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Description of slides showing aeromagnetic and gravity data for regional mineral exploration in Colorado, New Mexico, and Arizona

by

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Contents

Tables

Figures

(combined on plate 1 in pocket)

Abstract[1]

Examples of aeromagnetic and gravity data over $1^{\circ} \times 2^{\circ}$ areas are presented for regions near the Cripple Creek mining area, Colorado, and the Lordsburg-Tyrone-Silver City mining areas, southern New Mexico and Arizona. These data indicate broad crustal structures and compositional variations that are marked by magnetization and density contrasts. The focus is on anomalies that may signal large-dimension controlling structures for the emplacement of economic mineral deposits. An example is a continuous, quasi-linear, north-trending gradient in both gravity and magnetic data located west of Cripple Creek area along long. 105° 30′ W. This trend correlates with two mineral deposits of the Southern Rocky Mountains Front Range. It also correlates in part with an area of volcanic rock and with a mapped fault complex (Elkhorn-Currant Creek-Else-Westcliffe). The trend is interpreted to indicate a continuous crustal fault-system, although exposures of this system are discontinuous between areas of alluvium and volcanic-rock cover.

Similar geophysical trends exist in the Silver City to Tyrone area, where northeast-and northwest-trending anomalies appear to be marked by intrusion and mineralization. In this area, northwest-trending alluvial basins favor the use of geophysics to infer economically accessible but hidden bedrock whose association with exposed mineralization seems possible. An example of an inferred broad and relatively shallow, but hidden bedrock complex in association with more areally-limited mineralization is the Victorio Mountains area about 34 mi (55 km) south-southeast of Tyrone, New Mexico. The mineralization is within faulted sediments whose outcrop covers a small portion of the geophysical anomaly-complex.

[1]Geological Society of America, Abstracts with Programs, vol. 15, no. 7, abstract no. 05503 (General Economic Geology III).

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Introduction

This report summarizes some of the results of geophysical investigations in the Pueblo $1^{\circ} \times 2^{\circ}$ quadrangle, Colorado, and in the Silver City $1^{\circ} \times 2^{\circ}$ quadrangle, Arizona and New Mexico. The format of this report is a generalized description of 35-mm slides prepared for the Geological Society of America Annual Meeting (Klein, 1982). Colored slides showing the fundamental data have been released as a separate open-file report (Klein, 1983). Reductions at 1:500,000 scale of the base-maps and overlays used in preparing the slides are included here. A complete description of the residual aeromagnetic and gravity maps used for the present report are planned for publication by the U.S. Geological Survey as part of the Silver City $1^{\circ} \times 2^{\circ}$ quadrangle and the Pueblo $1^{\circ} \times 2^{\circ}$ quadrangle CUSMAP (Conterminous United States Mineral Assessment Program) folios.

Description of 35-mm slides

Slide 1.--Figure 1 is a location map showing the areas of study: the Pueblo $1^{\circ} \times 2^{\circ}$ quadrangle in south-central Colorado, and the Silver City $1^{\circ} \times 2^{\circ}$ quadrangle in southwestern New Mexico and southeastern Arizona.

The base map of fig. 1 is from the tectonic map of North America (King, 1969) with the locations of mineral deposits added from the preliminary metallogenic map of North America (Guild, 1981a). The deposits are shown by different size circles or dots to represent the relative importance of each deposit based on estimates of total metal/mineral content (past production plus reserves; Guild, 1981b, p. A3-A4). The larger circle indicates large deposits, the small circle indicates medium deposits, and the dots indicate small deposits. Small deposits (dots) are shown only for the two study areas (Tables 1 and 2). Large and medium deposits are shown for the whole region. The classification differs according to commodity, for instance copper deposits are classified as large, medium or small according to whether estimated metal content is greater than 1-million, 50,000 to 1-million, or less than 50,000 metric tons respectively, whereas gold deposits are classified according to metal content greater than 500, 25 to 500, or less than 25 metric tons.

The more productive mining centers in the areas under consideration are the Cripple Creek District, Colorado, in the north-central part of the Pueblo quadrangle; and in the Silver City quadrangle: the Safford (Lone Star) District, Arizona, located in the northwest quadrant of the quadrangle and the Central (Santa Rita) and Burro Mountains (Tyrone) Districts, New Mexico, located in the northeast corner of the quadrangle. The Central district is the more northeast of the latter two (fig. 1).

Table 1.--List of mineral deposits in the Pueblo $1^{\circ} \times 2^{\circ}$ quadrangle (Vandenwilt, 1947, Marsh and Queen, 1974, Guild, 1981a, b). See figs. 1 and 6.

Deposit	Index on fig. 6	Guilds no. and importance	Principal commodities
Trout Creek (P)	a	nl[1]	Au, Ag, Cu, Pb
Calumet	b	nl	Fe
Turret	c	nl	Cu, Au, Ag
Whitehorn	d	nl	Au, Ag
Cotopaxi	c	nl	Zn, Au, Cu, Ag, Be, Pb
Orient	f	nl	Fe
Blake	g	nl	Au, Cu, Ag, Pb
Westcliff-Silver Cliff (Hardscrabble)	h	57 (medium)	Ag, Au, Pb, Cu, Zn
Rosita Hills	i	58 (small)	Au, Ag, Pb, Cu, Zn
Tallahassee Creek	j	53 (medium)	U
Guffey	k	50 (small)	Cu, Zn, Au, Ag, Pb (W, Guild, 1981b)
Lake George (Tarryall Springs)	l	49 (medium)	Be, W
Cripple Creek	m	51 (large)	Au
Avery Ranch	n	54	U
Wet Mountains area	nl[1]	56	Th, RE[2]
Oliver Prospect	nl	55 (small)	W

[1]nl means not listed.

[2]RE is an abbreviation for rare earth elements.

Table 2.--List of mineral deposits in Silver City quadrangle (Guild 1981a, b). See fig. 8.

Deposit	Guilds no. and importance[1]	Principle commodities
Safford (Lone Star) District	AZ 95 (large)	Cu, Mo
Doz Cabezas District (Mascot Mine)	AZ 98 (small)	Cu (Au, Pb, Ag)
Duncan (Steeple Rock) District	Az 97 (small)	F-Au, Ag
Steeple Rock District	NM 40 (small)	Au, Ag (Zn, Pb, Cu)
San Simon District	NM 41 (small)	Ag, Pb (Zn)
Lordsburg District	NM 42 (medium)	Cu (Au, Ag, Pb,Zn, Mo)
Gila District	NM 39 (medium)	F
Burro Chief and Shrine (Burro Mts District)	NM 43 (medium)	F
Tyrone area (Burro Mts. District)	NM 44 (large)	Cu, Mo
Boston Hill	NM 45 (medium)	Fe, Mn, Ag
Hanover-Fierro District	NM 46 (medium)	Fe (Cu, Zn)
Central (Santa Rita) District	NM 47 (large)	Cu, Zn, Pb, Mo, Ag (Au, Sb, Fe)
Victorio District	NM 48 (small)	Pb, Ag

[1]Only those deposits classified as large by Guild (1981a, b) are listed; uranium deposits and Ca-Na-K salt-deposits are not listed.

Table 3.--Lineaments proposed by Mayo (1958). See figure 2.

Map Key	Name	Correlation with major mineral deposits[1]
A	Santa Rita Belt	Santa Rita, Tyrone, Bisbee, Cananea
B	Morenci Belt	Safford, Morenci, Pima-Esperanza-Twin Buttes, Questa, Globe, Casa Grande
C	Jemez Zone	Globe, Casa Grande
D	Front Range Zone (Colorado Mineral Belt)	Jerome (San Juan Mts), Leadville, Climax, Henderson, Nederland
E	(un-named)	none
F	(un-named)	Iron Springs
1	Texas Lineament	Ray, Tyrone
2	San Francisco Zone	none
3	Spanish Peaks Belt	(San Juan Mts.)
4	Cripple Creek Zone	Spor Mountain, Leadville? Cripple Creek
II	Walker Zone	none
III	Southwest Arizona Belt (Cananea Line)	Casa Grande, Pima-Esperanza-Twin Buttes, Cananea
IV	Central Arizona Belt	Jerome, Ray, Globe (?), San Manual, Bisbee?
V	Southwestern New Mexico Belt	Tyrone
VI	New Mexico-Utah Zone	Spor Mountain
VII	Southwestern Colorado Zone	(San Juan Mts)
VII	Central Colorado Belt	Leadville, Climax (?)
b	Colorado River Zone	none
d	Utah-Arizona Belt	Globe, Ray, Pima-Esperanza-Twin Buttes
e	Peloncillo Belt	none
f	Cordilleran Front Belt	Henderson, Climax, Leadville (?)

[1]mineral deposits locations from Guild 1981a, queried deposits are relatively distant from the lineament.

Figure 2 shows tectonic lineaments that have been proposed by Mayo (1958, see Table 3). The lineaments are shown as double-dashed lines on the tectonic and mineral deposits map of figure 2. The author does not necessarily support this lineament pattern, but some of these lineaments have independent documented support over part of their length. For example, Hollister (1978, p. 140) discusses the southeastern part of the Cananea trend (lineament III) and Turner and others (1982) discuss several northeastern trends one of which corresponds in general with the southwestern part of the Santa Rita Belt (lineament A).

The northeast trending pattern of mineralization of the Santa Rita Belt (lineament A) as well as parallel geologic structures have been noted in studies dealing with the economic geology of the Silver City area (Rose and Baltrosser, 1966). The possible correlation of gravity and magnetic anomalies to the Santa Rita belt is one of the focal points on slides 4 and 5 that deal with the Silver City quadrangle.

Studies of geophysical data from $1^o \times 2^o$ quadrangle-size areas, when integrated into larger regional pictures, may help clarify the existence, the diagnostic geophysical signatures, and the economic implications of sub-continental-size crustal patterns such as proposed in the lineament network of Mayo (1958).

Slide 2.--Figure 3 shows the residual Bouguer gravity map of the Pueblo $1^o \times 2^o$ quadrangle, Colorado. The area is from lat. 38^o to 39^o N and long. 104^o to 106^oW. The line contours (fig. 3) are at a 5-mgal interval. The area shown measures about 60-mi (96-km) north-south and 100-mi (161-km) east-west. Gravity control, consisting of 2395 stations, is shown by dots (Boler and others, 1982).

Generalized geologic features of the Pueblo quadrangle (Tweto, 1979) are shown in fig. 4. The contact between Precambrian through Paleozoic rock outcrop and younger rock and alluvium is shown by a thin line (fig. 4) bordering the nearly blank eastern half of the figure; major faults are shown by heavier lines; and intrusive bodies of late Mesozoic and younger age are shown by patterned areas. The dense-dot pattern indicates mid-Tertiary intrusions (Tmi); the random-dash pattern indicates Laramide (late Cretaceous-early Tertiary) intrusions (TKi). Figure 6, described with slide 3, labels some of the areas discussed below.

The surface geology and physiography of this area changes abruptly across a north-south line at about lat. 105^oW, with the Rocky Mountains on the west and the Great Plains on the east. The two different terranes are distinct in gravity (fig. 3) with strong north-northwest trends evident in the western half of the map compared to the east-trending gradients and generally smoother variations in gravity intensity in the eastern half of the map. The pronounced northward decrease in gravity seen in the northest part of the map over the Great Plains reflects the deepening of the Paleozoic section and the Precambrian bedrock toward the Denver Basin to the north (off the map).

Pikes Peak Batholith (Precambrian), centered in the circular pattern of faulting on the north-central part of the map (fig. 4 and label 5, fig. 6), shows a generally uniform and positive but moderate intensity of gravity. This batholith, its geophysical signatures, and its proximity to

Cripple Creek (m, fig. 6), the second-most productive gold deposit in the United States (Noble, 1974) provides a target that invites additional study. Some of the speculations and data about this area can be found in Holmer (1949), Kleinkopf and others (1970), Pratt and Zietz (1973), and Barker and others (1975).

Thirtynine Mile Volcanic Field (Tertiary) located in South Park on the northwest corner of the map (between 1 and 4, fig. 6) is represented by generally low gravity which reflects the low density of the volcanic and volcaniclastic rocks of this area.

The Wet Mountains area (5, fig. 6, Precambrian metamorphic rocks intruded by mafic and alkalic stocks), located in the south-central part of the western half of the map, is marked by a general gravity high and several superimposed anomalies of small dimension that coincide with intrusions (highs) and volcanic centers (lows). The north-trending gradient on the western edge of the Wet Mountains area correlates with a similar trend in aeromagnetic data and will be discussed with slide 3. The Wet Mountains area has been recognized as a significant thorium province (Olson and others, 1977; Guild, 1981 a, b).

The Sangre de Cristo Mountains (Precambrian and Paleozoic rock), located in the southwestern corner of the map is represented by a northwest-trending gravity high bounded to the southwest by a pronounced low over the San Luis Valley graben. This gravity pattern is typical of fault-blocked basin and range terrane.

Slide 3.--Figure 5 show residual aeromagnetic map of the Pueblo 1^{o} x 2^{o} quadrangle. The line contours are at 20 gamma intervals. This map is the result of merging several different surveys. The original data, obtained at elevations ranging from 9,500 ft to 14,400 ft (2,900 to 4,400 m) have been upward continued to a common elevation datum of 14,400 ft (4,400 m).

Pike's Peak Batholith near the north-central border area (fig. 4, 5 label 5 of fig. 6) is associated with a magnetic low which is sharply bounded to the southwest by a steep gradient. The gradient is thought to represent the contact between the Pikes Peak Granite (1.0 b.y.a.) and older, more magnetic, Precambrian granites. This interpretation is in contrast to the suggestion of Pratt and Zietz (1973) that the fundamental low over the batholith may be a reflection of reversed magnetization. The present interpretation requires fewer assumptions than that of Pratt and Zietz and it is consistent with straight-forward model of magnetic contrasts across the contact (Frances M. Boler, U.S. Geological Survey, unpublished data, 1981).

Southwest of Pikes Peak Batholith, the older (1.5-1.7 b.y.a.) Precambrian granitic terrane (4, fig. 6) is represented by an area of generally high magnetic intensity containing numerous smaller-dimension anomalies. This terrane is bounded on the west by sharp and quasi-linear north-trending magnetic gradient (A, B on fig. 6). The smaller anomalies in this area represent a variety of sources created by intruded stocks, volcanic centers (magnetic lows) and fault controlled structures. One of the lows is associated with the Cripple Creek volcanic center (m, fig. 6) which has been studied in detail by Kleinkopf and others (1970).

A major magnetic high with two centers extends southeast and east from the older-Precambrian granitic terrane discussed above into the Great Plains (6, fig. 6). This high is believed to reflect a zone of similar older-Precambrian lithology buried beneath the alluvium and sedimentary rocks of the Great Plains.

The Wet Mountains area (3, fig. 6), located in the south-central part of the western half of the map, is represented by a large two-part magnetic high. A northeast-trending low (H, I, fig. 6) dividing the high occurs partly in association with the Silver Cliff and Rosita Hills Volcanic centers (h, i, fig. 6). This low may indicate a northeast trending crustal weakness. If this is so, however, mapped surface geology does not indicate its nature. Kleinkopf and others (1979) have presented a detailed geophysical report on the Silver Cliff and Rosita Hills area.

The western border of the map shows several relatively small-dimension magnetic highs that generally trend northwest. These highs indicate structurally-high Precambrian rocks and, locally, lithological contrasts created by intrusion. The southern Sangre De Cristo Range (south of 2, fig. 6), which is marked by a northwest-trending gravity high, shows a similarly trending magnetic low. Together, these characteristics indicate the influence of thick, dense and non-magnetic Paleozoic sedimentary rock.

The Thirtynine Mile Volcanic Field located on the northwest corner of the map is represented by a general magnetic low in conjunction with the gravity low discussed with slide 2. Local anomalies in both gravity and magnetic data within this area are indicating structural relief in the Precambrian bedrock beneath the cover of volcanic rocks.

Figure 6 shows geophysically inferred structures of the Pueblo $1^{\circ} \times 2^{\circ}$ quadrangle. Inferred fault controlled boundaries are shown by the heavy-diagonal-dash lines. Compositional boundaries that are possibly indicating contacts between distinct igneous or metamorphic masses are marked by the dashed lines. Certain structural trends are identified by capital letters, and the enclosed terranes are numbered. Major mineral deposits (Table 1) are indicated by heavy dots and labeled with lower case letters.

One of the major features that has been interpreted is a generally north-trending fault zone (A, B, C, D, E). This zone is indicated by a nearly continuous and locally linear gradient in gravity and magnetic data. The fault zone is composed of several labeled segments: A, correlating with the Elkhorn Fault and the east edge of the Thirtynine Mile Volcanic Field; B, correlating with the Currant Creek - Ilse Fault and the southeast edge of the Thirtynine Mile Volcanic Field; C, correlating with the Texas Fault and other northeast-trending faults and also with the northwest border of the Wet Mountains metamorphic and intrusive complex; D, correlating with the Alvarado fault and the inferred southwest boundary of the Wet Mountains; and E, correlating with the Westcliffe fault and the southwest boundary of the Wet Mountains highland topography.

This en-echelon trend, A-E, is believed to indicate a continuous zone of faulting and igneous activity. It is possibly a branch of the Rio Grande Rift zone whose main northward extension into Colorado has been inferred by Tweto (1968) to be associated with the San Luis Graben, located in the southwest corner of the map. This zone may have acted as a conduit for crustal magmas that generated the Tertiary volcanic centers along its length and locally produced base and precious metal concentrations (deposits k, j, h, i, e, see Table 1). The metal concentrations appear to be partly controlled by the intersection of this zone with northeast- to east-trending faults as indicated, for instance by the geophysical trends such as K, J, H, I. The northeast-trending faults are probably older (Tweto, 1968) and may have had a multiphased history of penetrating the deep portions of the crust or the upper mantle. Thus the older faults have a greater likelihood of containing metal-enriched differentiates of more primative magmas.

Slide 4.--Figure 7 shows a residual Bouguer gravity map of the Silver City $1^{\circ} \times 2^{\circ}$ quadrangle, Arizona and New Mexico. This map was produced from the complete Bouguer gravity of Wynn (1981) by filtering out wavelengths longer than 78 mi (125 km). The area covers lat. 32° - 33° N, long. 108° - 110° W, an area of about 60 mi (96 km) in the north-south direction, and 100 mi (161 km) in the east-west directions. The contour interval is at 2.5 mgal.

Generalized geological features of the Silver City quadrangle (fig. 8) are from a geologic base map composited by the U.S. Geological Survey for mineral assessment studies (Wynn, 1981, Richter and Lawrence, in press). Faults, contacts of outcropping bedrock with alluvium, and Laramide (TKi, late Cretaceous-early Tertiary) and Middle Tertiary (Ti) intrusions are shown with lines and patterns similar to those described with slides 2 and 3. Figure 10, which is described with slide 5, labels some of the areas discussed below.

Locations of mineral deposits having total production exceeding $1,000,000 are shown by heavy dots on fig. 8 (Richter and Lawrence, in press). The more productive occurrences include the Safford (Lone Star) porphyry copper deposit located along the north edge of the map in the northeast-quadrant, the Santa Rita (Central), Hanover-Fierro, and Pino Altos deposits of porphyry copper, iron, and base metal replacements located in the northeast corner of the map, the Tyrone porphyry copper, flourite and precious metal deposits located southwest of Santa Rita in the center of the northeast quadrant of the map, and the Lordsburg precious metal and copper deposits, located just southeast of the map center. Important deposits are also located in the Victorio Mountains (near the southeast corner of the map), in the Central Peloncillo Mountains (near the center of the southern border of the map), in the Dos Cabezas and Chiricahua Mountains (in the southwest quadrant of the map), and in the Summit Mountains (near the north-central part of the map).

The northwest-trending grain of gravity highs and lows (fig. 7) reflects the Basin and Range horst and graben structure. Some of the other anomalies reveal buried structures that are not evident from geological mapping.

In the northeast Pino Altos Mountains, a highland covered by volcanoclastic and volcanic rocks on the northeast corner of the map, an abrupt gravity decrease occurs just northeast of the Cretaceous-Tertiary Pino Altos stock. The gravity minimum (1, fig. 10) trends northwest along a fault zone that leads into the Mimbres fault, a primary northwest-trending structural boundary on the northeast side of the Pino Altos Mountains. The gravity gradient into this low makes an abrupt but short-length change of strike from northwest to northeast at a point which is aligned with some of the major northeast-trending faults of the Santa Rita and Tyrone mining areas.

The Burro Mountains, located centrally in the northeast quadrant of the map, is composed predominantly of Precambrian rock intruded by the mineralized Tyrone Stock.. These mountains are partly marked by a distinct gravity low centered on the Stock and bordered by areas 15-18 (fig. 10). This low can be recognized on the map (fig. 4) as a southwesterly protrusion of the otherwise strongly-linear northwest trending low that bounds the southwest edge of Pinos Altos Mountains.

The southern segment of the Burro Mountains, located south of the Tyrone Stock, is marked by high gravity (in the area of 25-26, fig. 10) that trends with increasing amplitude to the southeast. The maximum of this trend is found over alluvial cover to the southeast of the Precambrian rock outcrop.

The Victorio Mountains in the southeast quadrant of the map are located on the southwest edge of a large-dimension gravity high. This high is a northwest-trending feature starting near the east edge of the map at about $32^{o}15'$. It is sharply truncated by a northeast-trending gradient (F, fig. 10) that suggests a westward displacement of the buried gravity source. The apparent westward-displaced continuation of this high leads into the southern segment of Burro Mountains (discussed above). The Victorio Mountains have horizontal dimensions less than 1/4 of those of the gravity anomaly against which they abut. These mountains are composed of Tertiary volcanic rocks and mineralized Paleozoic sedimentary rocks which, from the indications of gravity, are only a peak of a major mass of relatively shallow bedrock.

The alluvial-covered terrane in the center of the map, between the Summit Mountains in the north and the Lordsburg District in the Pyramid Mountains to the south is marked by a double-peaked gravity high (near 21 and 25, fig. 10). This high continues into outcrop areas in the Summit and Pyramid Mountains. The low between the two peaks of this northward trending gravity high (south of 21) is one of several indications of buried structurally controlled lithological contrasts that appear along a northeast-trending belt (A, B, C, D, E, fig. 10) extending from the east edge of the Pino Altos Mountains, across the northern edge of the Tyrone stock and extending into southwest quadrant of the map.

Slide 5.--Figure 9 shows a residual aeromagnetic map of the Silver City quadrangle. Contours are at an interval of 25 gammas. The data has been upward-continued to an average elevation of about 11,000 ft (3,350 m) from original data flown at elevations ranging varying from 500 ft (150 m) above ground to 10,000 ft (3,050 m) barometric (U.S. Geological Survey 1974, 1979, 1980).

Two of the larger northwest-trending magnetic features that are related to graben structure are the lows associated with the Safford-San-Simon graben extending southeast from the northwestern quarter of the map and the low related to the Animas Graben in the south central portion of the map (near 31b, fig. 10).

A large amplitude low northeast of the Pinos Altos Stock (1, fig. 10), located in the northeast corner of the map, is over Tertiary volcanic rocks, however, it is probably due in part to the dipole effect of the source causing the high just to the southwest (5, fig. 10). The southeast apex of the latter high is mainly associated with the Pinos Altos pluton (near 4a, fig. 10). Two smaller-dimension highs, nearly circular in form are seen to the east of the Pinos Altos pluton. These highs are associated with the Fierro-Hanover and Santa Rita stocks. The Pinos Altos, Fierro-Hanover and the Santa Rita Stocks are all associated with massive magnetite-replacement deposits, and possibly have deeper mafic and relatively magnetic cores, both of which could contribute to the pronounced magnetic highs (Jones and others, 1964).

In contrast to the magnetite rich deposits, the mineralized Bayard Fault Zone (near 3b, fig. 10), and the Tyrone stock (near 17, fig. 10) are associated with magnetic lows. These lows are thought to be accentuated by hydrothermal destruction of magnetite but due in large part to the predominance of magnetite poor host rock, Paleozoic carbonates in the Bayard Fault Zone and silicic igneous rock in the Tyrone area. The low in the area of the Tyrone Stock is characteristic of the composition of the intrusion and its Precambrian granitic host. Evidence that the granitic host is relatively non-magnetic is provided by the magnetic low (24, fig. 10) coinciding with the large granitic mass of similar composition exposed in the southern portion of the Burro Mountains just south-southwest of the Tyrone stock. This low of the southern Burro Mountains is one of the conspicuous features of the east-central portion of the map competing in distinctiveness, form, and trend to the large graben-related lows seen in the western portions of the map.

The older metamorphic Precambrian rocks northwest of the Tyrone stock are reflected by a magnetic high (11, 12, fig. 10) that extends southwest across the alluvial covered Lordsburg Mesa area.

North of the Lordsburg Mesa area, in the north-central part of the map (north of 20, fig. 10), is a prominant 400-gamma magnetic high that indicates a major magnetic source (probably older Precambrian rock) buried under Tertiary volcanic rocks and alluvium.

Southeast of the southern Burrow Mountains is a magnetic high (23a, fig. 10) whose source is entirely buried. This high encompasses much of the southeastern quadrant of the map, but is locally broken by a low trending south-southwest. A small outcrop of Paleozoic limestone occurs to the east of the northeastern lobe of this high. The Victorio Mountains are west of the southeastern lobe. Both gravity and magnetic data in this area suggest a complex structural pattern in rocks at relatively shallow depth beneath the surface rocks and alluvium.

Figure 10 shows intrusion and fault controlled boundaries, inferred from gravity and magnetic data. Interpretation is limited to the region southeast of a line from the Pino Altos Mountains to the Chiricahua-Dos Cabezas Mountains. Specific boundaries and anomalous areas are labelled for general reference, but few of these are discussed in this report.

Some of the inferred boundaries coincide with mapped faults or contacts in the Santa Rita and Tyrone areas; notably, the northeast trend C (note the labels on the northeast quadrant) correlates with the Barringer Fault of the

Hanover-Fierro (5) and Santa Rita (4a) area and marks the northeast boundary of the most productive mineralization. The continuation of this trend C into the Tyrone area (17, 18a) corresponds with the Burro Chief Fault, a control for mineralization in the Burro Mountains. Trend C is not specifically extended southwest, but such an extension would be seen to intersect a series of gravity lows and magnetic lows at least to the northeast margin of the Central Peloncillo Mountains in the vicinity of 31a.

The northwest-trending boundaries (unlabelled) correlate chiefly with the edges of mountain ranges and may be inferred to relate the mid-Tertiary horst and graben pattern whereas the northeast-trending boundaries (A-F) are transverse to the ranges; continuity of the latter are seen primarily over areas of known or suspected high relief in the bedrock. It is thought that these northeast-trending geophysical boundaries are indictating contrasts caused by structural and compositional contacts that occur in the Precambrian basement. The systematic alignment of several of the northeast features may reflect large dimension structures along a zone of crustal weakness, part of which has served to tap crustal and upper mantle magmas.

Conclusions

Data summarized here allow speculation that: 1) The Pueblo $1^{\circ} \times 2^{\circ}$ quadrangle, Colorado, is traversed by a continuous system of north-south faults that may provide deeply penetrating conduits for magma and mineralizing fluids to reach the surface. Intersections of the faults of this system with older northeast trending structures may provide particularly strong and localized conduits for mineralizing fluids. 2) The Silver City $1^{\circ} \times 2^{\circ}$ quadrangle, Arizona and New Mexico, shows several northeast-southwest directed geophysical features that may reflect part of the hypothetical Santa Rita trend. The features form a fairly wide zone in which some of the features are correlative with known mineralization. This zone is thought to be indicative of a system of deeply penetrating conduits for the rise of magma. 3) The Victorio Mountains in the southeast quadrant of the Silver City $1^{\circ} \times 2^{\circ}$ quadrangle are a relatively small geologic outcrop located over an area distinctive in having a large-dimension gravity-high and in its complexity of aeromagnetic patterns. It is thought that these Mountains are but a remanent of a buried terrane of complex faulting and igneous intrusion.

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Figure Captions

Figure 1.--Location map showing the areas of study, the Pueblo $1^\circ \times 2^\circ$ quadrangle in south-central Colorado, and the Silver City $1^\circ \times 2^\circ$ quadrangle in southwestern New Mexico and southeastern Arizona.

Figure 2.--Lineaments proposed by Mayo (1958).

Figure 3.--Gravity anomaly map of the Pueblo $1^\circ \times 2^\circ$ quadrangle. Contour interval is 5 mgal.

Figure 4.--Generalized geologic features of the Pueblo quadrangles (Tweto, 1979).

Figure 5.--Magnetic anomaly map of Pueblo $1^\circ \times 2^\circ$ quadrangle. Contour interval is 20 gammas.

Figure 6.--Geophysically inferred structures of the Pueblo $1^\circ \times 2^\circ$ quadrangle. Heavy lines generally represent inferred fault control, lighter lines represent inferred lithological contrasts. Mines are labeled with lower case letters (Table 1). Distinctive terranes (numbered) and geophysical trends (upper-case letters) are labelled.

Figure 7.--Gravity anomaly map of the Silver City $1^\circ \times 2^\circ$ quadrangle, Arizona and New Mexico. Contour interval is 2.5 mgal.

Figure 8.--Generalized geological features of the Silver City $1^\circ \times 2^\circ$ quadrangle (Richter and Lawrence, in press).

Figure 9.--Magnetic anomaly map of the Silver City $1^\circ \times 2^\circ$ quadrangle. Contour interval is 25 gamma.

Figure 10.--Preliminary geophysically inferred boundaries in part of the Silver City $1^\circ \times 2^\circ$ quadrangle. Specific geophysical anomalies are numbered; major northeast-trending geophysical features are lettered.