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A Sericite Spectral Index and Its Applications for Exploration in the Luoboling Porphyry Cu-Mo Deposit, Shanghang, Fujian Province

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1 Introduction

Sericite herein refers to a group of white mica minerals, including muscovite, paragonite, phengite, and illite composed of a white mica mineral with the number of interlayer cations (e.g. Na, K) less than two per formula. Sericite as an alteration mineral is pervasive in the Luoboling porphyry Cu-Mo deposit; however only specific species of sericite are closely related to Cu-Mo mineralizations, which are hardly identifiable by naked eye,. Mineral mapping with near infrared spectroscopy is very effective in distinguishing species of sericite. In this study, a sericite spectral index is established, and an example for its application is present.

2 Geological Setting

The Luoboling Cu-Mo deposit is the largest porphyry-type end member in the Zijinshan epithermal-porphyry Cu-Au-Ag-Mo system. The orebodies are primarily hosted in early Cretaceous granodioritic porphyry circling around a weakly porphyritic granodioritic stock. The No.Ⅰ and No.Ⅱ orebodies, showing a saddle-like shape, contain about 95% of Cu and Mo ores of the deposit. Ore minerals include chalcopyrite, molybdenite, pyrite, and minor amounts of digenite, bornite, covellite, galena, and sphalerite. Main gangue minerals are quartz, sericite, chlorite, k-feldspar, biotite, anhydrite, kaolinite, dickite, alunite, and pyrophyllite. Hydrothermal alteration shows, from lower to upper, a weak potassic-phyllic zone (K-Phl, potassic alteration telescoped by phyllic alteration), a chlorite-phyllic zone (Chl-Phl), a pyrite-rich kaolinite-phyllic zone (Kl-Phy), and an advanced argillic zone composed of dickite-quartz and alunite-dickite-quartz assemblages locally at the top of the system.

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3 Sampling and Analytical Methods

Samples for spectral measurements were collected, based on core logging results, from 51 diamond drill holes with sampling intervals generally between 2m and 3m. Representative samples of diameters larger than 1cm were dried naturally before measurements. BJKF-1 portable near infrared mineral analyzers were used for measurements. 21 samples from 3 drill holes on a N-W section were chosen for microprobe analyses. Diamond drill core was sampled for Cu and Mo assay at intervals of about 2m. Cu and Mo were analyzed by flame AAS and spectrophotometry, respectively.

4 Results and Interpretation

Two species of sericite, i.e. muscovite and illite were identified by spectral mineral mapping. In the upper advanced argillic zone and Kl-Phy zone, muscovite generally shows Al-OH wavelengths shorter than 2205nm; in the middle Chl-Phl zone, illite is typified by an Al-OH wavelength longer than 2205nm; and in the lower K-Phl zone, illite is characterized by the longest Al-OH wavelengths (about 2210nm). Illite with a trace amount of muscovite in the Chl-Phl and K-Phl zones are closely associated with Co-Mo orebodies. Microprobe study of sericite indicates that there is an inverse correlation between Al and (Fe+Mg). Muscovite with shorter Al-OH wavelengths is generally rich in Al and poor in (Fe+Mg), while illite with longer Al-OH wavelengths shows higher (Fe+Mg) and lower Al. Previous studies on sericite indicate that the replacement of octahedral Al^{3+}, by Fe^{2+} or Mg^{2+} results in an increase of the Al-OH wavelength (Post and Noble, 1993; Duke, 1994), which can well interpret the above microprobe analytical data.

This suggests that infrared spectral data of serictie can reflect compositional variations of the mineral. Specific

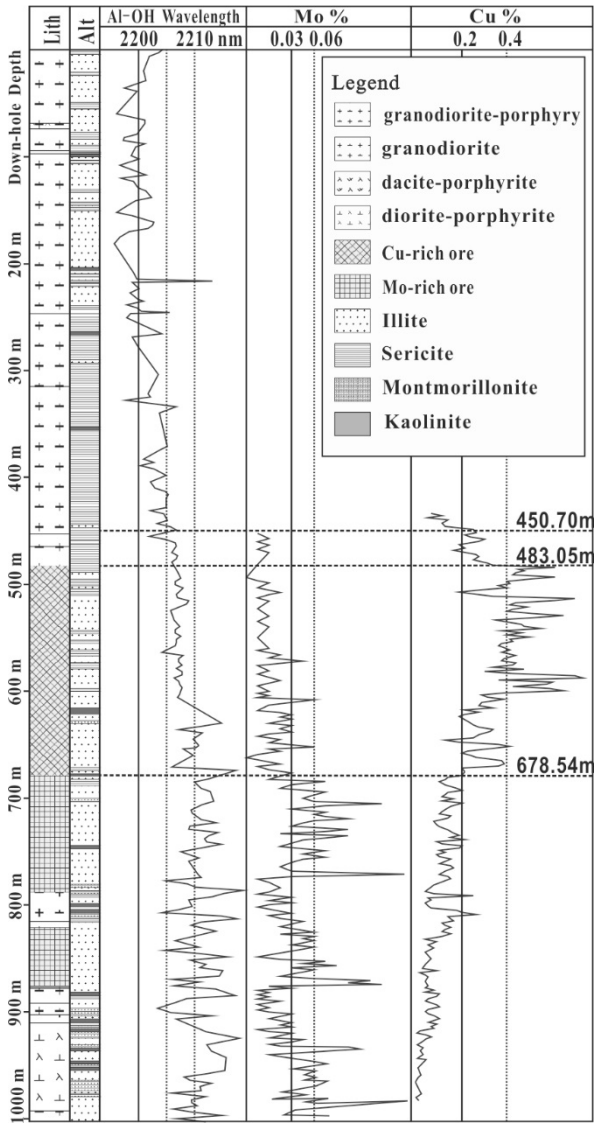

Fig.1 Variations of Al-OH wavelength of sericite, Cu and Mo grades in the drill hole VII05.

species of sericite, characterized by relatively long Al-OH wavelengths and low Al content, can be an effective indication for Cu-Mo mineralization.

5 Application of the Sericite Spectral index

Drill hole ZKⅦ05 from the Luoboling deposit is a good example to show the application of the sericite spectral index. In this drill hole, based on the spectral data of sericite, a 50m down-hole length of drill core was collected for Cu and Mo assays, and low-grade orebodies were verified by the assay. Sericite and ores are zoned as follows: (1) 0m ~ 450.70m, muscovite and illite with short Al-OH wavelengths (<2205nm), and no Cu, Mo mineralizations identified; (2)450.70m ~ 483.05m, muscovite with longer Al-OH wavelengths (2205nm ~ 2210nm), and Cu mineralization with 0.1<Cu<0.2% and Mo<0.03%; (3)483.05m ~ 678.54m, illite and minor muscovite with longer Al-OH wavelengths (2205nm ~ 2210nm), and Cu-rich ore with Cu>0.2% and Mo<0.03%; (4) 678.54m ~ 1002.88m, illite and minor muscovite with the longest Al-OH wavelengths (around 2210nm), and Mo-rich ore and mineralization with Cu<0.2% and Mo>0.03%. Cut off grades used for this deposit are 0.2% and 0.03% for Cu and Mo, respectively.

Illite or muscovite with relatively long Al-OH wavelengths (>2205nm) can be an indicator of Cu-Mo mineralizations, and its Al-OH wavelengths will help distinguish between Mo-rich and Cu-rich ores.

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