Investigation of the effect of mineralogy in strenghth of schist rocks in Mouteh gold mine

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Abstract

In this study, due to the landslide in schist rocks, in the wall of Mouteh gold mines, including of the eastern wall of ChahKhatoon mine, it is important to identify the effective factors. Therefore, due to the diversity of schists in Chah Khatoon and Sanjadeh gold mines (two active mines in Mouteh Complex), to survey the mineralogy of schist rocks in Moteh gold mine has been done by identifying important factors in changes in rock strength. Cosequently, 10 schist samples from walls of these mines were considered for mineralogical, XRD studies. In the next step, these schists were subjected to uniaxial compressive strength (UCS) and Brazilian tests to estimate the mechanical properties and quality of rock mass in different zones of mineral walls. The results showed that the UCS and Brazilian index in these schists are directly and inversely related to the SiO_2 and Al_2O_3 contents of the rocks, respectively, as well as the secondary structures.Some factors such as the presence of secondary structures, continuous surface area, particle size, and mineralogical composition play an important role in the failure modes of these rocks. UCS and Brazilian strength of schists vary from 10 MPa to 72 MPa and 1.9 to 10.2 MPa, respectively. The lowest UCS occurs in strongly weathered rocks with low silica content. However, the type of clay minerals is effective in the stability of the mineral wall. Considering the presence of montmorillonite clay mineral in the eastern wall of Chahkhatoun mine, the rock resistance is moderate despite the high percentage of silica. UCS values of wet and dry rock samples containing muscovite and montmorillonite clay minerals were more different from those of other rocks. In this regard, the rocks with Illite clay minerals are more resistant than Smectite and montmorillonite minerals. In general, the resistance of schists depends on various factors

such as mineralogy, which is of great importance because of its involvement in the formation of secondary structures.

Key words: Mineralogy, Uniaxial compressive strength, Brazilian, Montmorillonite and secondary structures.

Extended Abstract

Introduction

Mines play an important role in the economy of some countries and mineral extraction is of special economic importance while observing safety. One of the important issues in the safety of mines is the stability of the walls of these mines. Moteh Gold Mines Complex is located 6 km away from Moteh village on Isfahan-Golpayegan road. The mine is located in a complex of a predominantly metamorphic rock complex. The gold mines, which often formed along fractures in altered areas, were all trapped by the accumulation of gold-bearing metallic minerals such as pyrite and gold-plated chalcopyrite within the rocks of the area within the fault fissures. The problem of falling in the walls of this mine is one of the problems that has been investigated in this research. One of the important influential factors in the strength of schist rocks and their stability in the walls of mineral ores is this type of rock, which has an important role in their engineering behavior. Studies have shown that the mineralogical composition of schist rocks is effective in their resistance. Petrographic characteristics such as structure and texture, mineralogy and microstructures have important effects on the strength of these rocks. In general, determining the strength of rocks is one of the most important parameters used in all engineering projects. Uniaxial compressive strength and indirect tensile strength are commonly used as standard tests to determine the strength of rocks. Mineralogical diversity and their size are important factors in heterogeneity in rocks and affect the physical and mechanical behaviors of rocks.

Study method

Since schist metamorphic rocks have a sheet structure and significant inequalities in their mechanical behavior are observed, therefore, one of the determining factors of mechanical behavior of these rocks is the presence of anisotropy and inhomogeneity. Therefore, in this study, with mineralogical studies, 10 schist samples from Moteh gold mine in the unstable walls of Chah Khatoon and Sanjdeh gold mines (active and extracting mines) (6 types of schist in the pit wall

of Sanjdeh mine, due to high The existence of more mineral reserves and 4 types of schists in the mineral peat wall of Chah Khatoon mineral has been studied according to the diversity of schists in those mines. Sampling is mostly done on walls that have already collapsed. Samples were prepared as fresh and without weathering as possible for petrographic and geomechanical studies. Thin sections and mineralogical studies of the samples were studied in the laboratory of Iran Processing Research Center located in Karaj. XRD analysis was also performed on the submitted samples. In the samples of petrographic studies, imaging was performed with ordinary light in a certain and fixed direction and the second layer was imaged with polarized light in the same direction as the first imaging. To determine the strength characteristics of schists in Amirkabir University Mining Laboratory, uniaxial and Brazilian strength tests were performed. Uniaxial compressive strength and tensile strength of Brazil were performed based on standard geotechnical tests. Samples prepared for these experiments were prepared according to the ISRM standard (1979, 1978). Uniaxial compressive strength test was performed with samples with a length of 120 mm and a length to width ratio of 2.5-2 at a pressure of 0.5 MPa /s. Tensile strength tests of Brazil were performed by loading the sample with a diameter of about 30 mm and a length to width ratio of 0.5-0.75 at a pressure of 0.5 MPa per second. In general, one of the most important and common experiments related to the mechanical studies of rocks is the uniaxial compressive strength test. Among the parameters obtained from this experiment; is uniaxial compressive strength, the modulus of elasticity and Poisson's ratio, which are very important in stone engineering projects. Despite the simple appearance of this experiment, many factors affect the test result, some of which include: mineralogy composition, rock texture, rock density and porosity, moisture in the sample, sample dimensions, loading speed, how to prepare the sample Etc., which in this study all cases have been considered. The Brazilian method is one of the most common methods for determining the tensile strength of rock. The basis of this experiment is the application of diameter pressure on a cylindrical specimen, which causes tension in the direction perpendicular to the load axis. When the tension created exceeds the strength of the rock, the rock begins to fail tensile.

Results and discussion

In this study, in the schist rocks of Moteh gold mine, the minerals in the schists and the mineralogical composition of the samples were determined based on the percentage of minerals according to the rock texture. XRF analysis of mine schist rocks was also performed. On the other

hand, by performing uniaxial and Brazilian compressive strength tests on schist rocks, the role of mineralogy on their strength was investigated. Resistance measurements were performed for all samples under the same conditions (perpendicular or parallel to the stratification) and in dry or wet conditions. In general, the resistance of schists depends on several factors, which are mentioned below: 1- Schist anisotropy (secondary structure): is one of the intrinsic characteristics of the mass of these stones and includes any level of discontinuity. The most important of them. Therefore, the strength of the rock is related to the orientation of the minerals. 2- Degree of metamorphism of schist rocks: One of the factors that is effective in reducing the anisotropy of schists is the increase in the degree of metamorphism and the result of growth and recrystallization of minerals, which reduces the anisotropy of rock. Since most of the Moteh gold ores are formed in regional metamorphism (in Chah Khatun and Sanjdeh mines) and its minerals are quartz, mica, garnet, albite and alkaline feldspar, so in this study only the mineral is affected. Are resistant to these rocks. 3- Existence of clay minerals: The presence of clay minerals in the structure of schist rocks reduces their resistance to a great extent. The rocks with illite clay minerals are more resistant than smectite and montimorillonite minerals. 4- Schist mineralogy: The presence of resistant minerals such as quartz (SiO_2) increases the strength and Al_2O_3 reduces the strength of the schist rock. Because the minerals in the schist create a secondary structure, for example the presence of biotite and muscovite causes layering in the schist, the type of minerals present in the schist resistance is effective. The presence of mica and calcite also significantly reduces the final strength. In general, important factors (which) play an important role in the strength of schist rocks are the combination of mineralogy and secondary structures in the rock. One of the important factors that cause the formation of secondary structures in schist rocks is the type of mineral Are stones.

Conclusion

The following conclusions were drawn from this research showed:

Some factors such as the presence of secondary structures, Schistosity, particle size, and mineralogical composition play an important role in the failure modes of schists. The most important factor in rock resistance on shcists is Mineralogical composition.

- Mineralogical composition is very important in schist rocks, due to it creats secondary structures in them and it has very important effect on strength of schists.

- UCS and Brazilian index in schists are directly related to the SiO_2 and inversely to the Al_20O_3 in this rocks. UCS and Brazilian strength of schists vary from 10 MPa to 72 MPa and 1.9 to 10.2 MPa, respectively.

Key words: Mineralogy, Uniaxial compressive strength, Brazilian, Montmorillonite and secondary structures.

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