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Geological and geochemical signatures of the calcite quarry in the southeast of Biga (Çanakkale, Turkey)

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Abstract

Calcite is a significant industrial raw material used in many fields owing to its properties. For this reason, determining the calcite quarry's geological and geochemical characteristics promotes the sector. This study was carried out to explain the geological and geochemical properties of the marble blocks of Paleozoic metamorphics located in the Biga peninsula. The length of this area, operated as a calcite quarry, is 350 meters, and its width is around 50 meters. Although alterations are partially observed due to the effect of faulting, the alteration is quite low in the main production area. Secondary minerals are rarely seen in fractures and cracks in marbles that display texturally granular texture. In geochemical analyzes, CaO values are around 55%, and MgO values are quite low. These data show that the calcite quarry suggests remarkably useful properties in terms of industrial raw materials.

Introduction

Limestone consists of calcite, whose chemical formula is $CaCO_3$ (calcium carbonate). It is largely used in many sectors in aggregate, powder, block, etc., owing to its physical and chemical properties [1]. The most important sectors are the metal, paper, ceramics, chemistry and construction sectors. For this reason, it is inevitable to research limestone, an extremely remarkable industrial raw material, and determine its physical and chemical properties.

The quality of the calcite mineral is determined by its grain diameter, colour and chemical purity [2-3]. The hardness of pure calcite is three according to Moh's scale, and its specific gravity is around 2.6-2.7 g/cm^3 at 20°C [3]. Carbonate rocks consisting of calcite with these properties are generally used as aggregates. In order to satisfy this need, the geological and geochemical characteristics of the calcite quarries should be explained.

When the geological framework of Turkey is reviewed, significant carbonate belts stand out. While some belts spread in relatively long and continual areas, a block or lenticular structure occurs in some areas for tectonic reasons. This study explained the geological and geochemical properties of the limestones in the Biga (Çanakkale) peninsula in Western Anatolia.

Material and Method

A 1/10,000 scaled geological map of the study area was drawn up. The contact relations of the units were completed in the field and redrawn in the Corel Draw program. In supplement, thin sections of the samples collected from the calcite quarry were made in ITU-JAL and examined under a polarizing microscope. Eventually, the geochemical analyzes of the samples were carried out with the X-ray fluorescence (XRF) spectrometer method. The data gathered were described in the office.

Geological Background

Pre-Tertiary rocks in the district crop out in tectonic belts, which spread in a NE-SW direction [4]. These tectonic zones consist of the İzmir-Ankara zone, Sakarya zone, Çetmi melange and Ezine zones from east to west, respectively.

The study area is located in the Sakarya zone defined by Şengör and Yılmaz [5]. Kazdağ metamorphics and Karakaya complex come together with tectonic contact. According to the Turkish Tectonic Units [6], the study area is located within the Paleozoic-Early Mesozoic subduction-subduction complex.

The base of the study area is the Kalabak Unit. Within this unit, there are Torasan formations and Çamlık Metagranodiorites are observed. The Torasan formation, which mainly includes phyllites, schists, metarhyolite, marble blocks and metaserpentinite blocks, is cut by the Çamlık Metagranodiorites. As a result of the deformations that occurred in the province, these two units belonging to the Kalabak Unit came together in some areas with a tectonic contact. The Karakaya formation of the Karakaya complex overlies this basement unit with angular unconformity. The contact of this unit, which consists of metamorphic rocks, with the basic units is generally tectonic (Figure 1).

Detailed investigations were implemented in the calcite quarry area, which is included in these lithologies and defined as the Marble member. The mineralogy, petrography and geochemistry of the rock, along with the structural relationship of the marble contact, are explained.

Characteristics of Calcite Quarry

The study area has an already operated calcite quarry in the east of Değirmen creek. This quarry operated using the calcite mineral belonging to the Marble blocks in the Torasan formation. Located on the site in a northwest-southeast direction, this marble block is approximately 350 meters long and 50 meters wide. This unit is cut by two NE-SW and NW-SE direction faults.

In the enterprise opened at 540 m elevations of the unit, it is observed that it is bordered by a fault along the dry stream and is in the form of a lens in the Torasan formation (Figure 2). Its weathering color and morphological features are easily recognized in the field. In the continuation of the unit towards the northeast, it is observed that the alteration color turns dark grey-blackish grey.

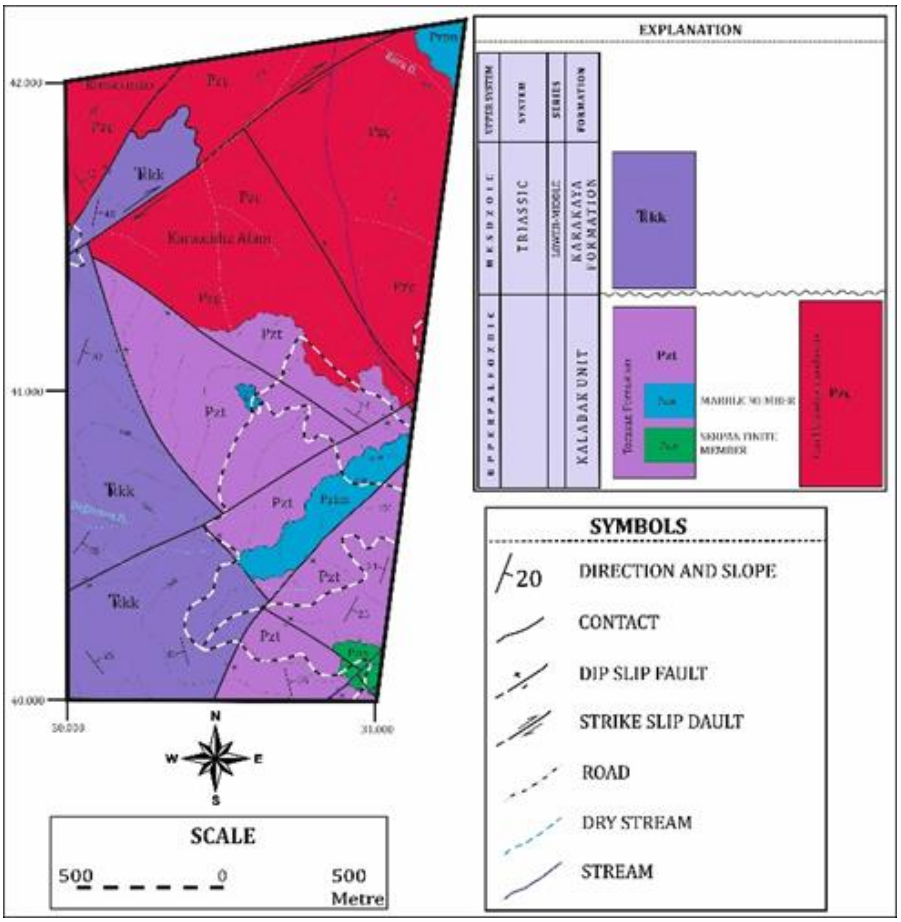

Figure 1. Geological map of the study area

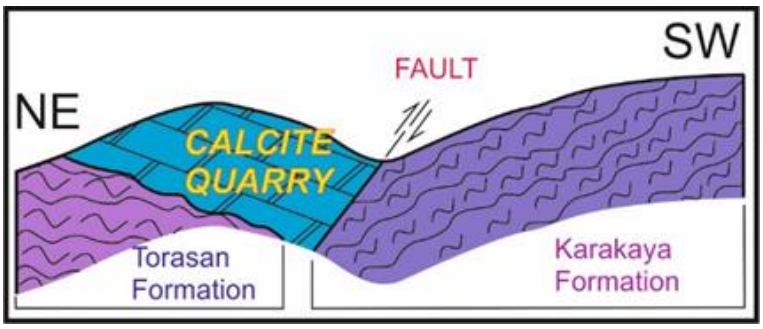

Figure 2. Geological cross-section of the calcite quarry district (without scale)

Petrography

Thin sections of the same samples were examined under a polarizing microscope. The examination determined that the rock has a crystalline mosaic texture (Figure 3). The rock is monomineralic and consists entirely of calcite crystals. Opaque minerals and quartz-type silicate minerals are remarkably rare. No alteration-decomposition is observed except for the iron oxide yield. The frequency of fissures and cracks is low in micro terms of the rock. It is seen as very plain and homogeneous regarding mineral content and structural elements (Figure 3).

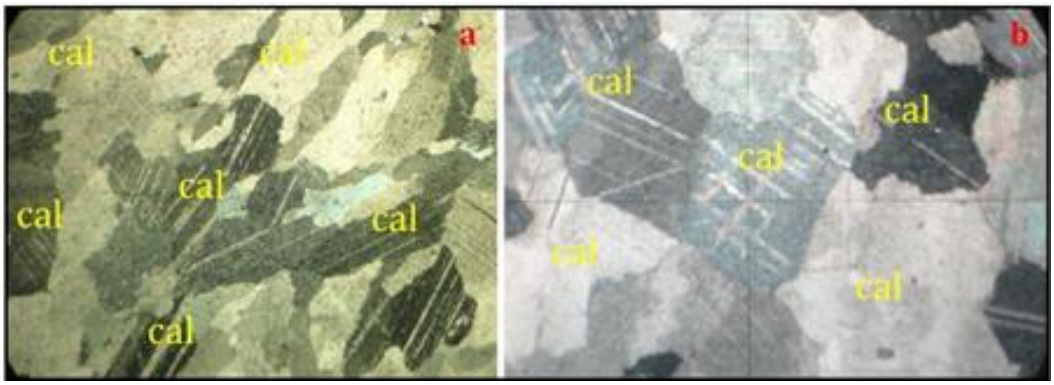

Figure 4. Microphotograph of marble (Abr: cal, calcite)

Geochemistry

It is recognized that the SiO_2 concentration in the samples is between 0.1-1%, the MgO concentration is between 0.27-0.66%, and the CaO concentration is around 55%, respectively.

Conclusion

The geological and geochemical characteristics of the Marble member of the Torasan formation located on the Biga peninsula were explained. The contact relationships of the Marble member, considered a calcite quarry, were determined. This unit, which extends approximately NE-SW, has a length of approximately 350 meters and a width of approximately 50 meters. Petrographic and geochemical explanations of calcite, a useful mineral in the marble member, were carried out. As a result of the study, it was determined that the calcite in the quarry, which was observed as a block, was medium-coarse crystalline, was less affected by deformations in terms of fractures and cracks, the alteration was at low levels, the CaO value was around 55%, and the MgO content was quite low.

Structural geology studies should also be done for the geological features of this area, which is used as a calcite quarry. The physical parameters of the calcites in the quarry, which are planned to be used as aggregates or similar material, should also be explained.

Acknowledgement

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