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New advances on uranium exploration using airborne hyperspectral remote sensing technology: A case study of Xuemisitan volcanic belt, Xinjiang, China

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Hyper-spectral remote sensing is an important new technique for geological and mineral exploration, especially the airborne hyper-spectral remote sensing had achieved a lot of manifest exploration effects in some countries [1-3]. 2011, an airborne hyper-spectral survey was carried out in Xuemisitan paleozoic volcanic metallogenic belt, Xinjiang, China, where the Baiyanghe uranium deposit and many mineralization dots existed, using CASI(Compact Airborne Spectrographic Imager) /SASI(Shortwave infrared Airborne Spectrographic Imager) hyper-spectral survey system. Through data processing and mineral mapping, thirteen various of minerals named Al-rich sericite(also called muscovite or mica in other studies), Al-medium sericite, Al-poor sericite, chlorite, epidote, pyropyllite, dickite, kaolinite, carbonate, alunite, gypsum, hematite, goethite were identified and mapped. Sequently, the field examination and spectrometry, some important fault and lithology interpretation were carried out. Based on above works, several important problems related with application of hyper-spectral information to uranium exploration were studied. Some new advances were achieved given below for communication.

1. The difference in comparative temperature and PH conditions for three kind minerals of Al-rich sericite, Al-medium sericite, Al-poor sericite identified by SASI airborne hyper-spectral remote sensing was proposed specifically. By means of microscopic studies, X-ray diffraction of whole rock and clay mineral, electro-probe analysis, and analysing and investigating their spatial distribution characteristics, Al-rich sericite and Al-poor sericite was considered be formed in the hydrothermal fluid environment with a comparative higher temperature and acidity, and with a comparative lower temperature and alkalinity respectively, while the Al-medium sericite was both accompanied in the evolution of Al-rich sericite and Al-poor sericite.

2. The hydro-mica related with uranium mineralization was discovered to be Al-rich sericite. Through studies on the spatial distribution relationship between uranium mineralization and Al-rich sericite, Al-medium sericite, Al-poor sericite in Baiyanghe U deposit and other U dots in surface and deep drill-hole, it was found that uranium mineralization in volcanic rock was mostly related with Al-rich sericite, and partly Al-medium sericite, rather than Al-low sericite. The Al-OH absorption wavelength for hydro-mica associated with U mineralization was focused on the range of 2200nm～2210nm.

3. Three new type of mineral assemblage favourable for U ore-forming based on the metallogenic geochemical barrier were proposed by studying the alteration characteristics of Baiyanghe U deposit and other U mineralization dots. They were: (1)Pyropyllite/alunite/dickite(acidity)→Al-rich sericite(weak acidity)→Al-poor sericite (weak alkaline) assemblage.(2) Al-rich sericite (weak acidity) →Al-poor sericite (weak alkaline) assemblage.(3)Hametite(oxidiation)+Al-rich sericite(weak acidity)→Hametite(oxidiation)+Al-poor sericite(weak alkaline) assemblage. The three new mineral assemblages provide an important analysis idea for these mapping minerals spatially distributed in different place but relational by fault or other form. In past, hyper-spectral mapping minerals were used to make prospecting mostly by sole mineral or several minerals coexisted in the same place.

4. Good application effects were made in study area to U and Au, Cu exploration. Using airborne hyper - spectral information and above new analysis minds, many of areas favourable for U, Au, Cu exploration were targeted. More than ten anomalies of U, Au, Cu mineralization were found by field radiometric survey and chemical analysis of alteration rock sample. Three areas were evaluated to have great exploration potential respectively for U and Au and Cu by some trenching confirmation.

References:

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