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Spectroscopic Mapping of the White Horse Alunite Deposit, Marysvale Volcanic Field, Utah: Evidence of a Magmatic Component

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Abstract

Previous studies have demonstrated that the replacement alunite deposits just north of the town of Marysvale, Utah, USA, were formed primarily by low-temperature (100º–170º C), steam-heated processes near the early Miocene paleoground surface, immediately above convecting hydrothermal plumes. Pyrite-bearing propylitically altered rocks occur mainly beneath the steam-heated alunite and represent the sulfidized feeder zone of the H_2S-dominated hydrothermal fluids, the oxidation of which at higher levels led to the formation of the alunite. Maps of surface mineralogy at the White Horse deposit generated from Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) data were used in conjunction with X-ray diffraction studies of field samples to test the accuracy and precision of AVIRIS-based mineral mapping of altered rocks and demonstrate the utility of spectroscopic mapping for ore deposit characterization. The mineral maps identified multiple core zones of alunite that grade laterally outward to kaolinite. Surrounding the core zones are dominantly propylitically altered rocks containing illite, montmorillonite, and chlorite, with minor pyrite, kaolinite, gypsum, and remnant potassium feldspar from the parent rhyodacitic ash-flow tuff. The AVIRIS mapping also identified fracture zones expressed by ridge-forming selvages of quartz + dickite + kaolinite that form a crude ring around the advanced argillic core zones. Laboratory analyses identified the aluminum phosphate-sulfate (APS) minerals woodhouseite and svanbergite in one sample from these dickite-bearing argillic selvages. Reflectance spectroscopy determined that the outer edges of the selvages contain more dickite than do the medial regions. The quartz + dickite ± kaolinite ± APS-mineral selvages demonstrate that fracture control of replacement processes is more prevalent away from the advanced argillic core zones. Although not exposed at the White Horse deposit, pyrophyllite ± ordered illite was identified using AVIRIS in localized, superimposed conduits within propylitically altered rocks in nearby alteration systems of similar age and genesis that have been eroded to deeper levels. The fracture zones bearing pyrophyllite, illite, dickite, natroalunite, and/or APS minerals indicate a magmatic component in the dominantly steam-heated system.

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