# Using hyperspectral imagery to map hydrothermal alteration mineralogy over the epithermal system of the Yerington district (USA)

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This study examines spectrally active alteration minerals associated with various hydrothermal alteration events, some of which are related to mineralisation while others are not. To identify and visualize muscovite-pyrophyllite intergrowth, the study utilizes high spatial resolution airborne and laboratory-based hyperspectral images in the shortwave infrared (SWIR) over the Buckskin Range, the volcanic-hosted lithocap portion of the Yerington porphyry district in Nevada, USA.

Hydrothermal alteration mineralogy is mapped at the laboratory (26 μm), and airborne (1 m) scales using spectral wavelength maps in different SWIR ranges. The Al-OH absorption feature's wavelength position variability characterises outward zoning from alunite ± pyrophyllite to muscovite in the airborne spectral data. To differentiate zones of pyrophyllite predominance over alunite within the inner domain, the 1650–1850 nm wavelength range is used. The hydrothermal alteration mineralogy is characterised by alunite, pyrophyllite, muscovite, dickite, chlorite, topaz, and zunyite, which are improved by the laboratory data. A novel spectral index, the pyrophyllite-muscovite index (PMI), is developed to address the textural relationship of muscovite replacing pyrophyllite. Two aspects are considered in characterising intergrowths of pyrophyllite and muscovite at the laboratory scale: (1) the definition of pervasive versus veinlet-controlled textures and (2) a subtle shift detection in the wavelength position of the Al-OH absorption feature of muscovite from 2189 to 2195 nm. The muscovite replacement of pyrophyllite can be identified by combining spatial patterns with the textural relationship of the pyrophyllite-muscovite association. The late muscovite replacement of pyrophyllite indicates advanced argillic alteration due to intense acid leaching followed by late near-neutral pH magmatic-hydrothermal fluids that add K+ and potentially other alkali elements and metals in the epithermal environment. This study documents the hydrothermal muscovite-pyrophyllite intergrowth relationship. It contributes to a better understanding of the lithocap epithermal system and an improved assessment of its exploration potential for Au, Ag, and Cu mineralisation.

***Keywords:*** Hydrothermal alteration; hyperspectral images; Yerington porphyry