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

MISCELLANEOUS FIELD STUDIES MAP
MF-2407-C
version 1.0

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

By
Douglas B. Yager and Helen W. Folger
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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 Co) Winnemucca-Surprise dataset [Mean log value is 1.156; geometric mean ppm Co is 14]	log value (ppm Co) Humboldt River basin dataset [Mean log value is 0.917; geometric mean ppm Co is 8]
1.875 to 2.322 (>75)	1.464 to 1.756 (>29.1)
1.636 to 1.875 (43.3 to 75)	1.282 to 1.464 (19.1 to 29.1)
1.396 to 1.636 (24.9 to 43.3)	1.099 to 1.282 (12.56 to 19.1)
1.156 to 1.396 (14.3 to 24.9)	0.917 to 1.099 (8.26 to 12.56)
0.916 to 1.156 (8.2 to 14.3)	0.734 to 0.917 (5.4 to 8.26)
0.676 to 0.916 (4.7 to 8.2)	0.552 to 0.734 (3.56 to 5.4)
0.436 to 0.676 (2.7 to 4.7)	0.37 to 0.552 (2.34 to 3.56)
0.301 to 0.436 (<2.7)	0.146 to 0.37 (<2.34)

Humboldt River basin boundary

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

The distribution of cobalt 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 cobalt 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, Cu, Fe, Ni, Pb, Sb, Sc, 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 (3,549 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.

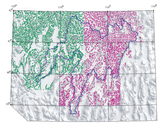

Figure 2. Winnemucca-Surprise mineral resource assessment and Humboldt River basin mineral and environmental assessment sample localities in green and red, respectively.

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, cobalt may be underestimated in highly siliceous samples. There were no qualified values (below the limit of detection) in the Winnemucca-Surprise and 22 qualified values in the Humboldt River basin datasets. Qualified values were substituted with the value of 1.4 ppm. Table 1 contains the statistical profile and lower limits of determination (LLD) of the two datasets. Figure 3 shows the lognormal distribution of the data. Because of the significant differences between the datasets' 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 cobalt. LLD, lower limit of determination; N, number; Dev, deviation.

	Winnemucca-Surprise		Humboldt River basin	
	CO PPM	LOG CO	CO PPM	LOG CO
LLD	1		2	
N of cases	3755	3755	3712	3712
Minimum	2	0.301	1.4	0.1461
Maximum	210	2.322	57	1.756
Range	208	2.021	56	1.756
Median	14	1.146	8	0.9031
Mean	16.7	1.156	9.0	0.9169
Standard Dev	10.6	0.240	4.0	0.1824
Variance	113.4	0.058	16.2	0.0333

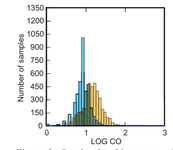

Figure 3. Overlapping histograms of log-transformed cobalt values. Humboldt River basin in blue and Winnemucca-Surprise in yellow, and where there is overlap, the histograms are green.

Cobalt (Co), a transition metal, occurs as a trace element in Cu-Ni-sulfide ores and forms minerals of complex sulfarsenides and sulfantimonides. It is considered an essential nutrient for plants; however, unusually high Co contents in soils may be toxic. (Kabata-Pendias and Pendias, 1992).

Globally, the concentration of cobalt is most enriched in ultramafic rocks (100 to 200 ppm) and mafic rocks (35 to 50 ppm) and ranges from 1 to 15 ppm for other igneous rock types. In sedimentary rocks, concentration ranges for argillaceous sediments and shale are 11 to 20 ppm, and 0.4 to 3 ppm for sandstone and carbonate rocks (Kabata-Pendias and Pendias, 1992). Cobalt concentrations in the Humboldt River basin range from < 2 to 210 ppm. The distribution of Co in the soils and sediments is strongly determined by the Mn-oxide phase present. Cobalt tends to be more mobile in soils that are oxidizing and acidic; however, the Fe and Mn-oxides adsorb mobilized Co before it can migrate far (Kabata-Pendias and Pendias, 1992).

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 data set 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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