Economic Geology
Vol. 98, 2003, pp. 1019–1027

SCIENTIFIC COMMUNICATIONS

MAPPING HYDROTHERMALLY ALTERED ROCKS AT CUPRITE, NEVADA, USING THE ADVANCED SPACEBORNE THERMAL EMISSION AND REFLECTION RADIOMETER (ASTER), A NEW SATELLITE-IMAGING SYSTEM

Lawrence C. Rowan,[†]

U.S. Geological Survey, Mail Stop-954, Reston, Virginia 20192

Simon J. Hook, Michael J. Abrams,

Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, California 91109-8099

and John C. Mars

U.S. Geological Survey, Mail Stop-954, Reston, Virginia 20192

Abstract

The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) is a 14-band multispectral instrument on board the Earth Observing System (EOS), TERRA. The three bands between 0.52 and 0.86 μm and the six bands from 1.60 and 2.43 μm, which have 15- and 30-m spatial resolution, respectively, were selected primarily for making remote mineralogical determinations.

The Cuprite, Nevada, mining district comprises two hydrothermal alteration centers where Tertiary volcanic rocks have been hydrothermally altered mainly to bleached silicified rocks and opalized rocks, with a marginal zone of limonitic argillized rocks. Country rocks are mainly Cambrian phyllitic siltstone and limestone.

Evaluation of an ASTER image of the Cuprite district shows that spectral reflectance differences in the nine bands in the 0.52 to 2.43 μm region provide a basis for identifying and mapping mineralogical components which characterize the main hydrothermal alteration zones: opal is the spectrally dominant mineral in the silicified zone; whereas, alunite and kaolinite are dominant in the opalized zone. In addition, the distribution of unaltered country rocks was mapped because of the presence of spectrally dominant muscovite in the siltstone and calcite in limestone, and the tuffaceous rocks and playa deposits were distinguishable due to their relatively flat spectra and weak absorption features at 2.33 and 2.20 μm, respectively.

An Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) image of the study area was processed using a similar methodology used with the ASTER data. Comparison of the ASTER and AVIRIS results shows that the results are generally similar, but the higher spectral resolution of AVIRIS (224 bands) permits identification of more individual minerals, including certain polymorphs. However, ASTER has recorded images of more than 90 percent of the Earth's land surface with less than 20 percent cloud cover, and these data are available at nominal or no cost. Landsat TM images have a similar spatial resolution to ASTER images, but TM has fewer bands, which limits its usefulness for making mineral determinations.

[†]Corresponding author: e-mail, lrowan@usgs.gov

0361-0128/01/3366/1019-9 $6.00