DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-900J
Pb, HILLSBORO AND SAN LORENZO QUADS., NEW MEXICO

Base from U.S. Geological Survey, Hillsboro, 1940 and San Lorenzo, 1956, 1:62,500

UTM GRID AND 1956 MAGNETIC DECLINATION AT CENTER OF SHEET

SCALE 1:48 000

Geology mapped by D. C. Hedlund, 1977

CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS

Qs } QUATERNARY

SEDIMENTARY AND VOLCANIC ROCKS

QTb, QTs } QUATERNARY AND TERTIARY

Trl, Trn, Tv, Tr, Tr } TERTIARY

Kv, Ks } CRETACEOUS

Pzu } PALEOZOIC

IGNEOUS AND METAMORPHIC ROCKS

p€u } PRECAMBRIAN

INTRUSIVE ROCKS

Tri, Trs, Tas } TERTIARY

Tql, Ta, Trsd } TERTIARY

Ka, Kql, Ki } CRETACEOUS

LIST OF MAP UNITS

Qs	UNCONSOLIDATED SEDIMENTARY DEPOSITS (QUATERNARY)
QTs	GILA AND SANTA FE FORMATIONS (QUATERNARY AND TERTIARY)
QTb	BASALTIC LAVA AND GILA AND SANTA FE FORMATIONS (QUATERNARY AND TERTIARY)
Tv	LAVAS AND ASH-FLOW TUFFS (OLIGOCENE)
Tr, Trl, Trn	RHYOLITE FLOWS AND DOMES (OLIGOCENE)
Tri, Trs	RHYOLITE PLUGS, STOCKS AND SILLS (OLIGOCENE)
Tas	ANDESITE SILLS AND DIKES (OLIGOCENE)
Tql	QUARTZ LATITE DIKE OR SILL (OLIGOCENE?)
Ta	ANDESITE SILLS (OLIGOCENE?)
Trsd	RHYOLITE SILLS AND DOMES (OLIGOCENE?)
Ka	ANDESITE DIKES AND SILLS (UPPER CRETACEOUS)
Ki	QUART MONZONITE, GRANITE, MONZODIORITE AND DIORITE (UPPER CRETACEOUS)
Kql	QUARTZ LATITE DIKES OF COPPER FLAT (UPPER CRETACEOUS)
Kv	ANDESITIC FLOWS OF COPPER FLAT (UPPER CRETACEOUS)
Ks	BEARTOOTH QUARTZITE (UPPER? CRETACEOUS)
Pzu	UNDIVIDED SEDIMENTARY ROCKS (PALEOZOIC)
p€u	UNDIVIDED GRANITIC AND HORNBLENDIC ROCKS (PRECAMBRIAN)

CONTACT--Dotted where concealed

FAULT--Dashed where approximately located; dotted where concealed. Where known, ball and bar on the downthrown side. U, upthrown side; D, downthrown side

ANTICLINAL AXIS--Showing crestline. Dashed where approximately located

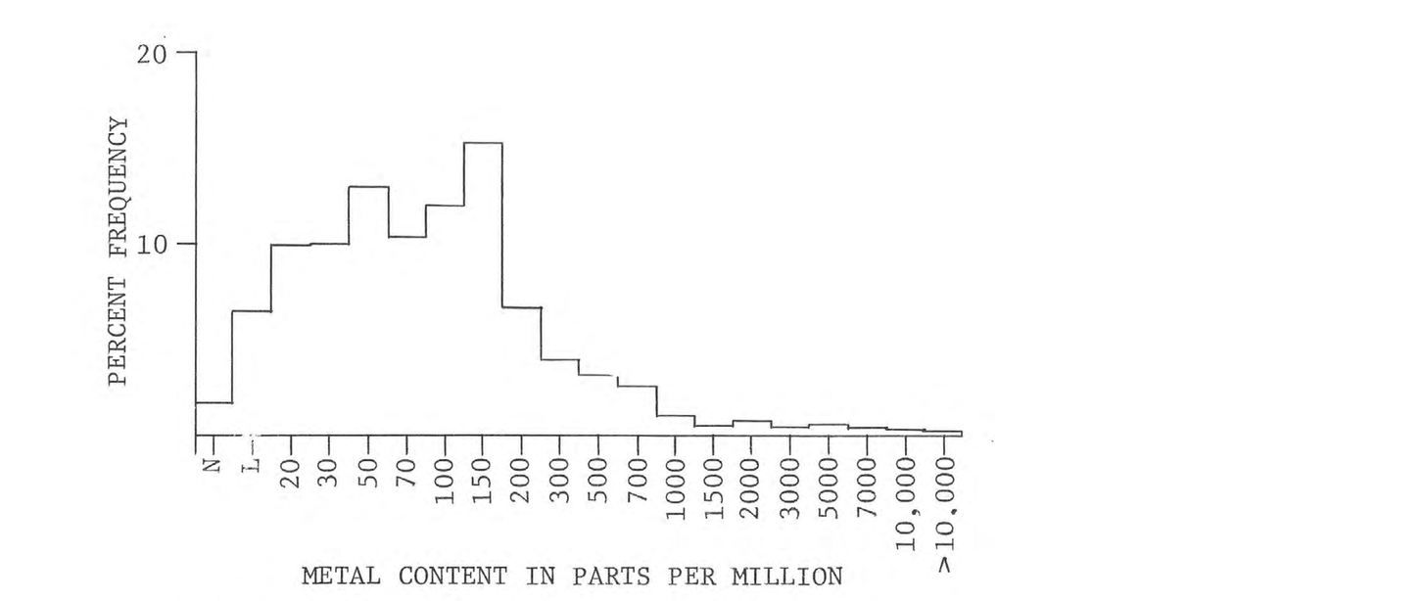
Geochemical Explanation

MAGNETIC (M-1) FRACTION--Isopleths approximately delineate source basins of stream sediments containing anomalous amounts of Pb in the magnetic (M-1) fraction. Hachures indicate low areas within metal anomalies; queried where control is lacking

Lead--≥200 ppm
Lead--≥700 ppm

NONMAGNETIC (NM-1) FRACTION--Patterned areas approximately delineates source basins of stream sediments containing anomalous amounts of Pb in the nonmagnetic (NM-1) fraction. Sample localities indicated by circles

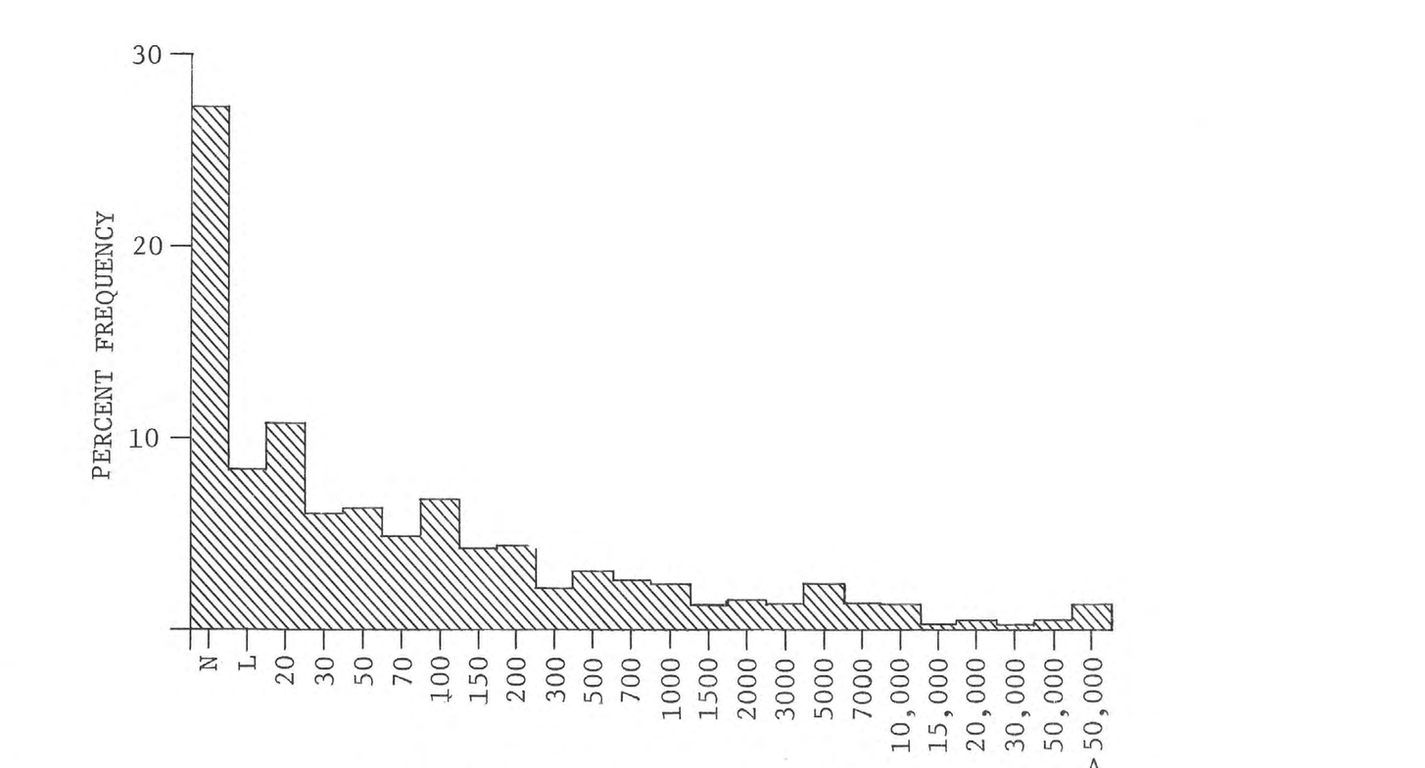
Lead--≥150 ppm
Lead--≥1,000 ppm
Lead--≥10,000 ppm



METAL CONTENT IN PARTS PER MILLION

HISTOGRAM SHOWING LEAD DISTRIBUTION, M-1 fraction

Number of samples, 1,102; N, metal value in sample is below spectographic detection limit; L, metal detected in sample but value is below the lowest spectographic standard for this metal.



METAL CONTENT IN PARTS PER MILLION

HISTOGRAM SHOWING LEAD DISTRIBUTION, NM-1 fraction

Number of samples, 1,102; N, metal value in sample is below spectrographic detection limit; L, metal detected in sample but value is below the lowest spectrographic standard for this metal.

DISCUSSION

This map shows the distribution of anomalous lead in the two sample fractions magnetic (M-1) and nonmagnetic (NM-1) plotted on a base which includes sample localities, topography, and generalized geology from Hedlund (1975a, b). It is part of a series of maps for several metals that accompany this folio. Distributions of lead values in each fraction are shown on the accompanying histograms.

Sample type

The sample material consists of the portion of pan-concentrated stream sediment having a specific gravity greater than that of bromoform. Prior to bromoform separation, magnetite was removed from the pan-concentrate sample with a hand magnet and discarded. The remaining heavy mineral sample was subsequently separated magnetically into two fractions magnetic (M-1) and nonmagnetic (NM-1). The magnetic (M-1) fraction is that portion of such material not magnetic at 0.1 ampere, but magnetic at a 1.0 ampere setting on a Franz Isodynamic Separator (forward slope 25°, side slope 15°). This fraction does not contain magnetite. The other sample fraction is not magnetic at a 1.0 ampere setting and is called nonmagnetic (NM-1) fraction.

The two sample fractions were examined for major mineral composition under the binocular microscope. Material referred to as a magnetic (M-1) fraction is comprised dominantly of limonite, manganese oxides and mafic rock-forming minerals. High metal values found in the magnetic (M-1) fraction are generally contained in limonite or manganese oxides. For this reason in anomaly interpretation this fraction is referred to as the oxide fraction. The nonmagnetic (NM-1) fraction is composed dominantly of light-colored rock-forming accessory minerals and primary and secondary ore minerals. If high metal values occur in this fraction they are predominately due to the presence of sulfides. For interpretation purposes this fraction is referred to as the sulfide fraction.

Analytical Methods

The two sample fractions from each sample locality were pulverized and analyzed for 30 elements by the semiquantitative spectrographic method of Grimes and Marranzino (1968). Results of these spectrographic analyses are reported within geometric intervals having the boundaries 1,200, 830, 560, 380, 180, 120, and so on in ppm, but are shown in the histograms by approximate geometric midpoints such as 1,000, 700, 500, 300, 200, 150, and 100. Precision of a reported value is approximately plus or minus one interval at 68 percent confidence, or plus or minus two intervals at 95 percent confidence.

Anomalous metal content as used here is considered to be an unusually higher content of metal than would normally be expected from the lithologies found in the map area. Sampling near the many known mineral deposits in the map area provided a comparative basis for recognizing these unusually high metal contents. The lead content of concentrate samples is not effected by lithology to the extent that the 80 mesh stream sediments are. Most of the lead related to lithology is removed with feldspar and clay during panning and the trace lead content most closely related to mineralization is retained in the stream-sediment concentrate. Because of this procedure the lead content of the concentrate relative to the -80 mesh sample is often decreased rather than increased unless there are lead minerals or oxide derivatives present in the sample. If these minerals are present, the ratio of anomalous lead to background is enhanced.

Lead values equal to or greater than 200 ppm in the magnetic oxide (M-1) fraction and 150 ppm in the nonmagnetic sulfide (NM-1) fraction are regarded as anomalous. The next higher plotting intervals for lead were chosen arbitrarily.

Geochemical implications of sample fractions for lead

Limonite and manganese oxides containing high lead values occur in the magnetic oxide (M-1 fraction and are derived from joint surfaces, fractures, and dispersions in caprock. This material is then mechanically transported to the stream bed. The lead-rich limonite and manganese oxides are thought to result from processes associated with mineralization and later oxidation. Much of the limonite is pseudomorphic after pyrite. In areas where this lead-rich limonite is found it may be derived from weathered primary halos of disseminated pyrite and accompanying high trace metals that may exist above concealed mineral deposits.

High lead concentrations in the nonmagnetic sulfide (NM-1) fraction occur where primary and secondary ore minerals are exposed at the surface and mechanically enter the stream bed.

Description of Anomalies

Both north and south of the Copper Flat area (northeastern corner of the map), high lead values are found in the magnetic oxide (M-1) fraction of the stream sediment concentrate. Some samples in the north also contain high lead in the nonmagnetric sulfide (NM-1) fraction. In both the northern and southern areas, high lead is derived from drainages that contain outcroppings of silicated limestone, marble, and propylitized andesite. Both areas also contain zones of silicification, jasperoid, and limonite staining. Much of the high lead in the magnetic oxide (M-1) fraction is derived from areas where these materials are prominent and the metal is probably contained within the limonite and jasperoid, possibly as Fe-oxide impregnated cerussite, vanadinite, wulfenite, or perhaps as adsorbed metal.

The high lead areas both north and south of Copper Flat are interpreted as peripheral skarn zones around mineralization at Copper Flat and the Hillsboro Lode District. Possibilities for skarn or Pb-Zn replacement deposits exist in both the northern and southern areas, judging from the extensive lead anomalies found there.

NEW MEXICO
QUADRANGLE LOCATION

The overall lead pattern on the nonmagnetic sulfide (NM-1) fraction has a roughly northeastern trend in the Copper Flat area, which is also a prominent influence for the quartz latite dikes. The greatest lead concentration coincides with veins in the Hillsboro Lode District, which is about 2 miles to the south of the quartz monzonite cupola. The nonmagnetic sulfide (NM-1) lead configuration shown on the map coincides mainly with the distribution of galena and possibly secondary ore minerals such as cerussite, vanadinite, and wulfenite in the area.

Scattered lead highs along the eastern map margin are due to metal leakage that is probably related to weak mineralization. Rock samples in the area have carried anomalous values at lithologic contacts and in stringers. Near the Wilson Ranch in the southeastern part of the map area, and possibly near the Nunn Ranch the high lead probably represents the northern extreme of mineralized rocks associated with the Lake Valley Mining district a few miles to the south of the map area. Alternately or perhaps additionally, the possibility exists that some of these lead anomalies are the eastern extreme of an east-west trend that clearly shows on the lead and molybdenum maps, and is believed to be related to a buried east-west trending geologic feature.

Additional lead anomalies in the nonmagnetic sulfide (NM-1) fraction occur on the western edge of the Hillsboro trough, the gravel filled area west of Copper Flat that extends south of Hillsboro. The high lead values are found mainly on tributaries to Trujillo Canyon. These nonmagnetic sulfide (NM-1) fraction lead anomalies are probably derived from mineralized outcrops of unknown economic significance that have supplied stream sediment to the drainage system. Portions of the mineralized source rock are probably covered by the postmineralization gravel from the Tertiary and Quaternary Santa Fe Formation. An anomalous, aeromagnetic low occurs in the vicinity.

The central portion of the map area which also constitutes the inner core of the Black Range is occupied by an apparently genetically related, and at least in part, structurally controlled system of lead anomalies (T. 16-18 S., R. 8-9 W.). The system of anomalies, when viewed as a whole, forms a roughly northwest-trending rectilinear pattern in the magnetic oxide (M-1) fraction with a possible superimposed northeast trend or interference pattern mainly shown by Pb, Ag, Mo, and Zn in the nonmagnetic sulfide (NM-1) fraction. The rectilinear, limonite (magnetic fraction) pattern consists of several nearly east-west and north-northwest linear anomaly trends which increase in intensity and seem to intersect in the areas of PA Mountain, Noonday Peak, Sawyers Peak, Log Cabin Peak. Ladrone Gulch, and north of Haystack Mountain. All of these intersection areas pose excellent targets for concealed mineral deposits. The eastern margin of this anomaly system is approximately bounded by the eastern uplifted block adjacent to the Pierce Canyon fault along which relatively high lead anomalies are localized mainly in the nonmagnetic sulfide (NM-1) fraction. The western margin trends subparallel to the Grandview fault and extension of Hedlund (1975a,b) which ostensibly is buried by the Tertiary Kneeling Nun Tuff, Mimbres Peak Rhyolite of Jicha, 1954 and other volcanics to the south of the Royal John Mine. The geochemical anomaly which is found in the vicinity of the Royal John Mine continues southward into the area covered by volcanics apparently reflecting a continuation of the mineralized rocks under the volcanics. An intrusive may also exist under the volcanic rocks in the vicinity of Noonday Peak as suggested by an anomalous aeromagnetic high there. This area also constitutes an intersection of linear geochemical trends and multielement anomalies intensify and cluster around the vicinity. In this area it is the magnetic (M-1) or Fe-oxide fraction that contains most of the anomalous lead rather than the nonmagnetic (NM-1) or dominantly ore mineral fraction. This suggests that the lead is derived from limonite and possibly manganese oxide-selvages and fillings in faults, fractures, and dispersions that have then mechanically entered the stream bed. These selvages and fracture fillings could represent part of an oxidized, primary leakage halo above concealed mineral deposits or the anomalous trace metals may have been mobilized and brought upward into the caprock by a ground-water convection cell generated by a late intrusion beneath the area near Noonday Peak. The presence of minor, sporadic lead occurrences in the nonmagnetic sulfide (NM-1) fraction in this area, suggests there are some through-going fractures or veins at the surface that still contain lead minerals not weathered to iron oxides.

One anomaly trend in the Black Range geochemical system striking nearly east-west, extends along the south-central margin of the map area from about 1.5 miles west of Noonday Peak eastward through PA Mountain and perhaps as far as Nunn Ranch (T. 17, 18 S., R. 6-10 W.). The anomaly pattern is sporadic on the nonmagnetic sulfide (NM-1) fraction is nearly continuous in the magnetic oxide (M-1) fraction and extends beyond the boundary of Pierce Canyon on the east. The anomaly pattern crosses all stratigraphic boundaries and cuts at nearly right angles the generally north-south fabric of mapped surface faults. The trend is apparently influenced by north-south structures in the vicinity of Pine Flat Mountain, where an anomalous aeromagnetic high also occurs. In the vicinity of PA Mountain and the Pierce Canyon fault very high lead concentrations are found. The PA Mountain area may be regarded as an intersection of east-west and north-northwest structural and geochemical trends. The general area may be an excellent exploration target The overall pattern of the east-west trending lead anomaly may be attributed to a concealed geologic structure. Aeromagnetic anomalies also show a similar trend across this portion of southern map area.

The Pierce Canyon anomaly trend, as described here, includes patterns of unusally high lead concentration beginning in the south, near Signal Peak and within O Bar O Canyon and extending northward along the Pierce Canyon fault zone in a somewhat locally discontinuous but linear band which seems to end near the Kingston Ranger Station or perhaps extends as far as the vicinities of Picket Spring Canyon and Ladrone Gulch. The general configuration leaves little doubt of the structural north-south control over the anomaly. The Pierce Canyon fault zone is intruded by porphyritic rhyolite and also talc alteration has been observed at various localities (Hedlund, 1974, oral commun.). In addition the Silvertail Mine and Log Cabin Mine (near Log Cabin Peak) and several small prospects are localized on or near this structure. This zone therefore appears to be a locus of intrusion, alteration, and mineralization and apparently some of the faults within the zone served as solution pathways. The strongest anomalies in the zone are found near the outcrops of intrusive porphyritic rhyolite. In the vicinity of PA Mountain, the anomaly pattern bulges to the east into the adjacent limestone which is extensively faulted. Although magnetic fraction (M-1) lead as well as other metals occur in the Pierce Canyon anomaly, the intensity is greater in the nonmagnetic fraction (NM-1), which is characteristic of metal anomalies derived from fault or fractures containing hypogene mineralization or oxidized secondary equivalents. The lead in this zone correlates best with anomalous W and Mo. Residual concentrations of such minerals as wulfenite and scheelite giving false impression of large metal concentrations at depth are indeed possible in the environment of this zone but, where conditions are favorable at depth, primary minerals such as galena and molybdenite may be in economic concentration. Therefore, the entire zone seems a good exploration target for deposits at depth.

Unusually high concentration of lead occur in the vicinity of the Royal John, Columbia, Grandview Mines and other mines north of and nearly connecting with high lead in the vicinity of Noonday Peak. These anomalies are associated with uplifted Paleozoic sedimentary rocks and Tertiary andesite of the Rubio Peak Formation and accompanying sulfide deposits, marble and skarn along the Grandview fault and extension Hedlund (1977a, b). These anomalies are strongest in the nonmagnetic fraction because of the close proximity of known sulfide deposits to the surface. However, the anomaly patterns in the nonmagnetic (NM-1) fraction extend sporadically in a southwesterly direction from the known mineral deposits, in terrain covered mostly by Kneeling Nun Tuff. Both lead and silver anomalies occur in these areas. These high metal values probably reflect through-going metal-rich fractures that may contain primary and secondary ore minerals now being weathered mechanically. Small tributaries were sampled instead of the main drainages over most of the Kneeling Nun terrain. This sample design in areas covered by Kneeling Nun Tuff allowed for the detection of anomalies with local sources in the volcanics themselves and precluded the possibility of erroneously attributing metal anomalies to a source in known mineralized Paleozoic rocks at the mines near the Black Range crest. This erroneous interpretation could occur if only the main tributaries from the range crest were sampled. The large tributaries were sampled at bifurcations near their source.

Limonite-held (magnetic fraction) lead forms another nearly east-west anomaly pattern from the vicinity of the Columbia Mine on the west, eastward through Seven Brothers Mountain, to an intersection with the Pierce Canyon trend near Log Cabin Peak. This same linear trend is extended westward by bismuth anomalies that are related at least in part to mapped faults and porphyritic rhyolite intrusions. In Tierra Blanca canyon, most of this anomaly trend is confined to tributaries from the northern side of the canyon, tributaries from the south side are not anomalous. This suggests, a fault or lithologic break between north and south sides of the canyon, but none have been mapped at the surface. The east-west trend of the anomaly must therefore reflect a concealed geologic control such as a basement fault or a buried contact.

In the vicinities of Bull Trap Canyon, Dry Gallinas Canyon and Thumb Ridge, lead anomalies occur in both magnetic oxide (M-1) and nonmagnetic sulfide (NM-1) fractions. The distribution of lead in these areas shows excellent spatial correlation with bismuth anomalies and the outcrop area of rhyolite porphyry intrusions. Aeromagnetic highs and an aeromagnetic lineament with an east-west trend also correlates with the lead anomalies. The high lead patterns form a tenuous trend that seems to extend east-northeastward to Ladrone Gulch; possibly as an anomaly trend subparallel to the two east-west patterns previously discussed. A possible intersection with westerly portions of the Pierce Canyon lead trend appears to exist in the vicinity of Ladrone Gulch. The area of Ladrone Gulch, and a close radius around it, constitutes an excellent exploration target, because it apparently is an intersection of geochemical anomaly trends and because an intensification of multielement anomalies, including most notably copper, occurs there.

A roughly elliptical halo formed by unusually high lead in the nonmagnetic sulfide (NM-1) fraction has a long axis trending northeast and occurs in the area surrounding Carbonate Creek, northwest of the town of Kingston. This halo could even include high metal anomalies west of Emory Pass, those in the vicinity of the Gray Eagle Mine, and areas northward that form a halo around tributaries containing low lead within upper Carbonate Creek and upper Picket Spring Canyon (T. 15-16 S., R. 8-9 W.). A low intensity aeromagnetic anomaly occurs in upper Picket Spring Canyon and an aeromagnetic high occurs farther west at the head of Ladrone Gulch. The area occupied by lead lows may contain a buried intrusive from which lead has been leached and deposited in the surrounding rocks or the halo may represent peripheral primary dispersion of lead.

The Rose Mine area described here is in the southwest part of the San Lorenzo quadrangle which occupies the uplifted block on the west side of the Mimbres fault, but does not include gravel filled areas on the east side of the fault in the vicinity of Shingle Canyon. The area is characterized by pervasively high lead values in both magnetic oxide (M-1) and nonmagnetic sulfide (NM-1) fractions as well as correlation with high copper values in both fractions. A well-defined aeromagnetic high is centered near the Rose Mine and shows a close spatial association with the lead anomalies as do some of the acid intrusives in the area. Much of the area of outcropping Paleozoic rocks contain sporadic patches of limonite and jasperoid which is the probable source of much of the lead in the magnetic oxide (M-1) fraction. Some chip samples of the jasperoid and limonite and limonitic samples from several of the fault zones in the area contain unusually high amounts of Pb, Zn, Ag, and Mo. The overall lead pattern, particularly the limonite (magnetic) fraction at 700 ppm, shows a general subparallel relationship to the Mimbres fault and associated faults of similar trend. The nearby Chino porphyry copper deposit is not believed the source of these metal anomalies, because later sampling has shown a low lead area to intervene between here and Chino a few miles to the west off the map.

High lead has been found in Quaternary gravels in the vicinity of Shingle Canyon. The high lead was probaly derived from the Georgetown mining district off the map to the west. A subjacent source for these high metal values is unlikely.

The Hendricks Peak anomalous area as described here includes anomalies on a number of metals in an area that includes portions of Mud Springs Canyon, Stitzel Canyon, Noonday Canyon, Rosencran Canyon, and Rabb Park. This general anomalous area which is located on the edge of the Mimbres valley fill is dominantly in the younger volcanic terrain but it also includes the area in which the Rabb Park moonstone sanidine-bearing rhyolite porphyry outcrops. The anomalous lead in the Hendricks Peak area is contained mainly in the nonmagnetic sulfide (NM-1) fraction and is accompanied by anomalous Ag, Zn, and Mo in both fractions. Outcropping fractures containing primary and secondary ore minerals are being mechanically weathered in this area as evidenced by lead anomalies in the nonmagnetic sulfide (NM-1) fraction and the visual identification of galena in the samples. Where the magnetic anomalies occur these fractures are probably filled with metal-rich Fe-Mn oxides because of greater weathering. The presence of a well-defined aeromagnetic low centered over Mud Spring canyon suggests that the anomalies may be a part of a leakage halo related to a buried pluton. The halo should be regarded as weak suggesting mineralization is either weak or at great depth.

REFERENCES

Alminas, H. V., and Watts, K. C., 1977, Interpretive geochemical map, Hillsboro and San Lorenzo quadrangles exclusive of the Black Range Primitive Area, Sierra and Grant Counties, New Mexico: U.S. Geol. Survey Misc. Field Studies Map MF-900 G.

Alminas, H. V., Watts, K. C., Griffitts, W. R., Siems, D. L., Kraxberger, V. E., and Curry, K. J., 1975a, Map showing anomalous distribution of tungsten, fluorite and silver in stream-sediment concentrates from the Sierra Cuchillo-Animas uplifts and adjacent areas, southwestern New Mexico: U.S. Geol. Survey Misc. Inv. Map I-800.

_____1975b, Map showing anomalous distribution of lead, tin, and bismuth in stream-sediment concentrates from the Sierra Cuchillo-Animas uplifts and adjacent areas, southwestern New Mexico: U.S. Geol. Survey Misc. Inv. Map I-881.

Alminas, H. V., Watts, K. C., Siems, D. F., and Kraxberger, V. E., 1977a, Map showing anomalous silver distribution in stream sediment concentrates, Hillsboro and San Lorenzo quadrangles exclusive of the Black Range Primitive Area, Sierra and Grant Counties, New Mexico: U.S. Geol. Survey Misc. Field Studies Map MF-900 C.

_____1977b, Map showing anomalous copper distribution in stream sediment concentrates, Hillsboro and San Lorenzo quadrangles exclusive of the Black Range Primitive Area, Sierra and Grant Counties, New Mexico: U.S. Geol. Survey Misc. Field Studies Map MF-900 D.

_____1977c, Map showing anomalous molybdenum distribution in stream sediment concentrates, Hillsboro and San Lorenzo quadrangles exclusive of the Black Range Primitive Area, Sierra and Grant Counties, New Mexico:: U.S. Geol. Survey Misc. Field Map MF-900 E.

_____1977d, Map showing anomalous zinc distribution in stream sediment concentrates, Hillsboro and San Lorenzo quadrangles exclusive of the Black Range Primitive Area, Sierra and Grant Counties, New Mexico: U.S. Geol. Survey Misc. Field Studies Map MF-900 F.

Grimes, D. J., and Maranzino, A. P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semiquantitative analysis of geologic materials: U.S. Geol. Survey Circ. 591, 6 p.

Harley, G. T., 1934, The geology and ore deposits of Sierra County, New Mexico: New Mexico Bur. Mines and Mineral Resources Bull. 10, 220 p.

Hedlund, D. C., 1975a, Geologic map of Hillsboro quadrangle, Sierra and Grant Counties, New Mexico: U.S. Geol. Survey Open-File Rept. 75-108.

_____1975b, Geologic map of San Lorenzo quadrangle, Sierra and Grant Counties, New Mexico: U.S. Geol. Survey Open-File Rept. 75-109.

_____1977a, Geologic map of the Hillsboro and San Lorenzo quadrangles, Sierra and Grant Counties, New Mexico: U.S. Geol. Survey Misc. Field Studies Map MF-900 A.

_____1977b, Mineral resources map of the Hillsboro and San Lorenzo quadrangles, Sierra and Grant Counties, New Mexico: U.S. Geol. Survey Misc. Field Studies Map MF-900 B.

Jicha, H. L., 1954, Geology and mineral deposits of Lake Valley quadrangle, Grant, Luna, and Sierra Counties, New Mexico: New Mexico Bur. Mines and Mineral Resources Bull. 37, 93 p.

Kuellmer, F. J., 1955, Geology of a disseminated copper deposit near Hillsboro, Sierra County, New Mexico: New Mexico Bur. Mines and Mineral Resources Circ. 34, 46 p.

_____comp., 1956, Geologic map of Hillsboro Peak thirty-minute quadrangle: New Mexico Bur. Mines and Mineral Resources Geologic Map 1.

U.S. Geological Survey, 1974, Aeromagnetic map of parts of Silver City and Las Cruces 1° by 2° quadrangles, southwestern New Mexico: U.S. Geol. Survey Open-file report.

Watts, K. C., Alminas, H. V., and Kraxberger, V. E., 1977, Map showing areas of detrital fluorite and cassiterite, and the localities of rock samples, Hillsboro and San Lorenzo quadrangles exclusive of the Black Primitive Area, Sierra and Grant Counties, New Sierra and Grant Counties, New Mexico: U.S. Geol. Survey Misc. Field Studies Map MF-900 H.

Watts, K. C., Alminas, H. V., Nishi, J. M., and Crim, W. C., 1977a, Map showing anomalous tungsten and gold distribution in stream sediment concentrates Hillsboro and San Lorenzo quadrangles exclusive of the Black Range Primitive Area, Sierra and Grant Counties, New Mexico: U.S. Geol. Survey Misc. Field Studies Map MF-900 I.

_____1977b, Map showing anomalous bismuth distribution in stream sediment concentrates, Hillsboro and San Lorenzo quadrangles exclusive of the Black Range Primitive Area, Sierra and Grant Counties, New Mexico: U.S. Geol. Survey Misc. Field Studies Map MF-900 K.

Weissenborn, A. E., 1948, A new occurrence of helvite [New Mexico]: Am. Mineralogist, v. 33, no. 9-10, p. 648-649.

MAP SHOWING ANOMALOUS LEAD DISTRIBUTION IN STREAM SEDIMENT CONCENTRATES, HILLSBORO AND SAN LORENZO QUADRANGLES EXCLUSIVE OF THE BLACK RANGE PRIMITIVE AREA SIERRA AND GRANT COUNTIES, NEW MEXICO

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