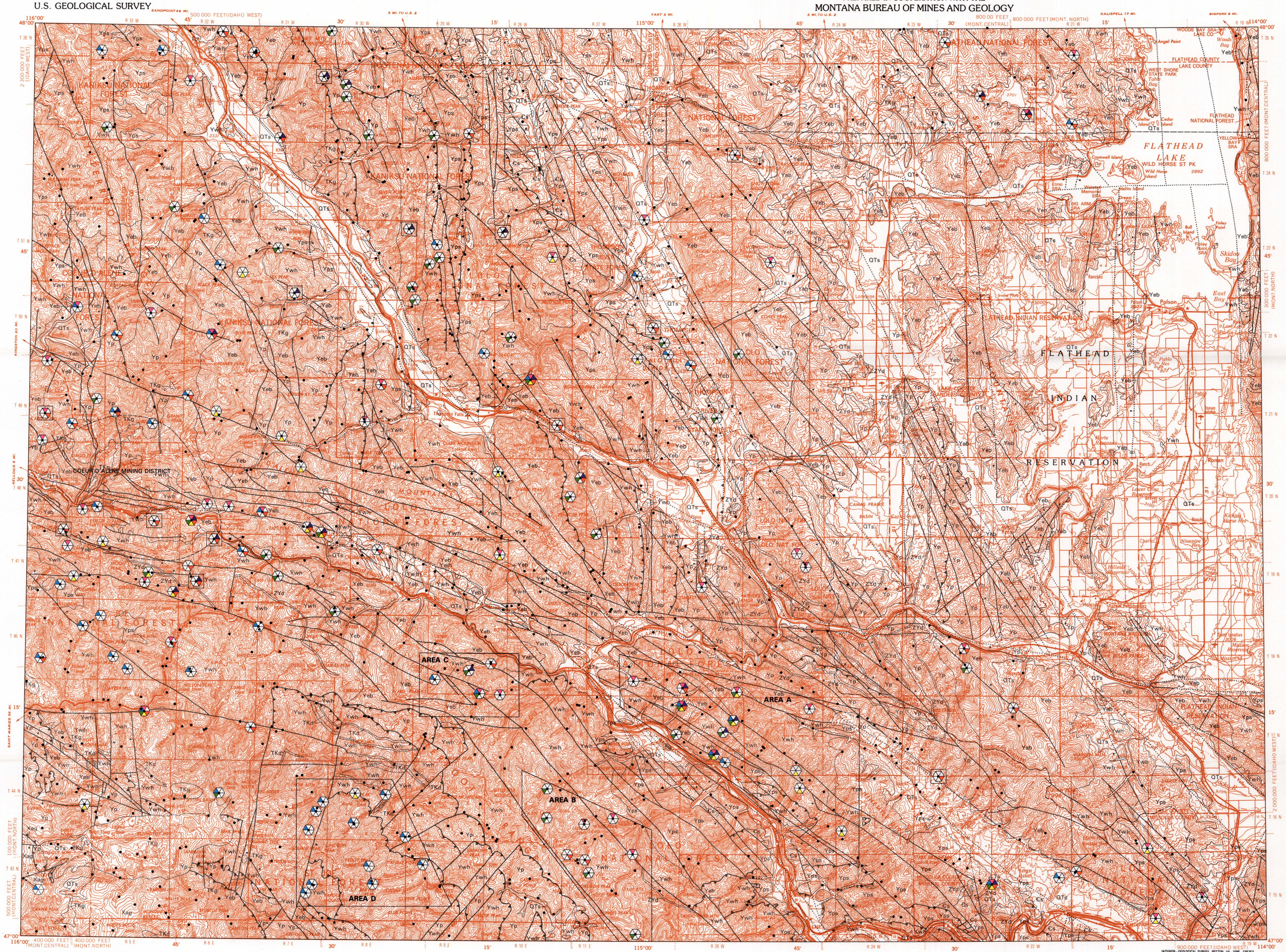

Base from U.S. Geological Survey, 1958, revised 1981
100,000-foot grid based on Montana coordinate system, central and north zones, and Idaho coordinate system, west zone

SCALE 1:250 000

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION

Geology by J. E. Harrison, A. B. Griggs, and J. D. Wells, 1970–80; assisted by H. R. Covington, 1972; Joseph Boggs, 1973; and J. P. Harrison, 1970–80

Note: The generalized and simplified geologic map was prepared as an underlay for various geophysical and geochemical data collected in the Wallace 1° x 2° quadrangle. A fuller treatment of geologic units and structure can be found on map I-1509-A in the Wallace CUSMAP folio.

EXPLANATION

Zn, Pb, Ag, Cu, Sb, As (hexagon) LOCALITY OF ANOMALOUS SAMPLE—At center of hexagon. Colored segments indicate anomalous metals present in nonmagnetic heavy-mineral concentrate. Arrow shows correct location of symbol displaced to avoid overprint. Square outline indicates Cu-Ag anomaly not related to stratabound Cu-Ag occurrence

• SAMPLE LOCALITY

CORRELATION OF MAP UNITS

Map units		Age
QTs		QUATERNARY AND TERTIARY
Tv		TERTIARY
TKg, TKd		TERTIARY AND CRETACEOUS
Unconformity		
Ꞓs		CAMBRIAN
Unconformity		
ZYd		LATE AND MIDDLE PROTEROZOIC
Yps	Missoula Group — Belt Supergroup	MIDDLE PROTEROZOIC
Ywh	Belt Supergroup	MIDDLE PROTEROZOIC
Yeb	Ravalli Group — Belt Supergroup	MIDDLE PROTEROZOIC
Yp	Belt Supergroup	MIDDLE PROTEROZOIC
Unconformity		
Xag		EARLY PROTEROZOIC

DESCRIPTION OF GEOLOGIC MAP UNITS

- QTs VALLEY FILL DEPOSITS (QUATERNARY AND TERTIARY)—Alluvium, glacial deposits, and semiconsolidated to consolidated conglomerate interlayered in places with shale, coal, and volcanic ash; shown only in major valleys and basins or along main stream courses.
- Tv VOLCANIC ROCKS (TERTIARY)—Largely andesitic to dacitic welded tuff
- TKg GRANITIC INTRUSIVE ROCKS (TERTIARY AND CRETACEOUS)
- TKd DIORITIC INTRUSIVE ROCKS (TERTIARY AND CRETACEOUS)
- Ꞓs SEDIMENTARY ROCKS (CAMBRIAN)—Includes Red Lion Formation, Hasmark Dolomite, Silver Hill Formation, Flathead Quartzite, and equivalent rocks
- ZYd DIORITIC TO GABBROIC SILLS AND DIKES (LATE AND MIDDLE PROTEROZOIC)
- Yps MISSOULA GROUP (MIDDLE PROTEROZOIC)—Includes Pilcher, Libby, Garnet Range, and McNamara Formations, Bonner Quartzite, and Striped Peak, Mount Shields, Shepard, and Snowslip Formations
- Ywh WALLACE AND HELENA FORMATIONS (MIDDLE PROTEROZOIC)
- Yeb RAVALLI GROUP (MIDDLE PROTEROZOIC)—Includes Empire, St. Regis, Spokane, Revett, and Burke Formations
- Yp PRICHARD FORMATION (MIDDLE PROTEROZOIC)
- Xag ANORTHOSITE, SCHIST, AND GNEISS (EARLY PROTEROZOIC)

CONTACT

FAULT—Dotted where concealed. Bar and ball on downthrown side; arrows show relative direction of apparent horizontal movement

THRUST FAULT—Dotted where concealed. Sawteeth on upper plate

INTRODUCTION

This map is part of a folio of maps of the Wallace 1° x 2° quadrangle, Montana and Idaho, prepared under the Conterminous United States Mineral Resource Assessment Program (CUSMAP). The publications in this folio are given in a U.S. Geological Survey Circular (Harrison and others, 1986b). Background information on the geology, mineral deposits, geochemical methods, and mineral assessment techniques are found in the pamphlet accompanying this map. It is recommended that the pamphlet be read prior to further study of the geochemical data.

This summary geochemical map shows the sample localities of nonmagnetic heavy-mineral concentrates that contain anomalous concentrations of silver, arsenic, copper, lead, antimony, and zinc in the Wallace 1° x 2° quadrangle. The concentrations of these elements were determined by emission spectrographic methods. The distribution of samples with anomalous concentrations of bismuth, molybdenum, antimony, and tungsten is shown on another map (Leach and Domenico, 1985). The purpose of this report is to summarize some of the geochemical data that have been used in part to produce a series of interpretative maps for some of the mineral resource occurrence models for the Wallace 1° x 2° quadrangle folio. The relations between geochemical anomalies and resource models are briefly discussed. Distributions of anomalous concentrations of selected elements in samples of stream sediment are shown on other maps of the Wallace quadrangle folio (Leach and Hopkins 1986a and b).

DISCUSSION

The samples of nonmagnetic heavy-mineral concentrates are derived from a variety of rock types as well as from several distinct types of mineral deposits. For purposes of resource appraisal, anomalous concentrations of signature elements in samples are arbitrarily defined as those in the top 5 percent of the data. For some elements, the anomalous percentile range was adjusted slightly from the 95th percentile to accommodate distinct breaks in the frequency distribution of the data. The concentration ranges we defined as anomalous are given in table 1.

Table 1.—*Anomalous concentrations of elements in samples of nonmagnetic heavy-mineral concentrates*

Elements	Lower limit of anomalous concentration (ppm)	Maximum concentration reported (ppm)	Percentile
Ag	15	1,000	96
As	500	10,000	95.7
Cu	700	30,000	95
Pb	1,000	50,000	95
Sb	200	10,000	97.5
Zn	500	20,000	95

Our objective is to apply broad-scale data to define large or regional geochemical patterns that may relate to mineral resources. The broad sampling net may not pinpoint individual undiscovered ore bodies or some known mineral occurrences. Many factors determine the sensitivity of reconnaissance-scale geochemical data to detecting the presence of mineral resources. The most important consideration is the geochemical nature of the particular resource—the size and exposure of the geochemical system and the relative mobility of the ore-associated elements present. For example, the probability of detecting a geochemically complex porphyry-molybdenum system that has a geochemical aureole of several kilometers is higher than that of detecting a geochemically simple stratabound copper occurrence of 100 meters or less.

The elements presented on this map did not occur in anomalous concentrations near know occurrences of epithermal silver, stockwork-porphyry molybdenum-tungsten deposits, or in areas that have geological favorability for the occurrence of Sullivan-type stratabound lead-zinc deposits. However, these elements were present in anomalous concentrations near know mesothermal base- and precious-metal veins and stratabound copper-silver occurrences. For these two occurrence models, the more significant geochemical anomalies are briefly discussed.

STRATABOUND COPPER-SILVER

The geochemical signature of samples that may be related to stratabound copper-silver is anomalous concentratations of copper or silver with lead as a permissible addition. Sample localities where we detected the presence of anomalous concentrations of zinc, cadmium, antimony, bismuth, or arsenic were not included as localities with a stratabound-type geochemical signature. Fifteen of the many localities that contain anomalous copper or silver in the nonmagnetic heavy-mineral concentrates are not considered to be stratabound copper-silver localities because of the presence of additional anomalous metals in stream sediments from the same site; these samples are indicated by a square outlining the map symbol. It is not clear whether this single geochemical system (Cu, Ag ± Pb) is present at all occurrences of stratabound copper-silver minerals. The stratabound copper-silver geochemical signature can also be derived from the many basic sills in the quadrangle as well as from some veins with simple mineralogy. Most of the localities with a stratabound copper-silver signature lie within the more favorable host rocks, which are widely scattered throughout the quadrangle (Harrison and others, 1986b). Therefore, we are confident that most of the sites with the stratabound signature do lie within drainages containing some stratabound copper-silver minerals.

MESOTHERMAL VEINS

This descriptive model includes a wide variety of lead, zinc, and copper veins that may carry significant amounts of silver, gold, and antimony. These veins include those of the Coeur d'Alene district as well as those in the greater Coeur d'Alene mineral belt which extends from Coeur d'Alene, Idaho, to Superior, Montana. The Coeur d'Alene district also contains stratabound copper-silver deposits and fine-grained disseminated galena-tetrahedrite-sphalerite ore bodies. The wide variety of deposits in the district results in a complex geochemical signature in which nearly all possible combinations of anomalous silver, copper, lead, antimony, and zinc are observed. Vein deposits similar to those of the Coeur d'Alene district also occur in an area near Superior, Montana. In addition, numerous lead, zinc, and copper veins with variable amounts of silver, gold, or antimony occur over a wide area in the Wallace guadrangle. The geochemical signature for "Coeur d'Alene" type vein overlaps and duplicates those of other base- and precious-metal veins in the Wallace quadrangle. Therefore, we have combined all the veins present within the Coeur d'Alene district with the widespread base- and precious-metal veins into a single category.

Common to the mesothermal veins is the general occurrence of antimony. Antimony-bearing veins form a crude outer zone around the Coeur d'Alene district and also occur at other places in the greater Coeur d'Alene mineral belt. This element is not part of the geochemical signature of any other types of mineral occurrence in the Wallace quadrangle—although it is a permissible element for the Sullivan-type model. Samples that contain anomalous concentrations of antimony may reflect some potential for mesothermal veins (and possibly Sullivan-type mineral occurrences), but its presence can be considered as definitely unfavorable for the other resource models in our study. However, the absence of anomalous antimony in a sample does not necessarily imply a lower favorability for mesothermal veins.

Although a single isolated anomalous sample may be significant, more importance should be given to samples with multielement anomalies and areas with clusters of anomalous samples that define anomalous belts or zones. In the Wallace quadrangle, zones and clusters of anomalous samples or nonmagnetic heavy-mineral concentrates are less well defined than those identified in the stream-sediment data. Many sample localities scattered throughout the quadrangle contain only one or perhaps two anomalous elements. Many of these isolated anomalous samples probably are related to the many occurrences of sulfide-bearing veins; others may reflect the presence of disseminated and localized occurrences of sulfide minerals indigenous to the clastic rocks of the region.

Significant clusters of anomalous samples of nonmagnetic heavy-mineral concentrates occur in and near the Coeur d'Alene district. These anomalous samples define a zone that extends further to the south of the district than is indicated by the stream-sediment data. A favorable zone for mesothermal veins that extended north and northeast from the Coeur d'Alene to the quadrangle border was shown by the stream-sediment data. However, this zone of favorability is not readily apparent from the several isolated samples of nonmagnetic heavy-mineral concentrates that contain only one or two anomalous concentrations of elements. Scattered thought the central and north-central area of the quadrangle are localities showing only one or two anomalous elements, which occur in areas that were identified as having a low to moderate favorability for mesothermal veins from the stream-sediment data. A cluster of sample localities that contain anomalous concentrations of silver, arsenic, copper, antimony, or zinc is in area A near Superior, Montana, where mesothermal veins are known to occur. This area was also identified as being highly anomalous from the stream-sediment data. Areas B and D contain clusters of generally single-element anomalies in the nonmagnetic heavy-mineral data but contain few anomalous samples of stream sediment. Known mesothermal veins occur in area B and a few prospects occur near area C.

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______1986b, Geochemical map showing distribution of stream-sediment samples that contain anomalous concentrations of partially-extractable antimony, bismuth, copper, lead, silver, and zinc in the Wallace 1° x 2° quadrangle, Montana and Idaho: U.S. Geological Survey Investigations Series Map I-1509-D.

GEOCHEMICAL MAP SHOWING DISTRIBUTION OF SAMPLES OF NONMAGNETIC HEAVY-MINERAL CONCENTRATES THAT CONTAIN ANOMALOUS CONCENTRATIONS OF ANTIMONY, ARSENIC, COPPER, LEAD, SILVER, AND ZINC IN THE WALLACE 1° x 2° QUADRANGLE, MONTANA AND IDAHO

By
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