

1 ½ 0 1 2 3 KILOMETERS

DATUM IS MEAN SEA LEVEL

FIGURE 4 -- DISTRIBUTION OF ANOMALOUS COPPER, LEAD

NEW

MEXICO

QUADRANGLE LOCATION

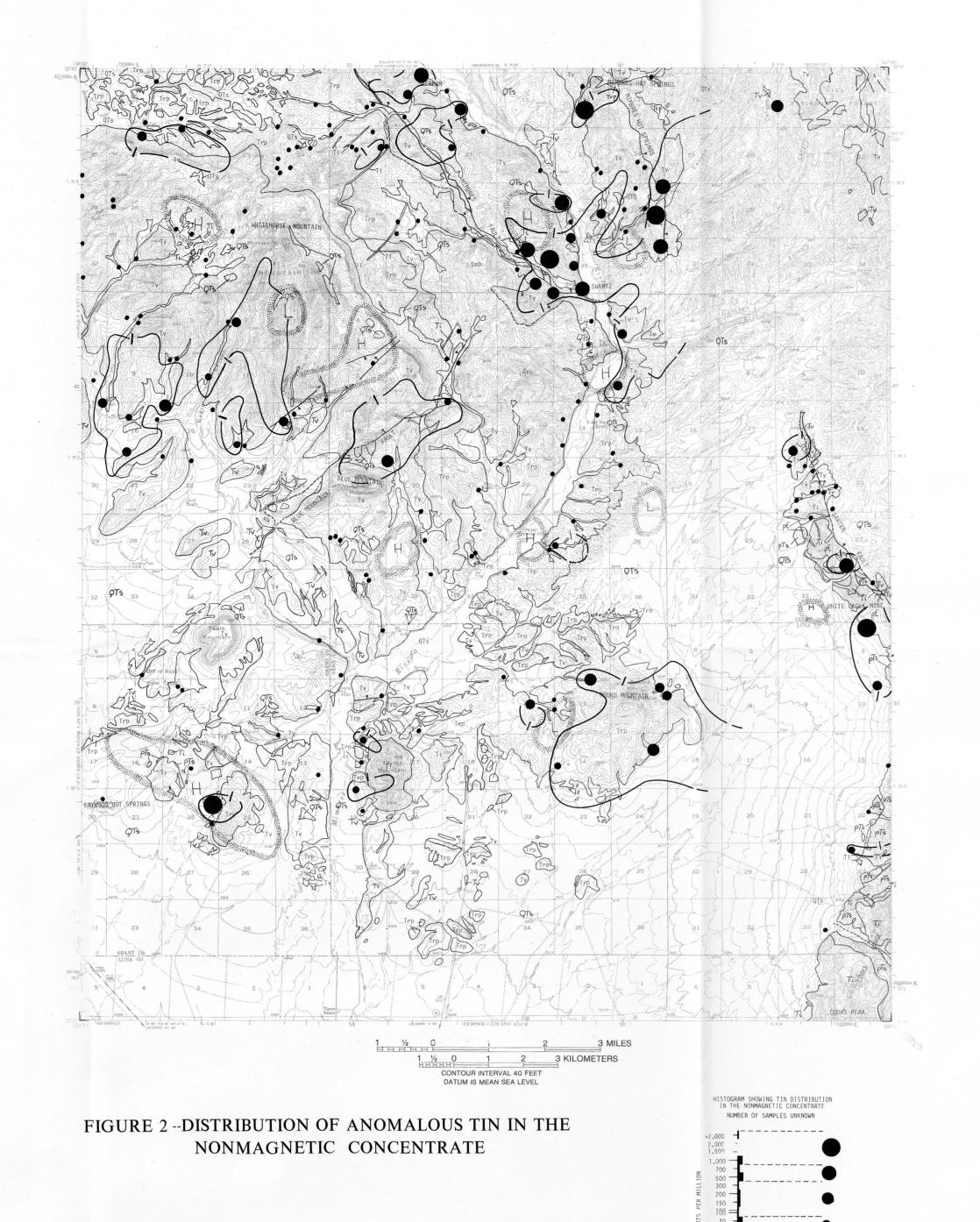
AND ZINC IN THE Fe-Mn OXIDE RESIDUE

20 40 50

L=detected but below the lowest reporting level. N=not detected at the limit of determination

HISTOGRAMS SHOWING ZINC, LEAD, AND COPPER DISTRIBUTIONS IN THE Fe-Mn OXIDE RESIDUE

PERCENT FREQUENCY L=detected but below the lowest reporting level. N=notdetected at the limit of determination.



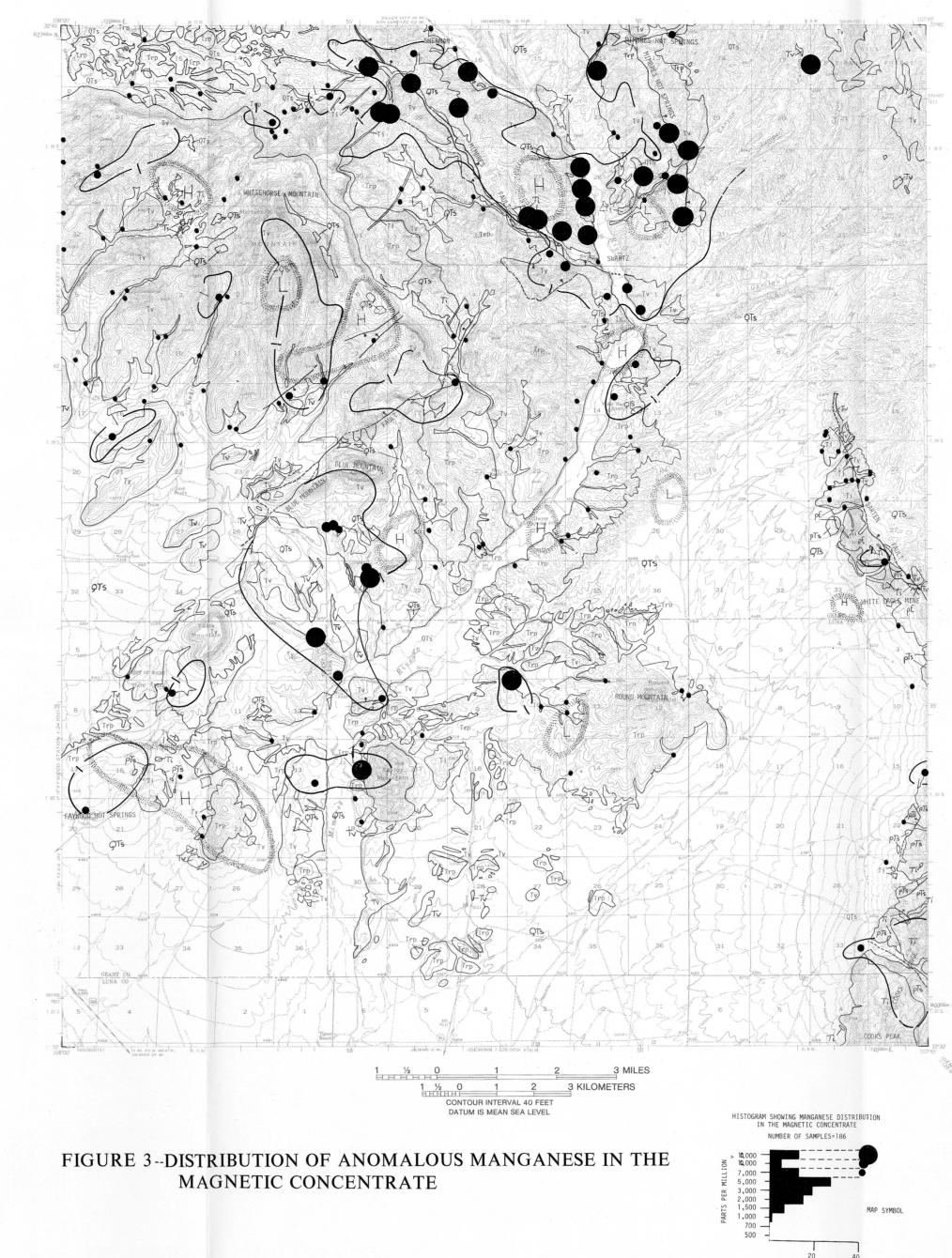
1 ½ 0 1 2 3 KILOMETERS

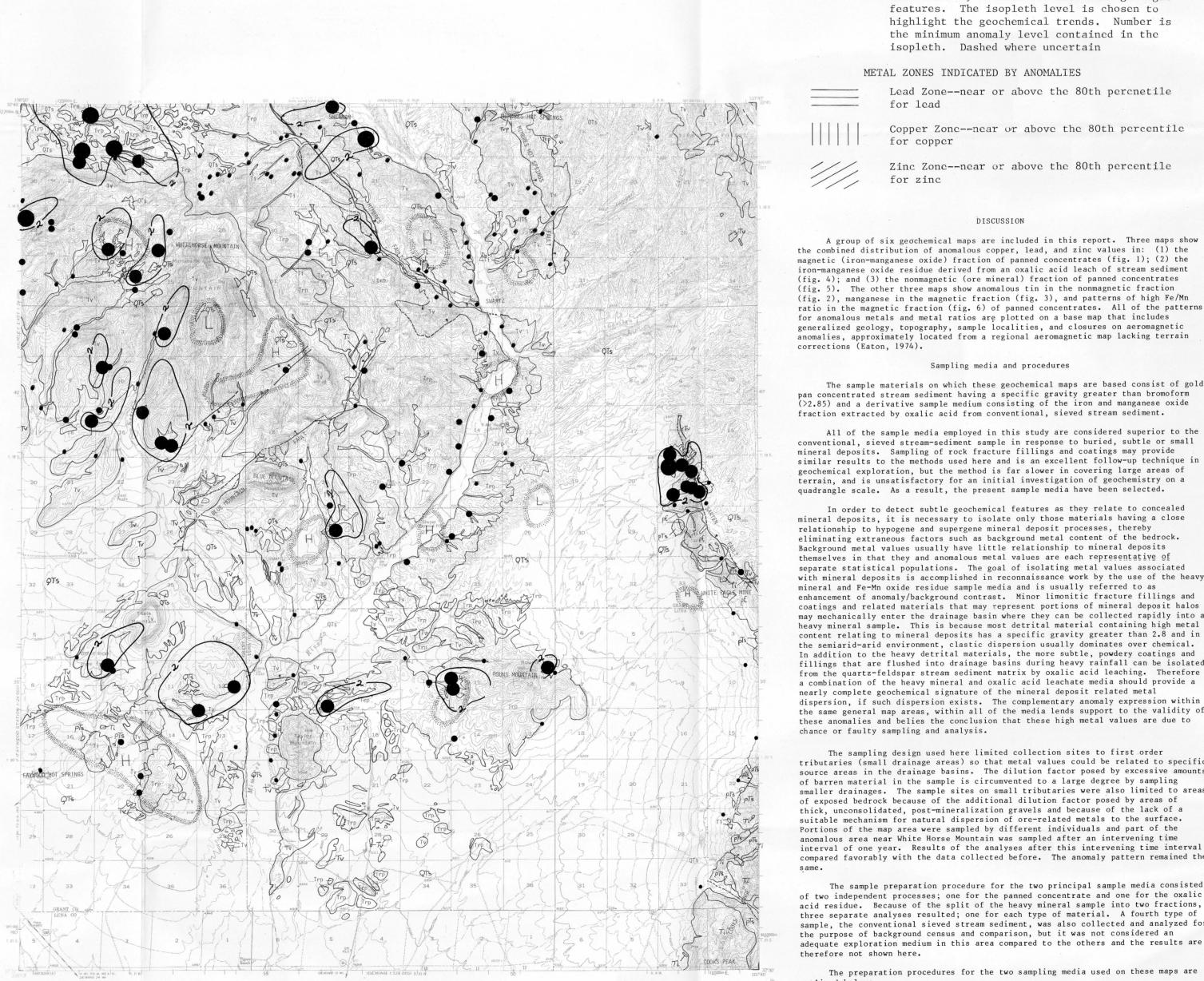
L=detected but below the lowest reporting level. N=not detected at the limit of determination.

DATUM IS MEAN SEA LEVE

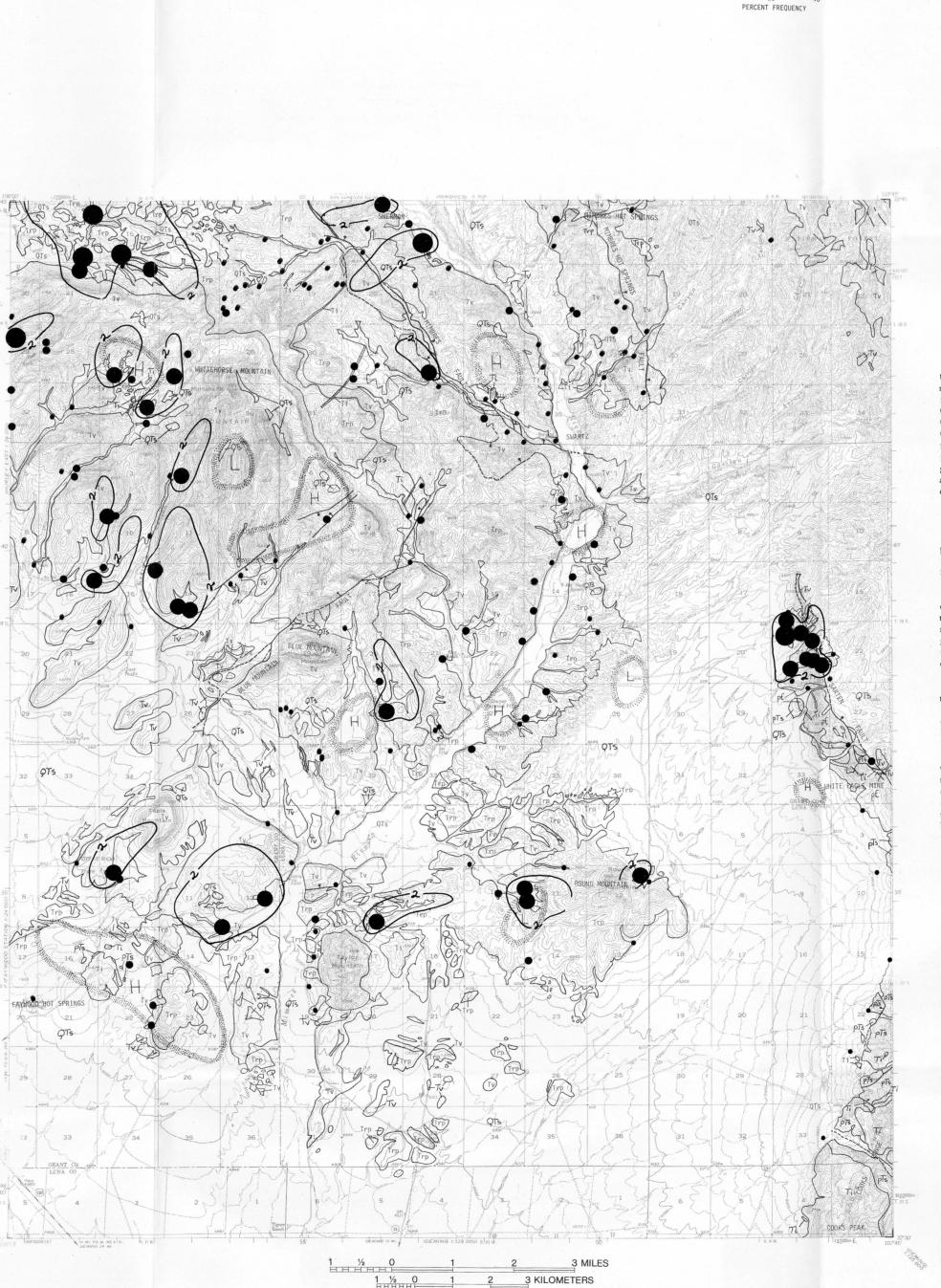
FIGURE 5 -- DISTRIBUTION OF ANOMALOUS COPPER, LEAD

AND ZINC IN THE NONMAGNETIC CONCENTRATE





DATUM IS MEAN SEA LEVEL

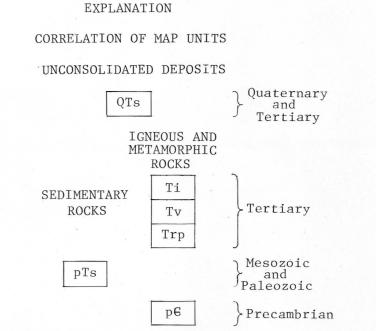


thick, unconsolidated, post-mineralization gravels and because of the lack of a suitable mechanism for natural dispersion of ore-related metals to the surface. Portions of the map area were sampled by different individuals and part of the anomalous area near White Horse Mountain was sampled after an intervening time interval of one year. Results of the analyses after this intervening time interval compared favorably with the data collected before. The anomaly pattern remained the The sample preparation procedure for the two principal sample media consisted of two independent processes; one for the panned concentrate and one for the oxalic acid residue. Because of the split of the heavy mineral sample into two fractions, three separate analyses resulted; one for each type of material. A fourth type of sample, the conventional sieved stream sediment, was also collected and analyzed for the purpose of background census and comparison, but it was not considered an adequate exploration medium in this area compared to the others and the results are

Panned concentrates--Subsequent to gold panning, magnetite was removed with a hand magnet and discarded as the initial step in preparation of the pan concentrate sample. The remaining light minerals were then removed using bromoform and the resultant heavy-mineral sample was separated magnetically into two fractions designated magnetic (M-1) and nonmagnetic (NM-1). The magnetic (M-1) fraction is that portion of the sample 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°) whereas

Following magnetic separation, the two sample fractions were examined for major mineral composition under the binocular microscope as a preliminary step prior to analysis. Material referred to as magnetic (M-1) is composed dominantly of imonite, manganese oxides, and mafic rock-forming minerals. High metal values found in the M-l fraction are generally contained in limonite (hydrated iron oxides) or manganese oxides as these materials are known to fix ore metals and most ore minerals are not magnetic at a 1.0 ampere setting.

Mafic minerals without sulfide intergrowths rarely contain above background



## DESCRIPTION OF MAP UNITS

QTs UNCONSOLIDATED TO CONSOLIDATED SEDIMENTS (QUATERNARY AND TERTIARY) -- Includes conglomerates, fanglomerates,

> INTRUSIVE ROCKS (TERTIARY) -- Includes dikes of felsic to mafic composition, hypabyssal intrusive domes of felsic composition, rhyolite and monzonite bodies in the Cooks Range and elsewhere and the granodiorite of Cooks Peak

VOLCANIC ROCKS (TERTIARY) -- Includes some rhyolite intrusives both differentiated and undifferintiated by Elston

terrace gravels, and alluvium

RUBIO PEAK FORMATION (OLIGOCENE) -- Includes andesite and latite flows and tuffs. Interfingers with other volcanic units but is generally the lowest volcanic unit in the sequence being deposited on the pre-volcanic surface

SEDIMENTARY ROCKS (PRE-TERTIARY) IGNEOUS AND METAMORPHIC ROCKS (PRECAMBRIAN)

---- CONTACT FAULT--Bar and ball on downthrown side; dashed

H CLOSURE ON AEROMAGNETIC ANOMALY--Approximately

GEOLOGIC SYMBOLS

SAMPLE LOCALITY--(Range of anomalous metal values for each metal and symbol is shown on the

GEOCHEMICAL SYMBOLS

Background metal content Level 1--Weak anomaly, near or above the 80th

Level 2--Moderate anomaly near or above the 85th Level 3--Moderately strong anomaly, near or above the 90th percentile Level 4--Strong anomaly, near or above the 95th

Level 5--Very strong anomaly, near or above the 99th percentile

percentile

—— ISOPLETHS--Enclose drainage basins containing the source of anomalous values or anomalous Fe/Mn ratios in the heavy-mineral concentrate from stream sediment. The isopleth patterns indicate metallization trends that may be controlled by surface or subsurface geologic features. The isopleth level is chosen to highlight the geochemical trends. Number is the minimum anomaly level contained in the isopleth. Dashed where uncertain

METAL ZONES INDICATED BY ANOMALIES Lead Zone--near or above the 80th percnetile

for lead Copper Zone--near or above the 80th percentile Zinc Zone--near or above the 80th percentile

for zinc

A group of six geochemical maps are included in this report. Three maps show the combined distribution of anomalous copper, lead, and zinc values in: (1) the magnetic (iron-manganese oxide) fraction of panned concentrates (fig. 1); (2) the iron-manganese oxide residue derived from an oxalic acid leach of stream sediment (fig. 4); and (3) the nonmagnetic (ore mineral) fraction of panned concentrates fig. 5). The other three maps show anomalous tin in the nonmagnetic fraction (fig. 2), manganese in the magnetic fraction (fig. 3), and patterns of high Fe/Mn ratio in the magnetic fraction (fig. 6) of panned concentrates. All of the patterns for anomalous metals and metal ratios are plotted on a base map that includes generalized geology, topography, sample localities, and closures on aeromagnetic anomalies, approximately located from a regional aeromagnetic map lacking terrain

Sampling media and procedures

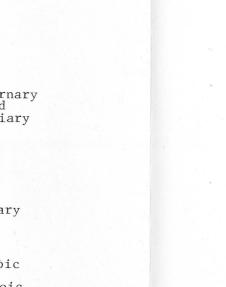
The sample materials on which these geochemical maps are based consist of gold pan concentrated stream sediment having a specific gravity greater than bromoform >2.85) and a derivative sample medium consisting of the iron and manganese oxide fraction extracted by oxalic acid from conventional, sieved stream sediment. All of the sample media employed in this study are considered superior to the conventional, sieved stream-sediment sample in response to buried, subtle or small mineral deposits. Sampling of rock fracture fillings and coatings may provide similar results to the methods used here and is an excellent follow-up technique in geochemical exploration, but the method is far slower in covering large areas of terrain, and is unsatisfactory for an initial investigation of geochemistry on a quadrangle scale. As a result, the present sample media have been selected. In order to detect subtle geochemical features as they relate to concealed mineral deposits, it is necessary to isolate only those materials having a close relationship to hypogene and supergene mineral deposit processes, thereby eliminating extraneous factors such as background metal content of the bedrock. Background metal values usually have little relationship to mineral deposits themselves in that they and anomalous metal values are each representative of separate statistical populations. The goal of isolating metal values associated with mineral deposits is accomplished in reconnaissance work by the use of the heavy mineral and Fe-Mn oxide residue sample media and is usually referred to as enhancement of anomaly/background contrast. Minor limonitic fracture fillings and coatings and related materials that may represent portions of mineral deposit halos may mechanically enter the drainage basin where they can be collected rapidly into a heavy mineral sample. This is because most detrital material containing high metal content relating to mineral deposits has a specific gravity greater than 2.8 and in the semiarid-arid environment, clastic dispersion usually dominates over chemical. n addition to the heavy detrital materials, the more subtle, powdery coatings and illings that are flushed into drainage basins during heavy rainfall can be isolated from the quartz-feldspar stream sediment matrix by oxalic acid leaching. Therefore a combination of the heavy mineral and oxalic acid leachate media should provide nearly complete geochemical signature of the mineral deposit related metal dispersion, if such dispersion exists. The complementary anomaly expression within the same general map areas, within all of the media lends support to the validity of

The sampling design used here limited collection sites to first order tributaries (small drainage areas) so that metal values could be related to specific source areas in the drainage basins. The dilution factor posed by excessive amounts of barren material in the sample is circumvented to a large degree by sampling smaller drainages. The sample sites on small tributaries were also limited to areas of exposed bedrock because of the additional dilution factor posed by areas of

therefore not shown here. The preparation procedures for the two sampling media used on these maps are

the nonmagnetic fraction includes all heavy minerals that are not magnetic at a 1.0 ampere setting. The 1.0 ampere setting provides a relatively clean split of the sample into dark (M-1) and light (NM-1) colored heavy-mineral components.

metal content, therefore these minerals are probably unimportant in anomaly interpretation in that they represent metal values in the background range. In anomaly interpretation, therefore, the magnetic fraction is referred to as the ironmanganese oxide fraction. The NM-1 fraction is composed dominantly of light-colored rock-forming accessory minerals and primary and secondary ore minerals. High metal values in this fraction are predominantly due to the presence of sulfides or their oxidation products. For interpretation purposes this fraction is referred to as the



## residue. Results of these spectrographic analyses for all of the sample media are measured within geometric intervals having the boundaries 1200, 830, 560, 380, 180, 120, and so forth, in ppm (parts per million), but are reported as and shown in the

histograms by the approximate geometric midpoints 1,000, 700, 500, 300, 200, 150 100, and so forth. 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

Copper, lead, and zinc anomalies are combined on some of the maps for convenience and because the anomaly distributions overlap and coincide within the same general areas. The combined maps provide a more complete picture of the verall anomaly configuration than would result from showing each metal separately. Metal zonation patterns have been depicted by labeling the anomalous metals in each area in order of decreasing metal prominence and, in the case of the iron-manganese oxide residue map (fig. 4), by cross-hatching. Both hypogene and supergene zonation seem to be reflected in these patterns, but the extent of both vertical and lateral supergene dispersion is difficult to determine. The best empirical examples of metal zonation occurs in areas near Whitehorse Mountain (secs. 25, 26, 35, 36, T. 18 S., R. 11 W.).

The anomaly levels shown by the symbols on the histograms and on the maps

represent ranges of metal content. These ranges are based on the percentile interval for each of these metals regardless of the inherent differences in absolute metal content between metals within each percentile interval. This approach was used because it facilitated interelement comparisons and made it possible to combine several metals having somewhat the same anomaly distribution on the same map, giving equal weight to each metal depending on percentile interval rather than metal content. Single element maps for copper, lead, and zinc would have been redundant otherwise. Where copper, lead, and zinc are combined on the same map, the highest percentile level for any of the three at each site was chosen as the representative level for that site. The isopleths are drawn so as to enclose the anomalous drainage basins. This represents the maximum area within which the source(s) of high metal values can be expected to be found. The integration of these anomalous drainage areas into smooth contours drawn on the topographic divides defines the overall target areas. The isopleth patterns indicate anomaly trends and highlight the relationship that geochemistry may have to metallogenesis, structure, and aeromagnetic anomalies. The anomaly level on which the isopleths are drawn, as shown by the contour numbers, represents the same percentile interval graphicall shown on the histograms and the lowest level map symbols enclosed by the isopleth The anomaly level chosen for contouring was determined by inspection and was dependent on whether coherent patterns could be obtained and if these patterns seemed to truly depict a possible cause due to localized mineralization processes. Isopleth levels are not the same for every map. Molybdenum, which usually is of interest in exploration is not shown in this

map series because its distribution in anomalous amounts is mainly limited to the area along the Mimbres Fault zone near Swartz and Sherman (sec. 17, T. 18 S., R. 10 W.) and near mined areas of the Cooks Range. These same areas contain anomalous copper, lead, and zinc as well as molybdenum; therefore, molybdenum makes no additional contribution. Other metals sought in the spectrographic analyses are similarly not shown because unusually high metal values were detected in only a few The anomalies depicted on these maps are distinctive in one respect; with the

of any of these anomalies, they are buried beneath volcanic caprock. Copper, lead, and zinc patterns in the magnetic fraction (iron-manganese oxide) are dominated by the distribution of anomalous zinc (fig. 1). The isopleth

the zinc distribution.

exception of those in the Cooks Range in the southeast corner of the map area, they

patterns drawn on level 2 anomalies are, with but a few exceptions, a reflection of

Two subparallel patterns trending north-northwest are shown on figure 1. One

occur in areas covered by Oligocene-Miocene volcanic rocks containing no visible

pattern coincides with and may be genetically related to the Mimbres fault zone as defined by Elston (1957). The patterns along this zone are mainly a reflection of high zinc and lead values. Although sample site control is lacking, the zonal pattern appears to continue southeastward beneath the unconsolidated sediments to as far as the Cooks Range (sec. 16, T. 19 S., R. 9 W.). There is a suggestion of a subsurface intersection of the Mimbres and Sarten faults as postulated by Elston (1957). Some geochemical contrasts emerge in the Cooks Range. For example, anomalous manganese values (fig. 3) were minor in extent, which indicates that in the Cooks Range manganese oxides are not an important component of the magnetic concentrate compared to those oxides of iron (fig. 5). Lead in association with iron oxides probably dominates the geochemical signature of the northern Cooks Range insofar as the magnetic fraction (fig. 1) is concerned.

The second subparallel zone on figure 1 begins west of Whitehorse Mountain

(secs. 25, 26, 35, 36, T. 18 S., R. 11 W.) and continues in a broken pattern southward as far as Round Mountain (secs. 11, 12, 13, 14, T. 20 S., R. 10 W.). This pattern reflects anomalous amounts of zinc, probably in association with iron oxides. A comparison of figure 1 with the Mn map (fig. 3) and the Fe/Mn map (fig. 6) shows that west and south of Whitehorse Mountain (secs. 25, 26, 35, 36, T. 18 S. R. 11 W.) iron oxides probably dominate over manganese oxides in the magneti concentrate. This conclusion is based on the high ratios of Fe/Mn and the lack of extensive manganese anomalies in the area. The iron enrichment in the magnetic fraction suggested somewhat sporadically by figure 6 and the zinc concentrations (fig. 1) may be residual, resulting from oxidation, leaching, and perhaps shrinkage of a primary pyritic halo; alternatively, there may be surface concentrations of relatively nonmagnetic hematite derivatives of magnetite which could also contain high amounts of zinc. If these iron-zinc concentrations represent weathered derivatives of magnetite the pattern in the magnetic fraction west of Whitehorse Mountain could be a reflection of an elliptical, zinc-rich tactite zone. Some caution is necessary in making this interpretation because the semielliptical pattern of the anomaly also parallels the outcrop pattern of the volcanic rocks in the area as shown by the contact on the geologic base between the Rubio Peak Formation (Trp) of Elston (1957) and the younger volcanic rocks (Tv). The possibility exists that an Fe oxide-zinc rich volcanic unit may be responsible for the anomaly. The mineral deposit significance of the anomaly therefore can only be established by follow-up investigation.

The level 1 copper anomalies (shown by symbols) in T. 19 S., R. 11 W. and areas farther south near Faywood Hot Springs reflect weakly anomalous values (fig . The histogram for magnetic fraction copper shows a mode at 70 ppm which usually would indicate lithologic background. The bedrock that covers a large part of the area in T. 19 S., R. 11 W., would contribute mafic mineral grains to the concentrate that could contain as much as 70 ppm copper as background and in this way account for the mode on the histogram. Abundant mafic grains were observed under the microscope. Metal content assigned as a level 1 anomaly would seem erroneously low on the basis of the histogram alone if it were not that comparison of figure l with other maps in the series (figs. 4 and 5) shows that other sample media not containing mafic minerals are high in copper in this general area. For example, areas of high copper values nearly coincide in the ore mineral NM-1 fraction (fig. 5) and in the Fe-Mn oxide residue (fig. 4). The high values in the NM-1 fraction are usually due to the presence of sulfide or oxide ore minerals (sparse pyrite was the only mineral identified), which strengthens the case for the existence of broad metallization reflected by patterns of low level but anomalous copper values scattered over a broad area.

The NM-1 concentrate contains the highest tin values of any of the media (fig. 2) and is the fraction in which most cassiterite would occur; therefore it probably is the most significant indicator of tin mineralization. The highest tin values probably reflect the presence of cassiterite in the map area, although it was not observed in cursory scans under the microscope. Lower, but still anomalous values of tin may reflect tin substitutions in other minerals occurring in the nonmagnetic fraction but because the variety of nonmagnetic minerals that would contain tin is not extensive, nor are they common; most of the tin is probably contained in unobserved, minor amounts of cassiterite.

Tin anomalies in the map area show close spatial association with known

rhyolite intrusions and some aeromagnetic anomalies. Tin probably in the form of cassiterite, is apparently associated with rhyolite dikes and domes occurring, for the most part, on the hanging wall (east) side of the Mimbres fault in the vicinity of Swartz (See Elson, 1957). One strongly anomalous tin value 3.2 km east of Faywood Hot Springs may be associated with the Faywood rhyolite dome located in secs. 22 and 23, T. 20 S., R. 11 W. Tin anomalies at Round Mountain (secs. 11, 1 13. 14. T. 20 S., R. 10 W.) are associated with an aeromagnetic low that suggests a possible altered, acid intrusive beneath the Rubio Peak Formation (Trp) covering the area. Normally bedrock of this composition (latite), would have a low background content of tin. Sparse, pink garnet was noted in some concentrates west of the aeromagnetic closure, indicating possible surface or near surface exposure of rock units displaying the effects of contact metamorphism. The Rubio Peak Formation (Trp) that outcrops in the area is at the base of the volcanic sequence (Elston, 1957) which precludes the existence of interbedded tin-bearing rhyolite flows which may be expected to give tin anomalies because, where these flows occur in other areas they are always younger in age. The presence of base metal anomalies as well, suggests that mineralization processes have taken place, though perhaps weak in

The manganese patterns (fig. 3) at the anomalous levels shown reflect the distribution of manganese oxide concentrations within the map area. The most pervasive manganese oxides are closely associated with the Mimbres and Mimbres Hot Springs faults as defined by Elston (1957), indicating a genetic association. The close proximity of these manganese anomalies to known hot springs such as those at the vicinity of Swartz, (Elston, 1957) would suggest that at least part of the manganese and perhaps accompanying trace metals were introduced by hot springs. Although manganese enrichment is indicated in the vicinity of Swartz (secs. 26, 34, and 35, T. 18 S., R. 10 W.) and south of the Mimbres Hot Springs (secs. 13 and 14, T. 18 S., R. 10 W.), the high manganese does not continue as far as the Cooks Range. The zone appears to terminate at or near the projected subsurface intersection of the Mimbres and Mimbres Hot Springs faults (near secs. 1, 2, 11, 12, T. 19 S.,

The oxalic acid leach technique appears to extract iron oxides and those amounts of trace metals contained in them preferentially over manganese oxides in the area. This inference is drawn from comparisons of the oxalic acid residue map (fig. 4), the Fe/Mn map (fig. 6) and the manganese oxide map (fig. 3). A proposal for the source of these iron oxides and accompanying high amounts of trace metals in the oxalic acid residue (fig. 4) is that the hydrous iron oxides and accompanying trace metals may have been introduced directly into caprock joints and fractures from ground water brought upward by a convection cell induced by a relatively shallow late volcanic intrusion(s). Ground water brought upward by other mechanisms and evaporated could produce the same effect. The material could then be flushed, during heavy rainfall, into the drainage basins. Alternatively, iron oxides and accompanying trace metals extracted by the oxalic acid technique may also be derived from the weathering to limonite of ore minerals in a relict-hypogene halo, where weathering and oxidation would be favored by zones of high permeability to oxidizing solutions such as would exist along fractures. The close association of the oxide

is probable that a combination of mechanisms have, and perhaps are still at work. The dominant mechanism is still somewhat conjectural. The strongest copper and lead anomalies in the iron-manganese oxide residue show a zonal pattern in T. 18 S., and T. 19 S., R. 11 W. (fig. 4), in roughly the same areas that are characterized by copper and lead anomalies in the nonmagnetic concentrate medium (fig. 5) and zinc with minor copper anomalies in the magnetic fraction (fig. 1). A distinctive characteristic of the anomalies in the oxide residue is the well-defined metal zonation shown. The zonation is characerized by a central lead zone surrounded and overlapped by zinc and broadly dispersed copper. Another area showing compound anomalies in the iron-manganese oxide residue is the vicinity of Round Mountain (secs. 11-14, T. 20 S., R. 10 W.). A central lead zone is again present, surrounded and overlapped by copper and zinc zones. Here again sparse base metal anomalies in the ore mineral concentrate (nonmagnetic) fraction (fig. 5) occur in association with those in the iron-manganese oxide residue. Sparse pyrite was the only sulfide mineral identified in the concentrates. Fairly substantial base metal anomalies occur in the magnetic fraction as well (fig. 1). As outlined above, the source for these anomalies appears to exist beneath the

volcanic caprock, possibly in association with an altered silicic intrusive at a

relatively shallow depth.

residue anomalies with those in the ore mineral concentrate (nonmagnetic)/fraction

(fig. 5) would favor the latter interpretation but would not exclude the former. I

Oxalic acid residues -- the second sample medium is referred to as the secondary iron-manganese oxide residue and was obtained by sieving conventional stream sediment to <0.18 mm followed by extraction of the iron-manganese oxide content and accompanying trace metals with hot oxalic acid. The resultant solution was filtere and evaporated to dryness. The filter paper used was a fast filtering Whatman  $41^1$ which allowed for the rapid separations found necessary in a field preparation technique. The dry residue was heated to a brown color after which it was pulverized and analyzed by emission spectrography. The method is described in greater detail by Alminas and Mosier (1976). The iron-manganese oxide residue probably reflects the trace element content

Analytical methods

method of Grimes and Marranzino (1968) in nearly the same manner as the oxalic acid

pulverized and analyzed for 30 elements by the semiquantitative spectrographic

The two heavy-mineral fractions (M-1 and NM-1) from each sample locality were

of only part of the Fe-Mn oxide material contained in drainage basin rocks and the iron-manganese oxides found in this residue may differ slightly from the material found in the M-l iron-manganese oxide heavy-mineral concentrate. The iron-manganese oxide residue will contain more of the fine grained, clay rich and powdery varieties of limonite that normally float off in the gold pan. The M-1 heavy mineral concentrate contains the coarser grained, detrital varieties of limonite that sink in the gold pan. The M-l concentrate may also contain large amounts of biotite, pyroxene, amphibole, and epidote which act as diluents. The diluents in the ironmanganese oxide residue are mainly the silica and alumina that accumulate in a sample having high clay content.

> Where the Fe/Mn ratio is >100 an introduction of iron from an extraneous source or unusually iron-rich residual surface concentration of iron is inferred (fig. 6). A ratio of Fe/Mn >100 exceeds the ratio to be expected from mafic rock forming minerals whose ratios usually range from about 10 to 70 (see histogram for Fe/Mn). Unweathered magnetite has been removed from the sample prior to analysis and it would be expected to make negligible contribution to the iron content. A possible source of some of the superimposed iron that gives the high ratios may be introduced pyrite. However, few clearly recognizable iron oxide pseudomorphs after pyrite were noted in samples that showed enrichment in iron. If the limonite is derived from pyrite, it is no longer identifiable as such. On the other hand, sparse, relativly fresh pyrite was identified in the nonmagnetic concentrate south of Whitehorse Mountain within the zone of copper-lead anomalies which is also an area of inferred iron enrichment.

The patterns for copper, lead, and zinc anomalies in the nonmagnetic

present in the nonmagnetic concentrate in anomalous amounts, they show comparable

distinguished by the very subordinate occurrence of copper as an important metal

the map area, is abundant as detrital zinc ore minerals in association with lead in

the nonmagnetic concentrate fraction (fig. 5) in the Cooks Range, whereas it occurs

mainly in the magnetic fraction in the north. Except in the southeast, zinc is far

indicating detrital zinc ore minerals are not important over most of the quadrangle.

This is perhaps because zinc was less abundant as a primary sulfide than were copper

and lead, but more probably, the greater abundance of zinc in the magnetic fraction

is a reflection of the instability of many zinc minerals at the surface giving rise

to high mobility of zinc in solution followed by ready fixation in secondary iron

oxides. There is a suggestion then that primary zinc ore minerals may become

relatively more abundant at depth in the areas covered by volcanics.

constituent and by an abundance of lead. This characteristic appears to be the

result of primary metal zonation on a quadrangle or regional scale, or it may

reflect the greater depths of erosion in the Cooks Range which have exposed Precambrian, Paleozoic, and Mesozoic rocks. Zinc, which is present in both parts of

more sparsely distributed than copper and lead in the nonmagnetic fraction,

of the map area and by lead in the southeast. Where both copper and lead are

anomaly/background contrast, especially south of Whitehorse Mountain. The

geochemistry of the Cooks Peak area (southeast part of the quadrangle) is

concentrate fraction (fig. 5) are dominated by copper and lead in the northwest part

Five areas within the Dwyer quadrangle constitute exploration targets that warrant further investigation. They are: (1) the Whitehorse Mountain area, ( near the town of Sherman, (3) near Swartz and Mimbres Hot Springs, (4) south of Blue Mountain, and (5) at Round Mountain. Commercial mineral deposits are not known to exist in these areas. A sixth area, the Cooks Range, (southeast part of map area) which may constitute a target for further exploration has in the past produced lead, zinc, silver, and fluorite from vein deposits. Geochemical anomalies in the Cooks Range are, for the most part, a reflection of these known mineral deposits. The five target areas cited above have an unknown relationship to mineral deposits, but of these significant geochemical anomalies, four are associated with anomalous aeromagnetic highs and lows (not terrain corrected). Every target area is on or near the intersection of a combination of northeast and northwest structural, geochemical, and aeromagnetic anomaly trends. The geochemical patterns for each of these areas recur on several map plots, but they are more prominent for some metals and sample media than for others; presumably because of hypogene metal zonation and supergene processes. The fact that the anomalies occur in several media involving

separate analyses substantiates the validity of these patterns as anomalous

areas are summarized below:

geochemical features and supports the accuracy of the sampling and analysis. The

1. South and west of Whitehorse Mountain T. 18 S. and T. 19 S., R. 11 W. The topographic low in secs. 26, 27, 34, and 35, T. 18 S., R. 11 W. is nearly encircled by an area containing high copper-lead values in the nonmagneti concentrates. The nonmagnetic anomaly patterns spatially correlate with a zone of high Cu values in the oxalic acid residue and magnetic concentrate fraction in sections to the south and west of the topographic low (figs. 1, 4, and 5). Lead in the oxalic acid residue occurs within the area of the topographic low perhaps in residual limonite concentrations; similarly for zinc in the magnetic concentrate. Part of the high copper-lead zone south of Whitehorse Mountain may be fracture controlled as indicated by the hint of an east-west long axis that cuts the drainage texture at nearly right angles in sections 1, 2, 3, 4, 9, 10, 11, and 12 (fig. 5) Air photos show a tenuous east-west lineament in the same general area (not shown on geologic base map). These anomalies may therefore reflect fractures filled by ore minerals, possibly as part of a primary leakage halo from below. The topographic low west of Whitehorse Mountain also correlates with the closure on an anomalous aeromagnetic high and an anomalous low occurs nearby to the southeast. The topographic low does not appear to have a genesis related to differential weathering of a weak lithology alone; therefore, the area of low relief may have resulted from shrinkage and subsidence. Neither primary or secondary ore minerals occur in the topographic low as demonstrated by the fact that the area is a geochemical low in the ore mineral (nonmagnetic) concentrate fraction (fig. 5). This would be the case if there were deep weathering and eaching. The area may be slightly enriched in iron (fig. 6). The natur of the topography and geochemistry suggests, but does not prove, the presence of a subsiding, leached outcrop overlying an oxidizing mineral deposit with zinc, lead, and minor relict copper partially fixed in overlying iron-rich fracture fillings and residual concentrations. Thi leached area appears in turn to be surrounded by a less leached leakage halo of lead and copper that is most pronounced to the south but surrounds the area discontinuously (fig. 5). The topographic low occurs at the intersection of a northwest trend of zinc anomalies in the magnetic (iron manganese oxide) concentrate (fig. 1) with a projected northeast trend of dikes and tenuously associated geochemical anomalies (fig. 5).

2. Near the town of Sherman (secs. 17, 18, 19, T. 18 S., R. 10 W.) geochemical anomalies are localized and intensified at the intersection of a northeast trend of dikes tenuously associated with high copper and lead values in the ore mineral (nonmagnetic) concentrate fraction (fig. 5) and the northwest trending Mimbres fault zone. Anomalous zinc, tin, molybdenum (not shown), and manganese also occur in higher than normal amounts in the area (figs. 1, 2, 3, and 5). The sources and significance ôf these anomalies are speculative, but metal leakage along dike-host rock contacts is inferred. A genetic association with a rhyolite dome occurring there (Elston, 1957) is also possible. 3. Near the town of Swartz and areas south of Mimbres Hot Springs (secs. 33-

36, 21-28, T. 18 S., R. 10 W.). Anomalies at Swartz occur near a projected, complex intersection of the northeast-trending Blue Mountain Fault with the northwest-trending Mimbres fault (Elston, 1957). Hypabyssal rhyolite domes and dikes occur in the area and nearby and copper, zinc, lead, manganese, (figs. 1, 3, and 5) molybdenum (not shown in this map series), and tin (fig. 2) are also associated. Most of the metal anomalies and the aeromagnetic anomalies are on the hanging wall (northeast) side of the Mimbres fault. Partially exposed intrusives in the area may indicate a larger, unexposed body at depth that may be mineralized. The principal target should be the aeromagnetic high centered in section 27. This aeromagnetic high appears closely related to the geochemical anomalies occurring in the Swartz area. 4. South of Blue Mountain (secs. 28-32, T. 19 S., R. 10 W. and secs. 24 and

25, T. 19 S., R. 11 W.). Geochemical anomalies of copper, lead, and zinc (figs. 1 and 5) show symmetrical distribution about an anomalous aeromagnetic high. The anomalies are located south of the intersection of the northeast-trending Blue Mountain Fault with a northwest trend of omalous zinc values (fig. 1) and of aeromagnetic highs and lows. Tenuously related copper anomalies occur to the northeast (fig. 5) in secs. 3, 4, 5, 8, 9, T. 19 S., R. 10 W.; these anomalies could be related to the Blue Mountain Fault or to a more general and wider northeasttrending zone of weakness represented by faults and dikes, one of which is shown on the geologic base. The main exploration target should be the aeromagnetic high which is probably indicative of a plutonic metal anomaly

5. Round Mountain (secs. 11-14, T. 20 S., R. 10 W.). Anomalous copper, lead, zinc, and tin values occur in the area in association with an aeromagnetic low. The area is near an apparent intersection of the northwest trending zinc (fig. 1) and an aeromagnetic low and a possible northeast trending zinc pattern in the ore mineral (nonmagnetic) concentrate fraction (fig 5). Tin anomalies, which usually have felsic rock affinities, the aeromagnetic low, and the observation of sparse amounts of garnet that may indicate contact metamorphism near the western side of the anomalous area suggest a silicic, possibly altered, intrusive beneath the normally low tin latite covering the area. As at Whitehorse Mountain, the anomaly patterns for oxalic acid residue show a central zone characterized by high ead values, overlapped and surrounded by copper and zinc. The targets for exploration should be the central lead zone which might represent the center of the potential mineral deposit or the associated aeromagnetic high which may be caused by a metal-rich, altered pluton.

6. Cooks Peak and scattered localities along the Cooks Range mainly sections 15, 22, 27, 33, and 34, T. 20 S., R. 9 W. in southeast corner of the map area, but also including the areas northwest of the White Eagle fluorite mine (sec. 34, T. 19 S., R. 9 W.). Anomalies in these areas are a reflection of the numerous mines having past production of lead-zincsilver and fluorite that are scattered along the mountain front. Most of the anomalies are due to mechanical dispersion of ore minerals away from these old workings as evidenced by the strong anomalies in the ore mineral onmagnetic) concentrate fraction (fig. 5). Lead and zinc are found in much more abundance in this area than is copper. Strong tin anomalies on tributaries draining the White Eagle Mine suggest a cassiterite association with the fluorite mineralization there which in turn implies genetic affinities to the rhyolite intrusives that occur in the area.

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> Base from U.S. Geological Survey, 1956 Geology from Elston (1957) Adapted to topographic base by K. C. Watts, 1975

FIGURE 6--DISTRIBUTION OF ANOMALOUS Fe/Mn RATIO IN THE

MAGNETIC CONCENTRATE