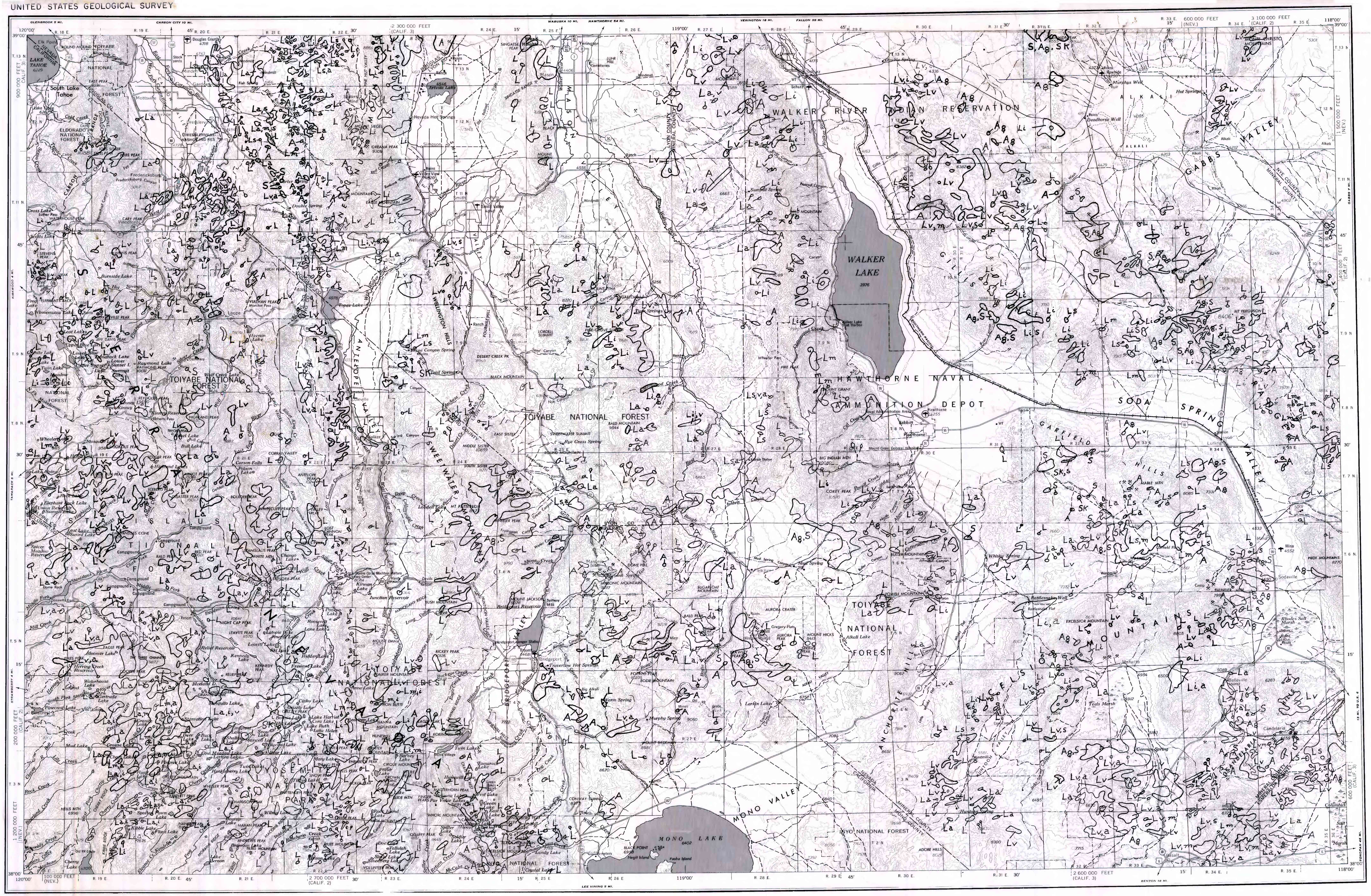
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

OPEN FILE REPORT 80-931



PRELIMINARY MAP SHOWING DISTRIBUTION OF ALTERED ROCKS AND LIMONITIC UNALTERED ROCKS IN THE WALKER LAKE 1° BY 2° QUADRANGLE, NEVADA-CALIFORNIA

By
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1980

U.S.Geological Survey
OPEN FILE MAP

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

The Walker Lake 1°x2° quadrangle, Nevada - California, is being evaluated as part of the Conterminous U.S. Mineral Appraisal Program (CUSMAP). A multidisciplinary approach involving analyses of geologic, remote-sensing, geophysical, and geochemical data is being used in CUSMAP to delineate areas within selected 1°x2° quadrangles that have significant potential for mineral discovery.

Remote-sensing techniques are being used to map the generalized distribution of altered rocks in the Walker Lake quadrangle and to aid in delineation of structural features, especially fault and fracture zones. This map showing the distribution of altered rocks is not yet complete but is being released at this time in order to stimulate comments and contributions from individuals concerning the distribution of altered rocks in specific areas. Compilation of this map was accomplished through field evaluation of areas that were determined to consist of limonitic bedrock (Rowan and others, 1980) by study of color-ratio composite Landsat Multispectral Scanner (MSS) images (Rowan and others, 1974, 1977).

Field evaluation of the limonitic areas has been time consuming because of several limitations that are inherent in this approach to compiling a regional map of altered rocks and because of the generally difficult access to many parts of the quadrangle. The most important limitations are the following: (1) limonitic altered rocks and limonitic unaltered rocks, such as those listed in the explanation, cannot be distinguished in the Landsat color-ratio composite images, (2) altered rocks that are not limonitic are not consistently detectable through analysis of the radiance data from the spectral bands of Landsat 1, 2, and 3 (Rowan and others, 1974; Abrams and others, 1977), (3) vegetation that is more dense than approximately 40 percent obscures limonitic bedrock (Rowan and Abrams, 1978), and (4) limonitic areas that are smaller than a MSS resolution element (79 m) are generally not detectable. Nevertheless, the occurrences of limonitic bedrock, as mapped in Landsat MSS color-ratio composite images, provide the most practical basis for compiling a map of altered rocks in the Walker Lake quadrangle.

Altered Rocks

Altered rocks in the Walker Lake quadrangle have been divided into six broad categories (see map explanation). Silicified rocks (Unit S) have undergone extensive cation leaching, commonly resulting in porous fine-grained masses of silica and minor argillic materials. Alunite is common, and kaolinite and pyrophyllite may be locally abundant. Some of these rocks are deficient in ferric iron and, therefore, cannot be consistently detected in the Landsat images; areas containing these rocks were mapped in the field.

Argillized rocks (Unit Ag) have kaolinite and montmorillonite as the dominant minerals. Sericitized rocks are included in this category owing to their limited distribution within the quadrangle. Many areas consist of both silicified and argillized rocks; the most abundant rock type appears first in map units (e.g., silicified and argillized rocks are Unit S, Ag, and argillized and silicified rocks are Unit Ag, S. Skarn deposits (Unit Sk) are mapped separately. Propylitized rocks are common in some parts of the quadrangle, but occurrences of these rocks are not shown in this map because they are generally not detectable in the Landsat MSS images.

This division of rocks and placement of the altered areas into these categories are based on brief field evaluation and are, therefore, tentative. Many areas, some of which encompass important mining districts, have not yet been categorized (Unit A). The map and categorization of the altered rocks will be refined as field studies progress and information is submitted by others familiar with the area.

Limonitic Unaltered Rocks

Limonite-stained but unaltered rocks have been divided into five broad categories. The distribution of these rocks is shown on this preliminary map to document the field observations concerning these rocks. Limonitic tuffs, flow rocks, and lahars are the most widespread unit (Unit Lv). In most areas where Unit Lv is exposed, the limonitic stain appears to be a result of weathering, but locally, cooling processes produced limonitic coatings. Some intrusive rocks (Unit Li), ranging from granitic to dioritic compositions, weather to limonite-stained surfaces owing to the oxidation of biotite, hornblende, and opaque minerals. Limonite is especially conspicuous where weathering has been accelerated along fracture zones. The sources of iron-oxide minerals in the limonitic metavolcanic and metasedimentary (Unit Lm) and sedimentary rocks (Unit Ls) are generally depositional and regional metamorphic processes rather than hydrothermal processes, but the distinction between original and hydrothermal limonite is difficult to make where both types are present. Unit La includes limonitic alluvial deposits and limonitic residual soil in the Sierra Nevada part of the quadrangle. Many areas consist of more than one of these broad categories of rocks; for these areas, the order of suffix symbols (v,i,m, etc.) indicates the relative abundance of the rock types. Unit L represents areas that consist of limonitic bedrock (Rowan and others, 1980) but have not been evaluated in the field.

Field evaluation of the limonitic bedrock map produced from the Landsat color-ratio composit images (Rowan and others, 1980) was conducted by the authors of this map and by others working in the area. We are particularly grateful for the contributions of the individuals named below:

Richard Armin, U.S. Geological Survey, Menlo Park, Calf.
Edward C. Bingler, Montana Bureau of Mines & Geology, Butte, Mont.
George Bergantz, U.S. Geological Survey, Menlo Park, Calf.
William Buckingham, U.S. Geological Survey, Reston, Va.
Maurice Chaffee, U.S. Geological Survey, Denver, Colo.
Christopher French, U.S. Geological Survey, Reston, Va.
Larry J. Garside, Nevada Bureau of Mines & Geology, Reno, Nev.
Richard F. Hardyman, Boise State University, Boise, Id.
N. King Huber, U.S. Geological Survey, Menlo Park, Calf.
Donald M. Hudson, University of Nevada, Reno, Nev.
Dann Johannesen, U.S. Geological Survey, Menlo Park, Calf.
William J. Keith, U.S. Geological Survey, Menlo Park, Calf.
Marguerite Kingston, U.S. Geological Survey, Reston, Va.
Frank J. Kleinhampl, U.S. Geological Survey, Menlo Park, Calf.
William J. Moore, U.S. Geological Survey, Menlo Park, Calf.
David Burton Slemmons, University of Nevada, Reno, Nev.
John H. Stewart, U.S. Geological Survey, Menlo Park, Calf.
Steve Weaver, U.S. Geological Survey, Menlo Park, Calf.

Although the information provided by these individuals is critical to the completion of a map showing the distribution of altered rocks in this quadrangle, the authors are responsible for the overall accuracy of this map.

Many limonitic areas have not been evaluated, and we hereby request information concerning the mineralogical compositions and textures of the rocks in these areas. In addition, suggested revisions of the map pattern and descriptions of previously evaluated areas will be carefully considered because of the limited amount of time that we devoted to most individual areas. Please submit this information to either author at the following address:

U.S. Geological Survey
National Center, Mail Stop 927
Reston, VA 22092

REFERENCES CITED

Abrams, M.J., Ashley, R.P., Rowan, L.C., Goetz, A.F.H., and Kahle, A.B., 1977, Mapping of hydrothermal alteration in the cuprite mining district, Nevada, using aircraft scanner images for the spectral region 0.46 to 2.36 µm: Geology, v. 5, no. 12, p. 736-738.

Rowan, L.C., Wetlaufer, P.H., Goetz, A.F.H., Billingsley, F.C., and Stewart, J.H., 1974, Discrimination of rock types and detection of hydrothermally altered areas in south-central Nevada by the use of computer-enhanced ERTS images: U.S. Geological Survey Prof. Paper 883, 35p.

Rowan, L.C., Goetz, A.F.H., and Ashley, R.P., 1977, Discrimination of hydrothermally altered and unaltered rocks in visible and near infrared multispectral images: Geophysics, v. 42, p. 522-535.

Rowan, L.C., and Abrams, M.J., 1978, Evaluation of Landsat multispectral scanner images for mapping altered rocks in the East Tintic Mountains, Utah: U.S. Geol. Survey Open-File Rept. 78-736, 73p.

Rowan, L.C., Krohn, M.D., and Purdy, T.L., 1980, Generalized map of the occurrences of limonitic rocks in the Walker Lake 1° by 2° quadrangle, Nevada-California: U.S. Geol. Survey Open-File Rept. 80-232, 1 sheet, scale 1:250,000.

EXPLANATION

Altered Rocks

S - Silicified rock

Ag - Argillized rock

S,Ag - Silicified and argillized rocks, silicified rock dominant

Ag,S - Argillized and silicified rocks, argillized rock dominant

Sk - Skarn deposit

A - Altered rocks, undifferentiated

Limonitic Unaltered Rocks

Lv - Tuffs, flow rocks, and lahar deposits

Li - Intrusive rocks, generally granite, granodiorite, or quartz diorite

Lm - Metasedimentary and metavolcanic rocks

Ls - Sedimentary rocks, including shale, siltstone, limestone, dolomite, and chert

La - Alluvial deposits, including upland gravel deposits, glacial deposits, and lateritic soil in the Sierra Nevada

Many areas consist of more than one of these broad categories of rocks; for these areas, the order of suffix symbols (v,i,m, etc.) indicates the relative abundance of rock types.

Limonitic Bedrock

L - Unevaluated areas consisting of limonitic bedrock