

Geological and geomechanical properties of the carbonate rocks at the eastern Black Sea Region (NE Turkey)



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ABSTRACT

Turkey located in the Alpine-Himalayan Mountain Belt has 35% of the natural stone reserves of the world and has good quality marble, limestone, travertine and onyx reserves especially in the western regions of the country. The eastern Black Sea Region with a 1.4 million meters cubes reserve has a little role on the natural stone production in the country. For this reason, this paper deals with investigation on the potential of carbonate stone in the region and determination of the geological and geo-mechanical properties of these rocks in order to provide economic contribution to the national economy. While the study sites are selected among the all carbonate rock sites, the importance as well as the representative of the sites were carefully considered for the region. After representative samples were analyzed for major oxide and trace element compositions to find out petrochemical variations, the experimental program conducted on rock samples for determination of both physical and strength properties of the carbonate rocks. The results of the tests showed that there are significant variations in the geo-mechanical properties of the studied rock groups. The density values vary from 2.48 to 2.70 gr/cm³, water absorption by weight values range from 0.07 to 1.15% and the apparent porosity of the carbonate rocks are between 0.19 and 3.29%. However, the values of the UCS shows variation from 36 to 80 MPa. Tensile and bending strength values range from 3.2 to 7.5 MPa and 6.0–9.2 MPa respectively. Although the onyx samples have the lowest values of apparent porosity and water absorption by weight, these samples do not have the highest values of UCS values owing to occurrence of the micro-cracks. The UCS values of the rock samples were also found after cycling tests. However, the limestone samples have less than 5% deterioration after freezing-thawing and wetting-drying tests, but travertine and onyx samples have more than 15% deterioration. Exception of the apparent porosity values of travertine samples, all geo-mechanical properties of the studied carbonate rocks were determined in the acceptance values given by Turkish Standards Institute (TSE) for using as a natural dimension stone. After these investigations, it is anticipated that in the near future the number of quarries and factories will increase and more types of natural stones will be discovered in the eastern Black Sea Region and thus this will provide economic contribution to the economy of the country.

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1. Introduction

Turkey has ample resources in terms of natural stones, especially marble, limestone, travertine, onyx and conglomerate, since it is situated in the Alpine-Himalayan orogenic belt that has the rich

natural stone resources in the world (Fig. 1). Turkey with about 5.2 billion m³ natural stone reserves with its well-developed processing industry is the one of the most important dimension stone producer of the world because these stones have a good quality and most variety of structure, colors and textures (Onargan et al., 2006; Uyanık, 2008). About 1500 marble quarries are in operation in the country and almost all are situated in the western part of the country (Yağız, 2010). Thus, there are 2000 factories and more than 9000 workshops in the marble sector. Natural stone production of Turkey has grown in the last decade. The export values have increased about 0,5 billion dollar in last five years and reached 2,13

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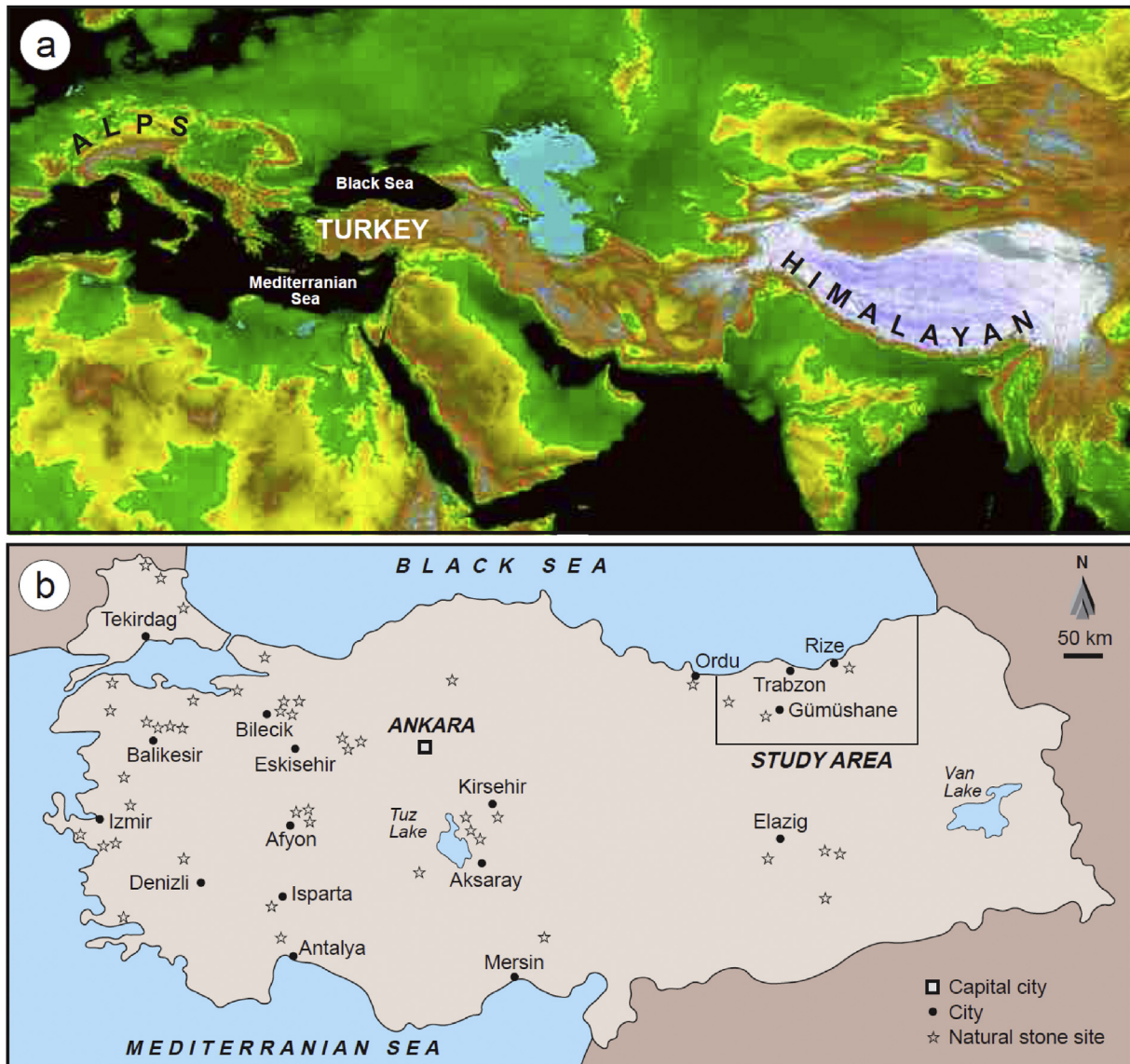


Fig. 1. (a): Location of Turkey on Alpin-Himalayan Orogenic Belt, (b): the most important natural stone sites in Turkey (b).

billion dollar in 2014. Although the northeastern part of the country, the study area, has a rich variety of metallic mine reserves (Yılmaz et al., 2003), the region has limited number of natural stone variety due to the geological structures (Ersoy et al., 2009, 2016; Özdemir, 2009).

Geological properties and formation conditions of carbonate rocks were commonly investigated in the region (Ersoy and Dilek, 2001; Arslan et al., 2005; Yılmaz et al., 2003; Kandemir and Yılmaz, 2009; Ersoy et al., 2011). The geo-mechanical properties of the carbonate rocks in the eastern Black Sea Region have also been studied (Çavuşoğlu et al., 2006; Babacan et al., 2009; Ersoy and Kanik, 2012; Ersoy and Kanik, 2012). Owing to the lack of investigations on the potential, distribution and engineering properties of the carbonate rock as a whole, new researches should be carried out to contribute to the national economy considering to the travertine and limestone potential of the region. The paper presents the investigation on the potential of the carbonate rocks in the northeastern part of the Turkey and especially focuses on the geological and the engineering properties of these carbonate rocks.

2. Materials and methods

2.1. Sampling location and regional geology

The study area is located in the northeastern part of the Turkey (eastern Black Sea Region) and the rough irregular land morphology consisting of landscape with steep slopes in the region were shaped under the control of the tectonic structures depending mainly NE-SW and NW-SE directed folds and faults systems (Fig. 2).

The eastern Pontide Tectonic Belt known as a paleo-island arc setting consists of a mountain chain 500 km long and 150 km wide along the northeast coast of the Turkey. This major metallogenetic province is represented by different periods of volcano-clastic activities from Upper Cretaceous to Neogene ages (Arslan et al., 1997).

Considering the basis of structural and lithological differences, there are two subdivided zones in the eastern Pontides (Bektaş et al., 1995). Pre-Late Cretaceous sedimentary rocks are widely exposed in the Southern Zone, whereas the Northern zone is characterized by Late Cretaceous and Middle Eocene volcanic rocks.

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