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Research Advances

New Identification of Sericite Subclass Minerals Using Airborne Hyperspectral Data in the Xitan Region of Gansu Province and its Significance in Gold Ore Prospecting

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Objective

Hyperspectral remote sensing has attracted much attention in remote sensing research during recent years. It can elaborately identify spectral characteristics of different objects by acquiring continuous spectral curves of ground objects, and can thus provide more information for geological research (Zhao Yingjun et al., 2015). With the deepening hyperspectral remote sensing research, scholars have focused from the classification of alteration minerals to the identification of subclass minerals in order to explore their significance for ore prospecting. This work utilized hyperspectral remote sensing technology in the Xitan region of Gansu Province to identify limonite and two types of sericite subclass minerals, and conducted field verification and geochemical survey. In addition, we analyzed the geological environment of subclass sericite minerals (Van Ruitenbeek et al., 2006) to provide evidence for gold ore prospecting.

Methods

CASI/SASI airborne hyperspectral data in the study area were acquired in July 2011. The spatial resolution was 2 m, and the spectral resolution of shortwave infrared data was 15nm. Ground ASD data of the calibration field were measured synchronously when airborne hyperspectral data were acquired. Empirical linear method was used for atmospheric correction, and the mixture tuned matching filteringmethod was adopted to extract limonite, short-wave sericite and long-wave sericite. For the first time, the Xitan alteration zone was recognized. Field geological survey, geochemical survey and spectral measurement were carried out to make the verification.We deployed seven survey lines along the long axis direction and short axis direction of this newly identified alteration belt and collected a total of 108 bedrock geochemical samples to measure their gold content by the Z-2000 graphite furnace atomic absorption spectrometry. The indoor ASD measurement probe was used to measure the alteration minerals of samples from this alteration zone. Spectral absorption characteristics of sericite samples near 2210nm were extracted after the process of spectral continuum removal. After extracting alteration minerals by using hyperspectral data, we superimposed geochemical gold anomalies on the hyperspectral alteration mineral distribution map, and compiled the remote sensing-geological comprehensive map of the Xitan region.

Results

Two types of alteration minerals, i.e., limonite and sericite, were extracted by using the CASI/SASI data of the Xitan region. According to the spectral absorption position, sericite can be further divided into two types, i.e., short-wave sericite with an absorption peak before 2210nm, and long-wave sericite with an absorption peak after 2210 nm. The limonite extracted by airborne hyperspectral data distributed both on the northern and the southern part of an inferred fault. The short-wave sericite mainly distributed on the south side of the fault, and the long-wave sericite mainly distributed on the north side of the fault. In the remote sensing geological comprehensive map (Fig. 1), it is clear that these areas with only one single type of alteration mineral were not favorable for gold mineralization. Moreover, there is no obvious gold anomaly in the area with both limonites and long-wave sericites. It is inferred that only these areas with both limonites and short-wave sericites have developed gold mineralization. The analysis of the ASD spectra of samples shows that characteristic absorption peaks of short-wave sericites from airborne hyperspectral data range from 2198 nm to 2203 nm, with an average of 2201 nm, while the long-wave sericites range from 2211 nm to 2216 nm, with an average of 2213 nm.

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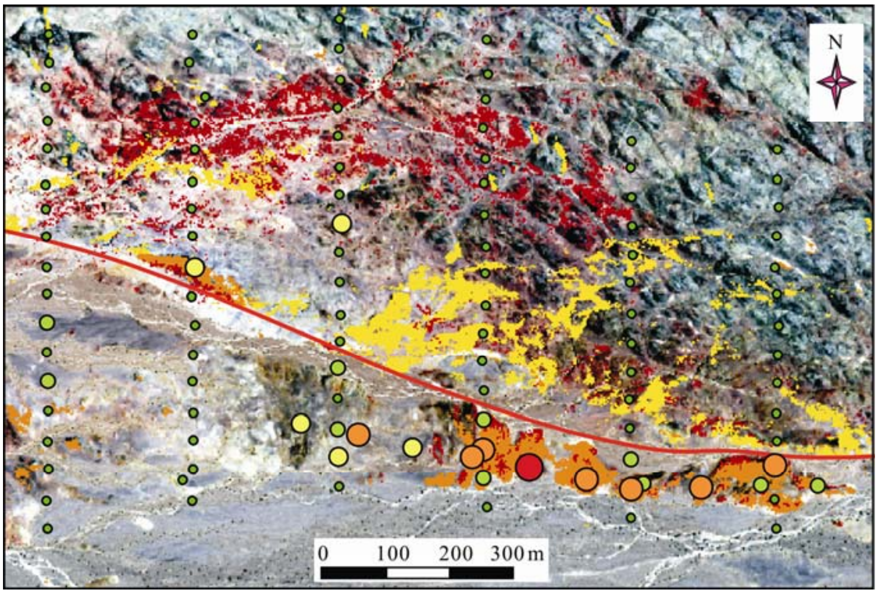

Fig. 1. Map showing comprehensive remote sensing and geological information of the Xitan region.
1, Inferred fault; 2, Limonite; 3, Short-wave sericite; 4, Long-wave sericite; 5, Geochemical samples with Au content <20 ppm; 6,Geochemical samples with Au content of 20–70 ppm; 7, Geochemical samples with Au content of 70–170 ppm; 8, Geochemical samples with Au content of 170–470 ppm; 9, Geochemical samples with Au content >470 ppm.

Field geological survey and rock-mineral identification indicate that the lithology of alteration zone with limonite and short-wave sericites is dark red sericitolite, and this mineral assemblage represents the gold metallogenic hydrothermal activity in this area. The northern side of this gold-bearing alteration zone was located near the NWW-trending fault. The landform of this alteration zone is a prominent hill, with Quaternary alluvium on both sides, and the regional lithology is Variscan granite. Long-wave sericite mainly developed in the Variscan reddish medium-fine grained monzonitic granite. Long-wave sericite may represent a hydrothermal activity closely related to the rock mass. The metallogenic geological setting of the Xitan gold anomaly zone is similar to other gold deposits in the Beishan organic belt of Gansu Province (Lei Shibin et al., 2016). Therefore, this technical idea of using airborne hyperspectral data to extract limonite and short-wave sericite will provide more criteria for regional gold prospecting.

Conclusions

(1) CASI/SASI airborne hyperspectral data can identify alteration minerals of limonite and sericite, and can further divide sericite into subclasses, i.e., short-wave sericite and long-wave sericite, which can effectively recognize the beresitization alteration zone intimately associated with gold mineralization.

(2) The ground ASD spectra in the Xitan region indicate that the characteristic absorption peaks of the short-wave sericite extracted from airborne hyperspectral data range from 2198 nm to 2203 nm, while the long-wave sericite range from 2211 nm to 2216 nm, with an average of 2213 nm.

(3) In the Xitan region, one single alteration mineral type of limonite or long-wave sericite has no clear ore prospecting significance. The alteration mineral assemblage of limonite and short-wave sericite can be used as a regional prospecting indicator for gold deposits.

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