

Modal Testing Technology Based on Geological Rock Mineral Analysis

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Abstract: With the continuous development of China's national economy, mining industry and related industries have made unprecedented progress. Rock and mineral analysis and identification is the basis and premise of various geological work, and has a very important guiding role. The purpose of this study is to analyze the minerals in geological rocks by modal test techniques. In this study, geological rocks of Nishiyama bay were selected as experimental objects. Local cores, debris, rock mineral block samples, rock mineral powder or soil samples were collected, then crushed, sorted, mixed, divided, prepared, and then tested quantitatively and quantitatively to determine the effective chemical composition of the rocks and minerals. Data is sorted and analyzed through modal analysis and test techniques of this research. The results show that the epidote minerals are the highest in the three mineral areas (10.30% ~ 55.94%, with an average content of 29.73%). The relative content of quartz is distributed in each percentage range. The number of samples distributed in the range of 40% ~ 50%, feldspar in the range of 10% ~ 20% is the largest, with 2865 samples, and dolomite minerals with the largest number in the range of 0%~10%. It is concluded that the modal testing technology in this study is very detailed and accurate for the analysis of geological rocks and minerals. This study contributes to the development of geological work.

1. Introduction

By analyzing and testing rock minerals, geological researchers can fully understand the specific composition and industrial value of rocks and minerals. Through the analysis of rocks and minerals, the proportion of each element can be determined. This is the guide to determine mineral classification and subsequent geological mining. Therefore, to ensure the correctness of rock and mineral analysis results is the basic requirement of geological rock and mineral exploration. The selection of analytical methods is the core content of rock and mineral analysis. In order to determine whether the analysis results are within the experimental error range and whether they can

be used as effective results.

Numerous data and information obtained from the analysis of rocks and minerals can provide effective assistance to researchers of geological conditions and global environment. Rock and mineral analysis methods vary depending on the type and geological conditions of rocks. Geological and mineral analysis methods are mainly divided into mechanical and chemical analyses. Machine analysis has features of high sensitivity, high selectivity, easy operation and fast analysis. It is suitable for the analysis of trace elements and trace elements, but there are problems that the relative error is large, the maintenance cost is high, and the popularity is low. The former chemical analysis has the advantage of low experimental cost, easy operation, and accurate accuracy, but it is unclear for quantitative analysis of geological and mineral samples.

In the research of mineral analysis and modal testing technology, Zeng G studied the lead isotope composition of vein and wall rock on the basis of analyzing the geological conditions of mineralization, and discussed the metallogenic epoch and ore-forming material source. The variation range of lead isotopic composition of minerals in this study is narrow, and it has the characteristics of common lead. The lead model age of the vein is 150-169 ma. The lead model age of vein can represent that the main metallogenic period of Pb Zn deposit is Yanshanian period. The distribution of ore bodies is controlled by NE trending faults in early Yanshanian period. The isotopic characteristics of the ore indicate that the area is multi-source, and all stratigraphic units may be the cause of mineralization. His method is not accurate [1]. Dill H G is located in a missing link between South Africa and South America. Its division is reflected in the distribution of HM, which is mainly concentrated in the coastal backshore and sand dunes. His HM is subdivided into three HM assemblages, reflecting the geodynamic evolution of some major deposits in the South Atlantic and Gondwana: the Gondwana Craton and the Proterozoic orogenic belt, Cr and BIF bearing deposits (rutile, zircon, ilmenite, tourmaline, garnet, chromite spinel), rift related and faulted magmatic petrology of mantle derived tubular rocks, such as kimberlites (zirconium) The lithology of the Cordillera type polymetallic stratabound deposit (tourmaline, hornblende, chlorite, rare earth phosphate) is also studied. The main HM changes from the stable craton in the east to the active fold belt (Andes) in the West follow the stability order of HM. His method is not stable [2]. De Barros E describes the experimental facilities of the modal test laboratory of the Institute of Aeronautics and Astronautics in terms of related instruments and data acquisition systems, metrology and computational resources. Taking a practical application as an example, he introduced a ground vibration test of UAV. His method evaluates the experimental facility in a typical GVT, using three shaking tables and 88 response measurement points under vertical and horizontal excitation. He uses the global excitation method to excite all the expected modes. His method is not practical enough [3].

This study first introduces the formation and classification of rocks, and then describes in detail the classification of mineral characteristic minerals. The rock and mineral analysis methods described in this study can be divided into instrumental analysis method and chemical analysis method. The main algorithms of this study are finite element modal analysis and rock micro pore structure. The experimental step of this study is to analyze the sample taking, then the sample preparation, then qualitative analysis, and finally verify the analysis results. The research results are analyzed by mineral characteristics and content, geological rock mineral spectral curve analysis, geological rock mineral characteristics analysis, modal test technology simulation accuracy analysis and geological rock pore characteristics analysis. It is concluded that the modal testing technology in this study is very efficient and accurate.

2. Geological Rock Mineral Analysis and Multimodal Technology

2.1 Formation and Classification of Rocks

Rock minerals are stable mineral solid aggregates formed in the natural state of single or multiple chemical elements in the crust under various geological processes. Rocks and minerals are the products of various geological processes in nature. Almost all rock minerals are composed of different minerals, and relatively few are composed of single mineral. Under the complex geological process and geological activities, various chemical elements and their compounds in nature contribute to the diverse combination of rocks and minerals through various combinations [4-5].

Rocks are the main purpose of geological surveys. It is an important part of the earth's substance consisting of solid minerals or mineral mixtures. Among them, rocks in the sea are called coral reefs, coral reefs, and Asagi. They are generally composed of certain minerals and several minerals with several biological relics and relics. Most rocks are made up of different minerals and are mostly composed of single minerals. Rocks are generally produced in nature. Natural rocks are classified into igneous rocks, sedimentary rocks and metamorphic rocks [6].

(1) Igneous rocks: known as magma rocks, are the products of cooling and solidification of magma formed by melting or partial melting of rocks in the mantle or crust.

(2) Sedimentary rock: it is also known as a hydraulic rock formed mainly on the surface and formed by chemical and biochemical solutions and colloid deposition by water flow or glacial transport, deposition, diagenesis.

(3) Metamorphic rocks: refers to material composition and structure of temperature, pressure changes, stress changes, and new rock deformation. However, in the solid state, the melting process is not performed [7-8].

2.2 Ore Characteristics

The main ore minerals are: argentite, chalcopyrite, galena, sphalerite, pyrite, etc. at the same time, metallic minerals such as limonite, white iron ore, goethite and hematite can be seen, and some of them are azurite, tetrahedrite, bornite, glauconite, etc. Gangue minerals mainly include quartz, fluorite, potassium feldspar, opal, chalcedony and a small amount of Sericite. The sequence of mineral formation: Pyrite (py) - sphalerite (SP) (chalcopyrite (CP)) - galena (GN) - hematite (HM) - argentite (ARG)

Fluorite (CaF_2): the fluorite in this area is mainly purple, light green to turquoise green, colorless, and a small amount is blue-green, brown, white, light yellow, etc.; the color of fluorite in different mining areas is slightly different, and the temperature and pressure conditions during mineralization in different mining areas, the composition of impurities in minerals and ores and trace elements affect its color [9].

Quartz (SiO_2): widely distributed in this region closely related to fluorite. Aggregates are mainly white and thin yellow. Density is 2.65 to 2.66 g / cm^3 . It is shaped like a hexagonal column of self shape and forms a parent crystalline group formed in a comb form. For example, hozan fluorite mine and other mining areas are relatively developed [10-11].

Kaolinite: kaolinite in this area is mostly white. The gloss is dim. Its hardness is close to 1. Its density is approximately 2.6 g / cm^3 . It is mainly formed by hydrothermal alteration and weathering of aluminosilicate minerals such as feldspar and mica. It is usually produced with irregular masses and soil (kaolinite clay) blocks. These are common near the roof and floor of both

sides of the vein. In general, ore that controls structural belt activity is mineralized after mineralization and the fragmentation of the ore is serious [12].

Other minerals: represented by chlorite and sericite, the content is relatively low, and the main distribution law is not uniform. Sometimes it appears near the ore body, sometimes in the roof and floor of the specific ore body. Under different surrounding rock conditions, the characteristics of altered mineral assemblage and alteration zoning are different.

2.3 Classification of Minerals

(1) Natural element mineral. It refers to the mineral of chemical elements. It can be divided into metallic elements, non metallic elements, and half metallic elements. Common minerals include gold, silver, platinum, natural copper, sulfur, diamond and graphite. Natural elements and minerals are low in nature, and there are about 90 kinds of natural elements and minerals known [13-14].

(2) Sulfide and its similar compound minerals. In many cases, there are abundant non ferrous metals, which are important metal sources such as molybdenum, lead, zinc and copper, and are of great economic value [15].

(3) Halides. Most of them are salt minerals formed under the influence of surface environmental conditions. Common minerals include halite, fluorite, etc.

(4) Hydroxides and oxide minerals. Common minerals include quartz, magnetite and bauxite, which are important sources of aluminum ore, iron ore, manganese ore, titanium ore and tin ore, with great economic value [16-17].

(5) Oxygen bearing salt minerals. It is a chemical element and a variety of oxyacid radical compounds, mainly silicate, carbonate, sulfate, phosphate, borate and tungstate, etc., which is the largest group of minerals [18].

2.4 Rock and Mineral Analysis Methods

(1) Instrumental analysis

Atomic emission spectrometry (AES): the measurement of the wavelength and intensity of electromagnetic wave radiated by the substance under thermal or electric excitation according to the internal energy level transformation of atoms or ions of each element. The atoms or ions of the test elements in the excited state will be released when they return to the ground state. The characteristic spectral lines of materials are used to determine the composition of materials, and to carry out qualitative and quantitative analysis of elements. The preparation of solid powder sample is its characteristic, which can avoid the error of dilution coefficient in the preparation of solution sample. The detection limit is lower. Multiple elements can be measured at the same time. The difference of evaporation behavior of elements under thermal excitation was used to avoid interference [19].

Atomic fluorescence spectrometry (AFS): a method for determining the content of the measurement element based on the fluorescence emission intensity of atomic vapor generated by the measurement element under excitation of radiant energy. The detection limit is low, the sensitivity is high, and the interference is low, and it is possible to measure a plurality of elements of simple spectrum, especially trace arsenic, antimony, bismuth, mercury, etc.

X-ray atomic fluorescence spectrometry (XRF): by measuring the energy and wavelength of X-ray with various characteristics emitted from various elements, the content of components determined in the sample can be obtained. The sensitivity to light elements is low, and it is easy to be affected by mutual interference and overlapping peaks, so absolute analysis is very difficult.

Standard samples are required for quantitative analysis [20-21].

(2) Chemical analysis

Gravimetric analysis: This refers to the use of appropriate methods (precipitation, gasification, extraction, electrolysis, etc.) under specific conditions to separate the determined components from other components in the sample, measure the mass of the substance, and calculate the determined substance according to it. Method of component content. Gravimetric method does not need to be compared with standard samples and reference materials, so it has high precision and is often used to correct the accuracy of other analytical methods. Gravimetry mainly includes precipitation, gasification, extraction and electrolysis. In the field of geological rock and mineral analysis, the precipitation method of gravimetric analysis is widely used [22-23].

Titration analysis: the main operation is titration, from the determination of solution volume analysis method, known as volume analysis. Titration analysis is a mature and stable method with high precision, simple and fast operation, simple and low-cost machine for analysis, which can be applied to titration of various types of chemical reactions. In the field of geological rock mineral analysis, the contents of copper, lead, zinc, aluminum, iron, manganese, calcium, magnesium and other elements are widely used.

2.5 Modal Analysis Theory

(1) Finite element modal analysis

Finite element modal analysis is a process of establishing modal model and solving modal parameters by numerical analysis. Its essence is to discretize the vibration problem of elastic continuum into a finite multi degree of freedom system [24-25].

When performing the finite element analysis in the structural system, assuming that the system has no external load, it means that the system is in free vibration state. As for solving the problem of structural frequency and mode shape (natural frequency and natural mode shape) of the system in free vibration state, the attenuation has little effect on the mode parameters of propeller, so the attenuation effect can be ignored. Therefore, the motion equation of the system in the state of free vibration without attenuation can be expressed as follows:

$$M\ddot{x}(t) + Kx(t) = 0 \quad (1)$$

Where m is the mass matrix, K is the stiffness matrix, $x(t)$ is the displacement vector, and $\ddot{x}(t)$ is the second derivative of displacement to time. Assuming that the solution of the above formula is a simple harmonic function, it can be expressed as follows:

$$\{x\} = \{\phi\}_i \cos \omega_i t \quad (2)$$

$\{\phi\}_i$ is the eigenvector corresponding to the i -th mode shape and has weighted orthogonality. ω_i is the angular frequency of simple harmonic motion and t is the time. The characteristic equation can be obtained by substituting the above formula into the equation of motion

$$(K - \omega_i^2 M)\{\phi\}_i = 0 \quad (3)$$

This characteristic equation contains a series of similar equations about the eigenvector. Since the amplitudes of all nodes of the system in the state of free vibration cannot be all zero, the determinant of coefficient in the above formula is equal to 0, that is to say, the coefficient determinant in the above formula is equal to 0.

$$\det|K - \omega_i^2 M| = 0 \quad (4)$$

$\omega_i^2 = \lambda_i$, for each eigenvalue λ_i , has an eigenvector $\{\phi\}_i$, which makes the determinant hold.

Through the formula $f_i = \frac{\omega_i}{2\pi}$, the natural frequencies f_i of the structure can be obtained, and the eigenvector $\{\phi\}_i$ can be used to represent the i-th mode shape.

(2) Basic theory of experimental modes

The essence of modal analysis is to use coordinate transformation method to solve the intrinsic value and eigenvector of the system. Eigenvalues contain modal natural frequencies, attenuation and other information, and eigenvectors with weighted orthogonality are used as transformation matrices. The physical coordinate system can be linked with the modal coordinate system. Generally speaking, the process of experimental modal analysis is to measure the time history of excitation and response through experiments, and use digital signal processing technology to obtain frequency response function or pulse response function to determine modal parameters.

The differential equations of motion constructed by multi degree of freedom vibration system can be expressed as follows:

$$M\ddot{x}(t) + C\dot{x}(t) + Kx(t) = F(t) \quad (5)$$

M is the mass matrix; C is the damping matrix; K is the stiffness matrix; F(t) is the load force vector; x(t) is the displacement vector.

The physical model is transformed into Fourier transform, which makes $x(t) = Xe^{j\omega t}$, $F(t) = Fe^{j\omega t}$ get

$$X(t) = H(\omega)F(t) \quad (6)$$

Frequency response transfer function:

$$H(\omega) = (K - \omega^2 M + j\omega C)^{-1} \quad (7)$$

Let ϕ_r be the r-order mode shape (eigenvector), then the FRF matrix can be expressed as follows:

$$H(\omega) = \sum_{r=1}^n \frac{\phi_r \phi_r^T}{(k_r - \omega^2 m_r + j\omega c_r)} \quad (8)$$

m_r, k_r, c_r represents the r-th modal mass matrix, modal stiffness matrix and modal damping matrix respectively. Each element of $H(\omega)$ can be expressed as follows:

$$H_{ij}(\omega) = \sum_{r=1}^n \frac{\phi_{ir} \phi_{jr}}{(k_r - \omega^2 m_r + j\omega c_r)} \quad (9)$$

Its physical meaning is the frequency response function of excitation at point i and response at point j. For any row of the frequency response matrix:

$$[H_{i1}, H_{i2}, \dots, H_{in}] = \sum_{r=1}^n \frac{\phi_{ir}}{(k_r - \omega^2 m_r + j\omega c_r)} [\phi_{1r}, \phi_{2r}, \dots, \phi_{nr}] \quad (10)$$

Each row of the frequency response function matrix contains all modal parameters, and each row corresponds to the r-th mode shape. This means that a line of frequency response function can be obtained and all parameters of modal analysis can be obtained by collecting vibration signals at specific fixed measuring points of test piece structure and exciting all measuring points in sequence. Similarly, all modal parameters can be obtained by stimulating at specific points and collecting vibration response signals at all measurement points.

2.6 Micro Pore Structure of Rock

The study of pore structure is one of the bases of reservoir classification and evaluation. The microstructure of compact storage layer is more complex. From the macroscopic point of view, the storage layers with different pore structures have different porosity and permeability. The analysis of physical facies of reservoir rocks needs to be based on the analysis of sedimentary facies and underdevelopment, and needs to be carried out with the help of quantitative standards in the world. The indexes to study the micro pore structure of reservoir and reflect the characteristics of seepage are: FZI and RQI.

FZI can more comprehensively calculate and present the geological characteristics of rock such as microstructure and composition

$$k = \frac{\phi_e^3}{(1-\phi_e)^2} \left[\frac{1}{F_s \tau^2 S_{gv}^2} \right] \quad (11)$$

K is permeability; ϕ_e is effective porosity; F_s is pore shape coefficient; τ is tortuosity of pore; S_{gv} is surface area of unit volume particles; $F_s \tau^2$ is called coefficient.

After dividing ϕ_e on both sides of the above equation, the square root is obtained

$$\sqrt{\frac{k}{\phi_e}} = \frac{\phi_e}{(1-\phi_e)} \left[\frac{1}{\sqrt{F_s \tau S_{gv}}} \right] \quad (12)$$

Define reservoir quality index

$$RQI = 0.0314 \sqrt{\frac{k}{\phi_e}} \quad (13)$$

Define standardized porosity:

$$\phi_z = \frac{\phi_e}{(1-\phi_e)} \quad (14)$$

Define flow zone index:

$$FZI = \frac{1}{\sqrt{F_s \tau S_{gv}}} = \frac{RQI}{\phi_z} \quad (15)$$

3. Experimental Design of Geological Rock Mineral Analysis

3.1 Sample Collection

This machine can test and study rocks and minerals and accept various test media. In general, cores, debris, rocks and mineral blocks, rock mineral powders, or soil samples are collected according to the need for research work.

Sampling usually follows the principle of point spacing equal to equal line spacing. Generally, 50 to 100m is standard line spacing, 3 to 5M is standard point interval, and it is possible to increase the density by the large change in the whole mineralization zone. When sampling, reduce sampling interval from 1 to 2 m. If the width of the body is narrow or the exposure is not clear, it is necessary to adopt a sampling method of 1 to 2 meters in order to avoid the missing data collection area.

The tonalite samples used in this study are from Yangchang silver lead zinc deposit in xishanwan. The sample is fresh and almost no change. A single mineral sample (pyrite and galena) used in the study of S and Pb isotopes is all collected from zk15-3 tonalite ore. The ore is relatively broken, and the main mineralization and alteration are yellowing, galena mineralization,

mineralization, chlorination and carbonation.

3.2 Basic Process of Rock and Mineral Analysis

(1) Analysis of samples taken

Sampling is the process of selecting appropriate sampling points in the mine to obtain the first sample from rocks and minerals according to the planned usage. Sample is the main body of rock and mineral analysis, and its quality directly affects the accuracy and reliability of analysis results. Due to the directionality of guiding mineral exploitation, it is very important to confirm reserves, so the work of samples should be paid great attention. When sampling, the sampling points of different areas and depths should be selected according to the basic geological conditions and terrain trend of the mining area. The more copies, the more representative, but too much will affect the processing.

(2) Sample preparation

Four steps are required for pulverizing, screening, mixing, and reducing a small amount of homogeneous original samples of typical analytical samples. The samples prepared for analysis must be consistent and have to ensure that the composition and content of the original sample do not change with the required particle size. Further reduction of samples must be combined with grinding because the sample size must also be compliant with the sampling pattern.

(3) Qualitative analysis

After sample preparation, the first step of laboratory analysis is to carry out qualitative and semi quantitative analysis of samples. The purpose is to quickly and simply test the effective chemical composition and content of rocks and minerals. This is the pointer to the subsequent laboratory analysis work. The effect of this method can effectively avoid blind testing and improve the experimental efficiency. In the actual chemical analysis work, it is not enough to know the chemical elements in the sample. It is necessary to test the content of main components, trace components, trace components and impurities in the samples. Further test analysis, namely quantitative analysis.

(4) Quantitative analysis

1) according to the specific requirements of the decision object. The essentials of the analysis must be determined according to the subject of measurement and the corresponding analytical method should be selected.

2) depending on the properties of the tested components. In general, an analysis method is selected according to some properties of the tested component.

3) depending on the content of the tested component. From the analytical experience of daily life, the chemical analysis method of the weight analysis and the titration method (volume analysis method) is selected for the measurement of the constant component, and the high sensitive instrumental analysis method for the measurement of the trace component is selected.

(4) influence of coexisting components. When selecting an analytical method, choose an analytical method that does not affect interference components or coexisting components. How to eliminate interference and effects. Common shielding methods include complex shielding methods, stacking shields, and sediment shielding methods.

(5) Verification analysis results

The results of chemical analysis are the final results of the analysis of rocks and minerals, and the overall value of chemical analysis is reflected in the analytical results. Analytical results are the direction of geological surveys, the value of mineral development, and the verification of mine reserves. After the analysis plan has been determined, the relevant operational procedures must be strictly followed in order to analyze and discuss the analysis results. If an illegal operation is found

in the experiment, immediately stop the analysis of the analysis plan and supervise changes until the relevant operating procedures and national standards meet. Implementation. Also, the quality of the analytical results must meet the requirements of national regulations, and the quality of the inappropriate quality is unacceptable and cannot be used for the analysis of rocks and minerals and the work of geological departments.

4. Mineral Composition of Geological Rock Modal Test Technology

4.1 Mineral Characteristics and Content of Geological Rocks

In order to better study the mineral composition of geological rocks, the whole rock mineral relative content data of 9067 sedimentary rock samples from 13 major petroliferous basins in China were collected. Among them, there are 4371 samples from Bohai Bay Basin, 2464 samples from Qaidam Basin, 576 samples from Ordos Basin, 459 samples from Santanghu basin, 309 samples from Songliao Basin, 302 samples from Jiuquan, 171 samples from Jiangnan, 141 samples from Zhungeer, 101 samples from Tuha basin, 68 samples from Sichuan, 62 samples from northern Jiangsu, 35 samples from Nanyang Basin and 8 samples from Tarim Basin.

(1) Chemical composition of sedimentary rocks

As shown in Table 1, the chemical composition of sedimentary rocks.

Table 1: Chemical composition of sedimentary rocks (WB /%)

	Quartz sandstone	Chert	Shale	Limestone	Dolomite	Ferruginous rock
SiO ₂	96.67	92.65	56.37	1.16	0.29	4.23
TiO ₂	0.19	0.11				0.14
Al ₂ O ₃	1.97	1.43	12.25	0.43	0.12	1.39
FeO ₃	0.57	2.66	1.09		0.14	37.75
FeO		0.24	1.93	0.28		7.24
MnO	0.06	0.34	1.57	0.59	21.31	1.69
CaO	0.09	0.12	0.28	53.81	30.69	22.7

It can be seen from Table 1 that the chemical composition of sedimentary rocks varies greatly with different rock types. Some quartz sandstone or siliceous rocks can contain more than 90% SiO₂, while limestone is highly rich in CaO. Other chemical components such as Al₂O₃, Fe₂O₃, MgO, CaO, Na₂O, K₂O, can also be obviously enriched in some types of ores.

(2) Quartz mineral content

As shown in Figure 1, the distribution diagram of the relative content of quartz minerals by X-ray diffraction is shown.

It can be seen from Figure 1 that there are 3271 samples with the relative content of quartz minerals greater than or equal to 50%, accounting for 36.1% of the total samples, and 5796 samples with the relative content of quartz minerals less than 50%, accounting for 63.9% of the total samples. It can be seen from the distribution interval diagram that the relative content of quartz is distributed in every percentage range, with 1657 samples distributed in the range of 40% - 50%, and the least in the range of 90% - 100%, with only 49 samples.

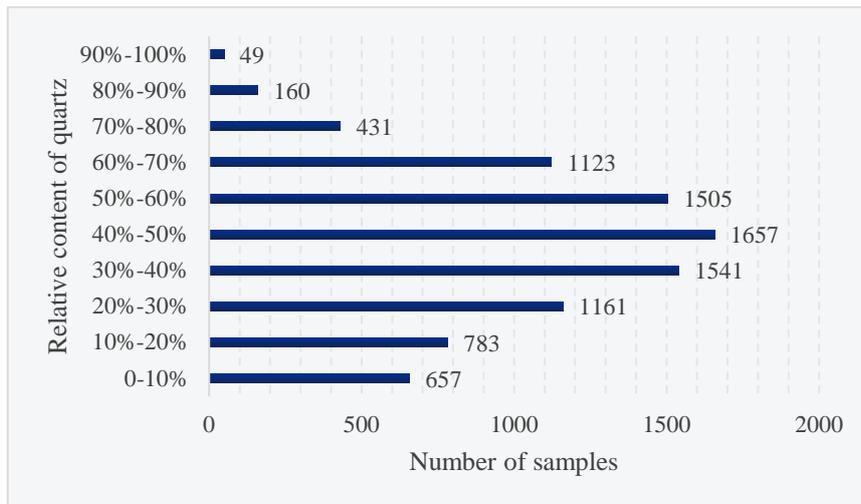


Figure 1: Distribution of relative content of quartz minerals by X-ray diffraction

(3) Feldspar mineral content

As shown in Figure 2, the distribution diagram of the relative content of feldspar minerals by X-ray diffraction is shown.

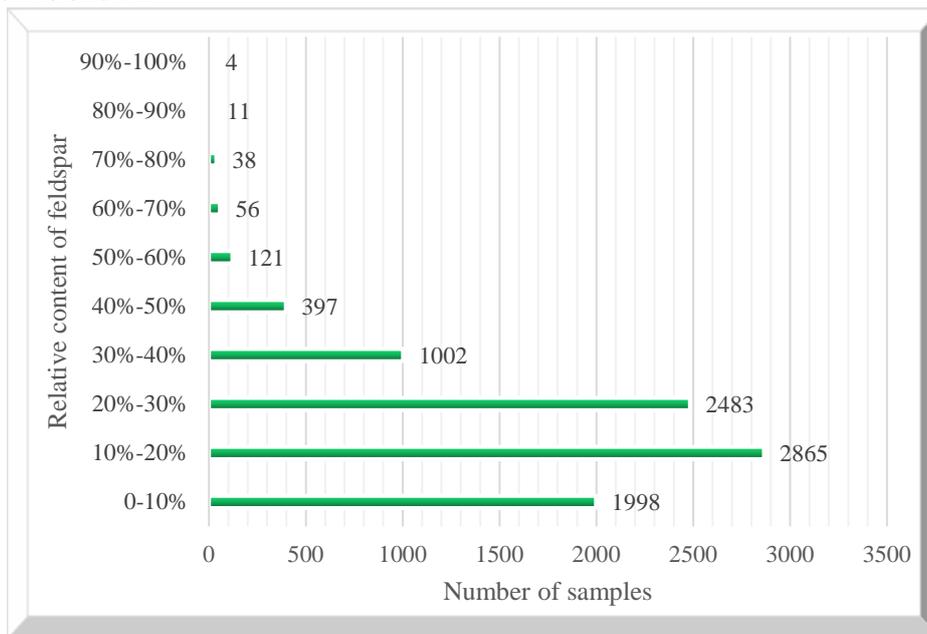


Figure 2: Distribution range of relative content of X-ray diffraction feldspar minerals

It can be seen from Figure 2 that there are 227 samples with the relative content of feldspar minerals greater than or equal to 50%, accounting for 2.5% of the total samples, and the quantity is small; there are 8840 samples with the relative content of feldspar minerals less than 50%, accounting for 97.5% of the total samples. It can be seen from the distribution interval diagram (Fig. 2-5) that the relative content of feldspar is distributed in all percentage ranges, with 2865 samples distributed in the range of 10% ~ 20%; the number of samples distributed in the range of 90% ~ 100% is the least, with only 4 samples.

(4) Dolomite content

As shown in Figure 3, the distribution diagram of relative content of dolomite minerals by X-ray diffraction is shown.

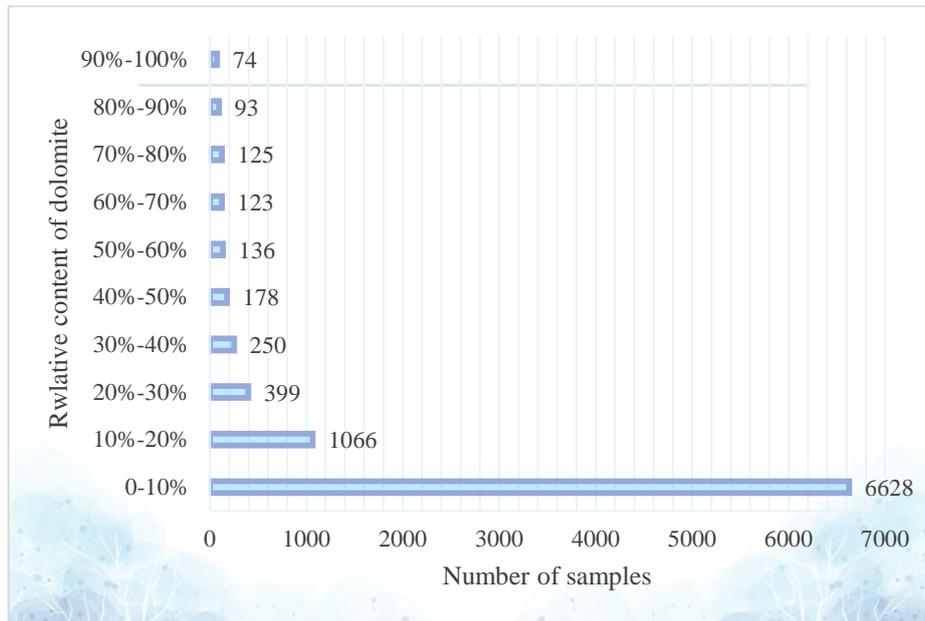


Figure 3: Distribution range of relative content of X-ray diffraction dolomite

According to Figure 3, there are 548 samples with dolomite mineral relative content greater than or equal to 50%, accounting for 6.0% of all samples, and 8519 samples with relative content of dolomite less than 50%, accounting for 94.0% of all samples. The distribution range of relative content of dolomite and calcite is similar, the number of samples distributed in the range of 0% ~ 10% is the most, with 6628; the number of samples in the range of 90% ~ 100% is the least, only 74.

The proportion of calcite dolomite mineral content in sedimentary rock samples was studied by adding calcite mineral content and dolomite mineral content. Among all the samples, there are 949 samples with calcite dolomite mineral content greater than or equal to 50%, accounting for 10.5% of the total samples, and 8118 samples with the relative content of calcite and dolomite less than 50%, accounting for 89.5% of the total samples. Compared with the distribution range of calcite and dolomite, the relative content distribution of calcite and dolomite is more uniform. As shown in Table 2, the relative content distribution of X-ray diffraction minerals in rocks is shown.

Table 2: Distribution of mineral relative content in rocks by X-ray diffraction

	0-10 %	10%-20 %	20%-30 %	30%-40 %	40%-50 %	50%-60 %	60%-70 %	70%-80 %	80%-90 %	90%-100 %
Quartz	657	783	1161	1541	1657	1505	1123	431	160	49
Feldspar	1998	2865	2483	1002	397	121	56	38	11	4
Dolomite	6628	1066	399	250	178	136	123	125	93	74

4.2 Spectral Curve of Geological Rocks and Minerals

As shown in Figure 4, the common spectral curves of rocks and minerals.

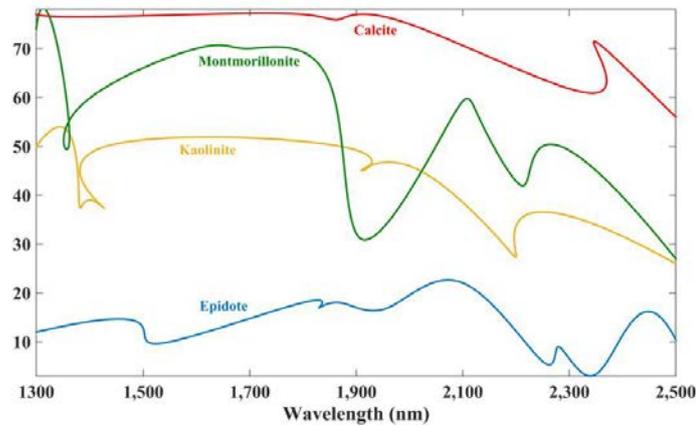


Figure 4: Spectral curves of common rocks and minerals

It can be seen from Figure 4 that for calcite, the typical carbonatite mineral curve is similar to dolomite, with CO₂- characteristic absorption peak at 2338 nm, reflecting the rule that the peak is small near 1900nm and the characteristic peak is obviously large; for illite and montmorillonite, their peak positions are basically the same, with absorption peaks at 1410nm, 1910nm and 2210nm, and Al OH characteristic peak at 2210nm, However, illite has one more absorption peak at 2400 nm, which is difficult to distinguish in actual measurement. For ordinary montmorillonite, the absorbance of crystal water and adsorbed water at 1410nm and 1910nm is higher; for aged stone, there are double absorption peaks around 1400nm and 2160nm; The spectrum curve shows that there are absorption peaks on both sides of 1900nm, and there are absorption peaks on both sides of 2310nm, which is characterized by the superposition of two peaks near 2300nm, reflecting the distribution law of characteristic peaks of FeOH; chlorite is similar to epidote, and there is an additional crystal water peak near 1410nm.

4.3 Mineral Characteristics of Geological Rocks

As shown in Table 3, the statistics of main heavy minerals in mineral assemblage area are as follows.

Table 3: Statistics of main heavy minerals in mineral assemblage area

	Maximum/%	Average/%	Standard deviation	Kurtosis
Amphibole	53.32	32.14	10.94	-0.05
Epidote	55.96	29.73	12.53	0.57
Metallic	45.47	17.89	11.76	0.93
Garnet	23.04	4.72	6.21	1.97
Sphene	6.63	3.17	2.12	0.16
Mica	12.94	2.17	3.77	2.41
Pyroxene	14.87	2.44	3.72	2.75

It can be seen from Table 3 that the most stable minerals in this area are epidote and amphibole, and the content of extremely stable minerals is significantly lower than the average level of the whole study area (1.62%). The epidote minerals are the highest among the three mineral areas (10.30% ~ 55.94%, with an average content of 29.73%). The dominant mineral combination is amphibole + epidote + metal minerals, the contents of limonite and magnetite in metal minerals are higher than those in other mineral areas to a certain extent; in addition, authigenic pyrite is also

found in most of the samples in this area, while there is no or occasional authigenic pyrite in the other two regions. The average value and standard deviation of main minerals in the area are shown in Figure 5.

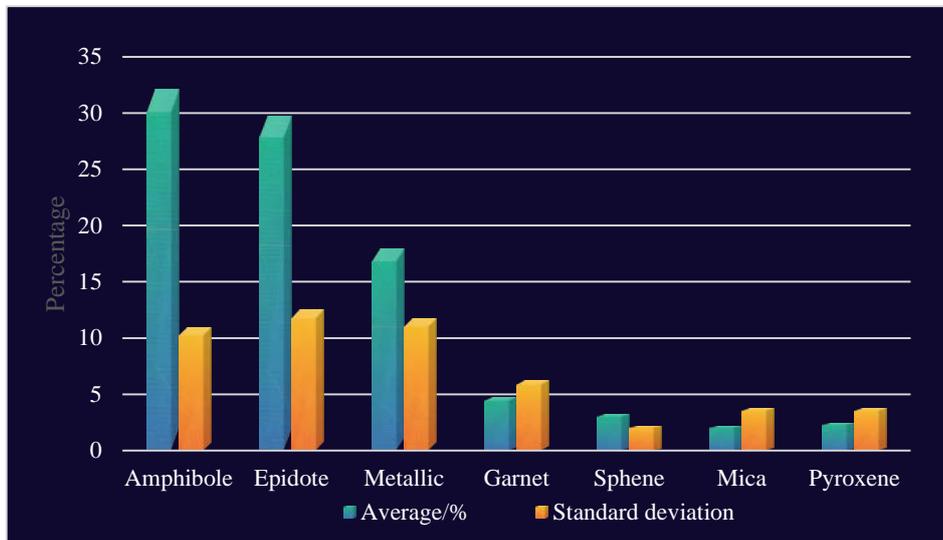


Figure 5: Average and standard deviation of main minerals

It can be seen from Figure 5 that the mica mineral content is relatively low (average content of 0.42%) compared with the whole area (average content of 2.10%), which is only about 1/5 of the content level in the study area. The dominant mineral assemblage is metal mineral + amphibole + epidote, and the characteristic minerals are garnet (9.74%) and ilmenite (18.06%). The content of detrital minerals is low (0.16%~25.87%, with an average content of 12.18%), and there is no authigenic pyrite in all sample stations.

4.4 Simulation Accuracy of Modal Testing Technology

As shown in Figure 6, the simulation MAC matrix orthogonal comparison diagram.

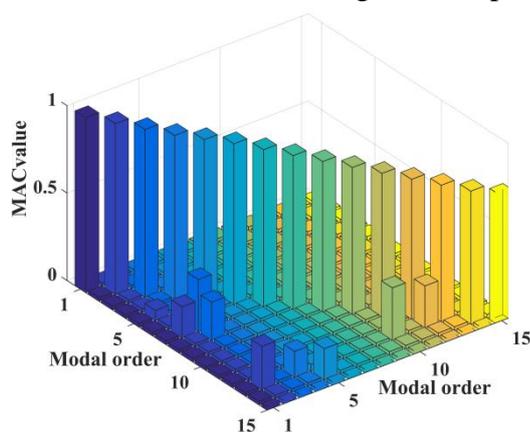


Figure 6: Simulation MAC matrix orthogonal comparison

According to Figure 6, the frequency difference between the two methods is small, which is

lower than 5%, and the orthogonal graph of MAC matrix is very similar between each test and simulation, and the modes of each mode are converged. The modal mode diagram of the test and simulation is consistent. Therefore, the two hybrid optimization algorithms proposed in this paper have good guiding significance for the optimization of large-scale structure measurement points, it has great practical value in engineering. As shown in Table 4, the frequency comparison between the test and the simulation is given.

Table 4: Frequency comparison between test and simulation

Modal order	Test frequency/Hz	Test frequency/Hz	Error%
1	6.024	6.093	1.133
2	15.974	16.603	3.784
3	35.528	36.975	3.912
4	38.317	37.579	1.968
5	39.494	37.672	4.849
6	46.756	48.759	4.107
7	46.905	49.182	4.634
8	55.074	56.918	3.245
9	62.418	65.364	4.508
10	73.488	73.815	0.451
11	98.645	97.036	1.665
12	138.544	137.411	0.826
13	145.103	143.655	1.011
14	159.995	159.052	0.594
15	229.357	229.033	0.143

From the comparison of test and Simulation in Table 4, it can be seen that the frequency difference between test and simulation is very small, less than 5%. The orthogonal graph of MAC matrix of test and simulation is very similar, and the mode shapes of each order of vibration obtained from test are orthogonal with respect to mass weight, and the mode shapes of test and simulation are consistent. Therefore, the weighted average modal kinetic energy coefficient optimization algorithm based on effective independence method is proposed in this paper, it has a good guiding significance for the optimization of structural measuring points, and has great engineering practical value.

4.5 Pore Characteristics of Geological Rocks

The study of micro pore structure of tight sandstone reservoir can not avoid the description and observation of intergranular pore, which makes the measurement technology of SEM very important. Similar to the casting sheet, although quantitative information can be obtained, it is mainly used to qualitatively analyze the properties of micro pores. As shown in Figure 7, the pore rate and face rate frequency diagrams are shown for various reservoir space types.

It can be seen from Figure 7 that the frequency of dissolved pores is the highest, up to 97.9%, followed by intergranular pores, up to 59.4%, and the next few categories are relatively few; however, it can be seen from the face rate histogram that the distribution frequency of intergranular pores is far greater than that of dissolution pores. The average of porosity was 3.2%. 17.9% of the holes had a face rate less than 1%, 27.8% had a face rate between 1% and 2%, 13.8% had a face rate between 2% and 3%, 10.3% had a face rate of 3% to 4%, 8.4% had a face rate of 4% to 5%, and 21.2% had a face rate above 5%.

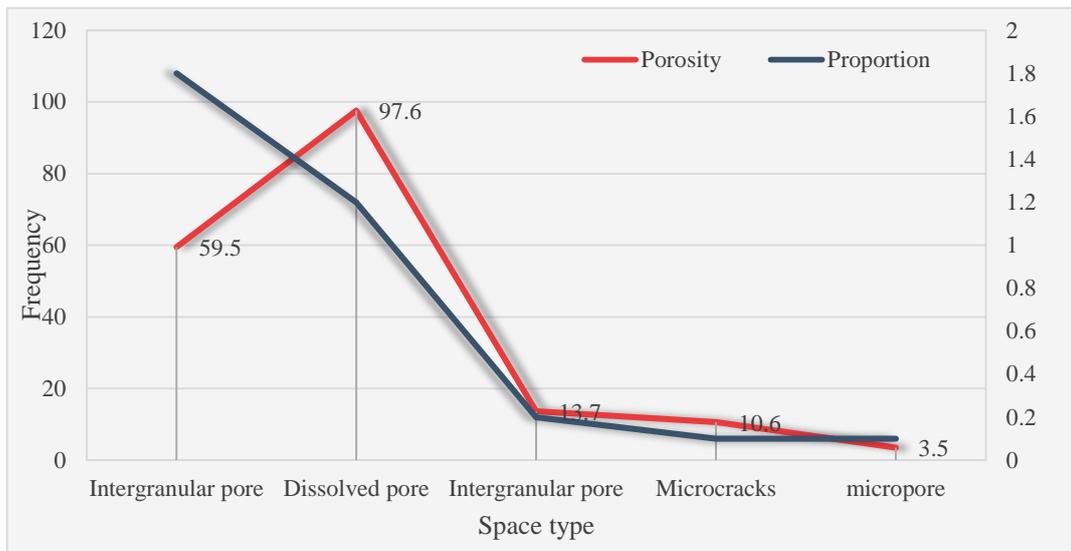


Figure 7: Frequency chart of porosity and porosity of various types of reservoir space

5. Conclusion

The geological rocks in this study are rich in silicon, aluminum and sodium, with relatively less calcium and magnesium. This is a partially alumina peraluminous calc alkaline rock with adamellitic quality. The geochemical characteristics of rocks are characterized by the mixing of crust and mantle. The characteristics of trace rare earth elements in the pipeline show that the ore forming fluid is rich in Cl and has the characteristics of relatively reductive crustal fluid at high temperature. The closer to the ore body, the greater the peak intensity, and the farther away from the ore body, the lower the peak intensity. The peak intensity, peak symmetry and half height width of absorption peak may reflect the crystallization degree of minerals after the change of surrounding rocks. The worse the crystallinity of metamorphic minerals is, the stronger the metamorphism of surrounding rocks is.

The peak displacement and peak intensity ratio of mineral near infrared spectrum vary with the distance from ore body. The closer to the mineral, the smaller the peak displacement, and the farther away from the mineral, the larger the peak displacement. The peak strength ratio and peak displacement of metamorphic minerals may reflect the type of ore metamorphism, the stability of element association in metamorphic minerals and the intensity of mineralization. The peak displacement may reflect the stability of the change of element composition in minerals. The smaller the peak displacement value, the lower the stability of the combination of internal factors, the stronger the mineral change, the stronger the mineralization and the larger the peak displacement value. The higher the stability of the combination of internal factors, the weaker the change of minerals and the weaker the mineralization.

Mineral resources are an important material basis for human society and an important guarantee for national security and economy. With the rapid development of science and technology, the analysis and test of geological rocks and minerals are more and more advanced technology is continuously used. It is very important to confirm that the selected analytical and experimental techniques are scientific and effective. Therefore, in order to ensure the correctness of the analysis and test results, it is necessary to clarify the basic significance of rocks and minerals, understand the importance of geological rock and mineral analysis and testing, and master the technical points of

analysis and testing.

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