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Research article

The Relationship Between Mechanical Properties and Quartz-Feldspar composition of sedimentary rocks

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Schmidt hammer
regression analysis

English Extended Abstract

Summary

The resistance properties of the intact rock are dependent on the mineralogical composition and texture of the rock material. In this research, some quantitative relationships were found between petrographic and mechanical properties of sedimentary rocks collected from different locations. The results revealed that stone-forming minerals have a great and governing impact on mechanical properties.

Introduction

In the past decades, several researchers investigated the relationship between mineralogical composition and geomechanical properties of different rock types. Much research has been done in the field of textural properties, and their impact on the mechanical properties and drillability [1]. Nonetheless, the influence of mineralogical and texture characteristics on engineering properties has not been well identified yet. This study aims to quantify the relationships between petrographic characteristics and mechanical properties of some sedimentary rocks [2-4].

Methodology and Approaches

Mechanical properties of samples such as uniaxial compressive strength and Brazilian tensile strength were determined in the lab. Then, XRD tests were accomplished to determine the mineralogical composition. Statistical methods were used to determine the relationship between the mineralogical composition of the rock samples and the mechanical properties.

Results and Conclusions

Quartz is one of the most important rock forming minerals. Previous experimental research reported very complex and contradictory results on the impact of quarts on uniaxial compressive strength (UCS) of rock. Some research reported that the strength of granite increases with the increase of quartz percentage. Others claimed that quartz harms the strength of granite due to its brittleness. Some others found no significant correlation [5-9]. In this research a direct linear relationship with a strong correlation coefficient between quartz content and UCS and a weaker correlation with the tensile strength was observed .

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Also, a strong inverse logarithmic relationship was observed between UCS and the feldspar content. (R2=0.84) that is in good agreement with some previous research. This phenomenon may be due to the presence of cleavage and micro-cracks in feldspar minerals. On the other hand, some research showed a direct relationship between the percentage of feldspar and UCS which contradicts observation in this research. Finally, an inverse strong correlation was observed between the feldspar content and Brazilian tensile strength and a weaker inverse correlation with the Schmidt hammer number. This can be due to the existence of weak bonding along the cleavage surfaces as well as the alteration of feldspars. This researcher also revealed that there is a direct strong logarithmic relationship between quartz to feldspar ratio (Q/F) with UCS, the Brazilian tensile strength and the Schmidt hammer number.

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