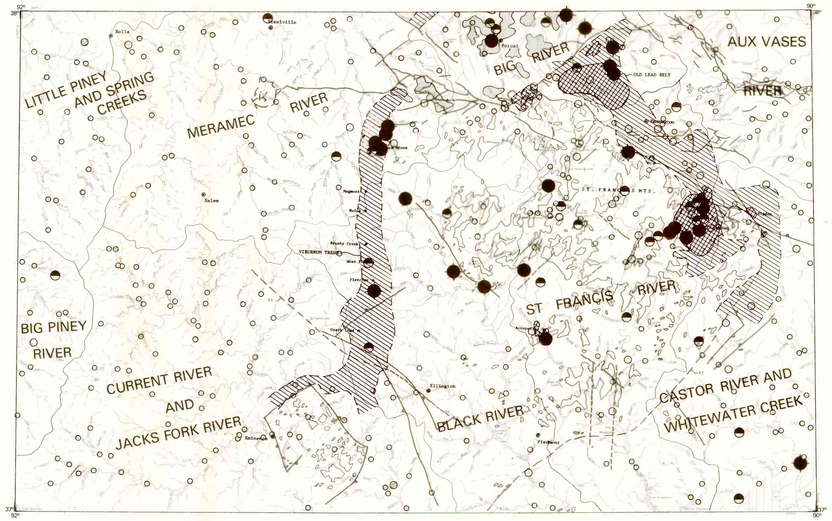
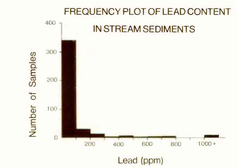
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

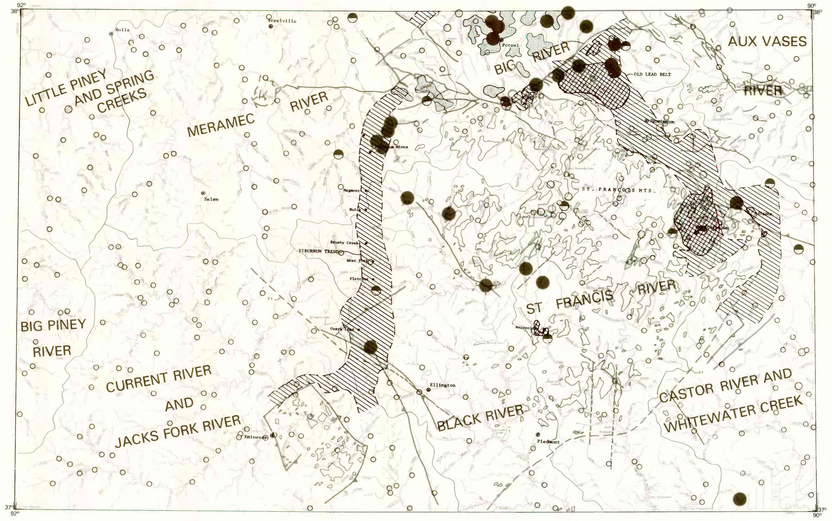
OPEN-FILE REPORT
82-388
SHEET 1 OF 2



Values of lead in ppm in stream sediment samples
- nd-99
- 100-199
- 200-499
- 500-999
- 1000+

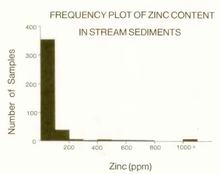
Map A.--Lead

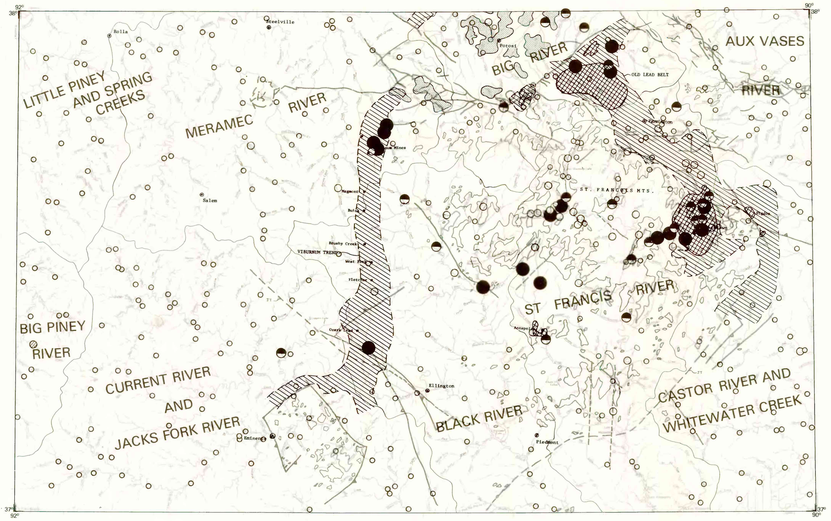




Values of zinc in ppm in stream sediment samples
- nd-99
- 100-129
- 130-199
- 200-999
- 1000+

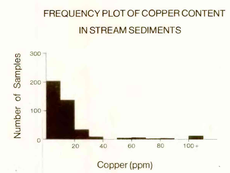
Map B.--Zinc

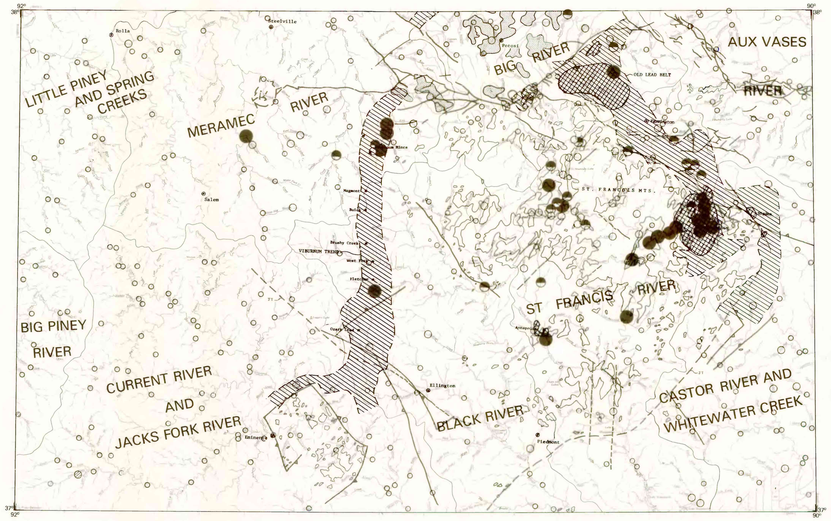




Values of copper in ppm in stream sediment samples
- nd-19
- 20-29
- 30-69
- 70-999
- 1000+

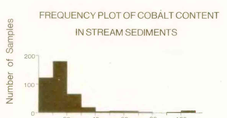
Map C.--Copper

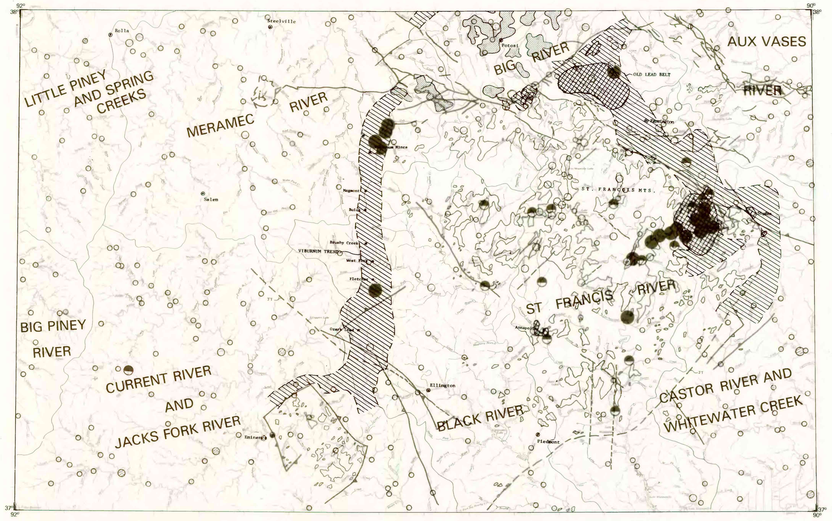




Values of cobalt in ppm in stream sediment samples
- nd-19
- 20-29
- 30-39
- 40-499
- 500+

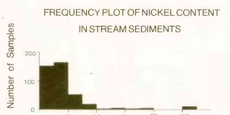
Map D.--Cobalt





Values of nickel in ppm in stream sediment samples
- nd-19
- 20-29
- 30-39
- 40-999
- 1000+

Map E.--Nickel



STREAM SEDIMENTS

SCALE 1:500 000

10 0 10 20 30 40 50 MILES
10 0 10 20 30 40 50 KILOMETERS

HEAVY-METAL CONTENT OF STREAM SEDIMENTS AND STREAM WATERS, ROLLA 1° X 2° QUADRANGLE, MISSOURI

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EXPLANATION

NOTE: Sample symbols and values are defined differently for each map. Anomalous samples are indicated by filled or partly filled symbols. Cross-hatched symbols represent values greater than 2 standard deviations from the mean of that river basin

TRENDS OF MINERALIZATION (FROM KISVARSANYI, 1977)—Includes the Virburnum trend, Old Lead Belt, and Mine Lamotte-Fredericktown area. Areas of past production or areas that contain known mineral deposits are cross-hatched

BARITE DISTRICT 1855-1965 (FROM KISVARSANYI, 1965)—Contains minor amounts of lead ore

PRECAMBRIAN IGNEOUS ROCKS

PALEOZOIC SEDIMENTARY ROCKS

MAJOR MINE IN THE VIBURNUM TREND

FAULT (FROM HEYL AND OTHERS, 1965, AND PRATT, 1978)—Dashed where inferred

POSTULATED FAULT IN SUBSURFACE PRECAMBRIAN ROCKS (FROM KISVARSANYI, 1979)—Bar and ball on downthrown side

DIVIDE BETWEEN RIVER BASINS

This map is part of a folio of maps of the Rolla 1° x 2° quadrangle, Missouri, prepared under the Conterminous United States Mineral Assessment Program.

INTRODUCTION

Geochemical studies of heavy-metal contents of stream sediments and stream waters were conducted in 1977-79 in the Rolla 1° x 2° quadrangle, Missouri, as part of a joint multi-disciplinary study by the U.S. Geological Survey and the Division of Land Survey, Missouri Department of Natural Resources. The objective of the joint study was to assess the mineral-resource potential of the area by integrated geologic, geochemical, and geophysical investigations. Stream-sediment and water geochemistry was investigated by Proctor, Sinha, Afzali, and Vanhorst, Department of Geology and Geophysics, University of Missouri-Rolla, under grant number USDI 14-08-0001-G-439. Although, the surface geochemistry may or may not reflect possible mineral resources at depth, we are making the data available as part of the entire geochemical data base of the quadrangle.

The Rolla 1° x 2° quadrangle contains several large and distinctive mining districts. The southeast Missouri lead district contains the largest known lead reserves in the world, chiefly in the deposits of the Viburnum trend. The ore occurs mainly in the Upper Cambrian Bonneterre Formation, although some ore has been mined from the underlying Lamotte sandstone. Major amounts of zinc and minor but significant amounts of copper, silver, cobalt, nickel, and cadmium are produced with the lead. Other important mineral resources include the residual barite deposits and associated barite-lead-zinc veinlets from the Cambrian Potosi and Eminence Dolomites in Washington County in the northern part of the quadrangle, and several subsurface Precambrian iron deposits near Ironton in the central St. Francois Mountains.

The major objectives of this study were to determine the Pb, Zn, Cu, Ni, and Co content of stream sediments and waters in the quadrangle, to relate the metal distribution to surface geology, known mineralized areas and mining-milling activities, and, if possible, to expressions of primary dispersion haloes from metallized zones in the region.

SAMPLING AND ANALYTICAL PROCEDURE FOR STREAM SEDIMENT

Four hundred-fifteen stream-sediment samples were collected and analyzed. Sample sites were selected to obtain representative channel samples of all major tributaries above their junction with the next higher order stream. Other samples were collected both above and below many of the main tributary junctions. Supplemental samples were taken from streams which drain areas of major dumps and mill tailings. Two kilogram samples were dried in porcelain casseroles in a 65°C oven, then sieved to -80 mesh. One gram of the sieved sample was placed in 20 ml of concentrated HNO_3 and heated in a sandbath for 3 hours at 92°C. The cooled solution was filtered through Whatman No. 1 quantitative filter paper and the volume brought to 100 ml with doubled distilled water. This method dissolves most of the surface absorbed metals, precipitated metals, and metal sulfides. There is little effect on ionically bound metal. The acid extracts were then analyzed for lead, zinc, copper, nickel, and cobalt by atomic absorption.

Determination of anomalous values

Maps A through E show the distribution, in parts per million, of acid leachable lead, zinc, copper, cobalt, and nickel in the stream sediments in the different drainage basins in the quadrangle. Histograms for data from the entire quadrangle are also shown for each element. Because the data are highly skewed, the 90th and 95th percentile (instead of 2σ) were chosen as threshold and anomalous values for each element. Anomalous values for the different metals are: Pb--500 ppm, Zn--200 ppm, Cu--70 ppm, Co--40 ppm, and Ni--40 ppm. The smallest symbol size was chosen by major breaks in the data (see histograms) and represents the bulk of values around the median (65-80 percent of the samples depending on the distribution for a given element). This could be regarded as a graphic equivalent of one standard deviation from the "average". Median and arithmetic mean metal contents, standard deviation, and range of metal values within individual basins (table 1) are provided for comparative purposes.

Samples which are not anomalous on a regional basis but which are greater than two standard deviations above the individual basin means are shown by a cross-hatched map symbol.

Distribution of elements

The stream-sediment data readily identifies two groups of basins. One group drains carbonate terrane with little or no mining activity. The metal values from this group cluster around the regional median and thus represent "average" or background values. The other group drains the igneous rocks of the St. Francois Mountains as well as Paleozoic carbonate sediments and contains the lead-zinc, barite, and iron district.

Most anomalous samples are from the second group of basins, and most cluster around areas of past or present mineral production. The St. Francis River basin drains the Mine Lamotte-Fredericktown district and the Annapolis Mine, and the high Cu, Ni, and Co values, as well as Pb and Zn, reflect the known Cu-Ni-Co subprovince near Fredericktown. The Black River basin and the southeast part of the Meramec River basin drain the New Lead Belt (Viburnum trend). The Big River basin drains part of the Old Lead Belt and the Ba-Pb-Zn district of Washington County. Thus the high metal values in this group of basins probably reflect additions to the background values caused by the weathering and erosion of mineralized outcrops, and contamination from mining, milling, and smelter activities. The higher values in the Old Lead Belt as compared to the Virburnum trend probably reflect ore-horizon outcrops, a longer period of mining, and, therefore, more time for tailings to enter the stream sediments, and less stringent environmental controls during the time the area was in production.

It is doubtful that these samples reflect a contribution from geochemical haloes of Pb-Zn deposits in the subsurface. For example, the newly discovered Pb-Zn ore body at Blair Creek in the southwestern part of the Viburnum trend shows no anomaly, probably because the mine is not yet producing and no ore has been brought to the surface and dispersed into the streams.

A few anomalous samples, however, occur in areas that cannot be related to mining, milling, or smelting activity. Anomalous lead and zinc samples in the southern part of the Castor-Whitewater basin and in the north-central part of the Meramec basin are of interest because they could represent metal additions from as yet undiscovered occurrences. Further sampling is required in these areas to determine the sources of the high metal contents.

No high concentrations of metals were detected in the "background basins" of the Current, Big Piney, little Piney, and Aux Vases Rivers. However, if anomalous metal contents are based on two standard deviations from the mean metal content of individual basins, several samples (shown by cross-hatched symbols) could contain significant metal enhancement from sources other than the primary metal content of the rocks. The samples from Little Piney Creek basin are near a known submetallic province of small lead-zinc occurrences. The others, however, should be further investigated to determine the source of the higher values.

SUMMARY

The samples of both media which are anomalous on a regional basis (half-closed and closed circles) could reflect metal additions from three sources: (1) outcrop of ore-bearing horizons; (2) dispersion halos from subsurface mineralization; or (3) contamination from mining, milling, and smelting activities at the surface. From the data received, we are unable to separate possibility 3 from possibility 2, and, therefore, anomalies near mining areas may or may not reflect subsurface mineralization and should not be used for resource evaluation. The data, do, however, provide a reliable picture of the heavy-metal content of the stream sediments and waters and as such are valuable as part of the total geochemical data base for the quadrangle.

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1/Use of commercial trade names is for descriptive purposes only and does not imply endorsement by the U.S. Geological Survey.