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Airborne Hyperspectral Remote Sensing Technology for Polymetallic Ore and Uranium Deposits Exploration in East Junggar

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East Junggar, as an important part of the central Asian metallogenic zone, is located in palaeozoic epicontinental active belt of Balkhash- Junggar microplate north rim of the Kazakhstan - Junggar plate. Rich and wide varieties of mineral resources concentrate in the area, especially precious metals and non-ferrous metals. In addition to gold, copper, tungsten, and tin, some uranium deposits and uranium mineralized points are also found in this area.

Mountain and desert area is very poor for mineral exploration and it is need remote sensing technology to take the lead. With the rapid development of remote sensing technology, the spectral resolution and spatial resolution is constantly improved. Those provide more and more important technical support ways and methods for the geological prospecting.

1 Introductions

In this paper, airborne hyperspectral data—CAS-SASI-TASI (parameters in table 1) of east junggar region is used to analysis and forecasting favorable areas of polymetallic deposits and uranium deposits. The airborne remote sensing data not only has high spectral resolution, but also has high spatial resolution (hereinafter referred to as the "high resolution").

Table 1 Parameter CASI-SASI-TASI

parameter	CASI	SASI	TASI
Spectral range	380-1050nm	950-2450nm	8.0-11.5μm
Number of Bands	288	100	32
Spectral resolution	2.3nm	15nm	125nm
IFOV (Instantaneous field of view)	0.028°	0.07°	0.068°

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At the same time, the ASD ground imaging spectrometer system and 102f the ground thermal infrared spectrometer also have been used for the field measurement. The former spectral range is 0.35-2.5 nm, with 2 to 10 nm spectral resolution; the later spectral range is 2-16 microns, with adjustable spectral resolution (2-16 cm^{-1}) .

2 Airborne Hyperspectral Data Processing and Its Applications

The empirical linear method for atmospheric correction has been used to CAS-SASI-TASI airborne hyperspectral image, and the alteration minerals of the study area are extracted according to the ENVI "Hourglass" processing technology. First of all, noise separation and the principal component transformation are achieved by MNF, and then end-members are chosen by PPI operation (iterative 20000). At last, images are made by spectral Angle classification (SAM) or mix modulation matched filtering (MTMF). Besides, expanding the brightness difference between different ground objects by gray level transformation, the enhanced texture feature which extrudes tectonic characteristics is achieved.

2.1 Applications to uranium exploration

Based on belt geochemical characteristics of the sandstone type uranium deposit that often enriched in the oxidation-peroxidation transitional belts and characteristics of various REDOX rock color, this paper enhanced and analyzed the REDOX information in remote sensing image for uranium exploration, Alteration mineral distribution maps are drawn by "Hourglass", the distribution of the oxidation zone, reduction zone and transition zone are analyzed, then favorable areas of uranium mineralization preliminary are selected. According to remote sensing image, combined with the

DEM data, the key elements for sandstone type uranium mineralization are effectively identified in the study area, such as the erosion source area, rich water, recharge area, runoff and discharge area. Result shows that mount KaLaMaiLi is the erosion source area, denudation was carried the Jurassic in the south and south west.

Compared with the alteration mineral assemblage and their distribution characteristics and structural characteristics of existing uranium deposits and mineralized points, comprehensive analysis of uranium mineralization potential is used for uranium metallogenic prediction in study area.

2.2 Applications to the polymetallic ore

Silicification is important to polymetallic deposits, especially gold and tungsten. TASI—thermal infrared hyperspectral data can effectively identify SiO_2 and its abundance. Gold and tungsten mineralization favorable areas are drawn through the interpretation of silicified belt and structural belt.

The preliminary geological research shows that different types of ore deposits with the different alteration mineral combination and spatial distribution characteristics. Based on the alteration mineral combination and distribution, interpretation from airborne hyperspectral remote sensing image, the alteration zoning features of porphyry copper deposits and other kinds of ore deposits alteration combination and distribution characteristics, the porphyry copper deposits and other kinds of ore deposits metallogenic prospect areas are drawn.

All in all, high resolution remote sensing provide more and more important technical support ways and methods for polymetallic (Au and Sn) ore and uranium exploration.

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