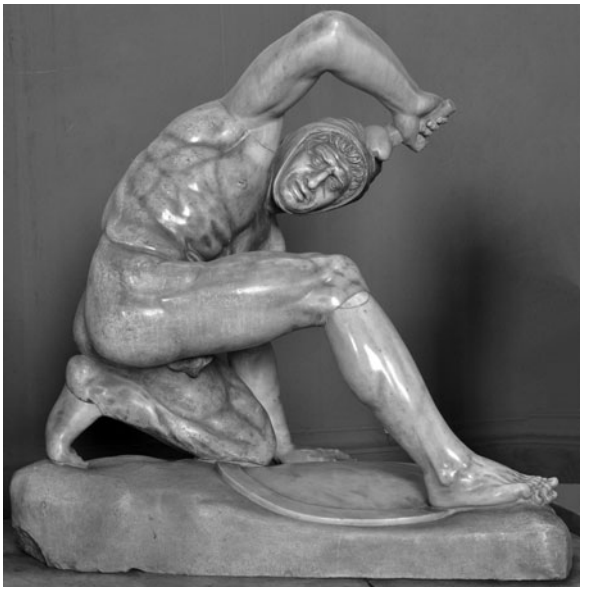

Fig. 4. The Kneeling Persian (inv. no. 2794) in the Galleria dei Candelabri at the Vatican Museums. *(Photograph by the authors. Reproduced by the kind permission of the Musei Vaticani.)*

were found by Cardinal Domenico Grimani in the early sixteenth century, perhaps on the northern side of the Quirinal Hill, where the family was building a palace (Stewart, 2004: 89). Another possible find-spot is the Baths of Agrippa (Palma, 1981: 52), located in the Campus Martius, between the Pantheon and the present-day Largo Argentina, where the Grimani had discovered already other antiquities. Toward the end of his life Domenico Grimani bequeathed his collection to the Venetian state and shipped it to Venice. No definite information survives on the discovery of the third Venetian barbarian, the Dead Gaul, but it is assumed that this statue was found with the other two barbarians.

The last of the Little Barbarians, the Kneeling Gaul in Aix-en-Provence, apparently followed a different path. It was part of the collection of Cardinal de Polignac, formed in Rome between 1724 and 1732, when he was French ambassador to the Vatican. The sculpture, however, may have been known since the fifteenth century, long before the discovery of the other barbarians (Palma, 1981: 77, cat. no. 23). In 1755 the French sculptor and restorer Lambert-Sigisbert Adam reported that the statue had been found at Rome in the ruins of the palaces of Nero and Marius, perhaps on the Palatine. In an attempt to put together all findings, it has been suggested (Stewart, 2004: 93) that the Palace of Nero might refer to the Baths of Nero, again in the Campus Martius, not far from the Baths of Agrippa, where at least two of the Venetian barbarians may have been found. The hypothesis, however, remains purely speculative.

THE ART HISTORICAL PROBLEM

Based on considerations of subject, style and size, it seems certain that there was a close connection between the ten Little Barbarians and the Lesser Dedication erected by Attalos I or Attalos II in Athens (Smith, 1991: 102; Ridgway, 1990: 291). Following a practice common in Roman times, the original bronze statues were copied in marble. The connection of the Aix-en-Provence Persian with these statues occasionally has been questioned. Based on the fact that it was found under different circumstances, Palma preferred to leave it out, including, instead, a Kneeling Persian, once part of the Giustiniani collection and now in the Museo Torlonia (1981: 46, cat. 5).[5]

More recently Korres (2004; see also Stewart, 2004: 181–98) reported the discovery on the Acropolis of over 50 cornice, orthostate and plinth blocks, which were convincingly interpreted as parts of the Lesser Dedication pedestal. The blocks bear numerous footprints and sockets meant to anchor series of interlocking bronze sculptures, both humans and horses, properly matching the 'two cubits' size mentioned by Pausanias. Although the dedicatory inscription has not been discovered yet, this find represents an important novelty and has reopened the discussion on the Little Barbarians, posing new problems and suggesting new hypotheses. The main problem is that none of the marble replicas seems to be perfectly compatible with the traces found on the blocks (Korres, 2004: 271; Stewart, 2004: 193; Gasparri, 2009: 170, cat. no. 78). Despite this, Stewart (2004: 186–8) has affirmed the close connection between the replicas and the originals, whereas other scholars have noted the existence in the copies of several stylistic and iconographic incongruities (Marszal, 2000: 203–4, 223). Without discarding the Lesser Dedication as a general model, they have argued that the rendering of the Little Barbarians includes elements that are typical of the Roman Imperial period and, therefore, cannot be considered exact copies of the bronze originals. For the same reason, reconstructing and dating the original monument on the basis of the copies is considered to be to some extent misleading.

Questions more strictly related to the marble copies include their chronology, the place of their manufacture and the character of the workshops. The exact place where the statues were found in Rome, if known with certainty, might provide useful chronological information, and it may well be that all the Little Barbarians, except perhaps the Aix-en-Provence Persian, were found in the same area of the Campus Martius. Information on the find-spot of the Venetian Barbarians, as discussed in the preceding section, might seem to favour the area of the Palazzo Grimani on the northern side of the Quirinal Hill, but Palma (1981: 52) noted that the area of the Baths of Agrippa is the only place where

[5] The Torlonia Persian, however, is slightly larger and is definitely made of a different marble, perhaps Parian. Palma (1981: 60) stated that it might be a Roman elaboration sculpted as a pendant of the Vatican Persian; and Overbeck (1882: 345) believed it to be a pastiche of ancient and modern parts. Including the Persian of Aix-en-Provence among the copies of the Lesser Dedication, in fact, seems to be a much more likely choice.

both the Grimani and Alfonsina Orsini could have excavated ancient marbles. The area of the Baths of Nero and Alexander Severus, which has been proposed as the find-spot of the Persian in Aix-en-Provence, is, in turn, not far from the Baths of Agrippa. Even were these hypotheses true, however, obtaining safe chronological information from them would be difficult. Whereas several scholars agree on the Baths of Agrippa as the sculptures' find-spot they variously date them to the late Republican age, when the Baths were built (Palma 1981: 52), or to the Hadrianic age, when they underwent one of several restorations.[6] In other words 'hard' archaeological data do not seem to provide conclusive evidence, and the sculptures basically are dated on stylistic grounds.

As for the place of manufacture, the original hypothesis was that the Little Barbarians were copied in Athens, where the Lesser Dedication was still in place at the end of the second century AD, when it was seen by Pausanias. Of course it is not easy to understand why the Athenian bronze sculptures should have been copied using 'Asiatic' marble instead of the prized and more easily available marble of the nearby Mount Pentelikon. To circumvent this problem, it was assumed that a second dedication existed in Pergamon where the statues could have been copied (Lippold, 1923; see also: Palma, 1981: 48; Moreno, 1994: 564, 586). The evidence supporting this hypothesis, however, is scanty and has been questioned (Ridgway, 1990: 291–2).

Most scholars now assume that the sculptures, perhaps manufactured by Aphrodisian sculptors, were made in Rome using imported marbles. Similarly to what happened in the sculptors' workshop discovered at Baia (Landwehr, 1985), the Aphrodisians could have worked from plaster casts taken from the originals in Athens. Sharp disagreement, however, still exists on the chronology, with dates ranging from the late Republican to the Antonine periods, as mentioned above.[7]

THE GÖKTEPE MARBLE QUARRIES

In 2006 ancient marble quarries, extending over an area of *c.* 0.5 km^2, were serendipitously discovered by Alì Bahadir Yavuz near the village of Göktepe in Caria, approximately 25 miles southwest of Aphrodisias (Attanasio *et al.,* 2008; Attanasio, Bruno and Yavuz, 2009; Yavuz *et al.*, 2009). At this site, which is relatively small compared to other famous ancient quarries, high-quality black

[6] The Baths, built between 25 and 19 BC and severely damaged by a fire in AD 80, underwent major restorations under Domitian, Hadrian, the Severans and in later periods (Ghini, 1999: 41). The Hadrianic restoration is convenient for the theory of Rudolph Horn (1937), who dated the barbarians to the Hadrianic or, perhaps, to the Antonine period. His theory has been supported more recently by Stewart (2004: 142), who has dated the statues to the first half of the second century AD on the basis of close analogies with the centaurs and the red faun from Tivoli, and by Marszal (2000: 223) on the basis of iconographic peculiarities typical of the Roman Imperial period.

[7] An even earlier date, the end of the second century BC, has been proposed recently by Rita Amedick (pers. comm.).

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and white marbles exhibiting fine or extremely fine crystal grain and with a compact and lustrous appearance were produced. The white variety, brilliant and uniform in colour, is virtually free from veins and greyish black spots. In contrast the black marble often shows wide yellowish white calcitic veins, often cross-shaped, which greatly facilitate its identification. The white marbles are present as large lenses within the black marble bed, and for this reason various shades of grey are found at the boundary between the two varieties. More often, however, the divide is quite sharp and made it possible to produce a highly characteristic, two-toned black and white stone that occasionally was exploited, especially in late antiquity, to obtain unusual colour effects.

In antiquity, quarrying took place in four different districts at Göktepe (Fig. 5). Districts 1 and 2, to the north, produced mainly black or sometimes grey marble, whereas white statuary marble was quarried in districts 3 and 4. The bichrome blocks came primarily from the southern part of the site, district 4, where the black marble surfaces again. As well as being the largest, district 3 is notable also for the presence of a big underground quarry (3C, Fig. 5), where, as at the *lychnites* quarry in the valley of Marathi at Paros and the Phrygian quarries of *Docimium,* the vein of highest-quality marble extended deep underground. In the case of district 3, the vein was buried beneath a thick layer of breccia (Fig. 6).

In quarry B at district 4, 21 shapeless white marble blocks dressed with a medium–large punch were found. In terms of size and finish, they closely resemble the blocks of Parian marble found in the *Fossa Traiana* near Ostia (Pensabene *et al.*, 2000) and, like them, almost certainly were intended for sculptural use. Two of the blocks bear quarry marks, and one of them also features a carved circular cavity made to house a lead seal, as is frequently found in the blocks of the *Fossa Traiana* and in many quarries known to have been under imperial control. These findings strongly suggest that, for at least part of their history, the quarries of Göktepe were under imperial administration.

From an archaeometric point of view the provenance from Göktepe usually can be proven unequivocally, owing to a combination of fine crystal grain, low manganese levels and high strontium concentrations that are unparalleled in any other known ancient marble site. On this basis, approximately 100 white and black sculptural artefacts as well as a limited number of black architectural elements have been identified to date. In the absence of historical sources, these data give us a partial understanding of the history of the quarries, their period of peak exploitation, the export of their marbles in the form of finished or semi-finished artefacts and raw materials. The distribution of these products is discussed below in connection with the dating and the place of manufacture of the Little Barbarians.

SAMPLING AND ANALYSES

Seven sculptures, the Dead Amazon, the Dead Giant, the Dead Persian and the Dying Gaul in Naples (Fig. 2), the Dead Gaul and the Kneeling Gaul in Venice

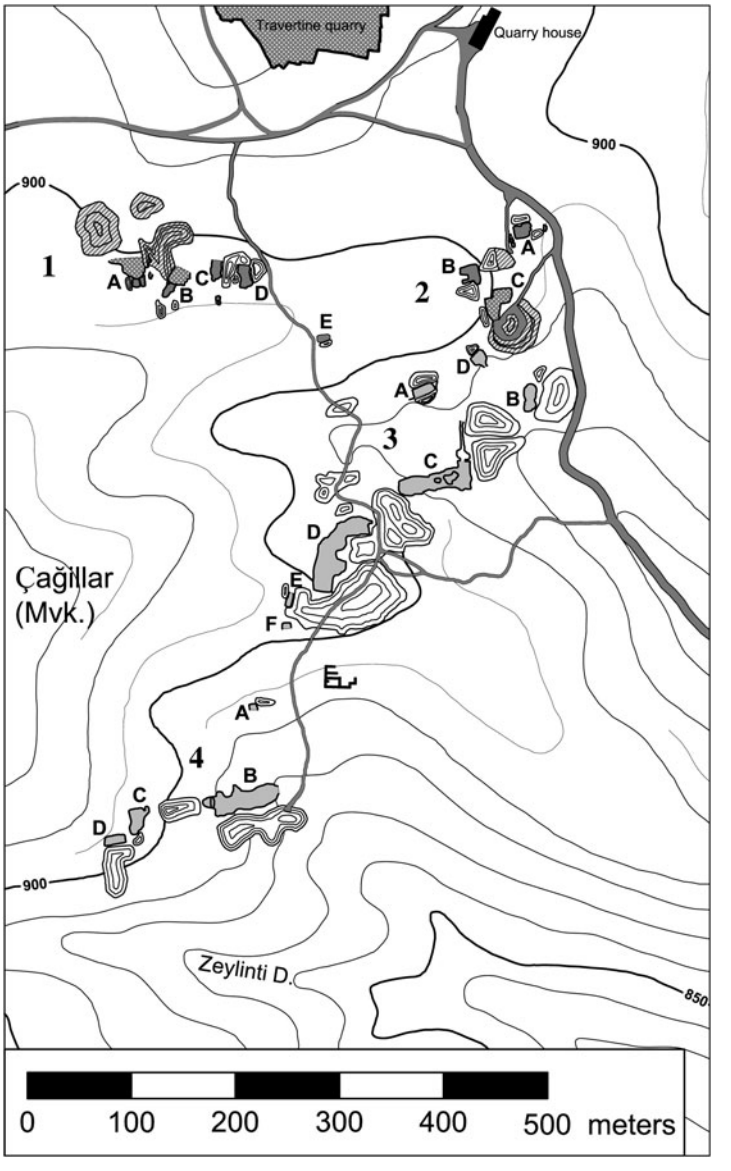

Fig. 5. Topographic sketch of the Göktepe marble site. *(From Attanasio, Bruno and Yavuz, 2009: 312, fig. 1.)*

(Fig. 3) and the Kneeling Persian in the Vatican (Fig. 4), were tested. Sampling the eighth Little Barbarian, the Falling Gaul or 'Breakdancer' in Venice, turned out to be impossible without causing some damage to the sculpture and was avoided.[8] In all cases the samples were tiny chips measuring approximately 2 × 2 mm in size

[8] Only a very small fragment from the restored plinth was obtained and easily identified as Carrara marble. This result is outside the scope of this work and will not be discussed further.

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Fig. 6. View of the underground quarry 3C, district 3, at Göktepe showing the thick breccia layer above the white marble vein. *(Photograph by the authors.)*

and 30–60 mg in weight. They were all taken from hidden positions near the plinths. After mechanical cleaning from surface patinas and impurities, petrographic, isotopic, EPR and trace analyses were carried out following the experimental procedures described in detail elsewhere (Attanasio, 2003: 81–100; Prochaska and Grillo, 2010).

All the samples exhibited maximum grain sizes (MGS) well below 1 mm (Table 1). Their provenance, therefore, was established using a subset of the general marble database including only the seven marble sites or districts known to produce fine-grained marbles.[9] They are: Afyon (65 samples), Altintaş (48 samples), Carrara (112 samples), Göktepe-3 (45 samples), Göktepe-4 (eighteen samples), Hymettos (48 samples), Pentelicon (154 samples).

The most probable quarries of provenance were determined by statistically comparing the properties of the unknown samples with the properties of the possible provenance sites with the aid of linear discriminant function analysis (Attanasio, Brilli and Ogle, 2006: 213–59). The classification rule, that is the combination of properties used for determining the provenance, was kept as simple as possible. Only the four most powerful discriminant variables were used for the calculations. They are the EPR intensity (manganese content), the strontium concentration, and the oxygen and carbon isotopic values ($\delta^{18}O$ and $\delta^{13}C$). Other variables, such as the EPR linewidth and the iron concentration,

[9] The white marbles of districts 3 and 4 at Göktepe exhibit very different values of EPR intensity, which is one of the most powerful variables in this context (Attanasio, Bruno and Yavuz, 2009). To obtain improved provenance results it is preferable to consider the two districts separately. Similar, although less definite, sample grouping is possible also in the case of the Afyon (*Docimium*) site and has been used previously. In this case, however, classifying the Afyon samples into different districts turned out to be unnecessary, and was avoided for the sake of simplicity.

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Table 1. Experimental values of the most important variables measured for the seven barbarian sculptures together with mean values and ranges (in parentheses) for the seven provenance sites considered in the text. The isotopic and EPR variables are given in ‰ or % with respect to specific standards (Pee Dee Belemnite for isotopes and Dolomite N368 BCS for EPR). The colour value is expressed as a % in an 8-bit scale where 0 represents black and 255 white. The concentration of the trace metals is given in parts per million (ppm) and the MGS values are in mm. Owing to the small size of the sample, no trace data are available for the Vatican Persian.

Sample *Quarry site*	**Inv. no./** *No. of samples*	**MGS mm**	**$\delta^{18}O$ ‰**	**$\delta^{13}C$ ‰**	**EPR intensity %**	**EPR linewidth %**	**Colour %**	**Mn ppm**	**Sr ppm**	**Fe ppm**
Dead Amazon	Naples, 6012	0.4	−1.35	3.43	2.1	50.4	75	11.3	1476.2	28.6
Dead Giant	Naples, 6013	0.25	−1.29	3.19	3.6	46.5	74	12.1	576.0	33.8
Dead Persian	Naples, 6014	0.25	−1.37	3.34	3.1	52.5	75	11.5	853.9	30.1
Dying Gaul	Naples, 6015	0.3	−1.63	3.31	2.8	53.2	73	14.2	1207.5	34.0
Dead Gaul	Venice, 56	0.35	−1.26	3.35	4.9	52.3	67	14.3	801.0	28.6
Kneeling Gaul	Venice, 57	0.25	−1.38	3.58	2.9	49.1	76	14.3	1216.0	35.0
Kneeling Persian	Vatican, 2794	0.25	−1.42	3.03	4.6	53.2	76	–	–	–
Carrara	*112*	*0.8*	*−1.89*	*2.11*	*68.5*	*63.4*	*83*	*34.4*	*162.8*	*117.3*
		(0.4/1.4)	*(−3.0/−0.5)*	*(1.1/2.6)*	*(10/237)*	*(55/80)*	*(57/99)*	*(7/19)*	*(124/237)*	*(45/361)*
Pentelicon	*154*	*0.96*	*−7.0*	*2.63*	*226.3*	*58.2*	*91*	*136.9*	*186.3*	*408.4*
		(0.6/1.8)	*(−9.0/−3.8)*	*(1.9/4.1)*	*(12/1009)*	*(38/100)*	*(68/97)*	*(35/497)*	*(152/291)*	*(158/1203)*
Afyon	*65*	*0.86*	*−4.32*	*1.80*	*242.5*	*53.9*	*76*	*129.1*	*154.0*	*340.0*
		(0.5/1.5)	*(−7.7/−2.3)*	*(−1.4/3.1)*	*(6/626)*	*(40/68)*	*(56/98)*	*(17/458)*	*(67/311)*	*(79/1054)*
Altintaş	*48*	*0.67*	*−5.38*	*2.27*	*158.3*	*57.7*	*75*	–	–	–
		(0.4/1.2)	*(−9.5/−2.8)*	*(1.1/3.4)*	*(3/765)*	*(42/85)*	*(48/87)*			
Hymettos	*41*	*0.69*	*−2.17*	*2.20*	*14.2*	*46.0*	*71*	*17.2*	*162.2*	*86.8*
		(0.4/1.2)	*(−4.3/−1.2)*	*(0.9/3.2)*	*(1/75)*	*(36/54)*	*(53/90)*	*(10/39)*	*(94/277)*	*(40/431)*
Göktepe-3	*45*	*0.64*	*−3.40*	*1.80*	*3.9*	*55.1*	*87*	*12.9*	*691.2*	*39.5*
		(0.4/1.3)	*(−6.6/−2.6)*	*(−4.6/3.4*	*(1/13)*	*(45/64)*	*(42/99)*	*(10/18)*	*(348/1039)*	*(29/95)*
Göktepe-4	*18*	*0.68*	*−3.43*	*1.78*	*21.6*	*46.4*	*86*	*19.8*	*535.9*	*43.3*
		(0.4/1.1)	*(−7.1/−2.2)*	*(−1.5/2.7)*	*(9/33)*	*(37/50)*	*(75/98)*	*(15/24)*	*(282/830)*	*(37/57)*
Göktepe — modern	*7*	*0.35*	*−3.09*	*2.00*	*16.8*	*48.3*	*75*	*17.8*	*114.7*	*117.8*
		(0.3/0.7)	*(−3.5/−2.3)*	*(1.6/2.3)*	*(11/30)*	*(45/55)*	*(66/93)*	*(15/23)*	*(100/130)*	*(85/205)*

were not found to improve appreciably the discrimination. Maximum grain size, normally an important factor, is of little importance in this study, since only fine-grained marbles are taken into account.

In other words, the classification procedure was kept as simple as possible, with the aim of focusing on the most distinct properties of the marble samples. Following this approach 88% of the database quarry samples can be identified correctly. The provenance of the unknown samples is determined on the basis of three numerical distance and probability parameters[10] and is deemed to be reliable when the probability parameters are above properly defined thresholds (Attanasio, Brilli and Ogle, 2006: 213–59).

THE MARBLE PROVENANCE OF THE LITTLE BARBARIANS

Table 1 reports the values of the most important variables measured for the six sculptures, together with the experimental means and the full variable ranges available for the seven marble groups present in the database.[11] All the unknown samples are very similar both macroscopically and analytically. The only widely changing parameter is the strontium concentration, which increases approximately 2.5 times on going from the Dead Giant (576 ppm) to the Dead Amazon (1,476 ppm), a result partly due to the exceptionally high concentration values shown by this impurity.

The results of statistical data analysis carried out as specified in the preceding section are listed in Table 2: they unequivocally indicate district 3 of the Göktepe site as the most likely provenance for the marble of all the sculptures.[12] The results of the analysis are also illustrated by the statistical graph (Fig. 7), which uses suitable combinations of the experimental variables in order to obtain optimal discrimination.

[10] **Distance:** distance of the sample under consideration from the centre of the ellipse that represents the quarry probability field. The central point of the ellipse expresses the average and hence most characteristic values of a quarry. The closer a point is to the centre of an ellipse, the more likely is the provenance from that marble site.

Relative (posterior) probability: the probability of the sample belonging to some group within the assumption that it originates in any case from one of the groups in the selection. The threshold is 60%. Low values indicate that the sample's assignment is in doubt between two or more groups.

Absolute (typical) probability: a distance-dependent parameter measuring the absolute probability that the sample belongs to the chosen group or, in other words, is a typical representative of the group properties. The threshold is 10%, corresponding to samples on the edge of the 90% probability ellipse. Low values indicate anomalous samples (outliers) or samples possibly not belonging to any group in the selection.

[11] Marble sites are, in general, relatively inhomogeneous in the sense that the variable values are spread over wide intervals. As a consequence, straight comparison with the properties of artefact samples, although useful, must be considered with caution.

[12] In the case of the Vatican Persian, no trace analysis could be carried out owing to the small size of the sample. In spite of this, the close similarity of other variables and the tight relationship among all the sculptures leave no doubt on the provenance.

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Table 2. Results of statistical discriminant analysis carried out on the barbarian sculptures using four discriminant variables (EPR intensity, strontium concentration, $\delta^{18}O$ and $\delta^{13}C$) and a database of possible provenances, including seven sites or districts: Afyon, Altıntaş, Carrara, Göktepe-3, Göktepe-4, Hymettos and Pentelicon. The distance and probability parameters are defined in note 10 and discussed in the text. The distance is given in arbitrary units (a.u.). In the absence of strontium data the provenance of the Vatican Persian was established using only three variables.

Sample	Inv. no.	Quarry	Distance a.u.	Relative probability %	Absolute probability %
Dead Amazon	Naples, 6012	Göktepe 3	10.5	100	3.5
Dead Giant	Naples, 6013	Göktepe 3	4.4	98	35
Dead Persian	Naples, 6014	Göktepe 3	4.4	99	36
Dying Gaul	Naples, 6015	Göktepe 3	6.4	100	17
Dead Gaul	Venice, 56	Göktepe 3	4.5	97	35
Kneeling Gaul	Venice, 57	Göktepe 3	7.8	100	10
Kneeling Persian	Vatican, 2794	Göktepe 3	7.0	70	15

As well as establishing the quarries of provenance, the results shown in Table 2 provide valuable information on the details of each assignment. The high values of the relative probabilities indicate that no possible alternative exists within the marble sites included in the database. This basically is due to the unique combination of low manganese and high strontium concentrations, which are typical of the Göktepe site only and definitely rule out the *Docimium* alternative, as well as any other known ancient site producing fine-grained white marbles.

On the other hand, the values of the absolute probabilities are not particularly high, and in two cases — the Kneeling Gaul in Venice and the Dead Amazon in Naples — these values fall at the border or below the 10% threshold limit defined above. This result, clearly illustrated also by the statistical graph, means that the properties of some samples are not fully typical or representative of the properties of their provenance site, that is Göktepe. The reason for this is twofold and may be understood easily by looking at Table 1. The atypical samples are those exhibiting extremely high strontium values, appreciably above the highest values measured for the quarry samples.[13] The atypical character, in fact, closely follows the strontium concentration values and increases steadily as the latter increases.

The second point to stress concerns the values of the isotopic ratios of carbon ($\delta^{13}C$) and oxygen ($\delta^{18}O$). They are very similar for all the sculptures tested and differ appreciably from the mean values exhibited by the Göktepe samples, as shown in Table 1 and by the isotopic plot (Fig. 8). The results shown in Table 2, however, suggest that the somewhat anomalous isotopic values are not

[13] The strontium values measured on 63 quarry samples in the entire Göktepe site range from 283 to 1,039 ppm.

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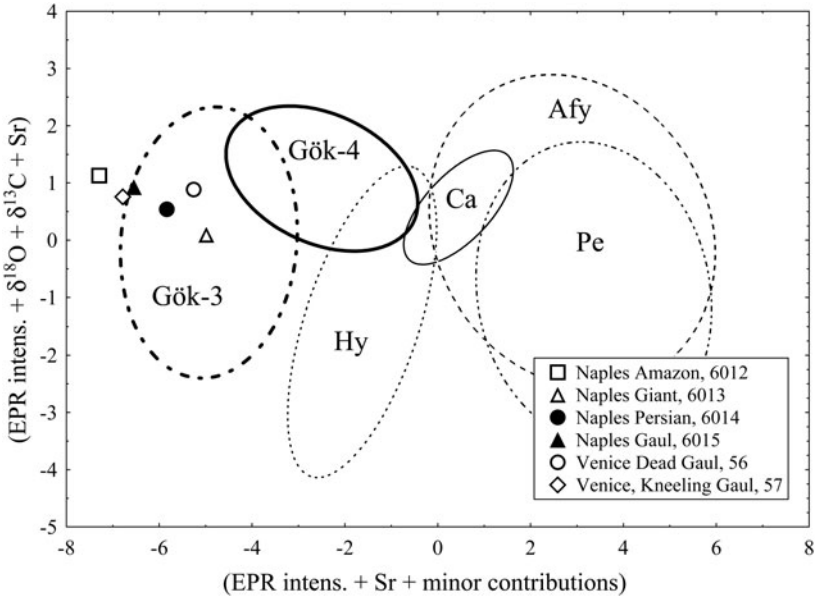

Fig. 7. Statistical plot illustrating the Göktepe provenance of the marble of the Little Barbarians. The Vatican Persian, for which trace data are not available, is not included in this graph. The graph, based on the linear combination of isotopic, EPR and trace analysis data, clearly shows the discrimination existing between Göktepe (especially district 3) and other fine-grained marbles. The graph illustrates also the slight atypicality of the Venice Kneeling Gaul (inv. 57) and of the Naples Dead Amazon (inv. 6012) discussed in the text. The quarry sites are represented by 90% probability ellipses. Altintaş is not included on the graph because trace data of its marbles are not available.

enough by themselves to classify the samples as atypical, a characteristic that stems entirely from their very high strontium concentrations. These isotopic anomalies are not problematic due to the fact that the C and O isotopic distribution at Göktepe is quite inhomogeneous and that, in this case, isotopes are not the key provenancing parameters.

In conclusion, the provenance of the Little Barbarians, based primarily on the combination of fine crystal grain, low manganese content and high strontium concentration, seems to be established firmly, and definitely rules out any other fine-grained source.[14] At the same time, the experimental data reveal some undesirable anomalies, which are discussed briefly in the next section.

[14] Another Little Barbarian, the Kneeling Gaul in Paris, is being studied presently by Philippe and Annie Blanc. They kindly informed us that the stone is definitely marble and not alabaster. Additionally, the fine grain, the weak cathodoluminescence indicative of low manganese concentration and the isotopic data very similar to the values presented here also strongly suggest that this sculpture was made using marble from Göktepe.

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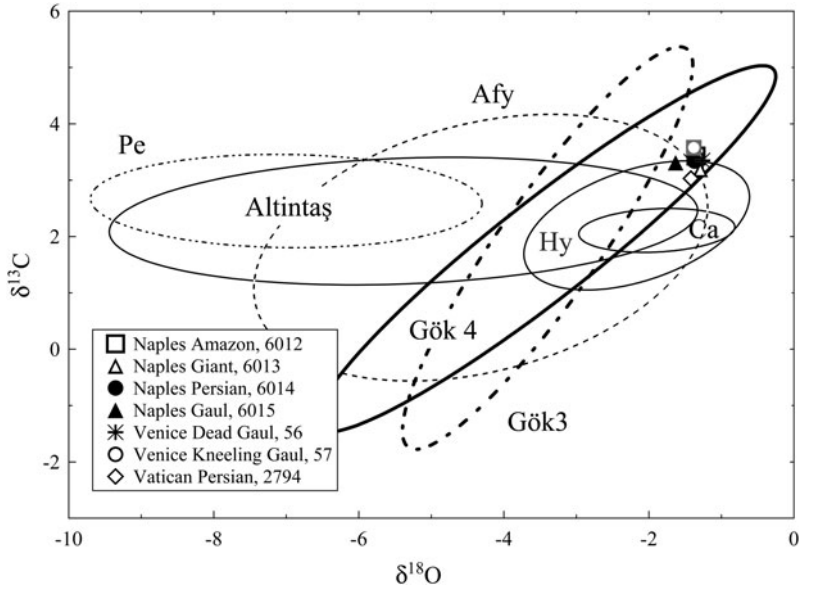

Fig. 8. Isotopic plot illustrating the results of the Little Barbarians analyses with respect to the seven quarry sites present in the database. The close similarity of the experimental results obtained for the seven statues is noteworthy.

ADDITIONAL CONSIDERATIONS ON THE PROVENANCE

The analytical anomalies mentioned above refer to the strontium concentration of the Dead Amazon in Naples and the Kneeling Gaul in Venice. All the seven sculptures tested exhibit closely similar isotopic ratios that are somewhat different from the values most commonly measured at Göktepe. All other parameters, notably the EPR intensity and the manganese concentration, are fully typical of the provenance site. In principle three different explanations can be given for the anomalies:

(1) Owing to particular geological conditions and to the properties of the marble protolith, the marble lenses in the Göktepe area may exhibit, for some variables, unusually large analytical variability. As a consequence, the marble of the Little Barbarians may originate from quarries that are still unsampled either within the ancient site or in its immediate surroundings.

(2) Assuming that the variability mentioned above is sufficiently large, it is also possible that the marble of the sculptures simply belongs to exhausted parts of the quarries already sampled.

(3) The marble of the Little Barbarians may originate from a different and still unknown site possibly located in the same area or even in a totally different region. The marble properties of this unknown site would be, by chance, very similar but not identical to the properties of the Göktepe marbles.

Existing data seem to confirm the assumption that the marbles in the Göktepe area may exhibit, at least in the case of strontium, quite large variability, thus

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supporting the first two hypotheses above. An abandoned modern quarry of white marble lies approximately 5 km southwest of the ancient site. No signs of ancient excavation could be found in or around the quarry; nevertheless, its marbles were sampled and tested for their striking macroscopic similarity with the marbles present in the ancient site. The results shown in Table 1 indicate that, although the modern quarry samples are, in general, analytically quite similar to the marbles from the ancient Göktepe quarries, they exhibit, quite unexpectedly, a much lower strontium concentration, closely similar to the values measured for *Docimium* and other fine-grained sites.

Obviously the variability argument is also valid within the quarries already sampled. As a consequence, the anomalies of the Barbarians may be due simply to the fact that modern testing is generally not carried out on the marbles used in antiquity. Quarry samples are usually taken from ancient quarry fronts, which represent the final stage of marble excavation and may be tens of metres away from the marble quarried in the heyday of the site. Such differences in location may have corresponded to different analytical properties. Marble properties generally are considered to be fairly homogeneous within a quarry or even within a site, and classification in general relies on this assumption. Marble homogeneity, however, depends in a complex way on a number of different causes, and the degree of homogeneity differs greatly in different marble sites.[15] In the case of Göktepe extensive (or fortunate) testing of the ancient marble-working debris, copiously present in the quarries, would be necessary to determine if material previously extracted had substantially different properties from the marble in surviving quarry fronts.

The last hypothesis, the possibility that the marble of the Little Barbarians originates from a still unknown marble site exhibiting macroscopic and analytical properties quite similar to Göktepe, is difficult to exclude definitely, as is the case also in relation to many other provenancing problems. In this case, however, it is considered to be unlikely and, in fact, untenable for three reasons. Statistically only two Little Barbarian sculptures turned out to be atypical or moderately atypical (absolute probabilities 3.5% and 10%, respectively). The other five samples are, in fact, fully representative of the properties of Göktepe marble. In addition, the particular combination of properties shown by the artefacts and the quarry samples has no parallel in any other marble site, either white or coloured, known in the mediterranean basin;

[15] The Carrara quarries are a well-known example of a compact and homogeneous distribution of properties, whereas the *Docimium* quarries near Afyon or the Aphrodisias city quarries encompass much larger regions of the variable space defined by isotopes as well as by other analytical properties. Probably the most instructive example of re-evaluation of data to explain artefact anomalies has been carried out on Pentelic marble (Matthews *et al.*, 1992). Other authors have followed a more controversial procedure, which is including artefact data into the quarry database (Gorgoni *et al.*, 2002). The question of the analytical variability of marbles and the underlying reasons have been discussed in a number of papers (see, for instance: Germann, Holzmann and Winkler, 1988; Matthews, 1988; Wenner, Havert and Clark, 1988; Mandi *et al.*, 1995).

and this unique combination makes the hypothetical existence of a second 'Göktepe-like' marble site highly improbable.

Finally, the Göktepe provenance of the Little Barbarians is strongly supported by arguments related to the history of the quarries and the artists who used its marbles.

CONCLUSIONS

Göktepe marble, already exploited for several of the most prized sculptures discovered at Aphrodisias,[16] became well established in Italy at the beginning of the second century AD, when both its black and its white varieties were used for the sculptural decoration of Hadrian's Villa (Attanasio, Bruno and Yavuz, 2010). Earlier exportation beyond Aphrodisias may have occurred occasionally during the later Julio-Claudian period, as suggested by a statuette of a black boar found in the Villa of Domitian near Sabaudia (Spinola, 1996b: 162, cat. no. 112; Attanasio, Bruno and Yavuz, 2009: 339) and by a white Artemis torso from *Caesarea Mauretaniae* (Attanasio, Bruno and Landwehr, 2012: 490–1); both are dated tentatively to the mid-first century AD. Göktepe marble had a surprisingly prominent presence in Hadrian's Villa. Eight black artefacts were tested and all originated from the Carian site, including the famous black Centaurs signed by Aristeas and Papias of Aphrodisias. Their signature seems to recognize not only the sculptors' outstanding workmanship but also the high quality of their materials. The range of white marbles present in the Villa is rather more varied. It includes Pentelicon and *Docimium* marbles, but Göktepe also has been identified with certainty in a portrait head of Hadrian, two portraits of his wife, Vibia Sabina, as well as three different decorative pieces. Apparently marble from Göktepe, or, more probably, the outstanding Carian sculptors using this material, rose steeply in popularity in élite circles during the early second century AD. The exceptional statue of Matidia Minor as Aura in Sessa Aurunca uses different hues of black Göktepe marble for its chiton and cloak; in this case the use of the stone probably was related to the close family ties between Matidia and the Emperor Hadrian, who had married her half-sister. From the early second century onwards sculptures manufactured of Göktepe marble are found in many different places in the Mediterranean,[17] their use continuing and apparently increasing until late antiquity at

[16] A study is being carried out on approximately 100 sculptures in the Museum of Aphrodisias. Preliminary data indicate that *c.* 25% of the marbles originate from Göktepe, whereas the others belong to the Aphrodisias city quarries and other white marble quarries in the territory of the city.

[17] Göktepe marble sculptures have been identified in the National Archaeological Museum of Athens (Attanasio, Bruno and Yavuz, 2009: 337), at *Caesarea Mauretaniae*, Algeria (Attanasio, Bruno and Landwehr, 2012), Lepcis Magna (standing statue of a Dame, inv. no. 498, unpublished) and Cyrene in Libya (standing female sculpture, unpublished), Chiragan, Toulouse (black fisherman, inv. no. 30316; torso of a faun, inv. no. 2005.1.1, unpublished).

Aphrodisias[18] and probably elsewhere, as demonstrated by the statues of the Esquiline group now in Copenhagen (Attanasio, Bruno and Yavuz, 2009: 338) if their fourth-century dating (Roueché and Erim, 1982) can be confirmed definitively.

The emerging history of the Göktepe marble quarries strongly supports the second-century dating for the Little Barbarians proposed long ago by Horn (1937) and supported by other scholars. The discovery of the quarries and the analysis of their products also adds information based on scientific data to epigraphic and stylistic analyses. Scientific analysis of marble, however, cannot provide a more detailed chronology than that just presented, since we are not aware of any substantial change that might have occurred in the use of Göktepe marbles during the second century. The problem of distinguishing between Hadrianic and Antonine dates must be left to archaeologists and art historians. On the basis of the same marble data, however, earlier chronologies, dating the Little Barbarians back to the first century BC or even earlier, appear to be quite unlikely and very probably can be ruled out. Philippe and Annie Blanc generously have provided information that definitely excludes the possibility that the Paris Gaul is made of alabaster. The similarity of its marble to the marble of the other Barbarians reinforces the point.

The marble provenance of the Little Barbarians also provides useful indications on the related question of the manufacturing workshops. Since the marbles of Göktepe, especially when first introduced, were used almost exclusively by Aphrodisian sculptors, the hypothesis that the Little Barbarians were made by an Aphrodisian atelier in Rome becomes quite likely. The evidence recently obtained on the possible importation of raw Göktepe marbles, at least of the black variety, to Rome fits this picture perfectly. Black Göktepe marble was, in fact, used by Francesco Borromini for the doorposts of a large portal in the Oratorio dei Filippini built in Rome between 1637 and 1640. In his *Opus Architectonicum*, Borromini referred to having found large amounts of this marble, which he called 'pietra di paragone', while excavating the foundations of the building (Connors, 1998: 75; Ciancio Rossetto, 2008). Although Borromini did not specify whether worked or raw marbles were found, the size and the shape of the pieces used for the doorposts seem to suggest that they were cut from quarry blocks.

A further question worth raising, despite the fact that in this case marble data do not provide crucial information, concerns the possible relationship between the Little Barbarians and the Ludovisi Gauls. Since Brunn (1870: 305) first noticed the strong resemblance between the Dying Gaul in Naples and the Capitoline Dying Gaul, scholars have argued about the connections between them (Palma, 1981: 52), sometimes suggesting that they could have been carved in the same workshop (Stewart, 2004: 136). At first, the results of the marble analysis seem

[18] The work in progress on the sculptures of the Museum of Aphrodisias clearly shows that the use of Göktepe marble increased remarkably in late antiquity: examples include the statue of Valentinian/Arcadius (inv. no. 10.182) precisely dated to AD 388–92, a male head (inv. no. 5830) and the bust of a sophist (inv. no. 5760), both dated between the end of the fourth and the beginning of the fifth centuries AD.

to weaken these ties, because large marble blocks were certainly available at Göktepe and could have been used for the over-lifesize Ludovisi Gauls, should their sculptors have so desired.[19] It must be added, however, that the production of large blocks was undoubtedly much more common at *Docimium*, whose marbles had been imported to Rome in large quantities since the beginning of the Imperial period. The possibility should, in any case, be allowed that the use of different marbles for the Ludovisi Gauls and the Little Barbarians does not provide any useful clue to the origin of the sculptors and may be due simply to the availability of suitable materials on the Roman market.

As already stated, marble studies cannot solve all the many problems connected with complex archaeological or art historical issues. Scientific provenance data, however, may offer support to some hypotheses put forward on the basis of stylistic analysis and historical information, and at the same time show that others are less likely. In this way an important source of information can be added to the debate.

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[19] This is demonstrated, for instance, by the huge Dacian statues now in the courtyard of the Palazzo dei Conservatori, which are approximately 2.5 m tall and made of black Göktepe marble.

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