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Building stones used in the construction of Stratonikeia and Lagina ancient cities (Muğla, SW Turkey)

Abstract

SW Turkey was called as the area of Caria in the archaic ages. This region hosts many ancient cities Stratonikeia and Lagina (Yatağan, Muğla), Idyma (Ula, Muğla), Kaunos (Ortaca-Dalaman, Muğla), Labranda (Milas, Muğla), and Gerga (Çine, Aydın) etc. Among these cities, Stratonikeia, Lagina come forward due to known as a gladiator's city and first pagan city in the world. Stratonikeia also includes the subsequent civilisations traces such as Romans, Byzantium, Seljuk State, Period of Emirates, Ottoman Empires and Turkish Republic. The remnants of these civilisations highly affected by the natural process such as sedimentation and earthquakes. During the reconstruction of these structures using an original building stone are highly important. Within this context, stones of Lagina and Stratonikeia are specified by visual inspections and their origins were compared with recent marble catalogues. White-purple-lilac-black coloured marbles were widely used for the construction of the base, side walls, pillars, seats of the amphitheatre, gymnasium, assembly and road and gates of both cities can be found in recent marble catalogues under the different trade mark. They can be easily supplied close marble quarries. Phyllite-schist-gneiss are metamorphic rocks that widely used at the on the base and side walls, crop out in northern part of the cities. Travertines were limitedly used in pillar and side walls of the Lagina ancient city. Travertine also has limited exposure surroundings of the Muğla. Additional more detailed and analytic studies require for the possible assessments in the future.

Keywords: stratonikeia, lagina, SW Turkey, ancient cities, building stones

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Introduction

Turkey is home to many ancient cities from different eras and civilizations. Their restoration and conservation is of great importance both in terms of cultural tourism and their transfer to the future generations in good condition. Restorations performed by unqualified people and the use of inappropriate building stones lead to unacceptable results, which are sometimes reflected in the press. Therefore, it is important to determine the characteristics of the building stones used in the ancient cities and to reveal where they can be obtained from. In the Archaic periods, Muğla and its surroundings (Figure 1) are known as Caria. This region is home to many ancient cities such as Stratonikeia (Yatağan), Lagina (Yatağan), Idyma (Ula-Akyaka), Kaunos (Köyceğiz), Telmesos (Fethiye), Labranda (Milas), Euromos (Milas), Iasos (Milas), Keramos (Ören) and Halicarnassus (Bodrum). Stratonikeia and Lagina, located in Yatağan, are of particular importance among the other ancient cities due to their locations and various features. In the construction of these cities, both Muğla and nearby Western Anatolia resources were utilized.[1–4] In this article, different building stones, which are visually identified in the ancient cities of Stratonikeia and Lagina, are compared with the units known in the region's geology and the marble catalogues of Muğla Marble Association (Figures 1–3). Final results require chemical analysis on both the ancient city and the local quarry samples, and identification and comparison of various engineering parameters.

Ancient cities, Stratonikeia and Lagina

Stratonikeia is an ancient city spread over a large area on the Yatağan-Milas highway before reaching the village of Eskihisar. Archaeological excavations were initiated by Prof. Dr. Yusuf Boysal in 1977 in the city, which is also known as the city of Gladiators, and today, these are conducted by Prof. Dr. Bilal Söğüt from Pamukkale University Faculty of Archeology (http://stratonikeia.pau.edu.tr/: access date: 01.09.2019). The city, where settlement has existed since the Hellenistic period, came to the forefront and its name was changed as Stratonikeia in 281 BC during the reign of Seleucus King Antiochus I.[5] Later, the city was used as settlement area during the Seleucus, Ptolemaios, Macedonians, Rhodes, Roman, Byzantine, Seljuk, Ottoman periods and it is being used as settlement area today.[6] Lagina is located in Yatağan District in Turgut Town. The first archaeological excavations in the region were carried out by Osman Hamdi Bey between 1891-1892 (http://lagina.pau.edu.tr/index4.html). In the following periods, the excavations were conducted by Prof. Dr. Yusuf Boysal between 1967-1970, and by Prof. Dr. Ahmet Tırpan and Prof. Dr. Bilal Söğüt after 1993 (http://lagina.pau.edu.tr/index4.html). In the area of the ancient city of Lagina, there are important buildings such as the Propylon Gate, the Stoa-sanctuary, the Temple of Hecate, the Altar, the Houses of the Priest's and the Chapel.[5,6,7,13] http://lagina.pau.edu.tr/index4.html: access date 2.09.2019) Although the article of Russell[3] and Walkens de Paepe and Moens[8] cited by him indicate that, local marbles were used in the construction of the city of Stratonikeia, a specific location or type of marble is mentioned.

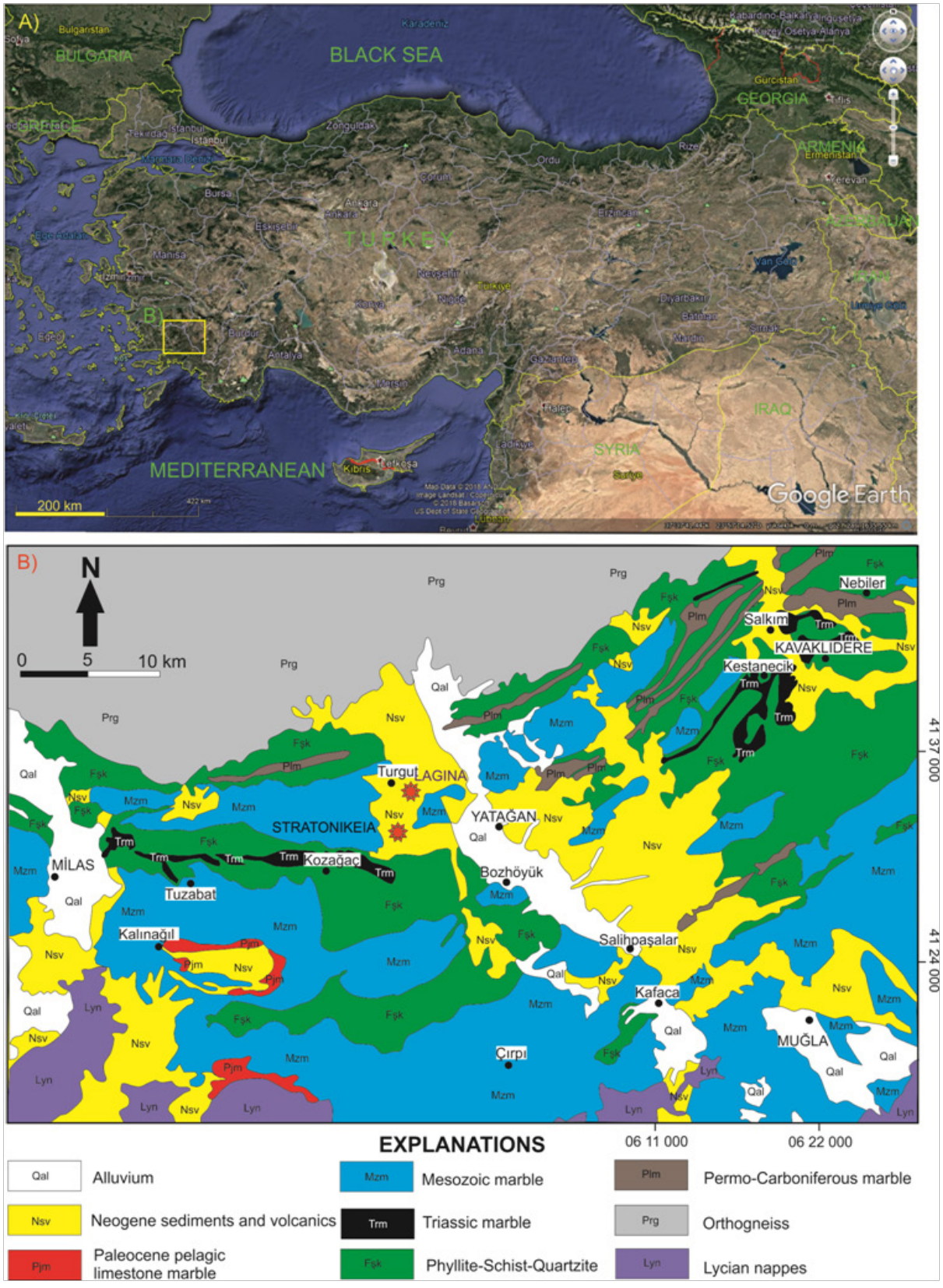

Figure 1 (A) Location map of the study area. (B) General geology map of the Muğla and surrounding region (modified after Candan and Dora,[9]; Yavuz et al.,[14]; Gül,[10]

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It was found during the field observations that, the blocks used on the walls and in the construction of floor structures of areas such as Gymnasium-Sports School, Bouleuterion-Parliament building, Columnar Street, Amphitheatre, Temple and the Water structure in the city of Stratonikeia; and the blocks used in the construction of the walls, floor and column structures of Propylon, Stoa and Hecate Temple in the city of Lagina, were mostly white, thin-medium crystalized marbles (Figure 2). In the catalogues, this marble is known as 'Caria White' or 'Muğla White'. Some of the white marble blocks were observed to be patterned. When examined carefully, it is understood that, the texture extracted from the same quarries and the marbles called 'Newyork marble', 'Azuro', 'Bianco Ibiza' are also used in the catalogue by the operator (Figure 3). This Mesozoic aged marble is already being operated in the quarries located in the west of Stratonikeia, and in Yatağan and Kavaklıdere (Figure 1B).

Figure 2 (A) White marble blocks used in the construction of the northern entrance gate of the city of Stratonikeia. (B) Blocks used in the construction of Gymnasium-Sports School in the city of Stratonikeia. (C) Blocks used in the construction of the Amphitheatre in the city of Stratonikeia. (D) The mosaics made of white, black and maroon coloured marble pieces located on the side of the entrance gate in Stratonikeia city. (E) The city of Lagina, Propylon-Entrance Gate Blocks. (F) Black marbles on the walls of the Propylon-Entrance gate in the city of Lagina. (G) Metamorphic rocks located on the basis of the Prophylon-Entrance gate in the city of Lagina. (H) Travertines used on the upper levels of the walls surrounding the Hecate Temple of the city of Lagina (photo obtained from Gül and Huylu,[11] Huylu.[12])

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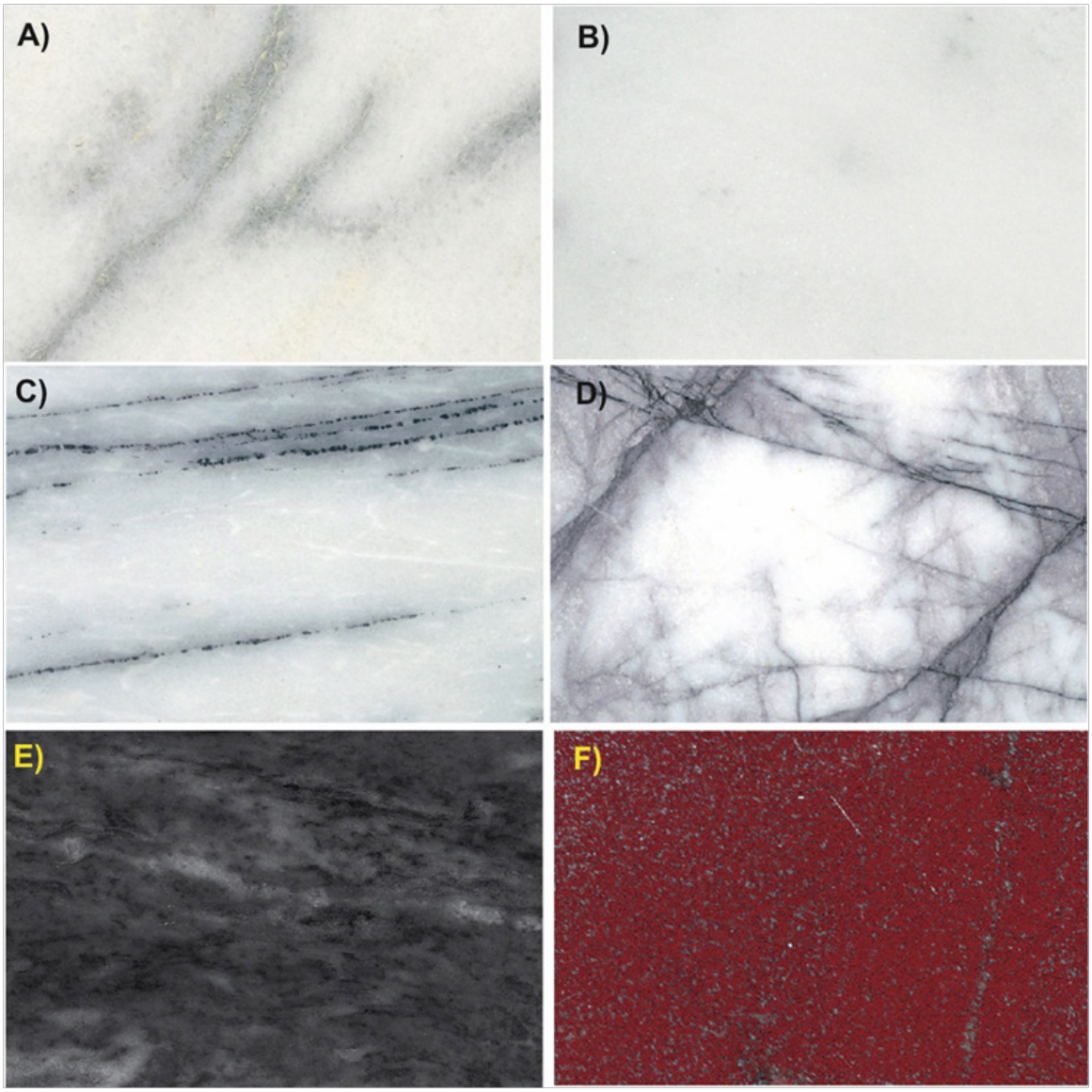

Figure 3 Catalog views of the Muğla marbles. (A) **'**Caria White' which is thought to be a source of white marble blocks. (B) 'Bianco Ibiza' which is thought to be a source of white marble blocks. (C) 'Newyork' which is thought to be a source of white marble blocks. (D) 'Milas Lilac' which is thought to be a source of veined purplish marble blocks. (E) 'Ayhan Black' marble which is thought to be a source of black marble blocks. (F) 'Ege Maroon' from which the maroon coloured marble pieces in the mosaics is thought to be obtained (Photos obtained from the Mugla Mermer official journal of Association of Mugla Marble Company; Gül and Huylu.[11])

Apart from the marble type mentioned above, other types of marble used in smaller amounts were also found in the field studies. Although the weathered, karstic cavernous, breccia marbles observed in the Columnar Street of Stratonikeia are yellowish white or creamy white, these were considered as white marble. This type of marble is found in the sections cut by the faults in the marble quarries, in the fault breccia zone developed due to the fault movement, and the excess water activity in this weakness zones caused the formation of yellowish off-white colour. In the city of Stratonikeia, it was observed that several columns and marble blocks were purple coloured veined marble. This marble is the marble type called 'Milas Lilac' and 'Milas Eggplant' in the catalogues (Figure 3D). In addition, though in a small number, some of the large blocks in the Lagina-Altar structure and on the walls of the Propylon-Entrance gate, in the Stratonikeia temple are black coloured veined marble blocks. This type of marble is black Triassic aged marble, and known as 'Karaöz-Black-Ayhan Black marble' (Figure 3E). Besides the marble pieces mentioned above, maroon-coloured marble pieces, which are extracted from the quarries around Kalınağıl-Milas and known as Ege Maroon-Milas Maroon are encountered in the mosaics found on the floor of the northern entrance gate of Stratonikeia (Figures 1B,2D&3F).

The various aged and coloured marble quarries were distributed all around the Muğla, and they can supply big blocks suitable for the large sized construction materials (Figure 1B). They can also easily have carved for small-scale structures. Thus different marble blocks should

be easily supplied during ancient times for the constructions of the cities. Unlike the other marbles, very cavernous and loose travertines are used on especially the upper parts of the walls surrounding the Hecate Temple of Lagina city. The travertine formations used in a limited amount are found around Milas, and especially around Denizli. Travertine, which is much easier to process than marble, was probably brought here and used as a result of the commercial relations in the period it was produced. In the construction of Stratonikeia and Lagina foliated-layered metamorphic rocks phyllite, schist and gneiss were also used. They were generally used at the bottom part of the marble buildings for supplying resistant floor. There is no active rock quarry on these rocks. Only feldspar and quartz quarries have operated on these rocks. A few stone quarries work on those types of rocks in further west (Bodrum town) of the ancient cities. However, those rocks can be found in close north of the ancient cities. Thus they might be supplied from the Menderes Metamorphic Massif rocks (orthogneiss) and cover units (phyllite-schist-quartzite) (Figure 1B). In the construction of Stratonikeia, which is known as the marble city and of its sacred city Lagina, local building stone marbles and other rocks were widely used. The building stones that may be needed during the restoration of both cities can easily be obtained from the immediate surroundings. Or, utilization of local building stones in the model reconstructions, which will be prepared for publicity purposes, would give better results.

Conclusion

As a result of visual inspection, both Stratonikeia and Lagina ancient cities were mainly constructed with using local geologic material. White marble, black-veined purple-white marble were mainly used for side wall-seats-pillar-gate and partially floor construction. Black marble and brecciated marble were used at a lower rate for side wall and pillar constructions. Travertine only used in some pillar and side wall of Lagina. Foliated metamorphic rocks including phyllite-schist-gneiss were generally used for the floor of the marble buildings for supplying a strong foundation. Nearly all geomaterials that used the Stratonikeia and Lagina construction were obtained from close geologic sources. If necessary, during the reconstruction, those materials can be evaluated after detail analytic and laboratory test.

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Conflicts of interest

Author declares that there is no conflict of interest.

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