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Specifications for glass-grade silicon materials, ornamental stone, gypsum, chrysotile asbestos, wollastonite, talc and graphite exploration

玻璃硅质原料 饰面石材 石膏 温石棉 硅灰石 滑石 石墨

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Specifications for glass-grade silicon materials, ornamental stone, gypsum, chrysotile asbestos, wollastonite, talc and graphite exploration

1 Scope

This Standard specifies the exploration and control level, the quality of exploration work, mineral resources / reserves classification and type conditions, mineral resources / reserves estimates, and other requirements for glass-grade silicon materials[1], ornamental stone[2], gypsum[3], chrysotile asbestos[4], wollastonite, talc, graphite. It puts forward the feasibility of the basic requirements for evaluation, and the types of deposit exploration for analogy and the general spacing of exploration projects for reference.

This Standard applies to mineral exploration, mineral resources / reserves estimates, acceptance, review geological exploration report of glass-grade silicon materials, ornamental stone, gypsum, chrysotile asbestos, wollastonite, talc, graphite. It can also be used as a basis for evaluation and estimation of mineral resources / reserves in the transfer, listing, exploration and financing of mineral exploration and mining of the above-mentioned minerals.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) or revisions do not apply to this Standard, however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 12719-91, *Exploration specification of hydrogeology and engineering geology in mining areas*

GB/T 13908-2002, *General requirements for solid mineral exploration*

1 The glass-grade silicon materials referred in this Standard are mainly used for flat glass commonly used silicon materials, including quartzite, quartz sandstone, vein quartz and quartz sand.
2 ornamental stone refers to the natural stone which is mainly used for the decoration of interior and exterior surfaces of buildings. There are mainly two types, that is, marble and granite.
3 Gypsum includes gypsum ($CaSO_4 \cdot 2H_2O$ and anhydrite ($CaSO_4$).
4 Chrysotile asbestos is also known as serpentine asbestos.

industrial value. When necessary, it circles exploration area for pre-feasibility studies, mine master plans and mine project proposals. For the deposit that can directly provide the development and utilization, its processing beneficiation test level shall reach the design requirements for mine construction.

Exploration is for a prospecting area that is known to have a deposit of industrial value or has been through the detailed investigation. By encrypting various sampling projects, the spacing is sufficient to confirm the continuity of the ore body. It determines the geological characteristics of the deposit in detail. It determines the ore body morphology, occurrence, size, spatial location and ore mass characteristics. It has a detailed identification of ore mining technical conditions. It performs laboratory flow test or continuous laboratory expansion test on mineral processing and dressing performance. When necessary, it shall carry out semi-industrial test for the feasibility study so as to provide the basis for the design of mine construction.

4 Exploration research level

4.1 Geological research level

4.1.1 Pre-investigation stage

Make a comprehensive collection of regional geological data and mineral distribution and other relevant information. Research to predict the geology and tectonics in the area, the distribution of ore spots and prospects of mineralization. When necessary, select favorable locations to carry out route geological reconnaissance. Make an analogy with known deposits of similar geological characteristics. Put forward potential mineralization areas for further work.

4.1.2 General investigation stage

Fully collect and study regional geological data and mineral distribution. According to the distribution of prospecting minerals, encircle a detailed investigation area or look for deposits (spot) found for further work. Make a general identification on the general investigation area geology and tectonics, ore-bearing, deposit distribution and prospects of mineralization. For ore deposits (spots) with further work value, it shall generally find out the distribution range of ore body, the number of ore bodies, scale, shape, occurrence, distribution and influence of sandstone, and the factors that affect, destroy the ore body.

4.1.3 Detailed investigation stage

4.1.3.1 Regional geology research

4.1.4.2 Research on orebody geology

Determine in detail the spatial distribution of ore bodies and their extent. Identify the scale, shape, occurrence and distribution of the main ore body and the distribution of the post-ore-bearing faults and magmatic rocks to the ore body. Find out the contrast sign of the ore body, make it connect rationally well.

Make a basic identification on the ore body's oxidation zone, weathering zone depth and cover thickness and distribution range. And understand its material composition. Study the effects of weathering (oxidation) on ore mining, mineral processing and other aspects. Study the karst development, distribution and destruction of the carbonate ore body.

For ornamental stone, it shall the nature, occurrence, distribution and regularity of joint fissures and bedding planes in ore bodies, the joint fissures, the spacing between bedding planes, the joint fissure rate, the aspect ratio (bars/m); the species, shape, size, quantity, occurrence, distribution of intensive conditions and laws of detachments, remnants, xenoliths, fine veins and other stains, color lines in ore bodies as well as the impact on blocks and block rate.

For gypsum, it shall study the impact or destruction of leaching, hydration on the ore bodies.

For chrysotile asbestos, it shall study the cotton body in the ore, cotton veins group, stone folder and other components; basically identify the cotton fiber type, output characteristics, cotton separator, nature of the composition and structural features; basically find out the cotton combination type within the cotton group, cotton spacing, stone folder output characteristics and the scale of the cotton group; study in detail the number of cotton groups in the ore body, the mutual arrangement of the form and spacing, the inter-cotton group stone folder output characteristics; study in detail the nature and distribution of graded or non-serpentine rock mass and its influence on ore body and ore.

4.2 Ore mass research

4.2.1 Pre-investigation stage

Compare with the known deposit and understand the mass of ore in the pre-investigation area.

4.2.2 General investigation stage

Make a general exploration on ore mass in the general investigation area. For the ore spots for the further work, it shall generally find out the ore grade, material composition, associated components, structure, composition and

Broadly identify the beneficiation of main ore type, processing technology performance. For general ores, it shall make comparative study on beneficiation performance and make a preliminary evaluation whether it can be used as industrial raw material. If the ores are used in domestic industry but without mature experience, it shall carry out the optional test or laboratory flow test.

4.3.3 Detailed investigation stage

It shall basically identify the type of ore dressing, processing technology performance conditions. For the ores requiring the beneficiation test, usually, carry out the optional test or laboratory flow test. For refractory ore or new types of ore, it shall perform the laboratory expansion continuous test and make industrial use evaluation. For ores that are easily selected near the production mines, with analogy conditions, it may make an analogy evaluation but not the beneficiation test.

4.3.4 Exploration stage

Make a detailed identification for the main types of ore beneficiation, processing technology and performance conditions. For the ore that needs to be beneficiated, it is generally necessary to carry out the laboratory flow test and, if necessary, a laboratory extension continuous test. For deposits with analogous conditions, easy-to-use ores, it shall carry out the optional or laboratory flow test. Semi-industrial tests are conducted on difficult or new types of ores. When necessary, large-scale mineral deposits shall be subjected to industrial tests. Choose the best process.

For gypsum ore with production experience and is available for the analogy, it may not carry out optional tests in general, but shall be evaluated on the basis of analogy. The wollastonite except scattered minerals or sandstone with more mixed minerals shall be hand-selected. In the crystalline graphite ore beneficiation test, it shall pay attention to the protection of the large-scale positive (+100 heads, 0.147 mm) of graphite and improve the output rate study.

For new types of ores such as glass-grade silicon materials, wollastonite, gypsum, it shall perform the test related to mineral industry use performance, as required by exploration investor.

For deposits that ornamental stone has not been utilized, according to exploration investor’s requirements, it shall test and study the ore processing technical performances, in general, including technical performances in sawing, grinding, polishing, cutting and other aspects as well as gloss and plate rate. For the mined deposits, the processing technical performance data of the ore that has been mined shall be collected. If it is confirmed that it is the characteristics of neotectonic activities, refer to the national earthquake intensity division and evaluate the deposit stability.

Investigate various geological disasters in the deposit (such as collapse, landslide, debris flow, karst, etc.), surface water and groundwater mass and other harmful substances, combining geology, hydrogeology, engineering geological conditions, make a comment on the geological environment quality before mining.

For the phenomenon that may damage and affect the geological environment of deposit, such as massif cracking, collapse, landslide, debris flow, karst collapse, land subsidence, water pollution and other environmental geologic effects, shall be predicted and commented so as to put forward prevention and control opinions. Make suggestions for preventing environmental pollution, protecting ecological balance and rehabilitating fields.

Investigate and study the dusts, tailings, waste residue, waste water, asbestos fibers and radioactive material that may cause environmental pollution or harm human health during the deposit mining, and put forward prevention and control suggestions.

For radioactive deposit, it shall investigate the source of radioactive elements in the water, atmosphere, soil and food organisms in the deposit, provide radiation environment monitoring information and comment on the quality of the radiation environment.

If out gas is found in the gypsum deposit, it shall investigate and understand its compositions and point out the effect on deposit mining.

4.5 Comprehensive exploration, comprehensive evaluation

In the pre-investigation stage, it shall understand the types of symbiotic and associated minerals and their characteristics.

In the general investigation stage, it shall have a general understanding of the occurrence features of symbiotic, associated minerals as well as the possibility of comprehensive utilization.

In the detailed investigation stage, it shall use the mineral project of main exploration to study and understand the symbiosis, associated mineral contents and material composition. For the symbiosis, associated minerals with industrial utilization value and economic benefits, it shall basically find out the occurrence state and the possibility of comprehensive utilization.

In the exploration stage, for symbiosis, associated minerals, it shall find out and study the species, content, occurrence state, distribution, enrichment conditions, and the relationship between the main mineral. For the “standard

In the detailed investigation, exploration stages of ornamental stone, in addition to deposit geological mapping, it also requires joint fissure investigation, making of joint fissures development graph. When the thickness of the ore body cover layer and weathering layer is greater than 2 m, it needs to make the thick line graphs of ore body cover layer and weathering layer. The scales of the two maps are the same as the topography of the deposit. The fractures of the ore-hosting joints may not be topographic lines, but the geologic bodies and their occurrences and tectonics (folds, faults and crushed zones) shall be plotted. It mainly reflects the development of joint and fissure in the orebody (the general occurrence of joints and fissures, of the different joints and fissures), the degree of development (the joint fissure density). Depending on the circumstances, it shall divide into different developmental zones, draw the joints fissure-intensive areas, bedding surface area. It shall also reflect the stain, color line-intensive areas (different types of stains, color-intensive areas). The joint fissures development map of ornamental stone deposit and thick line map of ore body cover layer and weathering layer shall be drawn, separately. If the situation is simple, it can also be combined with the topographic and geological maps of the deposit.

6.3 Remote sensing geology and geophysical work

6.3.1 Remote sensing geology

The geological exploration work shall make full use of remote sensing information provided in order to improve work efficiency and mapping quality.

6.3.2 Geophysical work

Geophysical data shall be fully collected. According to the specific conditions of the deposit and the application of the geophysical prospecting method, based on the principle of high efficiency and economy, the geophysical method shall be determined reasonably. Deposits with the premise of geophysical prospecting, combined with prospecting engineering, it shall use effective geophysical and geophysical methods as far as possible. With other exploration methods in delineation of ore body and geological body, it shall study the continuity of the orebody, understand the shape and occurrence of the orebody, determine the distribution of the cover layer, weathering layer, crushing zone, densely fractured zone, karst zone and solve the geological structure and some hydrogeology, engineering geological problems.

In the general investigation stage, geophysical anomalies with prospecting significance shall be dealt with; inspection and verification shall be carried out by using prospecting engineering, and the data shall be comprehensively analyzed and evaluated.

In the geophysical work in the detailed investigation, exploration stages, a specifications. Drilling sampling uses semi-core method. When the diameter of different times back to the core or adoption rate is greatly different, it shall take separately. The components of semi-core of collected sample and the remained half shall be basically similar. Sampling shall comply with the requirements of the relevant regulations. Be careful not to mix foreign matter into the sample. Crystal graphite sampling shall prevent splashing of graphite flake. Samplings of glass-grade silicon materials and wollastonite shall strictly control the bringing of tool iron and take measures to remove the tool iron brought into.

6.5.2.2 Sample collection of combined analysis

The sampling of combined analysis of glass-grade silicon materials, wollastonite, talc, graphite shall generally take single project as a unit. It shall, according to ore type, grade from sub-samples of several consecutive samples of the basic analysis, according to the ratio of single sample length of basic analysis, calculate the mass that each single sample shall weigh and form after complete mixing. When the ore composition changes slightly, the ore body is thin, the number of samples for single engineering basic analysis is small, it is also possible to combine sub-samples of the same ore body, ore type and grade of the adjacent project of the same mineral resource / reserve estimation block. The combined sample shall be taken from representative projects on each exploration line profile.

The lengths of combined analysis sample are generally: 8m ~ 10m for glass-grade silicon materials; wollastonite, talc can use the combination of few to several basic analysis samples; graphite uses the combination of five to ten basic analysis samples.

6.5.2.3 Sample collection of multi-element analysis

The multi-element analysis samples of glass-grade silicon materials, gypsum, wollastonite, talc, graphite shall be extracted one to two according to ore body, ore type, grade. The samples can be selected from the sub-samples of combined analysis or basic analysis. It can also collect representative samples, individually.

The glass-grade silicon materials shall, based on the needs of study on ore chemical composition, respectively collect a small amount of multi-element analysis of samples according to the variety.

The chrysotile asbestos shall, according to asbestos fibers, color, length, alteration and deterioration, splitting, sturdiness and other appearance characteristics, collect un-weathered representative primary structural fibers, respectively. Microscopically selected, pure asbestos tested by X-ray diffraction and unselected native fibers shall be subjected to multi-element concentrate;

2) the combined analysis item is crystalline (flaky) graphite; in addition to the fixed carbon, add the components that may be comprehensively utilized. For cryptocrystalline graphite, in addition to fixed carbon, ash content, volatile content, moisture, S, Fe_2O_3, it shall add other useful, harmful components according to multi-element ore analysis and spectral analysis data;

3) the multi-element analysis items are generally SiO_2, Al_2O_3, Fe_2O_3, FeO, MgO, CaO, Na_2O, K_2O, TiO_2, V_2O_5, P_2O_5, S, Cu, CO_2, H_2O^+, H_2O^-, fixed carbon, ash content, volatile content, etc.

6.5.2.7 Quality inspection of chemical analysis

The chemical analysis quality requirements shall be in accordance with DZ 0130.3-94 “Geological and Mineral Laboratory Testing Quality Management Practices - 13 Rock and Mineral Analysis Sample Preparation Procedure”. The laboratory undertaking the analysis shall implement quality control in the manner required by the regulations and conduct a comprehensive assessment of the analysis quality while conducting user assessments including internal and external inspections.

Internal inspection: the submitter shall, according to the ore type and grade representability, extract 10% of total number of basic analysis samples from coarse sub-samples (particle size is less than 1 mm) and encrypt to the original analyzer for inspection and analysis. The inspection items may be same with the analysis items in original analysis report. Or it may be determined to only carry out the inspection of main items by the submitter and the analysis laboratory. In addition to the statistical qualification rate (qualification is required as 80%), it shall also perform F inspection to determine.

External inspection: where a sample involved in the estimation of mineral resources / reserves is issued after an analysis report is included in the industrial indicators as an item for the evaluation of ore mass and other designated important items, the submitter and the laboratory shall extract 5% of total samples from the basic analysis samples to the designated laboratory for external inspection. If the number of basis analysis samples is small, it shall increase the number for the external inspection samples. The qualification rate of external inspection (referring to the original qualification rate) is required not be less than 80%. If there is systematic error between the result of external inspection and the result of basic analysis, it shall be determined by t inspection. If there is significant error in the determination, it shall use accurate and reliable method or standard analysis method to re-measure and determine.

Each variety is not less than one piece. It shall be confirmed by prospecting investors as the basis for variety identification. The sample shall be representative. And it shall ensure that the completely fresh and un-weathered rock can reflect the color, pattern (including defects) of this variety. The same variety of samples is divided into two parts: one finished product surface (used for decoration) that is processed, polished, of which the gloss is determined; the other finished product surface is not processed and polished. The size of finished product surface of polished sample is usually 30cm × 30cm. The size of finished product surface of unpolished sample is usually 10cm × 5cm. If the ore color, pattern have anisotropy, it shall take the samples of same number and specification along different directions as required.

6.6.2.2 Basic sample

Use the sample that divides variety as opposed to the standard sample. Usually, extract one from completely fresh rocks per spacing of 5 m of engineering. The size of finished product surface of sample is usually 10cm × 5cm. If the color, pattern have anisotropy, it shall extract one piece respectively along different directions as required. After the basic sample is wetted with water, it shall be compared with the wetted unpolished standard sample. Meanwhile, it shall select basic sample not less than 10% for processing and polishing. Compared with polished standard sample, it shall take the comparison between unpolished basic sample and the unpolished standard sample to divide the variety mass.

6.6.3 Determination of block yield of ornamental stone

6.6.3.1 Block yield in graphic (H_{tu})

Different development zones of joints, cracks, bedding surface, stains, color lines in deposit usually have two to three measuring points. If joints, cracks, bedding surface, pigmentation, color line change slightly in development, the total number of measuring points in each deposit shall not be less than 10 in general. The measuring area of each mearing point is usually not less than 40 m^2. There is no a perfect method currently for the determination of block yield in graphic. Usually, it measures the block yield in body illustration (H_1). Its method selects two parallel sections to overlap according to measuring point outcrop sketch map (scale is generally 1:50). Then intercept the block in a mining section in the overlay diagram. Count the volume of different types of blocks. Calculate the block yield of different types of blocks and total block yield. It shall also measure the block yield in surface graphic (H_m). The difference with the determination of block yield in body illustration is that it does not make the overlap diagram. It directly intercepts the block in the outcrop sketch map at the measuring point. In the determination of block yield in graphic, intercept the type and the block of the blocks. Assuming the for the determination of machine-selected cotton specific surface area. After testing, if the processed finished cotton does not meet the finished cotton indicators, it shall promptly inspect the processing equipment, or adjust the processing flow.

6.6.5 Determinations of wollastonite mineral content and ore physicochemical properties

6.6.5.1 Determination of wollastonite mineral content: the methods of using phase method to determine the mineral content and using chemical analysis to calculate mineral content are shown in Annex H.5.5 and H.5.6.

6.6.5.2 The determination of physical and chemical properties of ore can use combined analysis sample. According to different industrial usage, it usually determines the following items: the whiteness (natural whiteness or burnt whiteness) required for building ceramics (glazed tiles) used wollastonite, the whiteness, oil absorption, water soluble, water extraction pH value required for paint and coating used wollastonite, granularity or diameter-length ratio required for plastic, rubber reinforced packing used wollastonite.

6.6.6 Talc mineral phase analysis, single mineral analysis and asbestos qualitative analysis

6.6.6.1 Phase analysis: in order to determine the type of ore, usually, it shall carry out the naked eye and microscopic identification first to have a general understanding of the distribution of various types of ore body. Then perform sampling by a certain spacing. The sample shall use the combined analysis sub-samples or particularly extracted. Calculate the composition and content of phyllosilicate minerals in ore by chemical analysis, divide the ore type and determine various types of ore body boundaries. Phase analysis items are generally SiO_2, Al_2O_3, acid insoluble Al_2O_3, acid insoluble MgO, acid insoluble CaO. These items may be varied based on the number of magnesium-containing silicate minerals that make up the ore and different mineral calculation methods. When it proves that, after a certain number of phase analysis, in addition to talc in ore, other magnesium-containing silicate minerals are not contained or only a small amount of serpentine, chlorite and other harmful minerals are contained, the phase analysis shall be exempted or carried out less.

6.6.6.2 Single mineral analysis: take a few single mineral analysis samples of complex types of talc, tremolite, actinolite, chlorite for single mineral analysis.

6.6.6.3 Qualitative analysis of asbestos in talc: the ore body shall use the multi-element analysis sub-sample of ore; respectively take one to two

It mainly tests the un-weathered fiber, properly test the cotton affected by alteration and weathering. The sample used for tensile strength test is not permitted to have any damage to asbestos fiber. The number of testing samples is two to three. The sample for chemical multi-element analysis shall also be subjected to physical performance test.

As necessary, increase the number of certain items and samples. Sample mass depends on the testing needs.

6.7.3.4 Process, physical and technical performance tests of talc

Before physical performance test, it shall study ore structure, composition, mineral composition, mineral shape, granularity and embedded features under the microscope. For implicit crystal ore (talc clay), it shall also study the ore microstructure, the main components and the distribution features of associated useful, harmful components through X-ray diffraction analysis, differential thermal analysis, thermal gravimetric analysis, electron microscopy and other testing methods. On this basis, the respective sampling shall be carried out according to different ore type, scheduled industrial use for ore technology, physical properties determination and trial production, etc.

Take one to two representative samples for each ore type. The sampling mass, testing items and technical requirements shall be agreed by exploration investor and geological explorer and entrusted to the organization with testing ability to carry out the test. For the ore type with production practice, available for analog, it shall be agreed by exploration investor and geological explorer whether this experiment is required or not.

6.8 Rock (ore) physical and technical performance test sampling

6.8.1 Ore volume mass (weight) and moisture determination

6.8.1.1 For glass-grade silicon materials, gypsum, wollastonite, talc, graphite, it usually determines the small volume of mass (weight). There shall be no less than 20 ~ 30 pieces for each ore type or grade. The general specifications are 60cm^3 ~ 120cm^3. Glass-grade silicon materials shall determine massive volume of mass (weight) and try to maintain as it is. Loose layer of massive gypsum shall take appropriate amount of massive volume of mass (weight) according to the actual situation to test the sample. For talc and loose or fractured hollow graphite, it shall take one to two representative massive volume of mass (weight) sample according to each type. The specifications of massive volume of mass (weight) sample usually is not less than 0.125 m^3. While determining the sample of ore volume mass (weight), it shall also determine the humidity and grade of ore. The determination of talc humidity shall collect the samples distributed in different season, different depth.

6.8.1.2 There shall be no less than five representative samples for small volume mass (weight) sample, water absorption sample of ornamental stone.

6.8.1.3 The determination of chrysotile asbestos volume mass (weight) shall be based on cotton pulse distribution uniformity and fiber type. Cross-fiber ore shall be sampled and determined in small volume mass (weight) method. Longitudinal fiber ore determination uses the grooved sample for determining the cotton content. It shall usually use massive volume mass (weight) sample for comparison. The specifications are 100cm × 100cm × 50cm. The sample shall be representative. The quantity is three to five. The sample for volume mass (weight) testing shall be subjected to humidity determination at the same time.

6.8.1.4 If due to the geological and engineering geological research needs of the deposit, it shall take representative small volume mass (weight) sample for interlayers and surrounding rocks.

6.8.2 Testing related to technical conditions of deposit exploration

6.8.2.1 Respectively determine the compressive strength via two to three groups of samples according to type of glass-grade silicon materials, interlayers and surrounding rocks near ore. Respectively determine five to ten samples according to ore type for loose coefficient of sand ore. It shall also determine the natural repose for sand ore.

6.8.2.2 For the compressive strength, flexural strength and wear rate of ornamental stone, it shall respectively determine not less than three to five samples for each type. The specifications for compressive strength sample is 50mm × 50mm × 50mm. The specifications for flexural strength sample is 160mm × 40mm × 20mm. The specifications for wear rate sample is a Φ25 mm × 60mm cylinder. Considered on the needs of engineering geology research, it shall take representative samples to test the compressive strength, shear strength for interlayers and surrounding rocks near ore. Determine the frost resistance of ore on the basis of consideration of exploration investor.

6.8.2.3 The gypsum, chrysotile asbestos, wollastonite, talc, graphite shall determine the compressive strength, shear strength and other physical and mechanical properties of ores, surrounding rocks and main interlayers. Usually it shall respectively determine two to three groups of samples.

6.8.2.4 If out gases (such as CH_4, H_2S) are found in gypsum deposit, it shall conduct sampling to analyze its components.

6.9 Deposit hydrogeology, engineering geological work

The work quality shall comply with relevant requirements of GB/T 12719 macroscopically, on the necessity of project construction, the feasibility of construction conditions and the rationality of economic benefits; and provide references for whether to carry out geology work in exploration stage and recommending projects and whether to prepare project proposals.

The pre-feasibility study shall generally be based on a detailed examination.

7.3 Feasibility study

It is a detailed evaluation of the economic significance of deposit development. The feasibility study, first of all, needs to seriously investigate the mineral resources / reserves, production and consumption of the mineral resources at home and abroad, statistics and analysis. Analyze and predict the demands for domestic and foreign markets, product variety, mass requirements, prices, competitiveness. During the work, the resources (or raw materials) conditions shall be carefully analyzed. Take full account of the effects of geological, engineering, environmental, legal and government economic policies. On the scale of production, mining methods, development programs, mineral processing processes, product solutions, the choice of major equipment, water supply and power supply, the overall layout and environmental protection, etc., it shall conduct in-depth and detailed investigation, analysis and calculation and multi-program comparison. And according to the evaluation of the market price at the time, determine the investment, production and operation costs, sales revenue, profits and cash inflows, outflows, etc. The technical and economic data of the project can meet the needs of all parties involved in the investment review and evaluation, so as to have a basic understanding of whether the proposed project shall be constructed and how to build it.

Through the demonstration and evaluation of feasibility studies, it provides the basis for mining investment decision-making and project construction planning.

8 Mineral resources / reserves classification and type conditions

8.1 Mineral resources / reserves classification basis

8.1.1 Geological reliability

The degree of geological reliability reflects the different precision of the work results in the mineral exploration stage that is divided into four types: proved precision, controlled precision, inferred precision and predicted precision.

The proved precision refers that in the exploration scope of work area, according to exploration precision, it identifies in detail the geological characteristics of the deposit, ore body morphology, occurrence, scale, ore mass, grade and mining technology conditions. The continuity of ore body has been confirmed. The data on which the mineral resources / reserves estimates are based are exhaustive and of high credibility.

The controlled precision refers that in certain scope of work area, according to the detailed investigated precision, it basically identifies the main geological characteristics of the deposit, ore body morphology, occurrence, scale, ore mass, grade and mining technology conditions. The continuity of ore body has been confirmed. Mineral resources / reserves estimates are based on more data with high credibility.

The inferred precision refers that in general investigation area, according to the generally investigated precision, it basically finds out the geological characteristics of the deposit as well as the distribution characteristics of the ore body (ore spot), grade, mass, also including those extrapolated from the base stocks or resources with high geological reliability. Due to the limited information and uncertainties, the continuity of ore body (spot) is inferred with low credibility.

The predicted precision refers to the results obtained by pre-investigation on the area with huge mineralization potentials. The predicted amount of mineral resources shall be estimated only when there are enough data and comparing with the known deposits of similar geological features.

8.1.2 Economic significance

Find out mineral resources if the geological reliability is different. After different stages of feasibility studies, according to the evaluation of the economic rationality at the time. it may be divided into the economical, the marginally economical, the secondarily economical and the intrinsically economical.

The economical refers that its quantity and quality are calculated on the basis of production figures determined in accordance with market prices; it is mined under market conditions at the time of the feasibility study or pre-feasibility study; technically feasible, economically reasonable, permitted by the environment and other conditions, i.e., the average value of minerals mined every year is sufficient to meet the investment return requirements, or under government subsidies and/or other support measures, development is possible. Usually, the mineral resources with future average annual rate of return of mining enterprises greater than or equal to the industry benchmark internal rate of return, based on the industry benchmark discount rate of net present value of more than zero shall be classified as the economical.

technical conditions, etc.). It is the part obtained through detailed investigation, exploration and regarded as the economical, the marginally economical via feasibility study, pre-feasibility study, represented in the amount that the design, mining losses are not deducted.

8.2.3 Resources

It refers to a part of identified mineral resources and potential mineral resources, including the mineral resources proved as the secondarily economical through feasibility study or pre-feasibility study as well as the intrinsic economical mineral resources through exploration but not feasibility study or pre-feasibility study, and the pre-investigated and predicted mineral resources.

8.3 Mineral resources / reserves types (codes) and conditions

8.3.1 Reserves

8.3.1.1 Recoverable reserves (111)

It refers to the recoverable part of the proved economic basic reserves. It refers to the encrypted engineering lot according to exploration stage requirements. It delineates the ore body in three-dimensional space. It confirms the continuity of ore body. It identifies in detail the geological characteristics of ore bodies, ore mass and mining technical conditions with corresponding ore processing beneficiation test results. It has carried out the feasibility study, including the research and consequential modifications in mining, beneficiation, economics, marketing, legal, environmental, social and government factors. It proves that it was economical to mine at the time of calculation. The estimated recoverable reserves and the feasibility assessment result are highly credible.

8.3.1.2 Pre-recoverable reserves (121)

It refers to the recoverable part of the proved economic basic reserves. It refers to the lot that has reached the encrypted engineering in the exploration stage. It delineates the ore body in three-dimensional space. It confirms the continuity of ore body. It identifies in detail the geological characteristics of ore bodies, ore mass and mining technical conditions with corresponding ore processing beneficiation test results. But it only carried out the pre-feasibility study. It indicates that the mining was economical at the time. The estimated recoverable reserves are highly credible. The evaluation results of feasibility are generally credible.

8.3.1.3 Pre-recoverable reserves (122)

It refers to the recoverable part of the controlled economic basic reserves. It refers to the lot that has reached the working degree requirements in the detailed investigation stage. It basically delineates the ore body in three-dimensional space. It can surely confirm the lot with continuity of ore body. It basically identifies the geological characteristics of ore bodies, ore mass and mining technical conditions with corresponding ore processing beneficiation test results. For the ore that is easily selected with mature process, it shall also use the test results of same type of ore. The pre-feasibility study results show that the mining is economical. The estimated recoverable reserves are highly credible. The credibility of the feasibility evaluation results is general.

8.3.2 Basic reserves

8.3.2.1 Proved (feasible) economic basic reserves (111b)

The exploration stage, the degree of geological reliability, the stage of feasibility evaluation and the classification of economic significance are the same as described in 8.3.1.1. The only difference is that this type uses the amount expression not deducted with the design, the mining losses.

8.3.2.2 Proved (pre-feasible) economic basic reserves (121b)

The exploration stage, the degree of geological reliability, the stage of feasibility evaluation and the classification of economic significance are the same as described in 8.3.1.2. The only difference is that this type uses the amount expression not deducted with the design, the mining losses.

8.3.2.3 Controlled economic basic reserves (122b)

The exploration stage, the degree of geological reliability, the stage of feasibility evaluation and the classification of economic significance are the same as described in 8.3.1.3. The only difference is that this type uses the amount expression not deducted with the design, the mining losses.

8.3.2.4 Proved (feasible) marginally economic basic reserves (2M11)

It refers to the lot that has reached the working degree requirements of the exploration stage. It identifies in detail the geological characteristics of ore bodies, ore mass and mining technical conditions. It delineates the ore body in three-dimensional space. It confirms the lot with continuity of ore body. It has corresponding processing beneficiation test results. The feasibility research results show that at the time the mining was not economical but close to the profit and loss boundary. Only when the technical, economic conditions are improved, it shall become the economical. This part of basic reserves can cover all the exploration area; or it can be a part of the exploration area, distributed around or in the recoverable reserves. The estimated basic reserves are highly credible. The credibility of the feasibility was uneconomical, and the price of mineral products had to be significantly raised or substantially reduced to make it economical. The estimated amount of resources is highly credible. The credibility of the feasibility evaluation results is general.

8.3.3.3 Controlled secondary marginally economic resources (2S22)

It refers to the lot that has reached the exploration working degree requirements of the detailed investigation stage. The degree of geological reliability is controlled. The feasibility study shows that at the time of determination, mining was uneconomical, and the price of mineral products had to be significantly raised or substantially reduced to make it economical. The estimated amount of resources is highly credible. The credibility of the feasibility evaluation results is general.

8.3.3.4 Proved intrinsically economic resources (311)

It refers to the lot that has reached the exploration working degree requirements of the exploration stage. The degree of geological reliability is proved. But it does not do any feasibility study or pre-feasibility study. It only does rough research. The economic significance lies between the economical scope and the sub-marginal economical scope. The estimated amount of resources is highly credible. The credibility of the feasibility evaluation results is low.

8.3.3.5 Controlled intrinsically economic resources (332)

It refers to the lot that has reached the exploration working degree requirements of the detailed investigation stage. The degree of geological reliability is controlled. It only does rough research. The economic significance lies in the secondary marginal economical scope. The estimated amount of resources is highly credible. The credibility of the feasibility evaluation results is low.

8.3.3.6 Inferred intrinsically economic resources (333)

It refers to the lot that has only reached the exploration working degree requirements of the general investigation stage. The degree of geological reliability is inferred. The amount of resources is only estimated based on limited data. Its credibility is low. The feasibility evaluation only makes a rough research. The economic significance lies in the primary marginal economical scope. The credibility of the feasibility evaluation results is low.

8.3.3.7 Predicted resources (334)?

It refers that on the basis of regional geological research, aviation, remote sensing, geophysics, geochemistry and other unusual or very small amount recoverable thickness, rejection thickness of horse-stone, mining depth.

9.2 General principles of mineral resources / reserves estimation

9.2.1 The industrial indicators based by mineral resources / reserves estimation are provided by the prospecting investors. It shall be strictly implemented by the state regulations process. The estimation of the mineral resources / reserves used for mine construction design shall use the industrial indicators for specific deposits. It shall not directly provide the mineral resources / reserves used for mine construction design. Its estimation shall be based on the general industrial indicators (see Annex H).

9.2.2 The mass of each exploration results based by mineral resources / reserves estimation shall comply with requirements of regulatory procedures.

9.2.3 Mineral resources / reserves estimation objects and units (as follows)

a) If glass-grade silicon materials use raw ore to evaluate ore mass, it shall estimate the ore volume of raw ore. If using water-washed sands to evaluate ore mass, it shall respectively estimate the ore volume of raw ore, the ore volume of water-washed sands, in 10^4 t.

b) Ornamental stone shall respectively estimate the ore volume and block volume, in 10^4 m^3.

c) Gypsum shall estimate the ore volume, in 10^4 t.

d) Wollastonite shall respectively estimate the ore volume and mineral volume. For the deposit of which the ore can be hand-selected, in addition to the estimation of ore volume, it shall also estimate the hand-selected volume of concentrate, in 10^4 t.

e) Chrysotile asbestos shall estimate the mineral volume, in 10^4 t. And according to the sample length statistical method, estimate the resources / reserves of cotton at all levels.

f) Talc shall estimate the ore volume, in 10^4 t.

g) Crystal graphite shall respectively estimate the ore volume, fixed carbon (mineral volume). Implicit crystal graphite shall estimate the ore volume, in 10^4 t.

9.2.4 Mineral resources / reserves shall be separately estimated according to ore body, block, ore type, grade. Count the mineral resources / reserves of all deposits. Meanwhile, count the average grade (including mineralization rate, sand content, block yield) of all deposit ore or average value of main useful, harmful components of ore.

9.2.5 The mineral resources / reserves of total, associated minerals or tailings with comprehensive utilization value shall be estimated according to the actual exploration research level and the corresponding exploration requirements.

9.2.6 The stripping volume of waste rock (horse-stone, cover layer) shall be estimated according to the volume of waste rock blocks. The stripping volume shall be in 10^4 m^3.

9.2.7 The estimation scope of mineral resources / reserves does not include the goaf. The mineral resources / reserves of press mining area, no-mining area shall be estimated, respectively. For the deposit of which the shallow part can be in open pit mining, the deep part requires underground mining, if the open-pit mining realm can be determined, when exploration investors require to separately estimate, it shall separately estimate the mineral resources / reserves. For crystal graphite, when weathered ores and raw ores are greatly different in mining, mineral processing due to weathering, it shall, based on circled general dividing line, estimate the mineral resources / reserves of weathered ores and raw ores. If the weathering depth is shallow (less than 10 m) and weathered ore mineral resources / reserves are small, it may not divide the boundaries of the weathered zone.

9.2.8 Choose appropriate estimation method of mineral resources / reserves based on the characteristics of the deposit. Promote the use of new technologies and new methods to promote the use of computers in the estimation of mineral resources / reserves. However, the computer software used shall be approved by the relevant administrative department.

9.2.9 Usually, mineral exploration shall be closely linked with the feasibility evaluation. In the general investigation, detailed investigation, exploration stages, it shall carry out the rough study, the pre-feasibility study, the feasibility study evaluation. According to the feasibility assessment stage, economic significance and geological reliability, it shall respectively estimate various types of mineral resources / reserves. If the mineral exploration has completed, the degree of geological reliability reaches the level of inferred, controlled and proved, and the feasibility evaluation shall only do a rough study. When it cannot distinguish its true economic significance, it shall separately estimate the inferred intrinsically economic resources (333), the controlled intrinsically economic resources (332), the proved intrinsically economic resources (331). After pre-feasibility study and feasibility study, according to their economic significance, the categories of mineral resources / reserves shall be adjusted accordingly.

9.3 Requirements for estimation parameters of determination of mineral resources / reserves

cotton drop, feeding, fan, dust filter. The operation methods of each single machine are as follows:

a) before sample processing, it shall first check whether the operation of each single device is normal, the technical parameters are in line with the requirements; in addition, before the test, the test line shall start from backward; after the test, the power shall be turned off before and after the test;

b) gyratory sieve: feeding shall be even; the materials on sieve shall move downwards along with the entire sieve width, evenly distributed; when the material moves below the suction nozzle, asbestos fibers shall float on the material surface of sieve; when excluding the clogging mesh material, it is not allowed to change the shape and size of the mesh aperture;

c) the cotton suction mouth is used to suck away the asbestos fibers floating on the sieve surface layer; after cotton suction, when the content of free cotton of the remains on the sieve exceeds 0.1% ~ 0.2%, adjust the air velocity under the suction cotton (i.e., adjust the suction nozzle height and the apron angle), so as to make it meet the requirements of cotton suction; usually, in rough selection, the suction nozzle height is 80mm ~ 140mm, 100mm ~ 140mm for fine selection;

d) the cotton reducer, feeder, closed feeder and confined degree shall directly affect the effect of the cotton reducer; it shall ensure the sealing performance of closed feeder and perform the regular inspection; if the sealing performance is not good, it shall immediately update the rubber plate; feeder leakage is allowed less than 2%; the wind speed of cotton reducer inlet shall be at 18 m/s ~ 20 m/s;

e) blower: regularly use Pitot tube or manometer U-shaped pressure gauge to measure the pressure and wind speed inside the pipeline; the wind speed in the pipeline shall be at 15 m/s ~ 24 m/s; in order to ensure the wind pressure of the pipeline, regularly check the rated air pressure and air volume of the blower; find out the reason or replace the blower immediately when any problem is found;

f) dust filter: check whether the filter bag seams are firm, with or without off-line or broken line, with or without damage, whether the dust discharging is clogged; dust bucket fibers are too much mainly due to excessive wind speed, wind pressure and it shall inspect the pneumatic system.

The first cotton suction, air classification and processing:

When the air classification processing equipment is operating normally, carry out the no-load normal operation 3min ~ 5min, it shall be able to feed by the vibration feeder for sample processing. The free fibers on the sieve are sucked away by the suction nozzle and fall into the dust bucket (rough concentrate ores) via cotton reducer and feeder. Mix the residues on the sieve and the materials on the sieve with sieve mesh of 12.7 mm into the impact crusher. The materials on the second layer of sieve shall be used for the second cotton suction process. The materials under the second layer of sieve shall be rough refuse ore.

G.2.2.7 The second cotton suction

Same with the first cotton suction processing operation. The selected asbestos fibers shall be rough concentrate ores. The materials under the second layer of sieve shall be rough refuse ore. Put the materials on the gyratory sieve of the second cotton suction into a vertical shaft crusher for crushing. The crushed materials shall be pre-sieved. The testing materials after being crushed by the vertical shaft crusher shall go through a 0.5 mm aperture sieve for the third cotton suction procedure. The materials under the second layer of sieve shall be rough refuse ore. After the refuse ore is excluded, it can improve the cotton suction effects of cotton suction sieve.

G.2.2.8 The third cotton suction

Same with the first cotton suction processing operation. The selected fibers shall be rough concentrate ores. The materials under the second layer of sieve shall be rough refuse ore. Put the materials on the sieve into a wheel mill for crushing. Before the wheel mill is used, it shall inspect whether the equipment is intact, whether there is blocking phenomenon. Adjust the clearance between the pan and the drum less than 0.2 mm. It shall start when the contact between the two is too loose or tight. After operating with empty load for 3min ~ 5min, feed it according to the equipment processing amount. The crushed materials shall be scrapped to the pan feeding mouth at any time and discharged. Over-crushing is not permitted so as not to damage the fiber. The cotton content of feeding material cannot exceed 0.1% ~ 0.2%. The materials crushed by the wheel mill shall be pre-sieved. The pre-sieving method shall be same with pre-sieving processing method of testing materials after vertical shaft crushing.

G.2.2.9 The fourth cotton suction

Same with the first cotton suction processing operation. The selected asbestos fibers shall be rough concentrate ores. The residues on the sieve shall go into the wheel mill once more for crushing. After pre-sieving, carry out the cotton suction according to the fourth cotton suction procedures so as to

deposit						

H.2 General industrial requirements for ornamental stone

H.2.1 Types of ornamental stone

Ornamental stone refers to the rock with a certain decorative performance, physical and chemical properties, processing performance and can be processed into a certain size, mainly used for interior and exterior surface decoration of the building. At present, there are two types of natural decorative stone in China: marble and granite. Marble ornamental stone mostly belongs to the deposited carbonate rocks and related metamorphic rocks (such as marble, serpentinized marble, etc.), more suitable for interior decoration. Most of the granite-type ornamental stones belongs to various output magmatic rocks (granite, gabbro, diorite, porphyry, etc.) and metamorphic silicate-bearing rocks (such as gneiss, mixed rock, etc.), suitable for interior and exterior decorations.

H.2.2 General requirements for decorative performance of ornamental stone

The decorative performance of ornamental stone refers to it has certain color, pattern and gloss after processing. And they are related to its material composition (mainly mineral composition), structure, composition. Commercially, according to the color and pattern differences of ornamental stone, different varieties and different grades are classified. Usually, after the better (above middle level) ornamental stone is processed, it shall have pure color, harmony pattern, high gloss when it is assembled on a decorative surface.

The color spots, color lines in the ornamental stone affect the decorative performance, which are limited in the standards of block, plate. The hollow in the stone also affects the decorative performance (sometimes it can be remedied by some measures). The quartz, flint in carbonate stone may affect the decorative performance, it mainly affects the processing performance. Some metal sulfides, muds, organic matters exist in the stone. They shall affect the decorative performance and durability of stone because they are easy to be weathering. Therefore, stones with these impurities are generally not suitable for outdoor decoration.

As there is no specific standard for the classification of varieties and grades of ornamental stone, the market demand for ornamental stone is often different due to people, places and time. Therefore, the varieties of ornamental stone for exploration shall be determined by prospecting investors who shall determine the standard sample together with geological exploration organization. And it shall be used as the reference for identification of ore varieties to be explored.

H.2.3 General requirements for block yield of ornamental stone

H.2.3.1 The ornamental stone block refers to a rectangular hexahedron with certain degree. The mine block blackness of ornamental stone with an annual output over 3000m^3 can usually be divided into three types: the blockness is greater than or equal to 3m^3 for class I of block, greater than or equal to 1m^3 for class II, greater than or equal to 0.5m^3 for class III. Usually, the side length of block is not less than 0.5 m. The blockness of medium level and general level of ornamental stones are greater than 1m^3.

H.2.3.2 The block yield of ornamental stone refers to the percentage of total explored volume and obtained block volume. In general, the block yield is required not less than 20% for medium-grade of ornamental stone. In the circumstance similar with other technical and economic conditions, the requirements for the block yield of high-grade ornamental stone can be relaxed accordingly. The requirements for the block yield of general ornamental stone can be accordingly improved.

Block yield (%) = obtained block volume (m^3) ÷ total explored volume (m^3) × 100% •••••••••••(H.1)

H.2.4 General requirements for plate rate of ornamental stone

The plate rate of ornamental stone refers to the obtained polished plate area with a certain-specification after block is processed, usually in m^2/m^3. Usually, the plate rate of medium-grade ornamental stone is required not less than 18 (m^2/m^3). Under other similar technical and economic conditions, the requirements for plate rate of high-grade ornamental stone can be relaxed accordingly. The requirements for the plate rate of general ornamental stone can be accordingly improved.

Plate rate (m^2/m^3) = obtained polished plate area with a certain specifications (m^2) / volume of block to be processed (m^3) •••••••••••(H.2)

H.2.5 General requirements for mining technical conditions of ornamental stone deposit (see Table H.4)

Table H.4 -- General requirements for mining technical conditions of ornamental stone deposit

Recoverable thickness m	Horse-stone removal thickness m	Minimum mining standard height	Opencast mine side slope angle	Opencast mine Minimum chassis width	stripping-mining ratio m^3 / m^3

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