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Identifying and Mapping Alteration Minerals Using HySpex Airborne Hyperspectral Data in the Yudai Porphyry Cu (Au, Mo) Mineralization, Kalatag District, NW China

Wang Shanshan
Xinjiang Institute of Ecology and Geography, State Key Laboratory of Desert and Oasis Ecology, Chinese Academy of Sciences, Urumqi, China (wangshanshan@ms.xjb.ac.cn)

Airborne hyperspectral remote sensing data provide a wide range of rapid, non-destructive and near laboratory quality reflectance spectra for mineral mapping and lithological discrimination, thereby ushering an innovative era of remote sensing. In this study, NEO HySpex cameras, which comprise 504 spectral channels in the spectral ranges of 0.4–1.0 μm and 1.0–2.5 μm, were mounted on a delta wing XT-912 aircraft. The designed flexibility and modular nature of the HySpex aircraft hyperspectral imaging system made it relatively easy to test, transport, install, and remove the system multiple times before the acquisition flights. According to the design fight plan, including the route distance, length, height, and flight speed, we acquired high spectral and spatial resolutions airborne hyperspectral images of Yudai porphyry Cu (Au, Mo) mineralization in Kalatag District, Eastern Tianshan terrane, Northwest China.

Using hyperspectral images on our own HySpex airborne flight, we extracted and identified alteration mineral assemblages of the Yudai porphyry Cu (Au, Mo) mineralization (Kalatag District, northwest China). The main objectives of this study were to (1) acquire HySpex airborne hyperspectral images of the Yudai Porphyry Cu (Au, Mo) mineralization, (2) determine a workflow for processing HySpex images, and (3) identify alteration minerals using a random forest (RF) algorithm and a comprehensive field survey.

By comparing the features of the HySpex hyperspectral data and standard spectra data from the United States Geological Survey database, endmember pixels of spectral signatures for most alteration mineral assemblages (goethite, hematite, jarosite, kaolinite, calcite, epidote, and chlorite) were extracted. After a HySpex data processing workflow, the distribution of alteration mineral assemblages (iron oxide/hydroxide, clay, and propylitic alterations) was mapped using the random forest (RF) algorithm. The experiments demonstrated that the workflow for processing data and RF algorithm is feasible and active, and show a good performance in classification accuracy. The overall classification accuracy and Kappa classification of alteration mineral identification were 73.08 and 65.73%, respectively. The main alteration mineral assemblages were primarily distributed around pits and grooves, consistent with field-measured data. Our results confirm that HySpex airborne hyperspectral data have potential application in basic geology survey and mineral exploration, which provide a viable alternative for mineral mapping and

identifying lithological units at a high spatial resolution for large areas and inaccessible terrains.