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Mineral-geochemical analysis on the Danzhou tungsten-cesium polymetallic deposit, Hainan Province

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In the previous geological exploration, the distribution range and mineralization characteristics of rubidium-cesium mineralized bodies were preliminarily found in Danzhou rubidium-cesium polymetallic mining field (Tong Changliang,2014). However, there is lack of further research on the tungsten geochemical anomaly, as a result, constrained on the collective geological prospecting in this area, as well as the better understanding and identification on major minerals and associated minerals. During the project work of the researches on identification of occurrence state of elements, collective geological prospecting and assessments have been carried out in 2016 by China Non-Ferrous Metals Resource Geological Survey, focusing on examination and evaluation of tungsten geochemical anomaly. The geochemical exploration and tectonic lithofacies mapping have been conducted on the systematic synthesizing geological documentation and tectonic lithofacies research of previous boreholes, gaining some new mineralization information on tungsten ore.

In the guidance of mineral geochemistry research approach, the microscopic investigation of mineral, chemical phase analysis, nature heavy concentrate, electron microprobe analyses have been used in the systematic research on occurrence state of elements and then confirmed the authenticity of tungsten geochemical anomaly, so that it could provide the better basic knowledge about beneficiation method and process, and the suggestion to the prospecting direction in future.

1 Geological Characteristic

Danzhou rubidium-cesium polymetallic deposit is located in Hainan Island. The emergence strata are mainly the Ordovician Nanbigou Foramation (O*Nb*), the lower Silurian System Tuolie Association formation, and this deposit was mainly hosted in the middle rock section of the Tuolie Association Formation, whose protolith may be argillaceous siltstone, feldspar quartz fine sandstone, basic-ultrabasic volcanic rock, calcareous siltstone, banding tuffous limestone and banding argillaceous limestone. The protoliths are characterized by rock assemblage of banding limestone, dolomite limestone, siltstone and fine sandstone, which belong to restricted carbonate platform facies. The magmatite could be mainly formed during the Indosinian-Yanshanian intrusion while the W mineralization might be closely related to biotite monzonitic granite in subordinate phase of the Indosinian, as well as diorite and the intermediate-fine graingranite in first stage of the Yanshanian.

Tungsten-cesium polymetallic orebodies have been newly discovered in the Tuolie Association layer. The ore-hosted lithofacies are hydrothermal breccia facies and hornstone facies.

The tungsten orebody generally trends NE with a pitch angle of 27° and plunges NW with a plunge angle of 34° .The typical ore types consist of a hydrothermal breccia-type tungsten ore, and a hornstone-type tungsten ore. There is also a few quartz vein type tungsten ore and skarn-type tungsten ore.

2. Occurrence of tungsten

Research showed that the industrial mineral facies of Tungsten are mainly scheelite, and slightly wolframite, tungstate. The scheelite are accounted for 72.2% to 90.57%, whose WO_3 grade is from 0.145% to1.55%. The wolframite is accounted for 9.29% to 27.05%, whose WO_3 grade is from 0.02% to 0.58%. With the increasing percentage of wolframite (22.28% to 27.05%), the

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tungsten grade (0.33% to 2.13%) rise. The proportion of tungstate in the Tungsten ores is low, not more than 1%. In general, scheelite and wolframite are more available for recovery and utilization in the future.

The main industrial mineral of tungsten ore is scheelite, which is easy to separation. According to the texture and structure characteristics, the scheelite may be divided into six kinds occurrences, i.e., breccias scheelite, massive porphyrytic scheelite, thin vein like scheelite, disseminated scheelite, pearl string like scheelite, and dotted scheelite. The breccias scheelite, massive porphyrytic and thin vein like scheelite are the main texture and structure characteristic of the high grade tungsten ores.

According to the microscope observation, scheelite occurs as idiomorphic-granular, droplet-like and fragmentized breccia, which comprised varieties of solid mineral inclusions, including tourmaline, scheelite, apatite, sphene, quartz, plagioclase, ilmenite, Cs-rich phlogopite, pollucite, and cerium bagrationite.

3 Discussion

Scheelite is the mainly industrial mineral, and there is a few wolframite and wolfram ocher, therefore, it easy to beneficiation and recovery in the future.

Study on the utilization of the tungsten ores，with the ore dressing recovery percentage of 86.63% and scheelite's concentrate grade of 66.89%, which conducted by Hunan Research Institute for Nonferrous Metals, has shown that the tungsten deposit should be developed and utilized.

The minerals, such as Cs-rich phlogopite, pollucite and cerium bagrationite, have some value in comprehensive recovery and utilization in the future. Therefore, quality check of scheelite concentrates and tailings, as well as deep assessment and analysis of intergrowth-associated minerals of the ore-body deserve more attention, in order to explore the feasible plan to the dressing recovery of concomitant elements, such as Cs, REE.

Mineral-geochemistry research has manifested that the solid mineral inclusions formed from capturing antecedent minerals, fluid metasomatism and recrystallization. Three kinds of occurrences of scheelite indicated that Danzhou scheelite deposit had undergone multi-stage ore-forming process. Firstly, the early stage of breccias scheelite formed in the relatively stable metallogenic environment with abundant metallogenic materials, resulted in the development of the scheelite megacryst. Secondary, the pollucite-albite two phase solid mineral inclusions could have been captured by hydrothermal breccias scheelite, indicated that scheelite formed in the metallogenic system associated to the alkali-rich acid granites. Thirdly, idiomorphic-granular scheelite, tourmaline, and cerium bagrationite distributed along the silicified, potassium-alkali silicatization veins and tourmalinization veins, replaced and filled along the early stage of the fissures of hydrothermal breccia scheelite ores, showing the existence of superimposition and alteration mineralization by metallogenic fluid associated to the alkali-rich acid granites in the late stage. Droplet-like tungstenic solid solution, likely scheelite, distributed in the sphene, perhaps offer the significant ore-forming matters.

The coexistence of hydrothermal breccias scheelite, tungstenic silicified hydrothermal breccias, felsic hydrothermal breccias, tourmalinization hydrothermal breccias, and magmatic hydrothermal breccias, reveals the existence of hydrothermal breccias tectonic system (Fang Weixuan, 2016). It may be inferred that tungstenic hydrothermal breccias and breccias scheelite in it, indicated the deep mineralization center of Wenxipo W-Cs multi-metal ore block. What more, the breccias scheelite and relevant alteration tectonic lithofacies might have been the symbols of mineralization center at the depth of this deposit.

4. Conclusion

From the above, it may be summarized as follow. (1) In the Danzhou tungstate -cesium polymetallic mining block, tungstate is mainly in the form of scheelite, and there is a few wolframite and wolfram ocher, so scheelite and wolframite are the major available industrial minerals. (2) The enrichment location of hydrothermal breccias scheelite maybe indicated the mineralization center in the deep of tungstate -cesium polymetallic mining block. (3) The Cs-rich phlogopite, pollucite and cerium bagrationite, occurred as solid minerals inclusion in the scheelite, have some value in comprehensive recovery and utilization, therefore, the analysis on the beneficial element, like Cs and REE, should be done, to explore the feasible technology to the dressing recovery of Cs and REE.

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