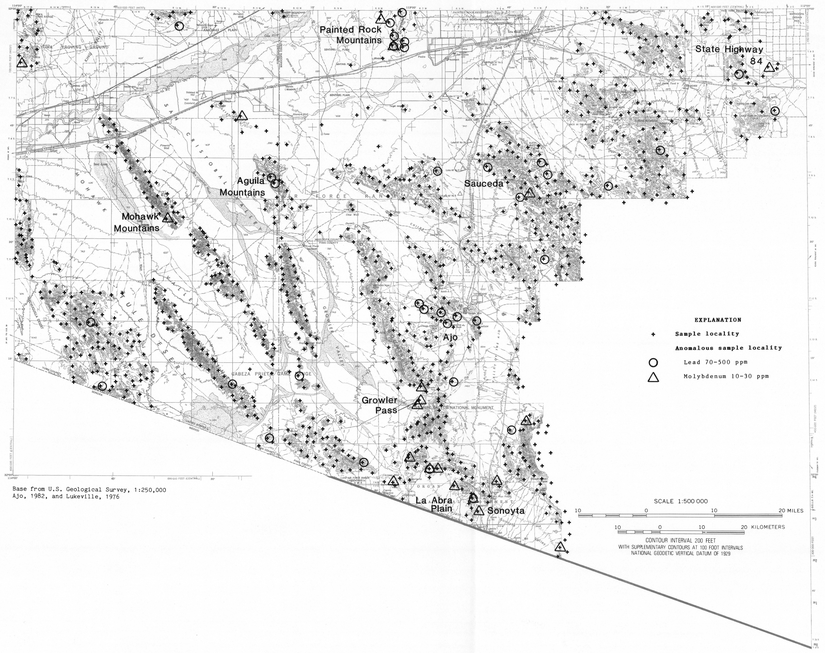
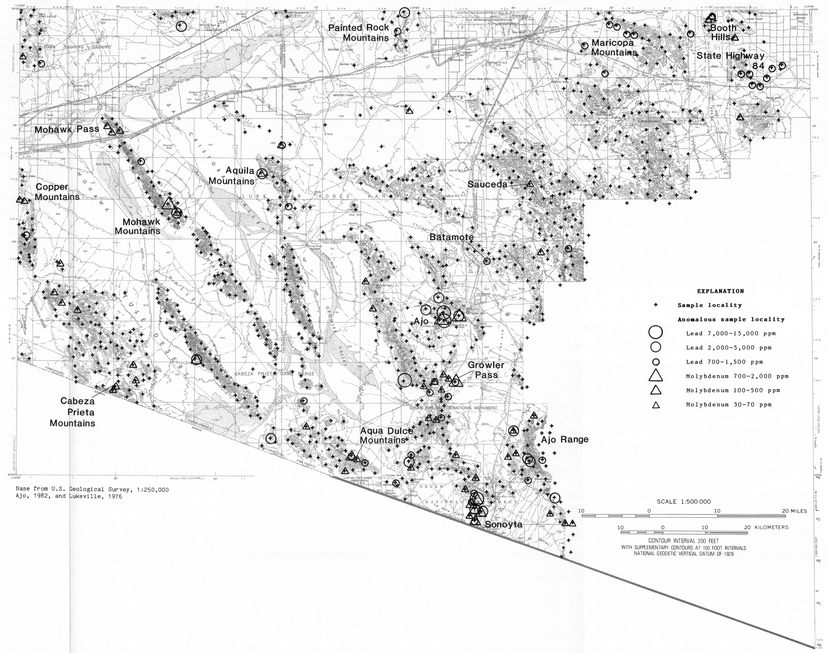


MAP A–MAP SHOWING ANOMALOUS CONCENTRATIONS OF LEAD AND MOLYBDENUM IN STREAM SEDIMENT



MAP B–MAP SHOWING ANOMALOUS CONCENTRATIONS OF LEAD AND MOLYBDENUM IN HEAVY-MINERAL CONCENTRATE

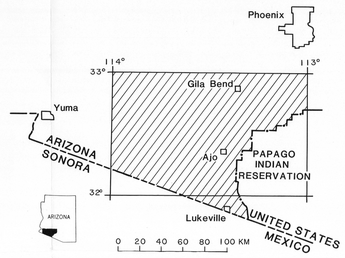


Figure 1.--Index map showing study area (ruled).

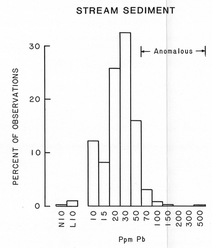


Figure 2.--Histogram showing distribution of lead in stream sediment. N, none detected; L, detected but below lower limit of detection; number beside "N" and "L" is lower limit of detection.

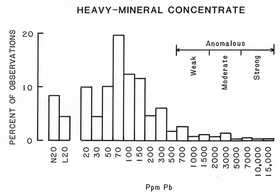
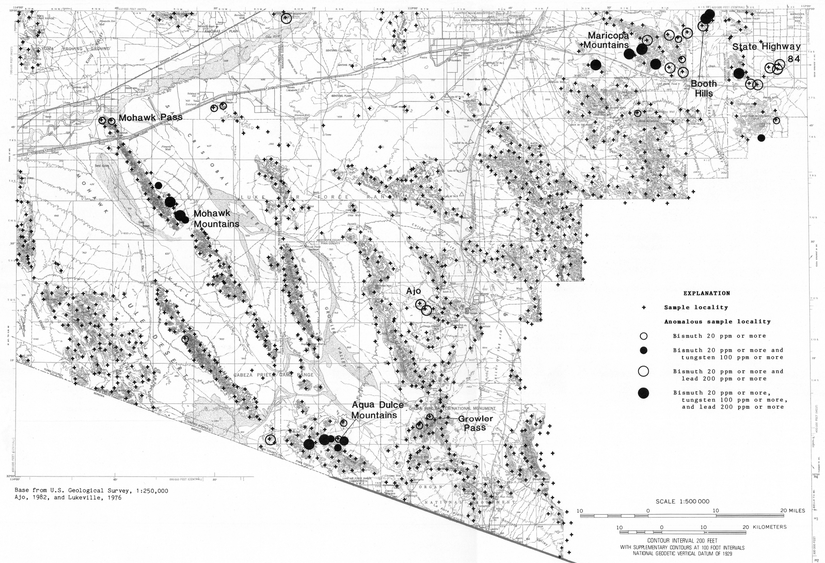
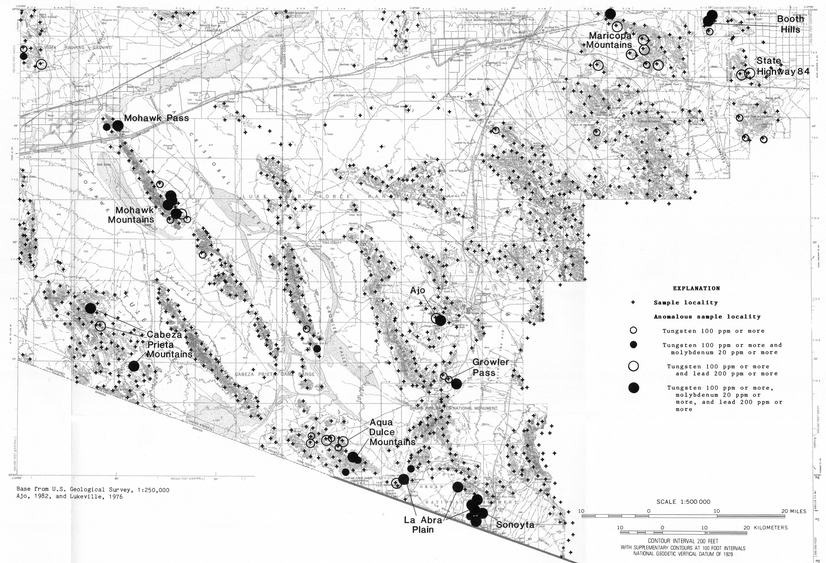


Figure 3.--Histogram showing distribution of lead in heavy-mineral concentrate. N, none detected; L, detected but below lower limit of detection; number beside "N" and "L" is lower limit of detection.



MAP C–MAP SHOWING ANOMALOUS CONCENTRATIONS OF BISMUTH IN RELATION TO TUNGSTEN AND LEAD IN HEAVY-MINERAL CONCENTRATE



MAP D–MAP SHOWING ANOMALOUS CONCENTRATIONS OF TUNGSTEN IN RELATION TO MOLYBDENUM AND LEAD IN HEAVY-MINERAL CONCENTRATE

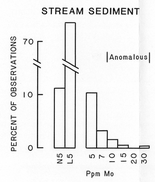


Figure 4.--Histogram showing distribution of molybdenum in stream sediment. N, none detected; L, detected but below lower limit of detection; number beside "N" and "L" is lower limit of detection.

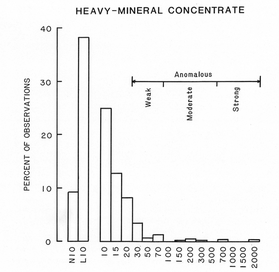


Figure 5.--Histogram showing distribution of molybdenum in heavy-mineral concentrate. N, none detected; L, detected but below lower limit of detection; number beside "N" and "L" is lower limit of detection.

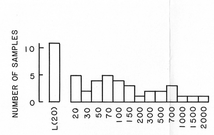


Figure 6.--Histogram showing distribution of detectable bismuth in heavy-mineral concentrate. L, detected but below lower limit of detection; number beside "L" is lower limit of detection.

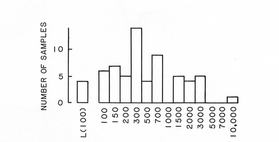


Figure 7.--Histogram showing distribution of detectable tungsten in heavy-mineral concentrate. L, detected but below lower limit of detection; number beside "L" is lower limit of detection.

These maps are part of a folio of maps of the Ajo and Lukeville 1° x 2° quadrangles, Arizona, prepared under the Conterminous United States Mineral Assessment Program. Other publications in this folio include U.S. Geological Survey Miscellaneous Field Studies Maps MF-1834-A, 1834-B, and 1834-C and U.S. Geological Survey Open-File Reports 82-419, 82-599, and 83-734. Open-File Reports 82-419 and 83-734 constitute the basic data and initial interpretation on which this discussion is predicated. Open-File Report 82-599 is an aeromagnetic map.

INTRODUCTION

The geochemical reconnaissance sampling was done during 1979 and 1980. The area covered includes all of the Ajo 1° x 2° quadrangle in the U.S., except the Papago Indian Reservation, and includes part of the Lukeville 1° x 2° quadrangle west of the Indian Reservation and north of the Mexican border (fig. 1). A total of 971 sample localities yielded 971 samples of stream sediment finer than 30 mesh and 952 samples of the nonmagnetic fraction of heavy-mineral concentrate from stream sediments. Sample localities were selected on first-order drainage channels, generally reflecting a drainage basin of less than 1 km^2. Sample localities were further selected to represent the mountain ranges and their immediate flanks, largely ignoring the 80 percent of the map area underlain by a thick fill of young sediment in the basins. The average sampling density was one sample locality per 3.1 km^2 for the mountain ranges. All samples were analyzed by optical emission spectroscopy for 31 elements (Grimes and Marranzino, 1968). Collection, preparation, and analytical procedures are detailed in Barton and others (1982).

Small deposits of lead in veins have been reported in and near the quadrangles (Wilson, 1933; Keith, 1974 and 1978). In most of these, the veins were prospected or developed for their precious-metal content, primarily silver. The association of lead with molybdenum has been described in the Painted Rock Mountains (Wilson and Miller, 1974) and in the Mohawk Mountains (Keith, 1978). The association of tungsten and molybdenum has been described in the Gunsight Hills (Keith, 1974), 25 km southeast of Ajo in the Papago Indian Reservation.

Our data indicates that the association of lead with molybdenum is pronounced as are the association of lead with bismuth and the association of tungsten with either of these two assemblages (Theobald and Barton, 1983). These elements and their binary and ternary associations, all of which are interpreted to reflect mineralization, are discussed in the following paragraphs.

LEAD DISTRIBUTION IN STREAM SEDIMENT AND HEAVY-MINERAL CONCENTRATE

Histograms showing percent of observations and concentrations of lead in stream sediment and heavy-mineral concentrate are shown in figures 2 and 3, and anomalous sample localities are shown by triangles on maps A and B. The range of molybdenum concentrations in stream sediment is relatively narrow. Nearly 85 percent of the samples contain less than 5 ppm molybdenum. Except for the single, clearly anomalous sample having 30 ppm molybdenum from a locality in the Sonoyta Mountains, there is no clear definition of an anomalous sample population. The definition of the anomalous sample population is arbitrarily set to include samples having 10 ppm or more and lies between the upper 2 percent of the frequency distribution. This definition minimizes the effect of analytical uncertainty that is possible near the limit of analytical sensitivity. Clusters of sample localities that exhibit high molybdenum occur in the vicinity of Growler Pass and around La Abra Plain. The anomaly around La Abra Plain overlaps the western part of the anomaly in the Sonoyta Mountains--for example, anomalous sample localities for lead and molybdenum in heavy-mineral concentrate overlap (map B). However, the map pattern for anomalous stream-sediment sample localities strongly suggests that the molybdenum in this medium is related to La Abra Plain and that the apparent overlap in the Sonoyta Mountains is coincidental. Isolated anomalous molybdenum values, such as along State Highway 84, in the Sauceda Mountains, in the Painted Rock Mountains, and in the Mohawk Mountains (map A), likely reflect truly anomalous localities that would be parts of clusters of anomalous localities if there were more sample localities in those areas. A few of the isolated anomalous localities may simply reflect the upper tail of the background molybdenum concentration.

The range of values for molybdenum in the heavy-mineral concentrate (fig. 3) is considerably greater than that in stream sediment. A clear break in the frequency distribution at 500 ppm allows a more confident definition of an anomalous population above that value for 6 percent of the samples. The wide range in values for this remaining population, in excess of an order of magnitude, allows subdivision into weakly, moderately, and strongly anomalous samples. Clusters of these anomalous sample localities (map B) occur in the Maricopa Mountains, along State Highway 84, in the vicinity of Ajo, in the vicinity of Growler Pass, along a linear trend crossing the Ajo Range, and in the Sonoyta Mountains. Small, weaker, or more diffuse anomalies are in the Booth Hills, the Painted Rock Mountains, the Aguila Mountains, the Mohawk Mountains, and the Aqua Dulce Mountains. All of the lead anomalies appear to reflect lead-rich environments in areas having mineral-resource potential. Isolated anomalous sample localities are in the weakly to moderately anomalous range and may reflect the upper extreme of background concentrations of lead. Where these isolated localities have been examined, as in the Cooper Mountains and the Batamote Mountains (Huston, 1984), the lead is attributed to sulfide mineralization.

MOLYBDENUM DISTRIBUTION IN STREAM SEDIMENT AND HEAVY-MINERAL CONCENTRATE

Histograms showing percent of observations and concentrations of molybdenum in stream sediment and heavy-mineral concentrate are shown in figures 4 and 5, and anomalous sample localities are shown by triangles on maps A and B. The range of molybdenum concentrations in stream sediment is relatively narrow. Nearly 85 percent of the samples contain less than 5 ppm molybdenum. Except for the single, clearly anomalous sample having 30 ppm molybdenum from a locality in the Sonoyta Mountains, there is no clear definition of an anomalous sample population. The definition of the anomalous sample population is arbitrarily set to include samples having 10 ppm or more and lies between the upper 2 percent of the frequency distribution. This definition minimizes the effect of analytical uncertainty that is possible near the limit of analytical sensitivity. Clusters of sample localities that exhibit high molybdenum occur in the vicinity of Growler Pass and around La Abra Plain. The anomaly around La Abra Plain overlaps the western part of the anomaly in the Sonoyta Mountains--for example, anomalous sample localities for lead and molybdenum in heavy-mineral concentrate overlap (map B). However, the map pattern for anomalous stream-sediment sample localities strongly suggests that the molybdenum in this medium is related to La Abra Plain and that the apparent overlap in the Sonoyta Mountains is coincidental. Isolated anomalous molybdenum values, such as along State Highway 84, in the Sauceda Mountains, in the Painted Rock Mountains, and in the Mohawk Mountains (map A), likely reflect truly anomalous localities that would be parts of clusters of anomalous localities if there were more sample localities in those areas. A few of the isolated anomalous localities may simply reflect the upper tail of the background molybdenum concentration.

The range of values for molybdenum in the heavy-mineral concentrate (fig. 5) is considerably greater than that in the stream sediments (fig. 4). Though nearly 50 percent of the samples contain less than 10 ppm molybdenum, the upper range of the background concentration is in the range of 10-30 ppm. The break in the frequency distribution at 30 ppm allows clear separation of an anomalous population that includes 3 percent of the samples. The wide range in values for the anomalous sample population, in excess of an order of magnitude, allows subdivision into weakly, moderately, and strongly anomalous samples. Clusters of these anomalous sample localities occur in the Mohawk Mountains, in the vicinity of Ajo, in the vicinity of Growler Pass, along a trend crossing the Ajo Range, and in the Sonoyta Mountains. Small, weaker, or more diffuse anomalies are in the Booth Hills, the Painted Rock Mountains, the Aguila Mountains, the Mohawk Mountains, and the Aqua Dulce Mountains. All of the lead anomalies appear to reflect lead-rich environments in areas having mineral-resource potential. Isolated anomalous sample localities are in the weakly to moderately anomalous range and may reflect the upper extreme of background concentrations of lead. Where these isolated localities have been examined, as in the Cooper Mountains and the Batamote Mountains (Huston, 1984), the lead is attributed to sulfide mineralization.

MOLYBDENUM DISTRIBUTION IN STREAM SEDIMENT AND HEAVY-MINERAL CONCENTRATE

Anomalous concentrations for two or more elements in a sample provide a stronger indication of mineralization than does an anomalous concentration of a single element. The correlation coefficients of lead and molybdenum in heavy-mineral-concentrate samples is 0.24 (Theobald and Barton, 1983). Even though the severe truncation of the data at the limit of analytical sensitivity subdues the magnitude of this correlation coefficient, this is a significant correlation coefficient at the 99 percent confidence level. The spatial significance of this correlation of lead and molybdenum concentrations is shown on map C. On the map, there is pronounced overlap of anomalous values for the two elements in the Aguila Mountains, the Mohawk Mountains, in the vicinity of Ajo, and in the Sonoyta Mountains. Even where correlation of the concentrations of the two elements in individual samples is not so precise, the spatial association of anomalous sample localities for both elements is pronounced in several areas, notably in the vicinity of Growler Pass, in the Aqua Dulce Mountains, and in the Ajo Range.

The extreme truncation of molybdenum data in stream sediment (nearly 85 percent of the samples contain less than 5 ppm molybdenum) invalidates the numerical significance of a molybdenum and lead correlation coefficient in this medium. A weak association of the two elements is suggested by the proximity of anomalous sample localities shown on map A, most notably in the Painted Rock Mountains and in the vicinity of La Abra Plain.

BISMUTH AND TUNGSTEN DISTRIBUTION IN HEAVY-MINERAL CONCENTRATE

Bismuth and tungsten were detected in less than 5 and less than 7 percent, respectively, of the heavy-mineral-concentrate samples. Neither element was detected in stream-sediment samples. Histograms showing percent of observations and detectable concentrations of bismuth and tungsten are shown in figures 6 and 7. Detectable amounts of these two elements are considered to be anomalous, and the range of anomalous values, two orders of magnitude, is quite large. Both elements are commonly concentrated in the vicinity of mineral deposits, and bismuth, in particular, has been considered an indicator element for a wide range of deposit types (Boyle, 1974).

Close associations of (1) bismuth, tungsten, and lead and (2) tungsten, lead, and molybdenum are common in the map area (Theobald and Barton, 1983). Samples rich in bismuth are usually rich in tungsten and (or) lead. Samples rich in tungsten are usually rich in molybdenum or bismuth and (or) lead. Bismuth-rich samples are usually not molybdenum rich. This negative relation of bismuth and molybdenum effectively divides the anomalous sample population into the two, mutually exclusive ternary element assemblages--bismuth-tungsten-lead and tungsten-molybdenum-lead.

The geographic distribution of anomalous sample localities for bismuth and tungsten and their respective elemental associations are shown on maps C and D. The maps show a marked tendency for the anomalous sample localities, and particularly for those localities with an anomalous assemblage of elements, to cluster. The relatively few isolated anomalous sample localities usually have anomalous concentrations of only a single element. There is a pronounced association of clusters of localities having anomalous concentrations of bismuth with areas of known or suspected Precambrian granite in the Maricopa Mountains, Booth Hills, vicinity of State Highway 84, Mohawk Mountains, Aqua Dulce Mountains, and vicinity of Ajo (map C.) Though sample localities having anomalous concentrations of molybdenum do not usually have anomalous concentrations of bismuth, broader areas often have anomalous concentrations of both elements. Of the eight bismuth-rich areas, that in the vicinity of State Highway 84 is without anomalies and that in the Maricopa Mountains has only a single, weakly anomalous sample for molybdenum (map D). The areas having anomalous concentrations of bismuth also have anomalous concentrations of tungsten and its associated elements. In addition, prominent anomalies for tungsten and its associated elements are in the Sonoyta Mountains and around La Abra Plain, and scattered anomalies for tungsten only are in the Cabeza Prieta Mountains (map D).

AREAS HAVING ANOMALOUS CONCENTRATIONS OF LEAD, MOLYBDENUM, BISMUTH, AND TUNGSTEN

A total of 17 anomalous areas are identified on the four maps. Twelve of these, the Ajo, Sonoyta, Mohawk Mountains, Painted Rock Mountains, Growler Pass, La Abra Plain, Aqua Dulce Mountains, State Highway 84, Maricopa Mountains, Booth Hills, Mohawk Pass, and Ajo Range anomalies,are discussed in the following paragraphs. The remaining five, the Aguila Mountains, the Batamote, the Cabeza Prieta Mountains, the Copper Mountains, and the Sauceda, are relatively weak or diffuse anomalies and are not discussed further. Except for the Batamote lead anomaly, identified on map B because it falls within a major anomaly for copper (Huston, 1984), the other 16 anomalous areas have clusters of anomalous sample localities. Following studies should include the isolated sample localities having anomalous metal concentrations. The scale of the sampling for this study is such that moderate-size deposits could be indicated by only one sample locality or perhaps even missed.

AJO ANOMALY

The strong anomaly at Ajo is reflected by two or more anomalous sample localities on all four maps. The broad lead anomaly in stream sediment (map A) is also reflected in heavy-mineral concentrate (maps B-D). In the heavy-mineral concentrate, the central part of the anomaly contains anomalous concentrations of molybdenum. Within the broad lead anomaly, we found anomalous concentrations of tungsten at two localities and anomalous concentrations of bismuth at two other localities. This multi-element anomaly is zoned, with the tungsten, molybdenum, and lead anomalies all in the immediate vicinity of the New Cornelia mine. The lead anomaly is more extensive both to the west and east of the central molybdenum anomaly, and it is in this peripheral area, west of the central anomaly, that the bismuth anomaly occurs.

The anomaly at Ajo is of interest primarily for comparative purposes. It provides a measure of the composition, size, and intensity of anomalous values in the vicinity of the known deposit at the New Cornelia mine. It is not likely that potential is indicated beyond what is already known.

SONOYTA ANOMALY

The Sonoyta anomaly is strongly reflected by the abundance of tungsten, molybdenum, and lead anomalies in a large, tight cluster. Many of the highest values reported in this investigation are in this anomaly. In addition to these elements, the area has anomalous concentrations of copper and the rarely detected elements antimony, silver, and zinc, but is impoverished in strontium. The La Abra Plain anomaly overlapping the Sonoyta anomaly, as is best seen in the distribution of molybdenum in stream sediment (map A). This overlap may contribute to the apparent intensity of the Sonoyta anomaly, but the distribution of antimony, silver, and zinc clearly identifies a separate anomaly in this area.

The Mesozoic metasedimentary rocks of the Sonoyta Mountains are riddled with mines and prospects of the Montezuma mining district. Some production of copper ore was reported (Keith, 1974). However, the geochemical assemblage is more representative of an epithermal precious-metal system than of the mesothermal base-metal veins described for the mines.

MOHAWK MOUNTAINS ANOMALY

The Mohawk Mountains anomaly is reflected by a cluster of strongly anomalous sample localities having anomalous concentrations of lead, molybdenum, bismuth, and tungsten in heavy-mineral concentrate (maps B-D) and by a single locality having anomalous concentrations of molybdenum in stream sediment (map A). This anomaly has been evaluated at a scale of 1:24,000 (R. G. Eppinger, written commun., 1984). The anomaly, apparently coherent at small scale, was found at larger scale to consist of at least four distinct anomalies, each related to a distinctive, fault-bounded, geologic terrane in a tectonic mosaic forming low hills to the east of the main ridge of the Mohawk Mountains. Though no mines are mentioned by either Wilson (1933) or Keith (1978) in this area, numerous prospects and a few small mines, all long abandoned, were visited during the large-scale evaluation. Most of these were on small silver- and base-metal-rich veins. The two most promising of the anomalies found during the large-scale evaluation do not seem to be related to these old prospects. One of these is a tungsten, bismuth, lead, molybdenum, and copper anomaly spatially associated with a large, complex aggregate. Ore minerals encountered in the surficial deposits include scheelite/powellite, wulfenite, and bismuthite. None of these were seen in outcrop. The second promising anomaly contains lead, bismuth, molybdenum, and tin in the easternmost low hills breaching the pediment surface. The anomaly patterns is arcuate and open toward the pediment to the northeast. Metasedimentary country rocks are cut by siliceous rhyolite dikes and are altered with abundant silica, quartz, sericite, and pyrite. Ore minerals in the aggregate zone include abundant fluorite with some wulfenite, bismuthite, and ketnerite. Fluorite was found in shattered and altered rocks near the rhyolite dikes. This arcuate anomaly is an almost perfect fit to a circular magnetic anomaly centered on the adjacent pediment (D. F. Klein, written commun., 1984). This combination of geochemical, geologic, and geophysical features could indicate a buried mineralized cupola beneath the pediment cover.

PAINTED ROCK MOUNTAINS ANOMALY

The Painted Rock Mountains anomaly is reflected by a cluster of sample localities having anomalous concentrations of lead and molybdenum in stream sediment and lead in heavy-mineral concentrate. The area is also rich in manganese, barium, and strontium, and, at one locality, copper. Veins containing barite and a variety of lead and molybdenum minerals have been mined in the Painted Rock district. The principal ore mineral in the best known locality of the district, the Rowley mine, is wulfenite, valued primarily as a collector's item (Wilson and Miller, 1974). The Rowley mine lies north of the Ajo quadrangle but similar occurrences probably produce the anomalies found in the southern Painted Rock Mountains. The more subdued lead anomaly in heavy-mineral concentrate (map B) and the absence of molybdenum in heavy-mineral concentrate compared with stream sediment (map A) indicates that the principal mineral containing lead and molybdenum in the secondary dispersion train is not wulfenite.

GROWLER PASS ANOMALY

The growler pass area has anomalous concentrations of lead, molybdenum, bismuth, and tungsten. The size and configuration of this anomaly are particularly well displayed by the cluster of anomalous sample localities for both lead and molybdenum in heavy-mineral concentrate (map B). The area also has anomalous concentrations of copper, antimony, and tin, but strontium is found in abnormally low amounts. The assemblage of elements suggests erosion into the middle or upper levels of a hydrothermal system. The rocks exposed in the lower terrane flanking the pass are Mesozoic sedimentary rocks. They are overlain to the north by late Tertiary volcanic rocks that form the main mass of the Growler Mountains. The anomaly is confined to the Mesozoic rocks, which are suitable hosts for early Tertiary mineralization. Small bodies of porphyritic, calc-alkaline intrusive rocks, presumably in the roofs of early Tertiary cupolas, cut the Mesozoic rocks within the anomaly (G. Haxel, oral commun., 1984). Small base- and precious-metal prospects and mines are in the vicinity.

LA ABRA PLAIN ANOMALY

Sample localities from the low hills surrounding the north side of La Abra Plate have anomalous concentrations of molybdenum, tungsten, and, less frequently, lead. The southern extension of this anomaly, in Mexico, has not been sampled. The anomaly is best displayed by molybdenum in stream sediment (map A) where extensive overlap from the Sonoyta anomaly is subdued. It is clearly present in heavy-mineral concentrate despite the overpowering appearance of the Sonoyta anomaly (map D). Sample localities from the north side of La Abra Plain also have anomalous concentrations of barium, strontium, vanadium, and thorium in heavy-mineral concentrate. The thorium in this anomaly is uniquely attributable to thorite. Similar assemblages have been described to the southeast, in Mexico (Mosier and Allcott, 1979), where they are attributed to a mineralization event associated with garnet-two-mica granite.

La Abra Plain is an anomalous topographic feature--a nearly circular plain set in the midst of long, northwest-trending basins and ranges. The geologic setting of the plain is described in Haxel and others (1984). Metamorphosed Precambrian and Jurassic rocks flanking the plain are complexly faulted and intruded by late Cretaceous and early Tertiary granite and are overlain by late Tertiary volcanic and sedimentary rocks. The plain itself is mantled by Quaternary and late Tertiary gravel and alluvium. The anomalous sample localities are on streams draining the pre-late-Tertiary rocks.

AQUA DULCE MOUNTAINS ANOMALY

An elongate cluster of sample localities in the Aqua Dulce Mountains have anomalous concentrations of bismuth and tungsten. Some of these localities have low-level anomalies of lead and molybdenum in heavy-mineral concentrate. The western part of the anomaly, underlain by Precambrian rocks, is bismuth rich whereas the eastern part, in Paleozoic rocks, is tungsten rich. Other rare earth elements, all characteristic of a granitoid pegmatite assemblage, Keith (1974, p. 82) describes mine workings in the Aqua Dulce district as "several small, shallow prospect pits and shafts. Very minor production. Most work done was at Papago mine." Bryan (1925, p. 194) simply names the Papago mine as a point of geographic reference. The anomaly described in this report is too large, in the wrong part of the Aqua Dulce Mountains, and of the wrong assemblage of elements to reflect "weak and spotty copper-silver mineralization" now known in the area. Too little is presently known of the mineralization history of the Aqua Dulce Mountains to propose a model for the anomaly.

STATE HIGHWAY 84 ANOMALY

Lead, bismuth, and locally tungsten are found in anomalous concentrations at sample localities in the low hills along State Highway 84 in the northeast corner of the Ajo quadrangle. The area also has anomalous concentrations of manganese, thorium, lanthanum, and yttrium, and two sample localities have abnormally low concentrations of strontium. The thorium, lanthanum, and yttrium association suggests a relation to Precambrian granite exposed in the area, whereas the other elements suggest late magmatic or hydrothermal concentration of selected elements. The abnormally low level of strontium could reflect hydrothermal alteration. No prospects are known in the area, possibly because only the most resistant granite knobs are exposed above the pediment surface. The source of the metals that contribute to this anomaly is most likely concealed.

MARICOPA MOUNTAINS ANOMALY

A number of localities in the western part of the Maricopa Mountains have anomalous concentrations of tungsten, bismuth, lead, manganese, and yttrium. The anomaly is closely associated with the outcrop area of Precambrian granite and most likely reflects a hydrothermal event superimposed upon the granite. At least one manganese prospect is known at the west end of the Maricopa Mountains (Jones and Ransome, 1920).

BOOTH HILLS ANOMALY

The tight cluster of sample localities in the Booth Hills have anomalous concentrations of bismuth, tungsten, lead, and molybdenum. These sample localities have the highest concentrations of bismuth and molybdenum in the map area. The area also has anomalous concentrations of thorium, niobium, and, in some areas, tin. The anomaly is in a large area of granite of uncertain age and may reflect a late magmatic concentration of metals. The source for the metals have the anomaly could be concealed beneath the pediment flanking the northeast side of the Maricopa Mountains. This pediment partially buries the Booth Hills. No prospects are known in the area.

MOHAWK PASS ANOMALY

Several sample localities in the vicinity of Mohawk Pass have anomalous concentrations of tungsten, bismuth, lead, or molybdenum. Localities having anomalous concentrations of bismuth do not have anomalous concentrations of molybdenum. Heavy-mineral-concentrate samples from the area have anomalous concentrations of thorium, barium, strontium, and copper. Small quantities of base and precious metals and barite have been produced from mines in vein deposits in the Mohawk mining district (Keith, 1978), which is within this anomaly.

AJO RANGE ANOMALY

A long, northwest-trending cluster of sample localities having anomalous concentrations of lead and molybdenum in heavy-mineral concentrate transects the Ajo Range. Samples from this area also have anomalous concentrations of copper and tin (one has detectable silver) and are anomalously poor in strontium. Most of this anomaly is underlain by Miocene volcanic rocks. Isolated outcrops of presumed early Tertiary, calc-alkaline intrusive rocks are exposed through the pediment cover at the northwest end of the anomaly. The general nature of the anomaly suggests remobilization of metals from older rocks beneath the exposed volcanic rocks along a major northwest-trending structural zone. Only at the northwest end of the anomaly has erosion breached the volcanic rocks to allow direct measurement of the copper and silver concentrations in the underlying rocks.

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