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# Characterization of limestone at the Bandeirantes mine in Tocantins

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**ABSTRACT**
This work involved the characterization and analysis of the stratigraphic and structural parameters of a limestone deposit located in Bandeirantes-Tocantins, with the objective of providing a comparative reference with other similar carbonate occurrences in the region. Limestone is a mineral amendment widely used in restoring poor soils and correcting the pH of acidic soils. The state of Tocantins has large reserves of limestone, which has encouraged industries and companies in the region. The use of limestone in agriculture is essential to increase productivity in acidic soils. The work seeks to identify impurities in the extracted limestone, characterize the local lithostratigraphic unit, explore the methods of use of the final product and contribute to the development of the region. The study involved a literature review and consultation of various sources of information on the formation of carbonate rock deposits and the characteristics of the deposit in question.

**Keywords:** Limestone, Deposit, Characterization.

## 1 INTRODUCTION

Limestone is a mineral corrective that is used for the recovery of soils impoverished by continuous use, in addition to its efficiency to correct the pH of acidic soils (EMATER, 2016). The definition of mineral corrective is any material that, when applied to the soil, corrects one or more characteristics unfavorable to plants. The need to apply lime to correct the undesirable characteristics of some soils in agricultural production was already recognized even before the Christian era, when Greeks and Romans applied marls (a type of limestone) to their soils to increase crop productivity.

Limestone rocks are abundant throughout Brazil. According to the National Mining Yearbook (ANM), the sum of the measured, indicated and inferred reserves of limestone is in the order of 100 billion tons, and this is a number that grows every day, due to the constant geological surveys carried out throughout the country.

As a result, many new industries and companies have been installed in the region, bringing products with different characteristics and different extraction and processing processes. Due to the new deposits discovered, there is also a need to characterize this limestone, to obtain all the necessary information to know the processes inside and outside the industry, until it reaches the consumer/final product.

Figure 1 Location of the Deposit.

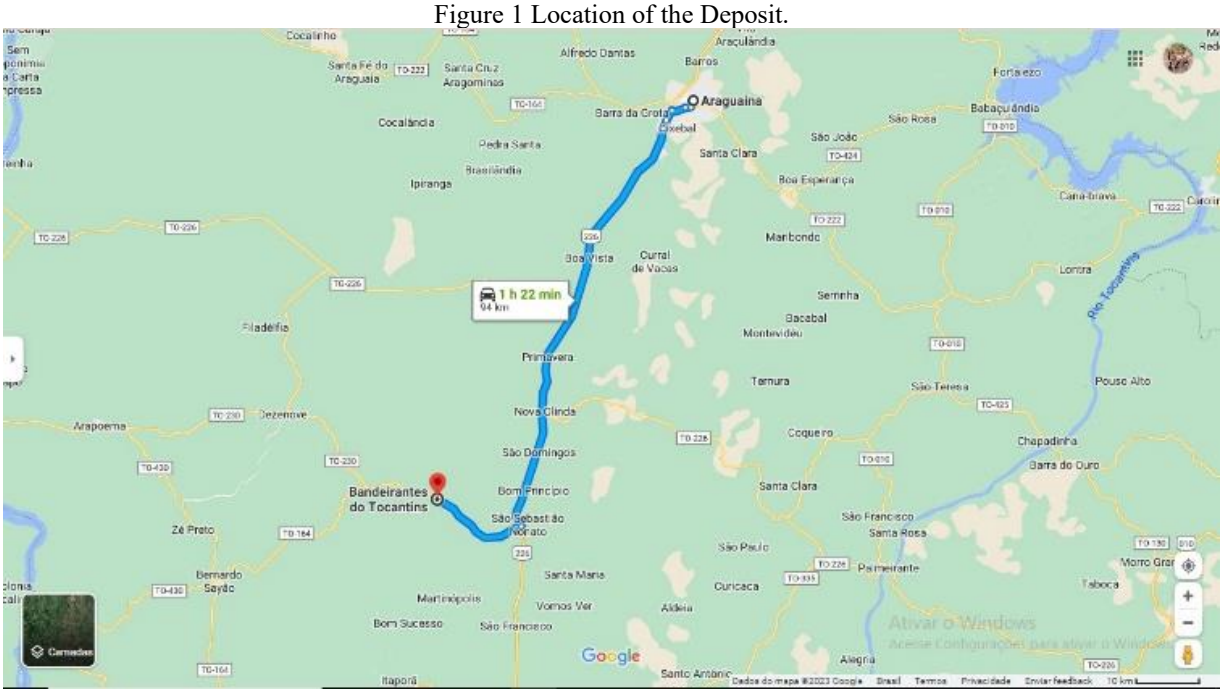


Figure 2 Aerial view of the mine.

## 1.1 RATIONALE

The main agricultural consumers of limestone in the State of Tocantins are the producers of sugarcane, cotton, soybeans, cattle and corn. Its production is dependent on the agricultural sector, as it is considered an extremely important agricultural input to leverage crop productivity. In Brazil, 70% of arable land is acidic (OXFAM, 2019), which prevents the optimal supply of nutrients to plants. For effective plant growth in tropical climates, fertilizer is an indispensable component, due to the high level of precipitation and mineral leaching. By applying limestone, the activity of the three main

macronutrients, nitrogen, phosphorus, and potassium (NPK) is improved, which increases fertilizer activity in the soil.

In the state of Tocantins, limestone is a widely available ore and its various applications make it a significant resource (MOREIRA, L. 2005). Two limestone deposits were discovered through field studies in the north-central region of Tocantins, specifically with regard to the locality of Bandeirantes. The carbonate rocks discovered in them were linked to different lithostratigraphic units, the last association coming from sedimentary rocks found within the Piauí/Parnaíba Basin Formation (MOREIRA, L. 2005).

## 1.2 GENERAL OBJECTIVE

The main purpose of this work is to characterize and analyze stratigraphic and structural parameters of the Bandeirantes deposit, in order to develop comparative references with other occurrences of similar carbonate rocks in the area.

### 1.2.1 Specific objectives

- Identify impurities in the extracted limestone;
- Name and characterize the local lithostratigraphic unit;
- Analyze the geochemistry of different facilities;
- Explore the main methods used for the use of the final product;
- To contribute to the development of the region, both agricultural and industrial, through new studies related to the mining of limestone.

# 2 THEORETICAL FRAMEWORK

## 2.1 GEOLOGY OF LIMESTONE

Limestone is a sedimentary rock formed from chemically formed materials . Limestone is the most common raw material, representing 3 to 4% of the Earth' s crust, the other chemical elements that make up limestone are obtained from igneous rocks. This is due to corrosion and erosion. The diluted calcium is carried to the sea through the water stream . When it reaches the sea, most of the calcium is precipitated after dilution, because this element is poorly soluble in seawater (CANDEIA; LINS, 2005).

The carbon dioxide content of water can be reduced due to temperature changes and evaporation due to this process can form high chemical purity limestone.The calcium available in solution, following chemical precipitation, is used by a variety of marine life that agglomerates on the seafloor forming limestone shells. The shape and size of limestone are due to temperature, pressure,

and other conditions in which the deposit causes that disturb the physical quality of the stone (LIGHT; LINS, 2005).

The calcium found in calcite limestone is replaced by magnesium, a high magnesium salt content may be a contributing factor to the formation of magnesian or dolomitic limestone (LIGHT; LINS, 2005).

## 2.2 USES AND APPLICATIONS OF LIMESTONE

### 2.2.1 Dolomitic Limestone

This type of limestone is composed of and characterized by existing Magnesium (MgO) and Calcium (CaO), which are found in dolomitic limestone and are essential for correcting the pH of agricultural soil, which decreases acidity, as the continuous and prolonged use of ammoniacal nitrogen fertilizers has contributed to increased soil acidification. (LIGHT; LINS, 2005).

### 2.2.2 Calcitic Limestone

Calcitic limestone contains high magnesium content that distinguishes it from other types of carbonate rocks, so this limestone profile is widely used as a raw material for cement production. (LIGHT; LINS, 2005).

## 2.3 APPLICATIONS OF LIMESTONE

Carbonate rocks, which are profiled according to the magnesium and calcium content of each type, have many uses, so we can identify some key rocks that are used most often. (LIGHT; LINS, 2005).

### 2.3.1 Application of limestone in agriculture

For example, limestone slag and other derivatives, hydrated lime and quicklime are used to correct the acidity found in the soil and aid plant growth, it is necessary that lime application in the soil is carried out a few months before planting to correct the acidity before. The ideal soil pH for plant growth is between 6 and 7, especially dolomitic limestone, which promotes plant growth by providing two important soil nutrients, calcium and magnesium, and neutralizing the acidity produced by fertilizers such as ammonia, sulfate, and nitrate. (LIGHT; LINS, 2005).

### 2.3.2 Application of limestone in lime production

Lime is produced from limestone that is high in calcium or magnesium. Generally, high-calcium lime contains less than 5% MgO. When lime is obtained from limestone with a high magnesium content, the product is called dolomitic lime.[1]

Limes derived with high magnesium content produce dolomitic lime. In the burning process, calcium carbon is transformed by heat at temperatures between 900 and 1000ºC. The lime manufacturing procedure consists of first processing the limestone by taking the material to the kiln and, in some cases, the sample goes through a hydration step with water to reach the final product. (LIGHT; LINS, 2005).

### 2.3.3 Application of limestone in animal feed

Consumed by animals as a food supplement, as it contains calcium, derived from crushed pure calcitic limestone, as well as calcium inserts in marble and calcareous shells. The amount of this supplement varies according to the type of animal, with the silica content ideally low and its granulometry within the range of 95% below 150 µm and 80% below 74 µm. **[**1**]**

### 2.3.4 Application of limestone in water treatment

The hardness of water is caused by the existence of minerals such as magnesium, calcium, and chlorine, as well as the occurrence of specific metals**.** The pH of the water can be increased by up to 25% with limestone, which has been shown to be a successful alkalizing agent. The more limestone that is used, the greater its ability to increase alkalinity. Notably, limestone-shaped gravel is the most potent form and can reach values of around 25%, demonstrating its high level of efficiency in the water alkalinization process**. [2]**

## 3 METHODOLOGY

### 3.1 LITERATURE REVIEW

Regarding the formation of carbonate rock deposits, a literature search was carried out for this stage. The following research was then focused on the north-central region of the State of Tocantins, several sources were used to collect information on geological parameters related to the Bandeirantes-TO deposit to the J. Demito Group. Physical and virtual media such as manuals, articles and books were consulted. Publications from the Brazilian Journal of Geosciences were the main sources used during the research. The books on Sedimentary Geology (SUGUIO, 2003) and Amazonian Geology have been deeply researched. For internet searches, he used google, google scholar and BDTD (Brazilian Digital Library of Theses and Dissertations).

### 3.2 FIELD ACTIVITIES

The field activities took place at the Corgão Mine, about 94 kilometers from Araguaína to Bandeirantes – TO. The visit took place in June 2023, accompanied by **the mine supervisor engineer Vinícius Leonardo** and the Industrial Manager Pedro Bandeira Jr**.** Field activities include visiting the

CALTINS mining front, collecting samples, taking measurements of rock structures, and photographing outcrops.

## 3.3 FINAL RESULTS

Like the limestones of Xambioá and Couto Magalhães, the limestone discovered in Bandeirantes shares undeniable characteristics. These features are associated with the Paraguay-Araguaia sub-belt and were caused by geological changes that led to the deposition of the Lower Araguaia Group. At first, these deposits occurred in coastal and continental environments, forming a conglomerate, feldspathic and sandstone formation recognized as the Couto Magalhães Formation and the Morro do Campo Formation. Contamination caused by shale is a major obstacle in the limestone extraction process. Specifically in Bandeirantes, this impurity is concentrated in certain areas and can be conveniently disposed of in specific directions. These hurdles are significant in the mining process. Mining planning takes into account the slope angle of the limestone. To avoid instability problems, the mining fronts are usually facing the opposite direction to the angle of inclination (SSW direction). During our study, we identified several families of limestone fractures, but we did not perform measurements.

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