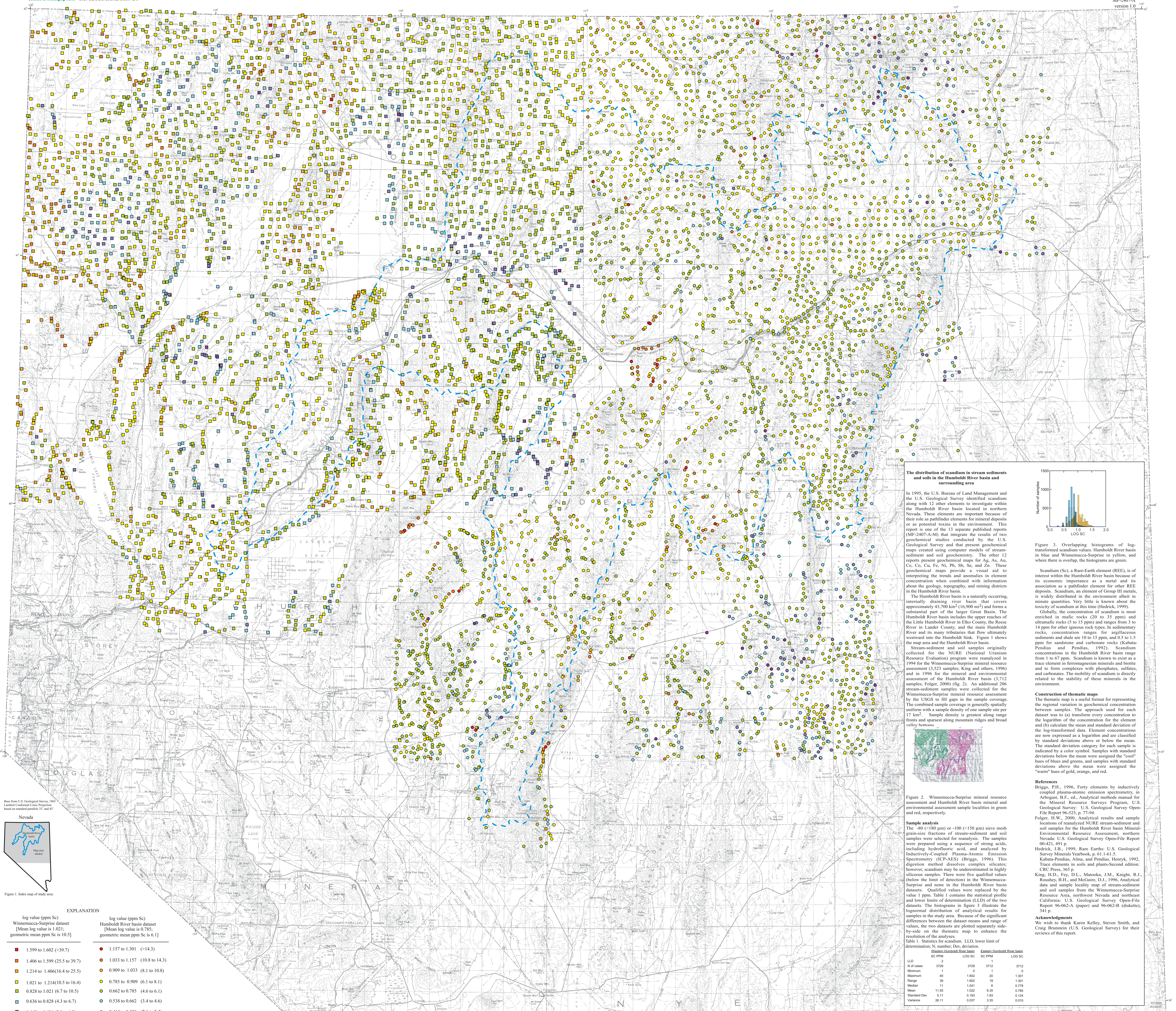
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES MAP
MF-2407-A
version 1.0



Base from U.S. Geological Survey, 1965
Lambert Conformal Conic Projection
based on standard parallels 33˚ and 45˚

Nevada

Figure 1. Index map of study area.

EXPLANATION

log value (ppm Sc) Winnemucca-Surprise dataset [Mean log value is 1.021; geometric mean ppm Sc is 10.5]	log value (ppm Sc) Humboldt River basin dataset [Mean log value is 0.785; geometric mean ppm Sc is 6.1]
1.599 to 1.602 (>39.7)	1.157 to 1.301 (>14.3)
1.406 to 1.599 (25.5 to 39.7)	1.033 to 1.157 (10.8 to 14.3)
1.214 to 1.406 (16.4 to 25.5)	0.909 to 1.033 (8.1 to 10.8)
1.021 to 1.214 (10.5 to 16.4)	0.785 to 0.909 (6.1 to 8.1)
0.828 to 1.021 (6.7 to 10.5)	0.662 to 0.785 (4.6 to 6.1)
0.636 to 0.828 (4.3 to 6.7)	0.538 to 0.662 (3.4 to 4.6)
0.443 to 0.636 (2.8 to 4.3)	0.414 to 0.538 (2.6 to 3.4)
0 to 0.443 (<2.8)	0 to 0.414 (<2.6)

Humboldt River basin boundary

The distribution of scandium in stream sediments and soils in the Humboldt River basin and surrounding area

In 1995, the U.S. Bureau of Land Management and the U.S. Geological Survey identified scandium along with 12 other elements to investigate within the Humboldt River basin located in northern Nevada. These elements are important because of their role as pathfinder elements for mineral deposits or as potential toxins in the environment. This report is one of the 13 separate published reports (MF-2407-A-M) that integrate the results of two geochemical studies conducted by the U.S. Geological Survey and that present geochemical maps created using computer models of stream-sediment and soil geochemistry. The other 12 reports present geochemical maps for Ag, As, Au, Ce, Co, Cu, Fe, Ni, Pb, Sb, Se, and Zn. These geochemical maps provide a visual aid to interpreting the trends and anomalies in element concentration when combined with information about the geology, topography, and mining districts in the Humboldt River basin.

The Humboldt River basin is a naturally occurring, internally draining river basin that covers approximately 43,700 km^2 (16,900 mi^2) and forms a substantial part of the larger Great Basin. The Humboldt River basin includes the upper reaches of the Little Humboldt River in Elko County, the Reese River in Lander County, and the main Humboldt River and its many tributaries that flow ultimately westward into the Humboldt Sink. Figure 1 shows the map area and the Humboldt River basin.

Stream-sediment and soil samples originally collected for the NURE (National Uranium Resource Evaluation) program were reanalyzed in 1994 for the Winnemucca-Surprise mineral resource assessment (3,523 samples; King and others, 1996) and in 1996 for the mineral and environmental assessment of the Humboldt River basin (3,712 samples; Folger, 2000) (fig. 2). An additional 206 stream-sediment samples were collected for the Winnemucca-Surprise mineral resource assessment by the USGS to fill gaps in the sample coverage. The combined sample coverage is generally spatially uniform with a sample density of one sample site per 17 km^2. Sample density is greatest along range fronts and sparsest along mountain ridges and broad valley bottoms.

Figure 2. Winnemucca-Surprise mineral resource assessment and Humboldt River basin mineral and environmental assessment sample localities in green and red, respectively.

Sample analysis

The -80 (<180 µm) or -100 (<150 µm) sieve mesh grain-size fractions of stream-sediment and soil samples were selected for reanalysis. The samples were prepared using a sequence of strong acids, including hydrofluoric acid, and analyzed by Inductively-Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) (Briggs, 1996). This digestion method dissolves complex silicates; however, scandium may be underestimated in highly siliceous samples. There were five qualified values (below the limit of detection) in the Winnemucca-Surprise and none in the Humboldt River basin datasets. Qualified values were replaced by the value 1 ppm. Table 1 contains the statistical profile and lower limits of determination (LLD) of the two datasets. The histograms in figure 3 illustrate the lognormal distribution of analytical results for samples in the study area. Because of the significant differences between the dataset means and range of values, the two datasets are plotted separately side-by-side on the thematic map to enhance the resolution of the analyses.

Table 1. Statistics for scandium. LLD, lower limit of determination; N, number; Dev, deviation.

	Western Humboldt River basin		Eastern Humboldt River basin	
	SC PPM	LOG SC	SC PPM	LOG SC
LLD	2		1	
N of cases	3729	3729	3712	3712
Minimum	1	0	1	0
Maximum	40	1.602	20	1.301
Range	39	1.602	19	1.301
Median	11	1.041	6	0.778
Mean	11.55	1.022	6.35	0.785
Standard Dev	5.11	0.193	1.83	0.124
Variance	26.11	0.037	3.35	0.015

Figure 3. Overlapping histograms of log-transformed scandium values. Humboldt River basin in blue and Winnemucca-Surprise in yellow, and where there is overlap, the histograms are green.

Scandium (Sc), a Rare-Earth element (REE), is of interest within the Humboldt River basin because of its economic importance as a metal and its association as a pathfinder element for other REE deposits. Scandium, an element of Group III metals, is widely distributed in the environment albeit in minute quantities. Very little is known about the toxicity of scandium at this time (Hedrick, 1999).

Globally, the concentration of scandium is most enriched in mafic rocks (20 to 35 ppm) and ultramafic rocks (5 to 15 ppm) and ranges from 3 to 14 ppm for other igneous rock types. In sedimentary rocks, concentration ranges for argillaceous sediments and shale are 10 to 15 ppm, and 0.5 to 1.5 ppm for sandstone and carbonate rocks (Kabata-Pendias and Pendias, 1992). Scandium concentrations in the Humboldt River basin range from 1 to 67 ppm. Scandium is known to exist as a trace element in ferromagnesian minerals and biotite and to form complexes with phosphates, sulfates, and carbonates. The mobility of scandium is directly related to the stability of these minerals in the environment.

Construction of thematic maps

The thematic map is a useful format for representing the regional variation in geochemical concentration between samples. The approach used for each dataset was to (a) transform every concentration to the logarithm of the concentration for the element and (b) calculate the mean and standard deviation of the log-transformed data. Element concentrations are now expressed as a logarithm and are classified by standard deviations above or below the mean. The standard deviation category for each sample is indicated by a color symbol. Samples with standard deviations below the mean were assigned the "cool" hues of blues and greens, and samples with standard deviations above the mean were assigned the "warm" hues of gold, orange, and red.

References

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Kabata-Pendias, Alina, and Pendias, Henryk, 1992, Trace elements in soils and plants-Second edition: CRC Press, 365 p.

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Acknowledgments

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SCALE 1:500,000

10 0 10 20 30 40 MILES

10 0 10 20 30 40 50 KILOMETERS

CONTOUR INTERVAL 500 FEET

NATIONAL VERTICAL GEODETIC DATUM OF 1929

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For sale by U.S. Geological Survey Information Services
Box 25286, Federal Center, Denver, CO 80225

This map was produced on request, directly from digital files, on an electronic plotter. It is also available as a PDF file at http://geology.cr.usgs.gov

Map Showing Scandium Concentrations from Stream Sediments and Soils Throughout the Humboldt River Basin and Surrounding Areas, Northern Nevada

By
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2003