DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

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39°00'

38°52'30"

113°00'

112°52'30"

0 1 Mile

0 1 Kilometer

SCALE 1:24000

PRELIMINARY DIGITAL CLASSIFICATION MAP OF LIMONITIC ROCKS CANDLAND SPRING 7½' QUADRANGLE, UTAH

By
M.H. Podwysocki and D.B. Segal

This preliminary map is the result of a digital classification of Landsat MSS (Multispectral Scanner) ratio data for mapping limonitic rocks as possible indicators of hydrothermal alteration. The term limonite is used as defined by Blanchard (1968), and covers a wide variety of materials including goethite, hematite, jarosite and lepidocrosite, among others. The printer characters on the map depict the unit area of a Landsat resolution element, a picture element (pixel) 80 meters square. Location accuracy of the pixels on this map is at worst ± 160 meters, and is in most cases ± 80 meters.

Landsat MSS ratios 4/5, 4/6 and 5/6 were used as variables in a supervised Euclidean Distance classifier. A color-ratio composite image (Rowan and others, 1974) was used as an aid in defining training areas necessary for a supervised classification. Spectral signatures for 12 classes of limonitic rocks were derived from the Landsat data. Based on the geology of known areas and the relative mean values in the ratios, the limonitic rocks were divided into three categories (fig. 1):

1) Strongly limonitic - rocks with a low 4/5 ratio and a relatively lower 4/6 ratio. Typically, these rocks appear red, vermillion, a strong yellow, pink, etc.

2) Weakly limonitic - rocks with a higher 4/5 ratio than the prior category; the 4/6 ratio is approximately the same value as 4/5. Some dark to medium brown rocks fall into this category.

3) Limonitic rocks with a thin vegetation cover. These rocks have 4/5 ratios comparable to the stongly limonitic category, but their 4/6 and 5/6 ratios are lower, reflecting the influence of vegetation. Vegetative cover may be as high as 40-50%.

Twelve classes of non-limonitic rocks were defined for comparative purposes. All were assigned to the "other" (non-limonitic rocks) category in the map classification. Efforts were not as exhaustive in defining all possible non-limonitic categories, as they were not as pertinent to the study. Those pixels which did not fall into any of the above categories are left blank in the classification map. Commonly, the blank areas represent heavy vegetation, areas of strong shadows in the raw MSS data, or playa surfaces. Occasionally, some pixels were unclassified for none of the above reasons. These fell mainly into the non-limonitic category and their omission from the classification was due to the non-exhaustive training on non-limonitic materials.

The following is a summary of classification results for the majority of the Richfield 1° x 2° quadrangle, and all tentative conclusions may not necessarily apply to this quadrangle. Generally, all known hydrothermally altered limonitic rocks fell into the strongly limonitic category. However, non-altered limonitic rocks were also classified into this category, such as pink tuff, purple quartzite, limonitically stained limestone, etc. Many strongly limonitic areas are fringed by weakly limonitic zones, presumably reflecting the dimunition in the amount of limonite away from the source. The weakly limonitic rocks cannot altogether be ignored, as some relatively small altered areas were classified into this category. Because of the non-uniqueness of the limonite signatures, field checking, examination of available geologic data and studying the spatial relationships of the limonitic areas are necessary to make a judgment as to the significance of the limonitic rocks.

Rowan, L.C., Wetlaufer, P.H., Goetz, A.F.H., Billingsley, F.C., Stewart, J.H., 1974, Discrimination of rock types and altered areas in Nevada by the use of ERTS imagery, U.S. Geol. Survey Prof. Paper 883, 35p.

Blanchard, R., 1968, Interpretation of leached outcrops, Nevada Bur. Mines Geol. Bull. 66, 196p.

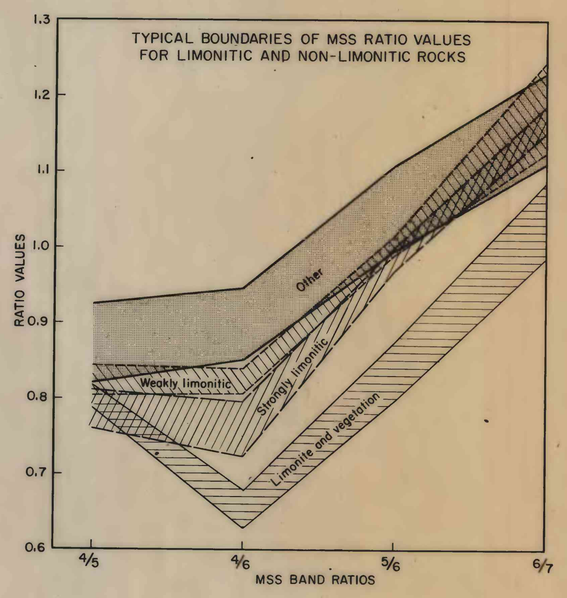

Figure 1 The lines bounding each category represent the extreme mean values for each ratio within a category. Generally, the shape of the bounding limits reflects the shape of the ratio curves for any class within the category. The overlap between categories is misleading, as each of the individual classes within a category has a distinctive set of mean ratio values that is separable from other classes within that category and from all other classes. Standard deviations associated with each of the ratio mean values typically range from 0.02 - 0.05.

EXPLANATION

- Strongly limonitic rocks
- Weakly limonitic rocks
- Limonitic rocks and vegetation
- Non-limonitic rocks
- Unclassified materials

This map is preliminary and has not been edited or reviewed for conformity with Geological Survey standards