Metallogeny of the Jinyu Graphite Deposit, Sichuan Province

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Abstract. Graphite deposit is important ore in Huili County, Sichuan Province. It is located in the middle part of the Kangdian axis and the middle part of the Kangdian basement fault uplift zone. The graphite deposit is located in the strata of the Dayingshan Formation of the Lower Proterozoic Hekou Group. The deposit belongs to sedimentary metamorphic graphite deposit formed under the dual factors of regional and thermal contact metamorphism. The ore body is strictly controlled by horizons. Graphite is composed of migmatized graphite quartz schist ore and migmatized graphite schist ore. The former is of the main type and the latter to the second type. Through comparative analysis of metallogenic geological and geophysical characteristics, it is considered that the gold rain graphite deposit is influenced by strata, structure, magmatic rocks, metamorphism, migmatization and other factors.

1. Introduction
With the rise of graphene application theory, the demand for graphite ore resources is increasing day by day, while the research level of graphite ore deposits is not high [1-3]. The Panzhihua area is rich in crystalline graphite resources, large and medium-sized. The deposits are mainly distributed in the Renhe District, Yanbian County and Hami, Panzhihua City. In Yixian County, the genetic type is sedimentary metamorphic type. The ore bearing rock of the graphite deposit in the Hequ is Lengzhu of the Kangding group of Early Proterozoic. In Huili County, the ore bearing rocks of the graphite deposit are migmatite gneiss and migmatite of the Dayingshan Formation, Hekou group. It is composed of granite, and the ore bearing rock of graphite deposit in Miyi County is Mesoproterozoic. The age of sericite phyllite in the first member of the Tianbaoshan Formation in the Huili Group, Paleozoic is slightly. The late Lengzhu and the Dayingshan formations are slightly lower in metamorphism. This paper discusses the genesis, metallogenic regularity of the Jinyu graphite deposit in the Huili County. The prospect is very important for searching for the same type of graphite ore in Panxi area to guide the significance.

2. Regional Geological Characteristic
The geotectonic position of this area lies in the upper Yangtze ancient land and Sichuan. The Kangdian foreland thrust belt of the southern and Northern Yunnan tectonic belt and the middle part of the Kangdian axis and the middle part of the Kangdian basement fault uplift zone. work area. It is located on the Fe-Cu-V-Ti-Sn-Pb-Zn-A-Pt rare earth asbestos metallogenic belt in Yangtze metallogenic province - Kangdian fault uplift. The belt can be subdivided into same metallogenic sub zone and the Yanbian paleoarc front basin Cu Ni Pb Zn graphite metallogenic subzone in the basin. The study area is located in the Cu-Ni-Pb-Zn graphite metallogenic subzone of the Yanbian forearc basin. All kinds of
mineral resources are abundant in the area. All, there are ferrous metals, non-ferrous metals, non-metallic, combustible organic ore production, building materials.

2.1 Strata
The exposed strata in the area mainly include lower Proterozoic Kangding Group and Hekou Group, middle Proterozoic Huili Group, upper Proterozoic Sinian system, Paleozoic Cambrian. The strata of the Neogene and Quaternary of the Cenozoic, Permian and Neogene. Lower Proterozoic is the Dayingshan Formation (Pt1dy) in the Jiehekou consists of migmatite, migmatite gneiss and migmatite. It is composed of granite, and its lower lithology is mixed gneiss with mixed flowers. It is composed of quartz schist, biotite quartz schist, graphite quartz schist and granulite. The lithologic layer in the lower part of the formation is the graphite ore bearing bed in the working area.

2.2 Structure
The area has experienced Jinning, Hualixi, Indosinian, Yanshan and Xishan structures. In the Huili Dongchuan depression trough area, the crust contracted and compressed under the control of the tectonic background, a series of strata in the area formed the anticline, syncline and thrust fault are mainly in the east-west direction, and the south is the main fault. The structure of the double-layer structure of the cost area is the superposition of the two Pattern. The lower layer constitutes the basement of the lower fold, and the EW fold develops. It forms the basement of the upper fold and develops the North-South fold. Many faults are common at this area. It is an important deep and large fault.

2.3 Magmatic Rocks
The magmatic activity of the Huili Dongchuan trough is strong and multicycle. On the whole, the two tectonic magmatic cycles are imperfect. They are Jinning cycle and Variscan Indosinian cycle. There are two stages. The main magmatic rocks are spilit, keratophyre and quartz angle porphyry, potash keratophyre, tuff, albite, metasodic volcanic breccia rock, ferruginous nepheline basaltic rock, etc. In addition, there are only a few areas in the region. A small number of the Yanshanian granite veins and diabase veins are intercalated in the Baiguowan coal formation in the strata.

2.4 Characteristics of Regional Minerals and Graphite Deposits
The area is rich in all kinds of mineral resources, including black gold. It belongs to nonferrous metals, non-metal, combustible organic minerals, building materials and metallurgical auxiliary raw materials. There are a lot of important graphite deposits in the region 14 of them are crystalline graphite ores, and the total amount of proven graphite minerals is 29.62 Mt. There are 5 large-scale ones.

3. Geological Characteristics of Study Area

3.1 Strata
In addition to Sinian system (ZBD, ZBG) and Xigeda Formation, it is mainly the Daying mountain of Lower Proterozoic Hekou Group stratigraphy. According to the different migmatization degree and lithologic association, the ore deposit is divided into three types. The Dayingshan Formation is divided into upper and lower members. Among the upper member is the main ore bearing horizon ore.

3.2 Structure
The structure in the working area is relatively developed, and the caprock in the area is mostly slightly inclined to the Horizontal output. The structural form of the basement layer is generally inclined northward. The dip angle of the NW monoclinic structure is mostly gentle to medium. There are folds, faults and compressional slip in different directions and scales moving surface. There are 8 faults in the working area.
3.3 Metamorphism, Migmatization and Rock Characteristics

(1) Metamorphism: the protolith formation of metamorphic rocks in the area is sedimentary rocks, complex type. Metamorphism is characterized by progressive metamorphic belts. The polyphase metamorphism is marked by kyanite sillimanite. Tectonic metamorphism shows that the stress and deformation are strong, and the linear fold is approximately the same as the crystallization. Migmatization and granite are common. Geotectonics of regional metamorphism belongs to linear geosyncline. These characteristics indicate that the regional metamorphism belongs to the "regional thermal flow metamorphism" type. The main crystalline graphite in this area. It was formed in this metamorphism.

(2) Migmatization: the graphite ore in the working area is enriched in the mixing. Migmatization surrounded by migmatite migmatite with high degree or residual rock mass. The effect of migmatization on the formation of graphite ore the main reason is to recrystallize and regroup the early formed graphite minerals set, slice size increases.

(3) Migmatite and its characteristics: the main rock is graphite quartz schist (if the content of graphite is more than 2.50%, it is called graphite ore) Banded migmatite, banded migmatite and striated banded migmatite.

3.4 Wall Rock Alteration

The wall rock of ore body roof and floor in working area is vein injected migmatite. They are migmatized sillimanite biotite schist and sillimanite biotite quartz Most of them are plagioclase, plagioclase and schist. The migmatite is only localized. The chemical composition of the graphite ore and the surrounding rock indicates that the ore body has a definite floor girth. The content of fixed carbon, loss on ignition and SiO₂ in rock are lower than those in ore body. In addition, other components are generally higher than ore body. This is mainly the length of the content of stone and mica is higher than that of ore body, while the ratio of quartz in ore body is generally higher than that in ore body. The content of surrounding rock is higher. Fixed carbon is in the intercalation and surrounding rock of ore body, the average content is in the range of 1.00%-2.00%, the carbon content is mostly below 0.5%. The ore body is in direct contact with felsic and granitic veins.

4. Geological Characteristics of the Deposit

4.1 Ore Body Characteristics

The ore bearing strata in this area is upper segment (Pt1dh) of the Dayingshan Formation of Lower Proterozoic Hekou group. The ore body occurs in the migmatite of granite and gneiss. Two graphite ores were found in the ore bearing strata of the working area (chemical) zone, respectively located in the south Xijiang slope and the northeast slope. Three graphite ore bodies are delineated in the Zuojiang slope ore block. 8 graphite ore bodies are delineated in the Mopozuo ore block. The orebody is lenticular and stratoid, and its occurrence is similar to that of surrounding rock.

The main body is I-1, its features are as follows: I-1 ore body, the surface consists of 7 exploratory trenches and 1 Soil stripping project. The middle and shallow parts are controlled by ZK0101 and ZK1401 drilling projects. The surface strike of the ore body is 3 950 m long and controlled by ZK0101. The inclined depth of the ore body is 290 m, and ZK1401 borehole controls the inclined depth of the ore body. The thickness variation coefficient of ore body is 83.37%, the grade variation coefficient is 17.35%, the thickness change is not stable, and the grade is changed. The ore bearing lithology is migmatized graphite quartz schist, surrounding rock. It is mainly quartz schist and migmatite.

4.2 Ore Quality

The ore minerals are graphite and gangue minerals are quartz, plagioclase and mica, biotite, etc. The ore structure is mainly scaly granular crystalloid structure. It is mainly parallel scale like disseminated structure, and then striped structure, etc. Through the collected particle size analysis, the samples were observed under the microscope. The graphite is mainly flake, leaf like particles and aggregates. There are more green graphite aggregates, so the mineral particles are larger. About 95.00% of the total amount
of graphite belongs to small and medium-sized flakes. The particle size of graphite is mainly between 64 μm and 128 μm. The ore is mainly concentrated in 24.00 - 128.00 μm.

5. Genesis of the Deposit
Since the 1920's, some scholars have paid close attention to some aspects. The China Geological Survey has been carried out on the graphite ore spots [4]. The statistics of nearly 60 graphite ore spots have been discovered, and the results show that: the metamorphic crystalline graphite deposits belong to the early Precambrian deposits. And the corresponding reserves account for 74.00% of China's proven reserves. Graphite ore deposits are widely distributed with large reserves, and the quality of graphite ore is good. There are two basic characteristics in the distribution of graphite mineral resources in China. It is mainly composed of crystalline graphite and aphanitic graphite; Mineral resources are widely distributed and relatively concentrated. Crystal stone of the Heilongjiang Province reserves are the largest, accounting for the total reserves of China 61%. There are more than 4.5 million tons of reserves in the region. The Sichuan, Shandong, Inner Mongolia, Henan and Shaanxi have concentrated crystalline graphite resources, more than 90% of the source reserves, as China's known industrial value. According to their genesis, they can be divided into regional metamorphism and contact metamorphism. There are three types of graphite deposits, i.e. texture type and magmatic hydrothermal type. Among them, crystalline graphite graphite deposits are mainly of regional metamorphic type and magmatic hydrothermal type. The contact metamorphic type is mainly cryptocrystalline graphite deposit. Ortega et al. [5] studied the volcanic rocks of borodale, England. According to the characteristics of carbon isotope, it is determined that the carbon comes from organism, and its mineralization mainly occurred in the Ordovician magmatism, a short period of time. Richard et al. [6] studied metallogenic geological characteristics and carbon isotope of Mesoproterozoic graphite deposits in the Western Plateau. According to the characteristics, carbon comes from the original algae and other biological organic matter, it belongs to organic origin.

The rock type also contains part of calcareous sedimentary rocks with little fire diagenesis, in general, is a set of sedimentary rock formation. In the Paleoproterozoic, about 2000.00 Ma, there is a set of sand and mud in the mining area. The organic carbon in the sedimentary rocks began to form graphite, and the influence of regional metamorphism, the graphite flakes in the sedimentary rocks gradually changed. In the process of metamorphism, the ore bearing ore was formed. Under the action of pressure and magmatic activity, the mineral in ore and surrounding rock is carbon also began to participate in mineralization, providing new carbon for the formation of graphite source. Therefore, it can be speculated that the evolution of the Jinyu graphite Deposit in the Huili County is mainly composed of three parts. It is a sedimentary metamorphic deposit. According to mineralization, ore bearing formation and ore body occurrence form. The genetic type of the deposit is caused by both regional metamorphism and thermal contact metamorphism.

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