

USE OF IMAGING SPECTROSCOPY DATA AS A PALEOTHERMOMETER MAPPING TOOL
FOR THE STUDY OF HYDROTHERMAL ALTERATION AREAS
SUCH AS CUPRITE, NEVADA, U.S.A. (Topic #2)

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Analysis of the spectral properties of minerals can be used to derive information about their chemical composition and geologic history. When this laboratory information is used to create mineral maps with data acquired by imaging spectrometers, geologic relationships are revealed on a grand scale in unprecedented detail.

Mineral abundance maps of 15 minerals were made of the Cuprite Mining District, Nevada using 1990 Advanced Visual and Infra-Red Imaging Spectrometer (AVIRIS) data and the Clark et al. (1990) Multiple Spectral Features Mapping Algorithm. This technique uses a modified least-squares fitting of isolated features from a laboratory reference spectrum to corresponding features in reflectance-calibrated AVIRIS data. Multiple features of each AVIRIS spectrum were simultaneously fit to multiple reference mineral spectra. Within the program a decision process judging among the best fitting reference minerals was used to derive the mineral(s) present in the spectrum of each pixel. Information from this selection process was then combined into images of each mineral found in the AVIRIS scene.

The Cuprite region consists of two "bull's eye" patterns of acid-sulfate hydrothermal alteration centers straddling U.S. Highway 95 in southwestern Nevada. Mineral abundance maps derived from AVIRIS data of the area show that the western center is zoned from sericite, at the exterior, to halloysite-dickite, kaolinite, Na-alunite, through K-alunite with halloysite in the interior. The eastern center is similarly zoned from halloysite, at the exterior, to kaolinite, intermediate (Na-K) alunite, through K-alunite, with a central core of siliceous sinter. Our study of the alunite distribution at Cuprite has lead to new insights on the spectral properties of alunite.

Laboratory spectral analysis of natural and synthetic alunite samples show complex variations in the wavelength position of the 2.2- μ m features thus enabling us to map alunite solid-solution composition using AVIRIS data. Synthetic alunite endmember compositions have 2.2- μ m spectral features which deepen and widen with increasing temperature. We theorize that, as alunite is heated, internal hydronium dissociates creating new hydroxyl bonds between sulfate oxygens and the hydrogen left from the hydronium dissociation. Apparently the increase of hydroxyl bonds is proportional to the maximum temperature achieved by the alunite and is spectrally displayed as a strengthening of the 2.2- μ m features. These changes can be measured with sufficient accuracy in AVIRIS data to create remotely sensed maps of hydrothermal paleotemperatures.

Alunite hydrothermal temperature maps of Cuprite derived from AVIRIS data show that the western center was hotter, implying it was once originally deeper than the eastern center. Geologic field relations indicate that both alteration centers were originally a single hydrothermal conduit, which was later faulted by the collapse of the Stonewall Caldera around 7.6 million years ago. Faulting exposed the shallower portion of the hydrothermal system in the eastern center and the deeper root in the western center. This new understanding, gained by examining the AVIRIS data, may help in the search for gold and other precious metals in the Cuprite Area.

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ABSTRACT

This paper presents an analysis of the results obtained by using colorimetric methods. On the other hand, a comparison of the samples taken from the same locations (Algeria), has been made with the studied soils. This will allow us to identify the sources of pollution. As to the quantification of the heavy metals, the extraction of the elements from the soil is the first view.

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INTRODUCTION

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