Study On Metallogenic Regularity and Metallogenic Prediction of Antimony Deposits in Western Yunnan China

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Abstract. West Yunnan is the Amain enrichment area of antimony resources in China. Therefore, this project comprehensively uses new geochemical methods such as geochemistry, secondary halo, electric adsorption, soil ion conductivity, and soil adsorption phase to extract the closely related electrical properties, ion conductivity, soil adsorption phase and other multivariate valid data. In ore near the range of soil ion conductivity anomaly and soil adsorption phase mercury, there is a significant ion anomaly in the peaks of electrical extraction of As, Sb, Ag and other elements, but the amplitude of this ion anomaly is larger than that of conductivity The rate anomaly and the amplitude of soil adsorption phase mercury are small. The research results of this paper can be used as a reference for the metallogenic regularity and metallogenic prediction of antimony resources in western Yunnan.

Keywords: Multivariate Information; Antimony Ore; Western Yunnan; Metallogenic Regularity; Metallogenic Prediction.

1. Introduction

With the increase of mining exploration depth, surface outcrop deposits and shallow deposits are gradually decreasing; due to the increasing shortage of mineral resources in China, the demand for the development of deep resources and alternative energy is increasingly strong. At present, the focus of exploration in the world is gradually shifting to areas with caprock belts. However, due to the difficulties in the exploration of its deep layers and various types of concealed zones, it is urgent to develop advanced and effective theories and technologies to guide the exploration and development of deep mineral resources in China. Therefore, it is very necessary to be able to quickly and accurately obtain information on hidden mines or blind mines on the ground [1]. The ore-hosting rocks of antimony deposits include sedimentary rocks, metamorphic rocks and igneous rocks, and nearly 90% of them occur in sedimentary rock formations. In the Sanjiang metallogenic belt, Sb is often produced as an independent mineral species, and a small part is associated with Au. The main genetic type is sedimentary-hydrothermal type, and then mineralized through Himalayan (hydrothermal) reformation. This project plans to use geoelectrochemistry, electrochemistry, soil adsorbed mercury and secondary halo to carry out multi-source and multi-source information acquisition on the upper part of the identified hidden ore body. Different methods are proposed to synthesize multivariate information prospecting models. This result has certain guiding significance for the mineralization mechanism and prospecting prospects of gold deposits in the western Yunnan region.

2. Geological feature map

The study area is located on the western edge of the Biluoxueshan-Chongshan fault zone of the Lushui-Nujiang fault, at the junction of the Tengchong and Baoshan plates, and is the crystalline basement of the Tengchong plate. Rock, biotite plagioclase granulite, mica schist and quartzite, and a large number of hornblende biotite plagioclase gneiss, plagioclase amphibolite and marble. Devonian, Carboniferous, and clastic rocks dominate the Paleozoic in this area. Among them, the most common metamorphic granites are mylonitized gneiss, granitic protomylonite, monzonite mylonite, tourmaline-garnet, silicon line biotite plagiophyllite and dark granite [2]. The fault structure

in this mining area is relatively complex, most of which are filled by late quartz veins, and the SiO2 content is relatively high, which can be used for the development of quartz ore. In the early stage, it was mainly a northeast-trending fault, with thinner quartz veins, no mineralization, and consistent with the direction of the fault. In the later period, multi-stage, multi-stage and multi-directional NW-NNW trending faults were developed, and their inclination was close to vertical. Mainly antimonite and chalcopyrite, a small amount of antimonite, bismuthite, azurite and pyrite. The main component of gangue is quartz, followed by calcite. The deposits are other-shaped, semi-euhedral, fine-coarse-grained, and there are various types of deposits such as vein-like, fine-vein-like, reticulate, and infested. On both sides of the mining area, there is strong silicification. The mineralization showed remarkable multi-stage characteristics. In the early stage, it was mainly manifested as disseminated veins, mainly manifested as prismatic schistoses, and in the later stage, it was mainly veinlet-type, accompanied by quartz, and it was also the main mineralization stage (Figure 1 is cited from DOI: 10.3868/j.issn.2085-1644.2018.08.012.)

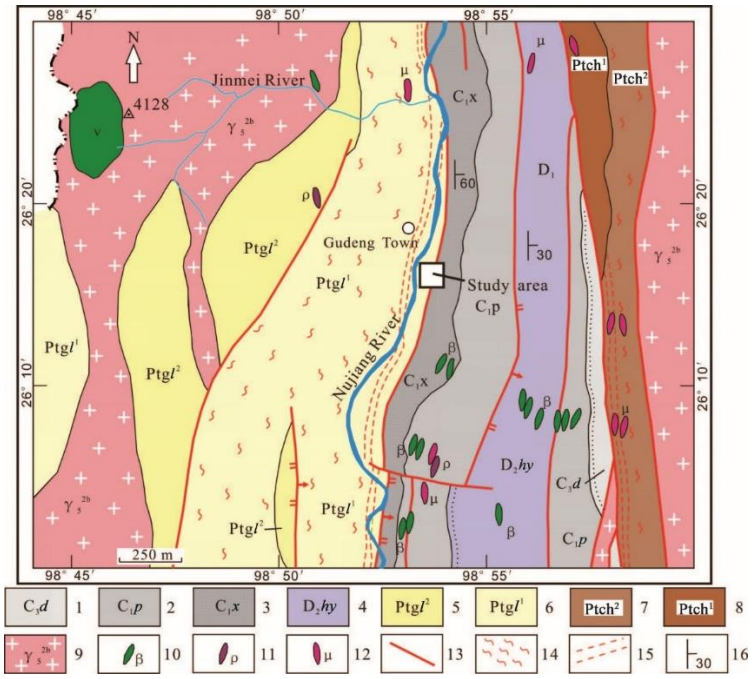


Fig. 1 Geological map of the Gaoligong structural belt

3. Collection and testing of samples

Select known concealed and semi-concealed antimony ores, make a soil geochemical cross-section on the upper part, measure its electrochemical, secondary halo, electric adsorption, adsorption phase and other geochemical characteristics, and study its relationship with different types of antimony ores. Ore correlations and obtain reliable multivariate information from them. Sampling and analysis methods: At each measuring point, dig a rectangular sample pit with a length of 40 cm, a width of 20 cm, and a depth of 30-40 cm, and take 4 kg of soil samples from the soil layer B, and divide the 4 kg into two parts. Parts, one of which is to dry 1 kg of B soil without mechanical processing to avoid damage to the natural particle size, pass through a 100-mesh sieve and adsorb phase mercury, soil ion conductivity and secondary halo to the soil. Elemental ion content was analyzed. Second, using a 4 kg sample, the electrochemical extraction test was carried out under roughly the same field conditions. Prepare the bipolar ion receiver and place it in a pit with a distance of 50 cm between two people, pour 1000 mL, then backfill and compact with the excavated soil, and connect the metal positive electrode and 8 V dry battery with electrode wires. The positive terminal of the battery is connected to the ion receiver, and the battery is placed outside the pit. Power was applied for 48 hours, electrodes were removed, and foam samples were returned for analysis for arsenic, antimony, and silver.

4. Impact of testing

This project takes the 61-line section of the Lushui antimony deposit in Nujiang Prefecture in northwestern Yunnan as an example, and uses geoelectrochemical, soil ion conductivity, soil adsorbed mercury, secondary halo and electrical adsorption methods to conduct comprehensive exploration. Section 61 has a total length of 220 m, and the ore body occurs in the lower and middle strata of the slope, which is a concealed and concealed metallogenic model [3]. On the top of the ore body, set 12 points according to the equidistant distance of 20 m, take electroextraction samples, analyze Sb, As, Ag, and conduct abnormal analysis on Sb, As, Ag, electro-adsorption Sb, As, Ag ions analyze. Electric extraction, secondary halos, abnormal electrosorption (antimony, arsenic, silver). Figure 2 (picture cited in A New Insight into the Cause of High-Conductivity Anomalies in the Subduction Zone) and Figure 3 (picture cited in The stability of subducted glaucophane with the Earth's secular cooling) are the experimental results.

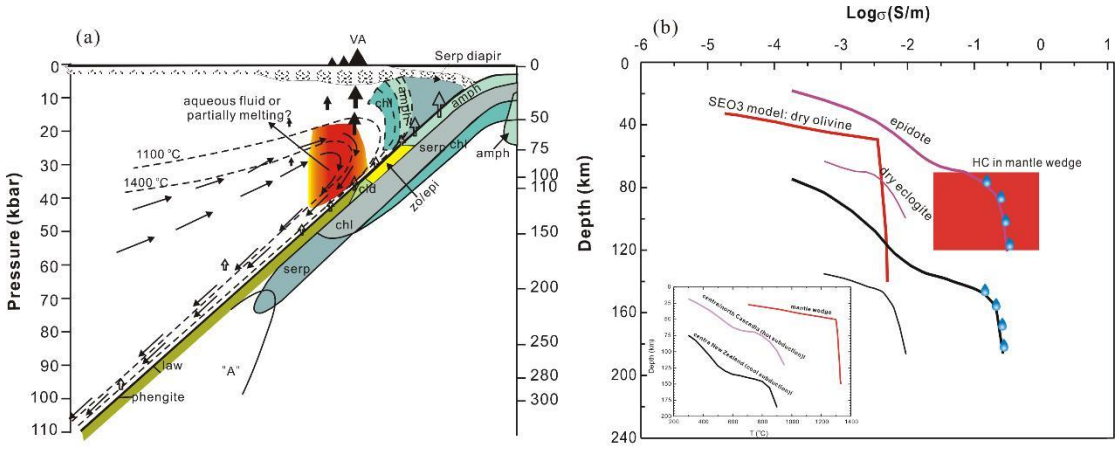


Fig. 2 Profile electroextraction, secondary halo, electrosorption of antimony, electrical conductivity, anomalous properties of soil adsorbed mercury

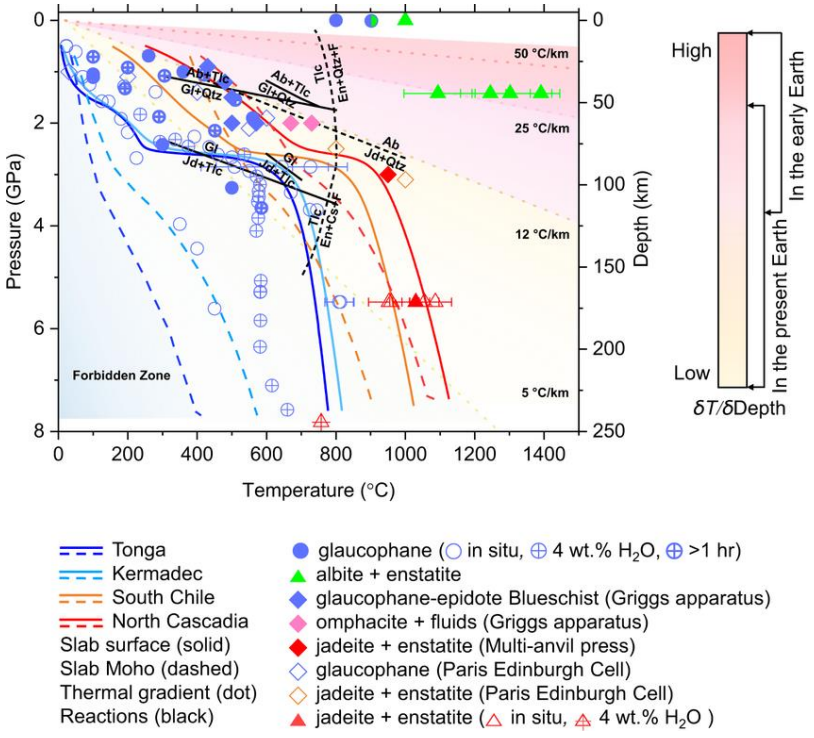


Fig. 3 Contour electroextraction, secondary halo,B anomalous properties of electro-absorption (As, Ag)

4.1. Abnormal characteristics of antimony extraction by electric method

Sb has obvious differences on 0~6 sections and 6~10 sections, its high value point is on 1 section, its peak is 0.48×10^{-6}, when the peak is 0.64×10^{-6}, its width is larger than 120 meters, its content is 0.4~0.64, which is equivalent to 2~3 sections of 2~3.6 background [4]. Its vertical distribution characteristics are basically consistent with those of deep antimony ore. The anomalies at points 8-10 are all single peaks, the highest value is at point 8, the peak is 0.44×10^{-6}, the width is 40 meters, the intensity is $(0.36\text{-}0.48)\times10^{-6}$, and the background is 0.2×10^{-6} 1.8-2.5 of 6. Through on-the-spot investigation and comprehensive analysis of geological data, it is believed that this is caused by the migration of elements in the formation after undergoing weathering.

4.2. Geochemical anomalies of secondary haloantimony

In this profile, the anomalous background of Sb is 43.66×10^{-6}, among which there are 5 anomalous points higher than the background, but the distribution of these 5 anomalous points is not uniform, the shape of the anomaly is irregular, and the anomaly fluctuates greatly [5]. An abnormal region is formed. On the slope, the 11 point value is 82.8×10^{-6}, which is 2.1 of the 2.1 background. Although the anomaly of this point is very high, its vertical projection cannot determine the specific|location of the deposit because of its Geological action caused its geological action.

4.3. Anomalous properties of antimony electrosorption

On the new section, there are only electro-absorbed Sb anomalies at points 0 and 3, the electro-adsorbed Sb anomaly at point 0 is 2.6 times that of the background (3.61×10^{-6}), and the width of the anomaly is 20 meters. The electro-adsorption Sb anomaly at the point is 11.83×10^{-6}, which is 3.2 times that of the background (3.61×10^{-6}). The width of the anomaly is 40 meters, and the vertical projection of this anomaly cannot completely cover the deep antimony.

4.4. Abnormality of extracting arsenic by electric method

As anomalies are distributed between points 0~6 and points 8~10, and the anomalies at points 0~6 show a wide double peak, with the highest values at points 1 and 4, and the peak values are: 2.8×10^{-6} and 3.6×10^{-6}, the abnormal width is more than 120 m, and the content range is $(1.2\sim3.6)\times10^{-6}$, which is 0.65~2.3 times of the background value (1.6×10^{-6}). This anomaly is closely related to deep antimony mineralization. The anomaly at points 8-10 is a single peak, its maximum value is at point 8, its maximum value is 1.88×10^{-6}, its width is about 40 meters, and its background is 1.6×10^{-6}. Through on-the-spot investigation and comprehensive analysis of geological data, it is believed that this is caused by the migration of elements in the formation after undergoing weathering. Secondary halo As anomaly characteristics: As anomalies are distributed between points 0~2 and points 6~8, and the anomalies at points 0~6 show three points anomalies, the highest value is at point 0, and the peak value is: 54.6×10^{-6}, the abnormal width is less than 40 m, and the content range is $(28.4\sim54.6)\times10^{-6}$, which is 1.5~2.8 times of the background (18.6×10^{-6}). This anomaly does not reveal deeper antimony ore. The anomaly at points 6-8 is a single peak, and its maximum value is at point 6, with a maximum value of 35.2×10^{-6} and a width of 60 meters, which is twice the background value of 18.6×10^{-6}. Through the on-site investigation of the mining area and the comprehensive geological survey of the mining area, it is considered that it is the weathering phenomenon that occurs on the surface of the mining area. Abnormal characteristics of electroabsorption arsenic: arsenic appears in 0-4 positions of the section, showing obvious fluctuations, its highest value is at 0 position, its peak value is 2.88×10^{-6}, the abnormal width is greater than 80 meters, and its concentration is in $(1.58\sim2.88)\times10^{-6}$, which is 1.1~2.0 of the background (1.51×10^{-6}). Vertically, this anomaly does not reveal deeper antimony ore. Abnormal characteristics of electro-extracted Ag: Ag anomalies are between points 1~6 and points 8~11 of the profile, No. 1~6 anomalies are mainly single-peak anomalies, the highest point is at No. The width is 100 m, and the content range is $(0.066\sim0.18)\times10^{-6}$, which is 8.4~25 times that of the background (0.006×10^{-6}). This anomaly is closely related to deep antimony mineralization [6]. The anomalies at 8-11 points are all single peaks, the maximum value

is at 8 points, the amplitude is 60 meters, the amplitude is 0.163×10^{-6}, and the intensity is 0.68-0.163, which is equivalent to the background (0.006-1.163) 8.6-23 times. This anomaly is mainly caused by weathering of the earth's surface.

4.5. The abnormal characteristics of secondary silver halo

Silver anomalies are distributed in 2-8 points, 2-8 points are rabbit-ear-shaped, the highest value is in 3 points, the peak value is: 0.44×10^{-6}, the width is greater than 140 m, and the content is (0.22-0.44)$\times 10^{-6}$, which is 1.0~2.1 times of the background (0.21×10^{-6}). The vertical exposure of this anomaly is consistent with the direction of deeper antimony mineralization. Characteristics of electro-adsorption Ag anomalies: Ag anomalies are distributed between points 0 and 3 on the cross-section, and points 0 and 3 are single ear-shaped anomalies, the highest value is at point 0, the peak value is: 8.08×10^{-6}, and the anomaly width is greater than 600 m, the content range $(1.5\sim8.08)\times10^{-6}$, which is 1.2~6.6 times of the background (1.22×10^{-6}). Since the vertical line of the anomaly shows that the distance from the deep antimony is too large, it cannot reflect the occurrence state of the deep antimony.

4.6. Ionic conductivity of soil

Viewed from the cross-section, the anomalies are mainly 2-10 points, showing the characteristics of "broad rabbit ears", the highest point is 5 points, the highest point is 8 points, the highest point is 54us/cm, and the highest point is 38us/cm , the anomalous width is about 200 meters, and the anomalous intensity is 24us/cm to us/cm, which is equivalent to 5.3 to 12 times the background us/cm. The longitudinal projection method of this anomaly can better reflect the surface position of hidden ore bodies buried deep underground [7]. Between points 1 and 8 of the profile, No. 1 to No. 8 anomalies are double peaks, and the highest peaks are at No. 2 and No. 5 points. The peaks are: 853×10^{-8} and 1268×10^{-8}, and the anomaly width is greater than 140 m, the content range $(346\sim1268)\times10^{-8}$, which is 2.6~8.8 times of the background (130×10^{-8}). Through the longitudinal projection of mercury absorbed by the soil, deeper "blind mines" can be found.

Using geoelectrochemistry, secondary halo, electric adsorption, soil ion conductivity and soil adsorption phase mercury, the existing research results show that there are obvious anomalies that cannot be used in the upper part of the mining area. In order to better save exploration investment and make accurate prospecting predictions in the surrounding areas, it is necessary to extract effective multiple information or effective combination information. According to the known anomalies in the ore body, effective multivariate data can be obtained, such as electrical extraction, soil ion conductance, soil absorption, etc., and the three need to be related to each other.

5. Conclusion

According to the known anomalies in the ore body, effective multivariate data can be obtained, such as electrical extraction, soil ion conductance, soil absorption, etc., and the three need to be related to each other. In terms of electrosorption and secondary halo, only a few elements are of better quality, so only some useful information can be provided. (1) According to the abnormalities measured in different ways on the upper part of antimony, if there is secondary corona or abnormal electrosorption, there must be abnormal electric extraction, if there is, there must be no secondary corona or abnormal electrosorption, so use Electroextraction is able to capture subtle anomalies that would not otherwise be captured. 2) The electrical extraction anomaly is an anomaly in the content of various elements above Member 61, and its vertical projection can reflect the location of ore bodies buried deep on the surface. The results show that in the upper part of the mining area, there are obvious mercury anomalies in soil ion conductivity and absorption state, which is consistent with the mineralization characteristics of the deep layer of the mining area. 3) The abnormal resistivity can be used as an indicator of the presence or absence of antimony and the degree of lateral distribution of antimony. 4) The abnormality of absorbed mercury in soil is a reliable sign, which is an important sign of the

source of antimony and finding out the spatial distribution of antimony. 5) Under the existing antimony ore-forming geological conditions, in the changing law of the content of metal elements such as gold, antimony, and silver, there are Significant changes in the content of gold, antimony and silver, but the change rule is smaller than that of metal antimony, which can provide a basis for the search for gold, silver, antimony and other elements in the Lushui mining area of Nujiang Prefecture in Northwest Yunnan.

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