THE EL PASO GEOLOGICAL SOCIETY

GUIDEBOOK
FIFTH ANNUAL FIELD TRIP

A GLIMPSE OF SOME OF THE GEOLOGY AND MINERAL RESOURCES SIERRA BLANCA—VAN HORN COUNTRY HUDSPETH AND CULBERSON COUNTIES TEXAS

APRIL 3, 1971

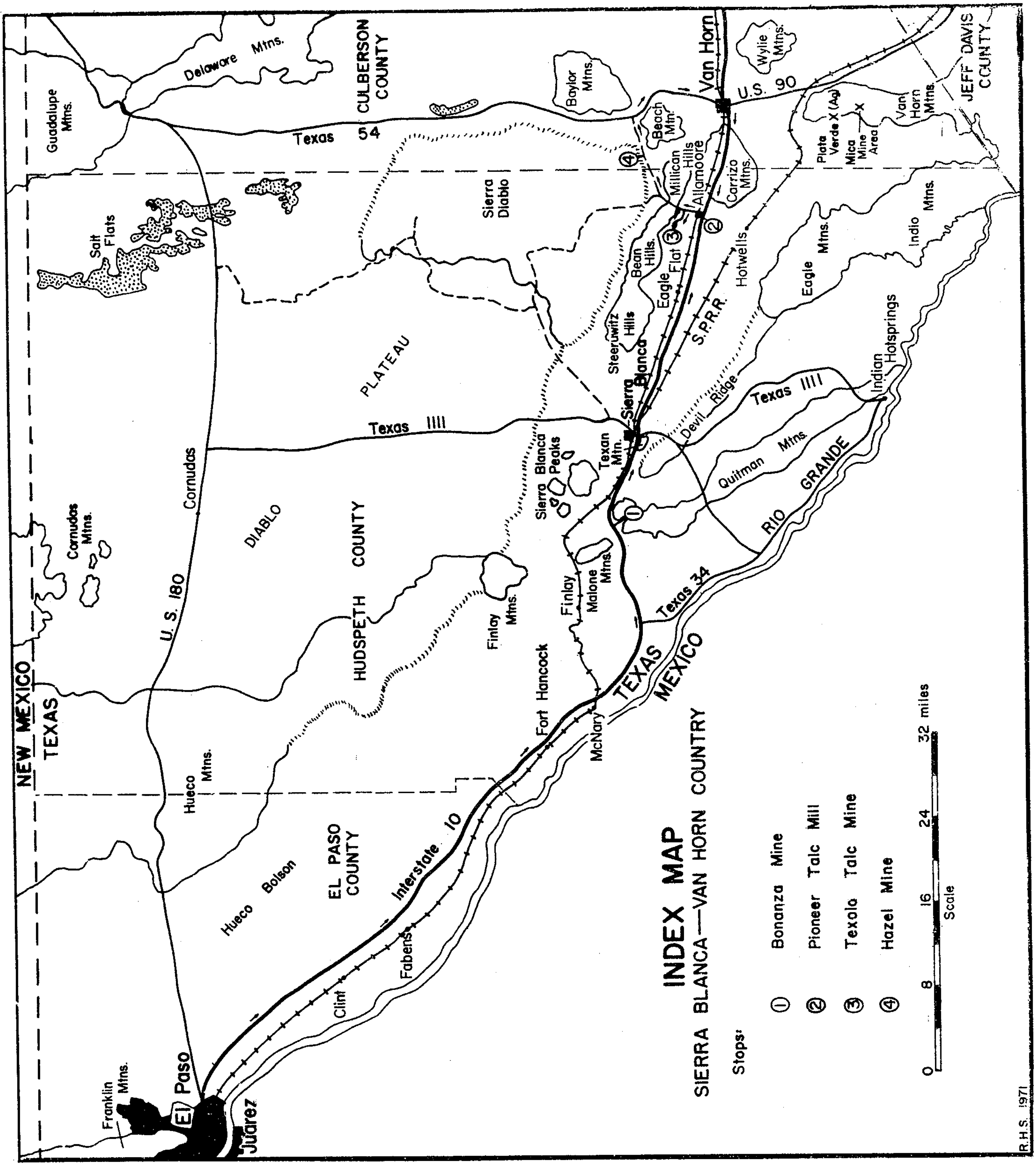

INDEX MAP
SIERRA BLANCA—VAN HORN COUNTRY
Stops:
① Bonanza Mine
② Pioneer Talc Mill
③ Texala Talc Mine
④ Hazel Mine
0 8 16 24 32 miles
Scale
R.H.S. 1971
NEW MEXICO
TEXAS
MEXICO
Guadalupe Mtns.
Delaware Mtns.
CULBERSON COUNTY
Texas 54
Baylor Mtns.
Van Horn
U.S. 90
Wylie Mtns.
JEFF DAVIS COUNTY
Beach Mtn.
Millican Hills
Allamoore
Carrizo Mtns.
Plata Verde X (Ag)
Mica Mine Area
Van Horn Mtns.
Salt Flats
Sierra Diablo
Bean Hills
Eagle Flat
Hotwells
Eagle Mtns.
Indio Mtns.
S.P.R.R.
Steeruwitz Hills
Sierra Blanca
PLATEAU
DIABLO
Texas 1111
Devil Ridge
Indian Hotsprings
Sierra Blanca Peaks
Texan Mtn.
Quitman Mtns.
RIO GRANDE
Cornudas
Cornudas Mtns.
HUDSPETH COUNTY
Finlay Mtns.
Finlay
Malone Mtns.
Texas 34
U.S. 180
Fort Hancock
McNary
Hueco Mtns.
Hueco Bolson
EL PASO COUNTY
Interstate 10
Fabens
Clint
Franklin Mtns.
El Paso
Juarez

TABLE OF CONTENTS

INTRODUCTION

The Trans Pecos region of West Texas has attracted the attention it deserves as a source of useful minerals both metallic and non-metallic. Because of the preoccupation of the people of Texas with petroleum production, many have overlooked the fact that there have been several important metal mines in this province and that talc deposits are still being worked here.

Undoubtedly other economic mineral deposits exist in the region awaiting discovery by intensive geological prospecting. The officers of the El Paso Geological Society and the field trip leader hope that this trip will heighten interest in the finding and developing of mineral deposits in Trans Pecos Texas.

We welcome all our visitors and know that they will wish to join us in thanking all those who made this trip possible. We wish especially to acknowledge the kindness of the Pioneer Talc Company in showing us through the mill at Allamoore and allowing the group to visit the Texola Talc mine. We also wish to thank Mr. Sandy Neal of Van Horn for permission to cross the Neal Ranch on the way to the Hazel Mine.

John M. Hills, President
El Paso Geological Society

EL PASO GEOLOGICAL SOCIETY OFFICERS

John M. Hills	President	University Texas - El Paso
Tom E. Cliett	Vice-President	El Paso Water Utilities
Dale E. Lockett	Secretary-Treasurer	El Paso Natural Gas
Robert D. Habbit	Councilor	El Paso Natural Gas
Jerry M. Hoffer	Councilor	University Texas - El Paso

Contributors to Guidebook

W. N. McAnulty	University of Texas at El Paso
W. R. Muehlberger	University of Texas at Austin
R. C. Rodgers	University of Texas at El Paso
Jesus Rubio	University of Texas at El Paso
R. H. Schmidt	University of Texas at El Paso
W. S. Strain	University of Texas at El Paso
M. A. Wiley	Atlantic-Richfield Company

Road Log

00.0		El Paso City Limit - East side, on Interstate 10. From this point to the Quitman Mountains Interstate 10 is built on unconsolidated sediments in the Hueco Bolson. The mountains in the distance on the right ahead are in Mexico.
5.1	5.1	Exit - Horizon Blvd.
10.2	5.1	Exit - Clint.
16.6	6.4	Exit - Fabens.
17.7	1.1	Rest Area, Comfort Station, on right.
20.5	2.8	Quitman Mountains in distance straight ahead.
25.6	5.1	Quitman Mountains straight ahead; Sierra Blanca Peak at 11:00 o'clock.
31.5	5.9	Mountains at 3:00 o'clock are in Mexico. They are composed of Cretaceous sedimentary rocks deposited in the Chihuahua Trough. The tilting and block faulting appears to be Basin-and-Range type structure. They are probably much more complex structurally than the view from this distance indicates. Thrusting of Chihuahua Trough sediments northwestward toward and against the Diablo Platform is clearly seen in ranges southeast of this area.
39.1	7.6	Exit - Fort Hancock.
45.0	5.9	Exit - McNary.
54.0	9.0	Exit - Farm Road 34; Tommy's Town; Replica of old Fort Quitman.
55.6	1.6	Fort Hancock Formation is exposed in hills on right. This formation contains appreciable bentonite. This section of the highway was recently rebuilt to stabilize the bentonitic clay base. Note A.
56.6	1.0	Finlay Mountains at 1:00 o'clock; Malone Mountains straight ahead.

The Finlay Mountains are elliptical in plan, elongated northwestward, about 10 miles to 5 miles wide. Northward, they connect with the Diablo Plateau. Their domical structure probably was produced by two uncovered laccolithic intrusions of mid-Tertiary age. Approximately 1650 feet of Permian sediments (Leonardian) are exposed in the central area. A thick section of lower Cretaceous sediments, including the Campagrande Formation, Cox Sandstone, and Finlay Limestone, is exposed in rings of hogbacks and cuestas. Dikes and sills of andesite and latite porphyries are abundant in the Finlay Mountains. Several dikes radiate from the center of a broad dome in the western part of the mountains. The area is highly faulted. No significant mineralization is known in the Finlay Mountains.

The Malone Mountains are composed of Permian, Jurassic, and Lower Cretaceous sediments. The only marine Jurassic rocks exposed in Texas, the Malone Formation, crop out in the Malones and nearby Quitman Mountains. The Malone block was thrust into its present location and the strata are strongly folded and faulted.

Gypsum is mined from an open pit located alongside the Southern Pacific Railroad (Briggs Siding) at the northwest end of the mountains. It is in the Briggs Formation, now believed to be Permian in age. The deposit is owned by Southwest Portland Cement Company. The gypsum is used in the manufacture of Portland cement in El Paso. The El Paso plant requires only about 15,000 tons per year, and mining is done during a six- to eight-week period each year. It is low-grade, ranging from 80 to 90 per cent gypsum, but it is satisfactory as an ingredient for Portland cement.

58.9 2.3 Northern Quitman Mountains straight ahead.

The mountainous block called the Quitman Mountains is made up of two distinct segments -- the northern and southern portions, separated by Quitman Gap. The southern portion is a structurally complex thrust block composed of a thick section of Cretaceous sediments. The northern Quitmans are composed of extrusive and intrusive igneous rocks. The northern half of the northern portion is composed of the Quitman Mountains intrusion, a differentiated body of predominantly quartz monzonite but also containing some diorite, syenite, and granite. The Square Peak volcanic series, about 3500 feet thick, covers about 16 square miles in the southern half of the Northern Quitman Mountains. This volcanic sequence includes rhyolitic, trachytic, lattic, andesitic, and basaltic flows and some tuffs. Rhyolite flows predominate. The Square Peak volcanics are almost completely surrounded by a ring of intrusive rock and a ring-dike origin for the Quitman intrusion was suggested by Huffington (1943). The central portion of the volcanic sequence has been dropped, probably by caldron subsidence, nearly 4500 feet. The volcanics are older than the Quitman intrusion, which is believed to have been emplaced during the Oligocene or early Miocene time (Gieger, 1965).

Mineral deposits containing silver, gold, uranium, lead, zinc, cadmium, copper, molybdenum, berryllium, iron, and fluorite are known in the northern Quitman Mountains. An appreciable amount of lead, zinc and silver, along with minor cadmium and copper, have been produced from small mines and prospects along the "Bonanza fissure." (Note B). Cretaceous and Jurassic sediments are metamorphosed along the contact with the Quitman intrusion. Minerals present in the contact metamorphic zone include: magnetite, hematite, garnets, chalcopyrite and secondary copper minerals, wulfenite, galena, sphalerite, epidote, tremolite, scheelite, helvite, and pyrite. Sizeable pods of high-grade magnetite are known to exist in the contact zone. Small veins of fluorite are known in the Square Peak volcanics about 3 1/2 miles southwest of Bug Hill.

61.9	3.0	Pass between the Malone Mountains on the left and the Quitman Mountains on right; Sierra Blanca Peak straight ahead.
64.2	2.3	Mileage marker 98. Take dirt road to right to Bonanza mine.
65.1	0.9	Good example of exfoliation of boulders on slope on right.
65.5	0.4	House on left side of road.

65.8	0.3	Road to Bonanza mine takes off on right. Drive through gate and on to Bonanza mine. Stop I. <u>Note B</u>. <u>Return</u> to Interstate 10 and turn right on it toward Sierra Blanca.
67.4	1.6	Interstate 10; turn right. Sierra Blanca Peaks straight ahead.

Sierra Blanca rises 2000 feet above the surrounding flats to an altitude of 6844 feet above sea level. It is the largest of five subconical intrusive bodies located just south of the escarpment of the Diablo Plateau. The other peaks, from west to east, are Round Top, Little Round Top, Little Blanca Mountain, and Triple Hill (Albritton and Smith, 1965). These bodies of porphyritic rhyolite and rhyolite intrude Cretaceous sediments of Washita and Fredericksburg ages. Contacts are generally covered by colluvium, but in the few places where they are exposed in arroyos the Cretaceous strata can be seen to dip away from the intrusion in places, and into it in other places. The peaks have been described as laccoliths. Several sills and dikes intrude the sedimentary rocks on the flanks of the peaks. Some are probably apophyses of the laccolithic bodies, but others which consist of andesite, hornblende andesite porphyry, and latite porphyry are cut by the laccolithic intrusions.

69.9	2.5	Devil Ridge straight ahead. This ridge continues southeastward to the Eagle Mountains.

The Quitman Mountains- Devil Ridge area consists principally of two mountainous belts in the form of an acute V, pointing northwestward. The Quitman Mountains from the broader arm; the Malone Mountains are at the apex. A discontinuous line of hills and ridges - Etholen Hill, Bluff Mesa, and Devil Ridge - forms the narrower arm (Albritton and Smith, 1965). Three major overthrusts, known from east to west as the Devil Ridge, Red Hills, and Quitman thrusts, converge in the area of the northern Quitman Mountains. The Devil Ridge thrust extends northwest of the area of convergence. It has been traced from a point west of the Finlay Mountains southeastward to Eagle Spring on the northern side of the Eagle Mountains, a distance of about 50 miles. A minimum shortening or horizontal displacement of 4.5 miles has been calculated for the

		Devil Ridge thrust on the northeast side of Devil Ridge (Smith, 1940). Yucca Mesa, a topographic prominence at the north end of Devil Ridge, is capped by Bluff Mesa Limestone (Trinity).
70.5	0.6	Highway is now crossing contact zone between Cretaceous sedimentary rocks and intrusive quartz monzonite. Contact metamorphic mineralization is widespread along this zone.
71.0	0.5	Good example of tectonic brecciation in Cretaceous limestone exposed in road cut on right.
73.7	0.7	Exit - Sierra Blanca.
74.1	0.4	Rock quarry on right, in Finlay Limestone (Cretaceous-Fredericksburg), supplied crushed stone for highway construction. This is Texan Mountain. The lower slopes are formed on the Cox Sandstone. (Trinity)
74.7	0.6	Dike of quartz latite porphyry cutting Cretaceous sediments is well exposed in road cut on right. Excellent example of porphyritic texture -- large euhedral crystals of sanadine and oligoclase in a fine-grained matrix.
76.0	1.3	Overpass Southern Pacific Railroad. Eagle Mountains at 1:00 o'clock.

The Eagle Mountains along with the Indio Mountains on the south and Devil Ridge on the northeast are part of a mountain range that begins just west of Ojinaga near La Mula, Chihuahua, and extends about 150 miles northwest. Eagle Peak is slightly over 7500 feet above sea level; the surrounding lowlands range from about 3200 feet on the south to 4400 feet on the north. The Eagle Mountains are made up principally of Permian and Cretaceous sediments and Tertiary extrusive and intrusive igneous rocks, but pre-Cambrian rocks of the Carrizo Mountain group crop out in limited areas on the northeast flank. Sediments deposited in the Chihuahua trough were asymmetrically folded and overthrust northwestward during the Laramide Orogeny (Late Cretaceous-Early Tertiary time). The volcanism occurred in Mid-Tertiary time.

The structure of the Eagle Mountains is dominated by thrust faults, strike-slip faults and folds formed in response to severe compression. Late Tertiary normal faults gave the mountains their gross outline and differential erosion gave them their present form (Underwood, 1962).

A stock-like body of syenite is exposed in the central and highest part of the mountains. Other intrusive rocks include dikes and sills of diabase, rhyolite, and trachyte. Volcanic rocks in the area include rhyolite, trachyte, volcanic breccia, and tuff.

Mineralization is widespread in the Eagle Mountains. Fluorspar deposits, both void filling and replacement types, are known in Cretaceous linestones and Tertiary volcanics. Approximately 15,000 tons of fluorspar has been mined in the Spar Valley area.

Gillerman (1953) estimated the reserves in the district, of or ore containing a minimum of 30 per cent CaF_2, to be 100,000+ tons. Veins in the pre-Cambrian schist on the northeast side of the mountains contain lead, zinc, copper, and silver minerals. Some zinc ore was shipped in 1900 from a vein located near the mouth of Spar Valley. This vein also contains azurite, malachite, and chalcocite. The Black Hill deposit (Dick Love Mine) produced several carloads of argentiferous lead ore, and the Silver Eagle deposit was mined for lead and zinc in 1940; sixty-six tons of ore were shipped. This ore contained hemimorphite, calcite, quartz, cerussite, galena, sphalerite, malachite, and silver in some form. There is a large area of copper mineralization in the Indio Mountains.

77.1	1.1	Diablo Plateau in distance on left; Carrizo Mountains ahead on right.
82.5	5.4	Talc mines in distance at 10:45 o'clock.
85.5	3.0	Talc shipping terminal on railroad on left.
86.4	0.9	Hueco Limestone (Permian-Wolfcampian) in scarp and slopes on left. The highway is crossing Eagle Flat, a smooth alluvial valley about 25 miles long and 5 miles wide, separating the Diablo Plateau from mountains on the south.

88.4	2.0	Talc shipping terminal on railroad on left. Eagle Mountains across flat on right; Carrizo Mountains on right ahead; Van Horn Mountains at 2:00 o'clock in distance.
90.4	2.0	Talc mines along base of low hills on left.
96.0	5.6	Intersection of Interstate 10 and County Road - Allamoore-Hot Wells. Turn left to Allamoore.
96.5	0.5	Pioneer Talc Mill. Stop II. Note C. Take County Road northward across railroad tracks.
97.6	1.1	Turn left on dirt road.
98.3	0.7	Turn left on dirt road.
100.0	1.7	Texola Talc mine. Stop III. Return to County Road.
102.4	2.4	County Road; turn left.
103.8	1.4	Enter valley cut across Millican Hills. Allamoore Limestone (pre-Cambrian = Castner Limestone in Franklin Mountains).
105.1	1.3	Garren Road House on right.
105.8	0.7	Road forks; keep right.
105.9	0.1	Sierra Diablo straight ahead. The scarps are capped by Hueco Limestone; slopes are on Hazel Formation (pre-Cambrian = Lanoria Quartzite in Franklin Mountains).

The Diablo Plateau is a large area of tableland of low relief mostly between 4400 and 5200 feet in altitude, which is bounded on the west by the by the Hueco Mountains and Hueco Bolson, on the south by the Sierra Blanca Peaks and the Sierra Diablo Foothills, on the southeast by the Van Horn Uplift, on the east by Sierra Diablo bordering Salt Flat, on the northeast by the Guadalupe Mountains, and on the north by the Cornudas Intrusives along the Texas-New Mexico boundary. It occupies the northwestern portion of the Diablo Platform.

The Diablo Platform came into existence during late Paleozoic orogeny that ended early in the Permian. It was a positive area throughout the remainder of the Permain Period and was probably exposed during Triassic, Jurassic, and early Cretaceous times. The Diablo Platform forms the northwestern border of the Chihuahua Trough and it served as a buttress against which strata deposited in the trough were thrust northwestward during the Laramide orogeny.

The Hueco Limestone (Permian) overlaps the truncated edges of all formations between the pre-Cambrian and uppermost Pennsylvanian on the Sierra Diablo. The base of the Hueco is not the same age everywhere because of the irregular pre-Permian surface upon which it was deposited. In the southern Sierra Diablo beds of upper Wolfcamp age rest on the Hazel Formation (pre-Cambrian).

Several east-west Tertiary faults cut across the southern end of the Diablo Plateau.

A chain of Tertiary laccolithic intrusions cuts the Permian and Cretaceous rocks of the Diablo Plateau. These include Cave Peak, Sierra Tinaja Pinta, Cerro Diablo, and the Cornudas Mountains. All of these rocks are highly alkalic in composition.

106.1	0.2	Take dim road to right. Road is on Hazel Formation (sandstone).
106.8	0.7	Dim road on right leads to Sancha Panza, St. Elmo, and Blackshaft copper prospects. Keep on main road.
107.0	0.2	Turn right on dim road. The road straight ahead leads to the Mohawk prospect.
107.5	0.5	Cattle guard.
108.5	0.5	Gate.
108.6	0.6	Beach Mountain straight ahead.
109.4	0.8	Cross major arroyo.

109.5	0.1	Turn right on dim road. Main road leads to Marvin-Judson prospect.
111.4	1.9	Gate.
112.2	0.8	Headframe - Hazel mine (East shaft). Stop IV. Note D. Continue eastward to Texas State Highway 54.
112.8	0.2	Road enters arroyo. Drive carefully.
113.2	0.1	Tumbledown Mountain at 3:00 o'clock; Baylor Mountain straight ahead.
113.9	0.7	Road forks - take road to right.
114.1	0.2	Beach Mountain at 3:00 o'clock. The Beach Mountain section was preserved in a depressed area during the period of pre-Permian erosion and was elevated to its present position during the last period of mountain building in the area. It is composed of highly faulted Bliss Sandstone, El Paso, and Montoya groups, and pre-Cambrian Hazel and Van Horn formations.
114.4	0.3	Ranch House; two gates.
114.8	0.4	Cattle guard.
115.4	0.6	Baylor Mountains straight ahead. The Baylor Mountains are capped by Hueco Limestone. The rocks of these mountains have been dropped down several thousand feet relative to the Sierra Diablo by a fault which lies between them.
115.8	0.4	Intersection with Texas State Highway 54. Turn right on 54. Good view of pre-Cambrian-Paleozoic contact in scarp of Beach Mountain on right.
117.0	1.2	Davis Mountains in distance ahead; Apache Mountains across flat on left.
118.9	1.9	Wylie Mountains straight ahead.
119.7	0.8	Van Horn Mountains and Mica Mine area straight ahead. Note E.

124.3	4.6	Talc mines in distance on right.
126.0	1.7	Van Horn; intersection of Highway 54 and Interstate 10 and proceed westward through town.
127.6	1.6	Holiday Inn on left. Hillside fault scarp on right; type locality of the Texas Lineament. Notes F and G.
129.9	2.3	Roadside Park on right.
130.5	0.6	Road cuts in Carrizo Mountain group (pre-Cambrian) metarhyolites, phyllites, etc.

A group of rugged hills beginning about three miles west of Van Horn and lying between the Southern Pacific Railroad on the south and the Texas and Pacific Railroad on the north make up the Carrizo Mountains. Most of this area is composed of pre-Cambrian rocks of the Carrizo Mountain group. The pre-Cambrian rocks are bordered by scarps of Permian limestone on the south and on the north. On the south, the Permian rests unconformably on pre-Cambrian, but on the north it is downfaulted against the pre-Cambrian rocks along the Hillside fault. On the east and west the pre-Cambrian rocks are covered by unconsolidated basin deposits.

Flawn (1953) mapped thirteen metasedimentary units and three intrusive meta-igneous units in the Carrizo Mountain group. Because the original sedimentary rocks in this area have been subjected to two periods of metamorphism and have intruded several times by igneous rocks, much of their original stratigraphic character has been disturbed and destroyed. The sequence is estimated to have a thickness of about 19,000 feet.

The metasedimentary rocks include metaquartzite, sericite schist, phyllite, meta-arkose, and chlorite-mica schist; the meta-igneous types include granodiorite, metarhyolite, and amphibolite. The rocks are now in the greenschist metamorphic facies, having retrogressed from a higher metamorphic grade. Possibly the retrogression occurred during the time the rocks were thrust northwestward over the Allamoore Formation along the Steeruwitz fault.

Reportedly, turquoise has been obtained from prospects in the Carrizo Mountains. Numerous shallow shafts, inclines, adits, and test pits have been excavated on thin veins of quartz and calcite containing small quantities of copper sulfides, but, so far as known, no ore was shipped from them. However, the many prospects are significant in that they reveal widespread metallic mineralization in the pre-Cambrian rocks of the area .

130.6	0.1	County line - leave Culberson County, enter Hudspeth County.
131.2	0.6	Good view of Hillside fault on right.
131.8	0.6	Talc mines in distance on right.
133.8	2.0	Gifford-Hill rock quarry on right, alongside railroad. This operation was started in 1926. The stone used for crushing is metarhyolite of the Carrizo Mountain group. It is used for railroad ballast and road metal. Immediately northeast of the plant on the opposite side of the railroad the hills are made up of Cretaceous conglomerates and sandstones of the Campagrande (Glen Rose) and Cox (Paluxy) formations. They are preserved on the north or downthrown side of the Hillside fault.
134.9	1.1	View of Millican Hills on right.
136.7	1.6	Intersection of Interstate 10 and Allamoore-Hotwells County Road. Loop closed; end of tirp. Drive carefully on the way home.

EXPLANATORY NOTES

NOTE A - ECONOMIC RESOURCES OF THE FORT HANCOCK FORMATION

Only two economic aspects of the Fort Hancock Formation have received much attention in the past. These are groundwater and clay used for drilling mud.

Groundwater production has been limited principally because porosity and permeability are low. A large part of the formation is montmorillonitic clay and silt. The stratigraphic units which do contain water usually produce small quantities. The major exception to this is an artesian aquifer about two miles south of Fabens, Texas. The water is produced from a gravel facies of the Fort Hancock. The system is believed to be connected with a similar aquifer across the Rio Grande and in Mexico. Recharge is probably from an arroyo which drains an area to the southwest in Mexico and which enters the Rio Grande near Fabens.

Except for the artesian system and a few shallow wells drilled near arroyos the water is high in total dissolved solids. Chlorite and sulphate ions are present far in excess of tolerable amounts for human consumption, stock water or irrigation.

The montmorillonitic (bentonitic) clay has been mined near Finlay, Texas and just south of Interstate 10, about a mile east of Tommy's Town. The clay was used in making drilling mud for the oil industry. These economic ventures were not successful.

Future economic development of the Fort Hancock Formation might include the use of montmorillonitic clay as drilling mud and as absorbent clay ("fuller's earth") in the refining of petroleum. Tremendous tonages are available, but research would be necessary to determine the most favorable localities.

Although no deposits of diatomaceous earth have been described, it is quite likely that they do exist in the Fort Hancock Formation. The formation is mostly fresh water lake deposits and similar lacustrine strata elsewhere contain diatomite. A careful search might reveal commercial deposits of diatomite in the Fort Hancock.

The prospect for future groundwater supplies from the Fort Hancock Formation is poor because of low porosity and permeability. Most of the water available, with the exception of the artesian supply near Fabens, is not potable. Desalinization may eventually be feasible and make the water potable, but the quantity will probably always be small.

W. S. Strain

NOTE B - THE BONANZA FISSURE ZONE

The Bonanza Fissured Zone is traceable on the surface for about 2.5 miles in nearly east-west direction across the north-trending westernmost ridge of the north Quitman Mountains. The Bonanza mine is located in the zone on the east side of the ridge, in Section 47, Block 72, T & P Ry. Survey, Hudspeth County, Texas. The mine is easily accessible from U.S. Interstate 10 by taking an improved dirt road southward at mile marker 98 for about 2.0 miles. It is approximately 81 miles southeast of El Paso and 10 miles west of Sierra Blanca, Texas.

HISTORICAL INFORMATION

W. H. Von Steeruwitz, working for the Texas Geological Survey, studied the Quitman Mountains in 1889 and reported mining activities at the Bonanza mine and the Alice Ray and Queen Anne prospects, all of which are located in the Bonanza Fissured Zone -- the Bonanza mine on the east side and the two prospects on the west side of the ridge. In the first and second annual reports published by the Texas Geological Survey, dated 1889 and 1890, respectively, Steeruwitz makes the following comments concerning the Bonanza area: "The working shaft (Bonanza mine), nearly perpendicular, follows the vein 90 feet to a drift east and west, from which drift a winze is sunk 110 feet deep. The ore vein, which is plainly visible in the drift, is from an inch to one foot or more thick, with pockets, on which some stopping has been done. The ore of the upper part of the vein is mostly galena, with 20 to 30 ounces of silver, zincblende, and a ferruginous combination of both metals, with occasional copper stains. Mr. Stevenson, the owner of the mine, claims to have shipped several hundred car loads of ore. Zinc seems to predominate in the lower part."

With reference to the Alice Ray prospect, Steeruwitz reported the following: "The lower tunnel of the Alice Ray mine . . . . is on the same lead as the Bonanza, opens about 400 feet above the shaft of the Bonanza, and runs about 200 feet into the mountains. One hundred feet above this tunnel another drift about 100 feet in length is driven in, and at the mouth of this drift a shaft is sunk. The ore vein, 2-12 inches, is plainly visible in the roof of the tunnels and at the bottom. The ore is mostly argentiferous galena and zincblende and so-called carbonates, in part a ferruginous silver-bearing silicate. Considerable quantities of ore were shipped from this mine, and many car loads are ready for shipment."

Concerning the Queen Anne prospect, Steeruwitz reported: "Nearby at the foot of the slope below the Alice Ray is the Queen Anne prospect, with a drift about 100 feet and a shaft 70-75 feet deep. The prospect looks favorable."

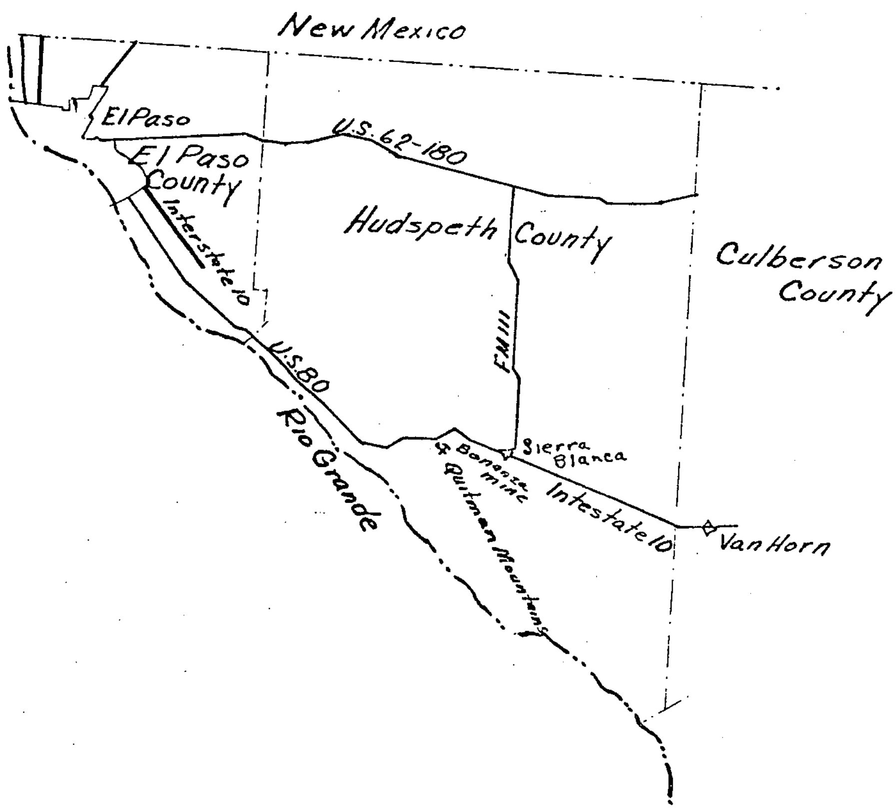
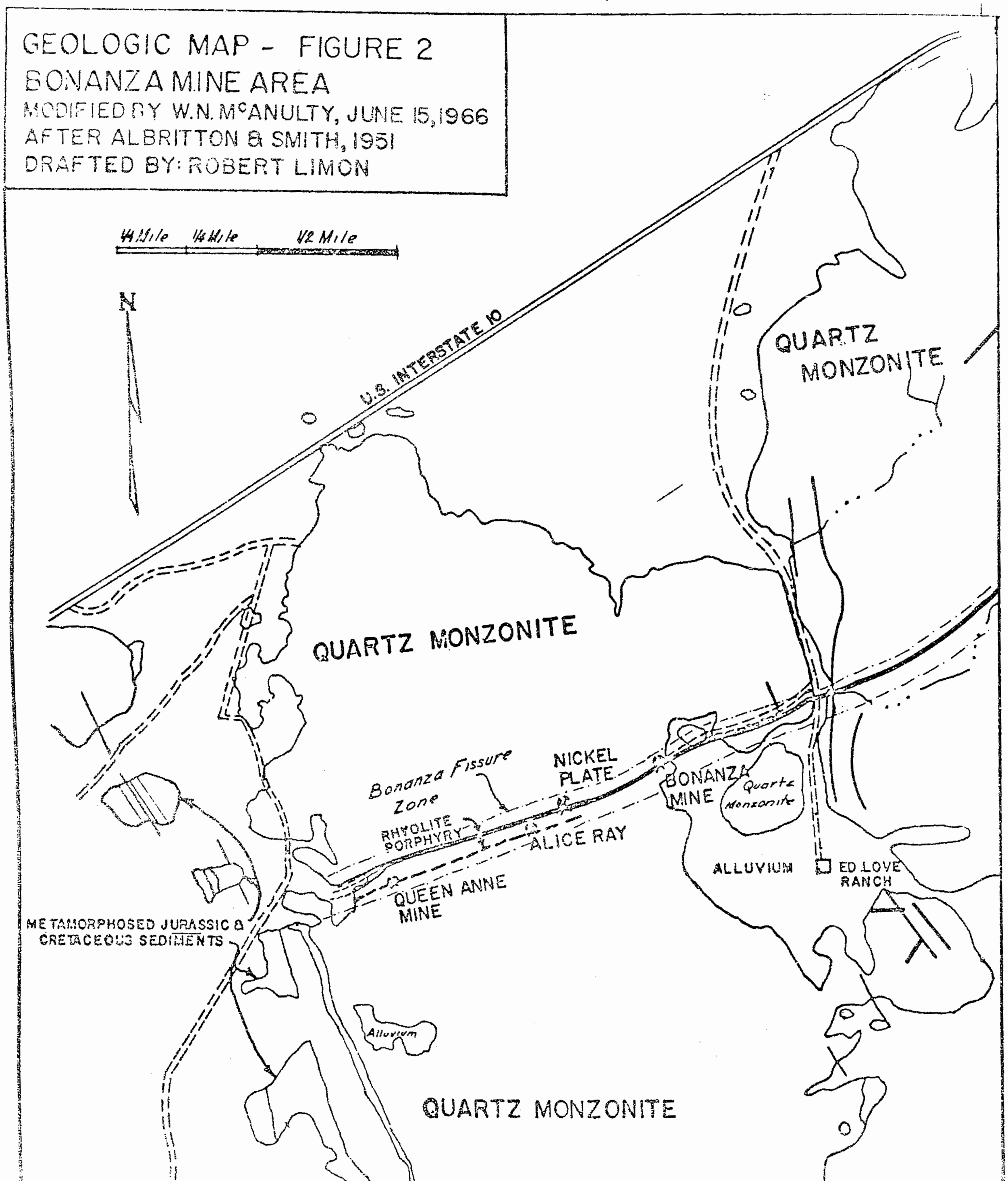


FIGURE I. INDEX MAP


GEOLOGIC MAP - FIGURE 2
BONANZA MINE AREA
MODIFIED BY W.N. McANULTY, JUNE 15, 1966
AFTER ALBRITTON & SMITH, 1951
DRAFTED BY: ROBERT LIMON
1/4 Mile 1/4 Mile 1/2 Mile
N
U.S. INTERSTATE 10
QUARTZ MONZONITE
QUARTZ MONZONITE
Bonanza Fissure Zone
NICKEL PLATE
BONANZA MINE
Quartz Monzonite
RHYOLITE PORPHYRY
ALICE RAY
QUEEN ANNE MINE
ALLUVIUM
ED LOVE RANCH
METAMORPHOSED JURASSIC & CRETACEOUS SEDIMENTS
Alluvium
QUARTZ MONZONITE

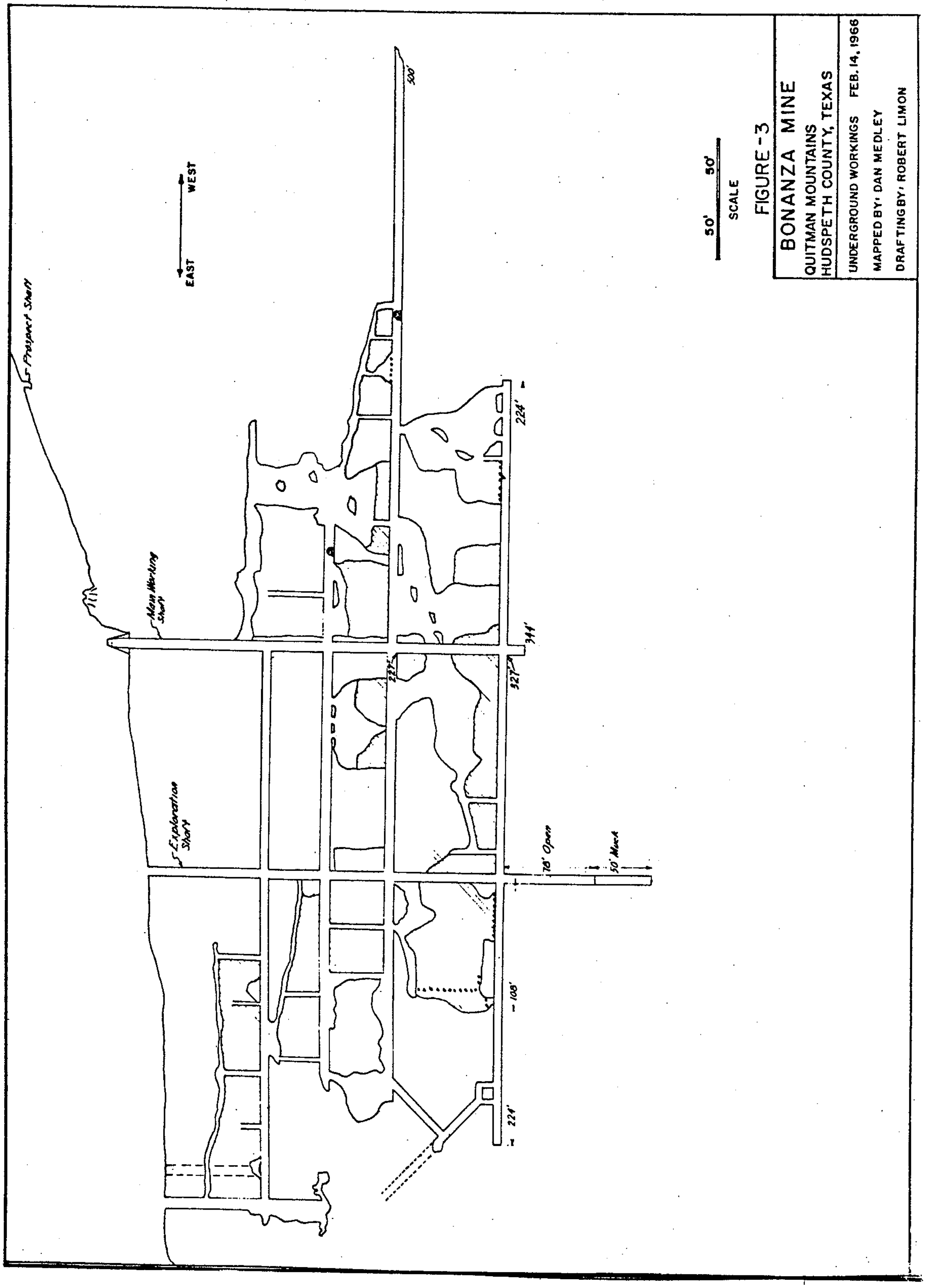
Steeruwitz goes on to say: "In the Quitman Mountains, the Bonanza and Alice Ray mines have shipped some good ores, containing 30 per cent and over of lead, 20 to 30 per cent of zinc, with 20 to 30 ounces of silver, and traces of gold." Unfortunately for the producers, there was no market for zinc at the time--in fact, the ore shipments were penalized forty cents per unit of contained zinc.

Apparently very little work was done at either the Alice Ray or Queen Anne prospects after the time of Steeruwitz's visit to the area. The Bonanza mine was worked intermittently through the years. Metallurgical Products, Inc. took over the Bonanza mine in 1964 and proceeded to de-water and re-timber the mine, and to mine and mill about 1100 tons of ore. The total production from mines and prospects in the Bonanza Fissured Zone is unknown. The Bureau of Economic Geology of the University of Texas reported in Bulletin 3401, published in 1934, that 1,488,474 pounds of zinc had been produced from the Bonanza and Alice Ray mines. No records of the lead and silver production are available, but it is likely that more lead than zinc was produced because in the early days zinc was not saleable. Ore shipped from these mines ran 30+ per cent lead, 25-30 per cent zinc, 20-30 ounces of silver, and a trace of gold. Metallurgical Products, Inc. is receiving payment for lead, zinc, silver, gold, and cadmium.

GEOLOGY

The part of the northern Quitman Mountains with which this report is concerned has been interpreted (Huffington, 1943) as a stock-like pluton (large intrusion of igneous rocks) of Tertiary age, composed predominantely of quartz monzonite, but also containing appreciable amounts of granite, granodiorite, syenite, and diabase. Small apilitic (fine-grained granitic material) dikes are numerous, both in and outside the Bonanza Fissured Zone. At least two rhyolite dikes lie within and roughly parallel to the strike of the zone. Strongly metamorphosed sedimentary rocks of Cretaceous and Jurassic ages crop out near the base of the western slope of the ridge of intrusive rocks. These metamorphosed rocks, originally limestones and shales, now consist mostly of garnet and calcium silicate minerals characteristic of contact zones. South of the Bonanza Fissured Zone, the Quitman pluton takes the form of a ring-dike, and encircles a thick section of extrusive igneous rocks (lava flows and tuffs), the Square Peak Series.

The intrusive igneous rocks are porphyritic and range from finely to coarsely granitic in texture, and are mostly gray to pink, but some are green and yellowish-brown. The quartz monzonite is much altered and decomposed into loose, "rotten" masses in places along dikes and in highly sheeted zones. Narrow aplite dikes frequently grade into quartz veins and veinlets. The intrusive rocks are cut by several joint systems, and sheeted zones are numerous. Slickensided surfaces along many of the joint surfaces attest to some horizontal and vertical displacement.


Prospect Shaft
Main Working Shaft
Exploration Shaft
EAST
WEST
500'
224'
344'
327'
18' Open
50' Muck
108'
224'
50'
50'
SCALE
FIGURE - 3
BONANZA MINE
QUITMAN MOUNTAINS
HUDSPETH COUNTY, TEXAS
UNDERGROUND WORKINGS FEB. 14, 1966
MAPPED BY: DAN MEDLEY
DRAFTING BY: ROBERT LIMON

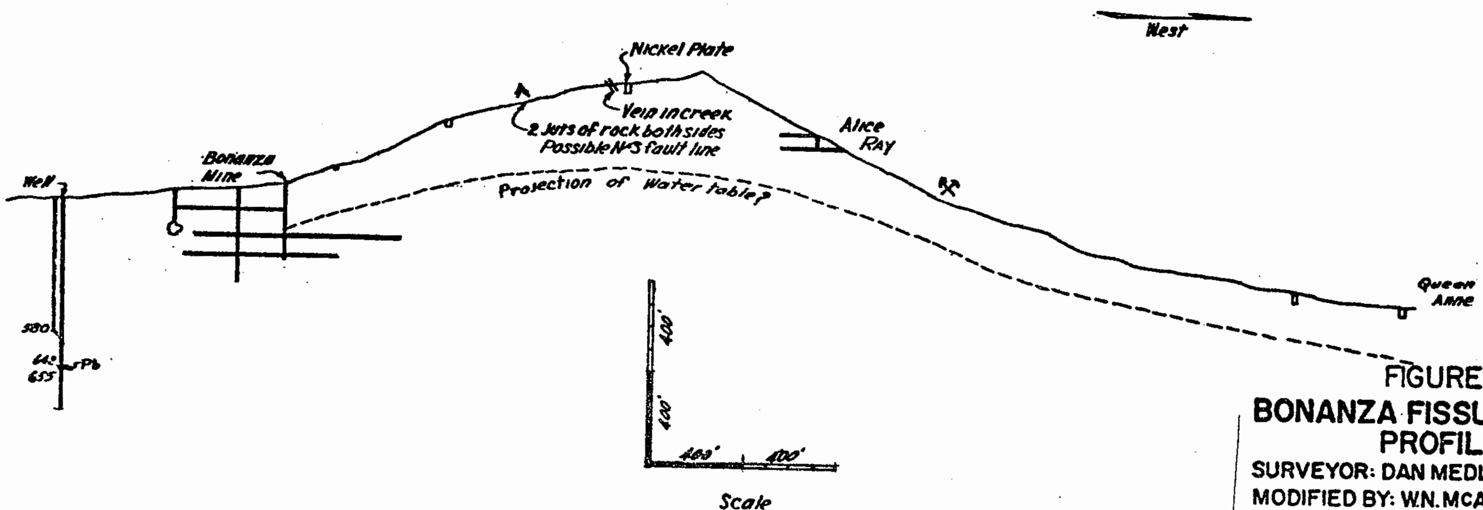


FIGURE-4
BONANZA FISSURED ZONE PROFILE
SURVEYOR: DAN MEDLEY
MODIFIED BY: W.N. MCANULTY JUNE 15,1966
DRAFTED BY: R.F. LIMON

The Bonanza Fissured Zone forms a conspicuous swath, 200-400 feet wide, across the ridge, nearly normal to the trend of the ridge. It strikes approximately N 80° E. A topographic saddle is developed on the zone where it crosses the summit of the ridge, and the zone can be traced easily on the surface on both the east and west slopes to the contact with alluvium on either side. Within the swath there are three or more separate sheeted zones, each roughly parallel to the strike of the major zone. These sheeted zones are the result of closely spaced, nearly vertical fractures or joints in the quartz monzonite. The individual sheeted zones range from 50 feet to 100 ± feet in width. Sheeted zones striking nearly north and east of north cut the Bonanza Fissured Zone at intervals.

Within and generally parllel to the strike of the Bonanza Fissured Zone are two or more dikes of rhyolite porphyry. One of these dikes, herein called the Bonanza dike, crops out over the full length of the outcrop of the fissured zone. It pinches and swells on the outcrop, ranging from a few feet to more than 50 feet in width. Where it can be seen in the Bonanza mine, it dips steeply (60-65 degrees northward) and is concordant with the major jointing in the quartz monzonite host. Another dike of rhyolite porphyry crops out in the saddle on top of the ridge, about 150 feet south of the Bonanza dike, and can be traced (intermittent outcrops) along the west slope. The Alice Ray prospect is located in a sheeted zone between these dikes.

The relationship between emplacement of the rhyolite porphyry dikes in the Bonanza Fissured Zone and the ore mineralization is not clear. Apparently, the dikes moved into a pre-existing zone of weakness. It is probable that the ore-bearing fluids and the magma which formed the dikes had the same parentage. The vein deposits of ore minerals formed along fractures in the quartz monzonite as well as along the contact between the dikes and the host rock. The rhyolite porphyry contains appreciable pyrite in places, most of which has been altered to hematite, but no lead, zinc, or copper minerals were observed in the rhyolite. The quartz monzonite is strongly garnetized over sizeable, irregular-shaped areas at several places along the contact with the dikes on the west slope. At other places along contacts and in highly sheeted zones, on both slopes, the quartz monzonite has suffered considerable kaolinization and is quite "rotten".

Mineralization

The following minerals occur in veins and veinlets within and roughly parallel to the strike of the Bonanza Fissured Zone: argentiferous galena, cadmium-bearing sphalerite, chalcopyrite, malachite, chrysocolla, wulfenite, pyrite, hematite, magnetite, limonite, quartz, altered feldspars, clay minerals, and traces of gold and uranium. Narrow quartz vein segments in aplite dikes, numerous in a north-trending sheeted zone on the east slope of the ridge, about 1200 feet west of the Bonanza mine, contain abundant blebs of coarsely crystalline molybdenite. The meta-sedimentary rocks along contact zones (exposed near the base of the west slope of the ridge) are composed largely of garnet and calcium silicate minerals (tremolite, actinolite, and eipdote), with appreciable specular hematite, scattered masses of magnetite, calcite, and traces of scheelite. The contact-metamorphic rocks also contain small amounts of galena, sphalerite, pyrite, chalcopyrite, malachite, and chrysocolla. Sizeable "patches" of the quartz monzonite have been nearly completely garnetized at places along the contact with rhyolite dikes in the Bonanza Fissured Zone.

The Ore Deposits

The Bonanza vein varies from one inch to more than two feet in thickness; the average width is 8-10 inches. The average strike of the vein is N 80° E and it dips 60-65° Northward. The vein usually follows fractures in the quartz monzonite host rock out several feet to the north of the Bonanza rhyolite porphyry dike, however, in places it lies along the rhyolite-quartz monzonite contact. Both walls are distinct in most places and slickensided surfaces are common. The vein pinches and swells in short distances, both horizontally and vertically. It widens up to 30+ inches in places, but even in the widest zones the width of the ore mineral zone is usually less than one foot. However, within some of the wider zones there are two or more branching seams of ore minerals.

The principal ore minerals are galena and sphalerite. Quartz constitutes most of the gangue; comb structure is common. Pyrite is fairly abundant, and a small amount of wulfenite is present in the upper levels. Silver appears to be tied up with the galena, and the sphalerite contains some cadmium. Gold and uranium occur in trace amounts. Chalcopyrite and oxidized copper minerals (malachite and chrysocolla) are sparsely disseminated through the vein material. The vein also contains appreciable amounts of specular hematite, magnetite, altered feldspars, and clay minerals. In the upper levels galena and sphalerite are present in approximately equal amounts, but the sphalerite content increases with depth.

The water table stands 200-300 feet below the surface, depending on the topography. The amount of water is relatively small -- about 2 or 3 gallons per minute in the lower levels. Therefore, water presents no great problem in mining; in fact, the water available is an asset for milling. The quartz monzonite is highly altered (kaolinized) in places and does not stand well--especially in the wet, lower levels.

The metal content of the concentrates produced in 1965-66 by Metallurgical Products, Inc. from ore taken from the Bonanza Mine, which contained about 4 per cent lead and 16 per cent zinc, averaged as follows:

Pb - 70%
Zn - 52%
Ag - 45 ozs.
Cd - 0.2%
Au - trace
Cu - 0.2%

W. N. McAnulty

References

Albritton, Claude C. Jr., and Smith, J. Fred, Jr., 1965, Geology of the Sierra Blanca Area, Hudspeth County, Texas, U. S. Geol. Survey, Prof. paper 479.

Huffington, R. M, 1943, Geology of the Northern Quitman Mountains, trans-Pecos Texas; Geol. Soc. Amer. Bull., V. 54, No. 7, p. 987-1047.

Steeruwitz, W. H. Von, 1890, Geology of the trans-Pecos Texas, Preliminary Statement: Texas Geo. Survey 1st Ann. Rept., 1889, p. 217-235.

________, 1890, Report on the geology and mineral resources of trans-Pecos Texas: Texas Geol. Survey 2nd Ann. Rept., p. 665-713.

NOTE C - ALLAMOORE TALC DISTRICT

Talc was discovered in the Steeruwitz Hills by Sam Rossman of Pecos, Texas and the first exploration was done by the Southwestern Talc Corporation of Llano, Texas in 1952. Exploration and development work in the area proceeded slowly until about 1960. Today there are more than 25 mines being operated by the following companies: Wes-Tex Corporation, an affiliate of Milwhite, Houston, Texas; Texas Talc and Mineral Corporation, Fort Worth, Texas; Pioneer Talc, an affiliate of Southern Talc, Atlanta, Georgia; Southern Clay, an affiliate of Georgia Kaolin Company, Gonzales, Texas; United Sierra, an affiliate of Cyprus Mines, Trenton, New Jersey, and Texas Talc, an affiliate of Dallas Ceramics, Dallas, Texas. Current production in the district is about 15,000 per month. Talc mining and processing in the district employ about 70 people. The district has been extended from the Steeruwitz Hills on the west, through the Bean Hills and on into the Millican Hills on the east, over a swath about 2 miles wide and 25 miles long. It has become an important talc district in the United States.

Crude talc is shipped by rail from Van Horn, Allamoore, Eagle Flat, and another siding between Eagle Flat and Sierra Blanca. Processed talc is shipped from Allamoore where Pioneer Talc operates a grinding, sizing, and bagging plant, as well as a calcining kiln. Southern Clay also operates a calcining kiln in Allamoore. Talc is an important industrial mineral and has many uses. Crude talc (ceramic grade) is used in the manufacture of tile. Higher grades are used in paints and cosmetics. The ceramics, paint, rubber, insecticides, roofing, and paper industries consume about 80% of the talc produced in the United States.

Prices received F.O.B. Allamoore vary according to grade from $4.50 to $7.50 per ton for ceramic grade to $75 per ton for paint grade. Most of the material is shipped to east and west coast markets. However, considerable amounts of ceramic grade are shipped to Monterrey and Mexico City.

The talc occurs in phyllitic units of the pre-Cambrian Allamoore formation in the Sierra Diablo foothills. This belt of low ridges is divided by drainages into three groups of hills, namely: the Steeruwitz Hills on the west, the Bean Hills in the center, and the Millican Hills on the east. Most of this area is made of deformed rocks of pre-Cambrian limestones and sandstones. In this area the Allamoore formation has been overridden on the south by the Carrizo Mountain Group (pre-Cambrian) along the Steeruwitz overthrust and in turn overrides the Hazel Formation (pre-Cambrian) on the north along a "surface of movement" (King, 1953).

The Allamoore Formation, oldest unit north of the Steeruwitz Overthrust, is made up of interbedded cherty limestone, phyllite, and intrusive and extrusive igneous rocks. Some of the limestone beds may be of algal origin. The thickness cannot be determined because of the complex structure but it is several thousand feet thick. The Allamoore is believed to be correlative with the Castner Limestone in the Franklin Mountains.

The origin of the talc is not known precisely. The chemical formula for pure talc is: $3MgO \cdot 4\,SiO_2 \cdot H_2O$ (31.9%, MgO; 65.4% SiO_2; 4.7%, H_2O). It is believed that talc is formed during periods of intense dynamic disturbance through hydrothermal alteration or contact metamorphism of preexisting rocks. The whiter, purer talc appears to be derived generally from sedimentary magnesium carbonate rocks, and that less pure grades are often derived from ultra basic igneous rocks. The carbonate beds which border the talc deposits in phyllite units of the Allamoore appear to be limestones rather than dolomites, therefore, the phyllitic material from which the talc was formed may have been magnesium-rich, basic tuff. Basic igneous sills and/or dikes are associated with the talc in several of the mines.

W. N. McAnulty

References

King, Philip B., and Flawn, Peter T., 1953, Geology and mineral deposits of pre-Cambrian rocks of the Van Horn area, Texas: Univ. of Texas Publ. No. 5301, Bureau of Economic Geology, The University of Texas.

NOTE D -- HAZEL MINE

History

The Hazel Mine, most important of several mines and prospects in the Allamoore-Van Horn copper district, has yielded more than 1 1/2 million pounds of copper and 4 to 5 million ounces of silver. It was discovered in 1856, but the most productive period in its history was during the 1880's and early 1890's. During that period as many as 400 workers were employed at the mine. It was worked intermittently from 1896 to 1948. The property is currently owned by the Hazel Mining and Milling Company, Dallas, Texas, and leased to Philip W. Beckley, Albuquerque, New Mexico.

Development

The Hazel mine workings consist of three main shafts, extensive underground stopes, drifts, and cross-cuts, and two open stopes. The deeper workings have been full of water since about 1900. The existing headframe stands over the East Shaft, the most important entry, sunk to a depth of 746 feet. Von Steeruwitz examined the mine in 1891 and reported that there were about 600 feet of drifts and cross-cuts on the 7th through 10th levels. Most of the high-grade ore taken from the mine came from the first four levels -- above 200 feet.

The West Shaft, located 1800 feet west of the East Shaft, was sunk to a depth of 375 feet, with about 350 feet of drift and cross-cuts worked from it. An Inclined Shaft, located 600 feet west of East Shaft, intersects the fourth level at a depth of about 200 feet. There are many other pits and shallow shafts between the East and West shafts.

Geology

The Hazel mine is located on the Hazel fracture zone, a series of sub-parallel, in echelon fractures in the Hazel Formation. This east-west fracture zone is clearly visible on aerial photographs as a discolored zone traceable for more than 3 miles west from the Hazel Mine. In and around the mine the Hazel Formation consists of very fine-grained, compact, closely jointed, minutely cross-bedded red sandstone and siltstone (Flawn, 1952). This is believed to be the upper part of the Hazel Formation; the lower part of the Hazel is made up of 2000 to 3000 feet of conglomerate.

The east-west Hazel fracture zone is intersected by a northwest trending fault at the Marvin-Judson prospect about 1 mile west of the Hazel mine. The ore appears to have been localized at intersections of small northeast-trending fractures and the main east-west fracture zone. The veins widen downward and it appears that the present surface intersects the top of the mineralized fissure system.

Mineralization

Ore minerals found in the Hazel deposits include chalcocite, tetrahedrite, argentite, native silver, tennantite, chalcopyrite, bornite, covellite, malachite, azurite, complex lead and zinc sulfides, and traces of gold and antimony. Gangue minerals are calcite, barite, and quartz. Interlacing veinlets of ore minerals pinch and swell along the strike and down dip. Brecciated areas between veins also contained interlacing of ore minerals. Many ore shoots found in the mine do not extend to the surface. Small pockets of rich ore were found at intersections of the veins and cross fractures.

"The whole gangue between the east and west shaft may be regarded as filled with low grade ore through which the richer veins, pockets, and veinlets are dispersed, and I regard it anything but an exaggeration to estimate the value of the ores in this mine as far as it is opened for work at twenty million ounces of silver" (Von Steeruwitz, 1892).

W. N. McAnulty

References

Flawn, Peter T., 1952, The Hazel Copper-silver mine, Culberson County: Report, Inv. No. 16, Bureau of Economic Geology, The University of Texas.

Steeruwitz, W. H., von, 1892, Trans-Pecos Texas: Texas Geol. Survey, 3rd Ann. Rept. (1891).

NOTE E -

An area of exposed pre-Cambrian rocks of the Carrizo Mountain group in a horst that forms the northwestern extension of the Van Horn Mountains is known as the Mica Mine area. The Van Horn Mountains constitute a block-faulted range beginning about 10 miles south of Van Horn and extending southeastward to the Sierra Vieja. The Mica Mine area is about 15 miles south-southwest of Van Horn, Texas.

Flawn (1951) mapped more than 80 pegmatite bodies one foot or more in thickness in the Mica Mine area. Both zoned and unzoned perthite-quartz-plagioclase-muscovite pegmatites are distributed throughout pre-Cambrian metasedimentary rocks in the area. The conspicuous mica content of the pegmatites gives the area its name.

Outcrops of mica were discovered in the area sometime around 1890. The first efforts to exploit the mica were started in 1910 by Texas Mica Company of Pecos, Texas. Attempts were made, without success, to develop mica and micaceous rock suitable for giving a "microlithic" finish to cement and other structural materials. In 1920, the Microlithic Company of Texas took over the property and spent large sums of money trying to develop the area. The property was connected with the Southern Pacific Railroad with a five-mile spur and a large mill and several houses for workers were constructed. The Mica Mine Town was nearly as large as Van Horn. The Microlithic Company planned to produce a product for facing cutstone, but the company went bankrupt in 1930. During World War II the property was leased to Texas Mica and Feldspar Company which operated it for a short time and produced about $5000 worth of "strategic mica".

Unless there is a marked increase in prices, it is believed that the area has no future in production of sheet or scarp mica as primary products, although scarp mica might be a valuable byproduct of other operations. There is a potential for production of feldspar, quartz, and scarp mica.

The old Plata Verde silver mine is located a few miles north of the Mica Mine area on the south flank of the Van Horn Mountains. It produced several thousand tons of silver chloride ore containing a small amount of copper.

W. N. McAnulty

References

Flawn, Peter T., 1951, Pegmatites of the Van Horn Mountains, Texas: Rept. Invt. No. 9, Bureau of Economic Geology, The University of Texas at Austin.

NOTE F - THE TEXAS LINEAMENT IN EAGLE FLAT, TEXAS

The Texas lineament, in Eagle Flat between Van Horn and Sierra Blanca, Texas, is an easily recognizable and definable structural and stratigraphic boundary. (Albritton and Smith, 1957, gives a good review and discussion of the concept of the Texas lineament and defined Eagle Flat as the type region for it.) To the north, thin, flat-lying platform sections of Permian and Cretaceous rocks rest on an intensely deformed sequence of Precambrian rocks; to the south, extremely thick, overturned and overthrust to the northeast, Cretaceous sedimentary rocks rest on an unknown and unexposed sequence of rocks. This prominent geological discontinuity can be recognized westward to El Paso along the Hueco bolson and constitutes the structural boundary between the Diablo platforms on the north and the Chihuahua tectonic trough on the south (DeFord, 1969).

Demonstrable strike-slip displacements along this zone in Paleozoic and younger rocks are insignificant to zero; dip-slip displacements are large. A Late Precambrian orogeny (1000 m.y. ago) produced the structural grain of the region that is parallel to the Texas lineament. Strike-slip motion along the lineament at this time is suggested by the right-lateral offset for over 150 miles (from near Ft. Stockton to west of El Paso) of a Precambrian isotopic age boundary. This offset in the Precambrian rocks and a comparable offset in the Ouachita front let Muehlberger (1965) to speculate that strike-slip movements on the Texas lineament were late Paleozoic and accompanied the formation of the major structures in the Permian basin of west Texas. Kottlowski (1970) has presented data which show that strike-slip motion along the Texas lineament cannot have occurred since the deposition of the upper Cambrian Bliss Sandstone. Therefore if there has been major strike-slip displacement along the Texas lineament it must be pre-upper Cambrian in age, and no older than the 1000 m.y. orogeny.

The Hillside fault, type fault of the Texas direction of wrench faulting (Moody and Hill, 1956), was shown by King (1965, p. 115) to be a dip-slip fault, with the north-side down in both late Paleozoic and post-Cretaceous displacements. He showed that the Permian Powwow Conglomerate contains clasts of Precambrian metarhyolite that is exposed in the Carrizo Mountains on the upthrown side of the fault. Furthermore, the clasts become fewer and less angular northward away from the fault. Because the conglomerate is still adjacent to its probable source, it is unlikely that any significant strike-slip displacement on the Hillside fault can have occurred since it was deposited.

Wiley's (1970) gravity and magnetic data enabled him to trace the Eagle Flat (= Texas lineament) structural boundary at its southeast end into the Rim Rock fault, which extends southward from 78 miles along the Texas side of the Rio Grande to the Chinati Mountains near Presidio, Texas. The Rim Rock fault, like the type region of the Texas lineament, along Eagle Flat, marks the structural boundary between the Chihuahua tectonic trough and the Diablo platform. Therefore the Texas lineament in Trans-Pecos Texas represents the early recognized part of this structural boundary, probably because of easy access by wagon, transcontinental highway and railroads in Ealge Flat. The significance of the Rim Rock fault, however, awaited the extensive studies by R. K. DeFord and his students at The University of Texas at Austin during the late 1950's and '60's into the remote and fairly inaccessible Rim Rock country.

W. R. Muehlberger and M. A. Wiley
The University of Texas at Austin

References

Albritton, C.C., Jr., and Smith, J.F., Jr., 1957, The Texas lineament: Internat. Geol. Cong., 20th, Mexico City, 1956, sec. 5, Relaciones entre la tectonica y la sedimentacion, p. 501-518 (1961).

DeFord, R.K., 1969, Some keys to the geology of northern Chihuahua: New Mexico Geol. Soc. Field Trip Guidebook, 20th, p. 61-65.

King, P.B., 1965, Geology of the Sierra Diablo region, Texas: U.S. Geol. Survey Prof. Paper 480, 185 p.

Kottlowski, F.E., 1970, Paleozoic geologic history of southwest New Mexico and northwest Chihuahua, in Seewald, Ken, and Sundeen, Dan, eds., The geologic framework of the Chihuahua tectonic belt, a symposium in honor of Prof. R.K. DeFord, November 4-6, 1970, Midland, Texas, sponsored by The West Texas Geological Society and The University of Texas at Austin, p. 16-18.

Moody, J.D., and Hill, M.J., 1956, Wrench fault tectonics: Geol. Soc. America Bull., v. 67, p. 1207-1246.

Muehlberger, W.R., 1965, Late Paleozoic movement along the Texas lineament: Trans. New York Acad. Sci., ser. 11, v. 27, no. 4, p. 385-392.

Wiley, M.A., 1970, Correlation of geology with gravity and magnetic anomalies, Van Horn-Sierra Blanca region, trans-Pecos Texas: Ph.D. dissertation, Univ. of Texas at Austin, 331 p.

NOTE G - THE TEXAS LINEAMENT AND MINERAL DEPOSITS IN TRANS PECOS TEXAS

The type locality (segment) of the Texas lineament (Albritton and Smith, 1956) forms the boundary between the Diablo platform and the Chihuahua trough in Hudspeth and Culberson Counties, Texas. This structural feature has been projected southeastward and northwestward from the type segment. Northwestward across Texas, New Mexico, and Arizona, it coincides with the northern margin of the Mexican geanticline (Oswald, 1961). Schmitt (1966) called this structural trend the Texas Structural Zone or Orogen and described it as a zone of wrench faults of long geologic standing. In view of its southeastward projection toward island arc structures in the West Indies, to the northeast coast of Brazil and on into offsetting structures at Mid-Atlantic Ridge, Schmitt suggested that it was involved with continental drift and continental margin tectonics. The northwestward extension across Texas, New Mexico, and Arizona may be related to Pacific basin fracture zones (Wertz, 1970).

In recent years several workers, including Mayo (1958), Osterwald (1961), Schmitt (1966), Gilbert and Sunner (1968), and Wertz (1970), has suggested that the Texas Lineament influenced localization of copper ore bodies in southeastern Arizona. Osterwald attributed ground preparation for the deposits to the geofracture. Wertz postulated that southeastern Arizona became a highly mineralized province because of greater shattering along the southern fringe of the Texas lineament. Structure maps prepared by Schmitt show clustering of deposits at intersections of major north-south structural features and the Texas Zone. He pointed out that more than half of the total copper production in the United States comes from deposits at the intersection of the Wasatch-Jerome Orogen and the Texas Zone. Schmitt suggested that rifts in this zone tapped copper-rich portions of the lower crust or mantle.

Essentially all commercial deposits of ore minerals in Trans-Pecos Texas occur within or near structural intersections with the Texas lineament or Zone. These include: the Van Horn-Allamoore district (Hazel, Blackshaft, St. Elmo, and Sancho Panza, with Cu, Pb, Zn, Ag, Sb, Au); the northern Quitman Mountains district (Bonanza and Alice Ray deposits, with Cu, Pb, Zn, Ag, Au, Cd); the Cave Peak district, with Mo and Cu; the Eagle Mountains-Indio Mountains district (Spar Valley, Black Hill, and Silver Eagle, with CaF_2, Cu, Pb, Zn, Ag); Plata Verde mine (Van Horn Mountains, with Cu and Ag); Shafter district Chinati Mountains, with Pb, Zn, Ag, Au, Cu, CaF_2); Bird Mine (Del Norte Mountains, with Pb, Zn, Ag, Fe; and the Terlingua district, with Hg.

Much more geologic study, with particular attention being given to major structural intersections, is needed in this area.

W. N. McAnulty

References

Albritton, C.C., Jr., and Smith, J.F., Jr., 1956, The Texas lineament: Inst. Geol. Congress, sec. 5, p. 501-518.

DeFord, Ronald K., 1969, Some keys to the geology of northern Chihuahua: In Guidebook, New Mexico Geology Society, 20th Field Conference - The Border Region, p. 61-65.

Guilbert, John M. and Sumner, John S., 1968, Distribution of porphyry copper deposits in the light of recent tectonic advances: In Guidebook III, Arizona Geological Society, Southern Arizona, p. 97-112.

Mayo, E.B., 1958, Lineament tectonics and some ore districts of the southwest: Mining Engineering, v. 10, p. 1169-1175.

Osterwald, F.W., 1961, Critical review of some tectonic problems in Cordilleran Foreland: Bull. Am. Assoc. Petrol. Geol., v. 45, p. 219-237.

REFERENCES

Albritton, C.C., Jr., and Smith, J.F., Jr., 1957, The Texas lineament; Congresso Geologico Internacional XX, Seccion V - Relaciones Entre La Tectonica la Sedimentacion, p. 501-518.

________, 1965, Geology of the Sierra Blanca area Hudspeth County Texas: U.S. Geol. Survey, Prof. Paper 479.

Baker, C.L., 1934, Major structural features of Trans-Pecos Texas, in Sellards, E.H., and Baker, C.L., The geology of Texas: Texas Univ. Bull. 3401, V. 2, pt. 2.

Dennis, W.E., 1946, Exploration of Silver Eagle zinc deposit, Hudspeth County, Texas: U.S. Bur. Mines Rept. Inv. 3962.

Evans, G.L., et. al., 1943, Texas mineral resources: Texas Univ. Bull. 4301.

Flawn, P.T., 1951, Pegmatites of the Van Horn Mountains, Texas: Econ. Geol., V. 46, p. 163-192, Reprinted as Texas Univ. Rept. Inv. No. 9.

__________, 1952, The Hazel copper-silver mine, Culberson County, Texas: Univ. Texas. Bur. Eco. Geol., Rept. Inv. No. 16.

__________, 1958, Texas mines boost talc output: Eng. and Min. Jour., V. 159, No. 1, p. 104-105.

Grieger, R.M., 1970, Quitman Mountains intrusion: in Guidebook, Biennial Field Trip, April 24-25, 1970, Permian Basin Section-Soc. Eco. Paleontologists and Mineralogists; Midland, Texas.

Gillerman, Elliott, 1948, The bedding-replacement fluorspar deposits of Spar Valley, Eagle Mountains, Hudspeth County, Texas, Econ. Geol., V. 43, p. 509-517.

_________________, 1953, Geology and fluorspar deposits of the Eagle Mountains, Trans-Pecos Texas: U.S. Geol. Survey Bull. 987, 98 p.

Huffington, R.M., 1943, Geology of the northern Quitman Mountains, Trans-Pecox Texas: Geol. Soc. America Bull., V. 54, No. 7, p. 987-1047.

King, P.B., 1935, Outline of structural development of Trans-Pecos Texas: Am. Assoc. Petroleum Geologists Bull., V. 19, No. 2, p. 221-261.

__________, 1949, Regional geologic map of parts of Culberson and Hudspeth Counties, Texas: U.S. Geol. Survey Oil and Gas Inv., Prelim. Map 90.

King, P.B., and Flawn, P.T., 1953, Geology and mineral deposits of the pre-Cambrian rocks of the Van Horn area, Texas: Texas Univ. Pub. 5301, 248 p.

King, P.B., and Knight, J.B., 1944, Sierra Diablo region, Hudspeth and Culberson Counties, Texas: U.S. Geol. Survey Oil and Gas Inv., Prelim. Map 2.

McAnulty, W.N., Sr., 1967, Fluorspar in Brewster County, Texas: Univ. Texas, Bur. Eco. Geol. Cir. No. 67-2.

_______________, 1970, Comments on some of the mineral resources of Trans-Pecos Texas, in Guidebook Biennial Field Trip, April 24-25, 1970, Permian Basin Section of Society of Eco. Paleontologist and Mineralogist.

_______________, 1970, The mineral potential of the Chihuahua Tectonic Belt, in Sym. on the Geologic framework of the Chihuahua Tectonic Belt, sponsored by the West Texas Geological Society and The University of Texas at Austin; in Midland, Texas, November 4-6, 1970 (reprinted in this guidebook).

Moody, J.D., and Hill, M.J., 1956, Wrench-fault Tectonics: Geol. Soc. America Bull., V. 67, no. 9, p. 1207-1246.

Redfield, R.C., 1946, Mica in Texas; Univ. Texas, Bur. Eco. Geol. Pub. 4301, p. 29 and 30.

Sellards, E.H., and Baker, C.L., 1934, The Geology of Texas, Vol. II, Structural and Economic geology: Univ. Texas, Bur. Eco. Geol., Pub. 3401.

Smith, J.F., Jr., 1940, Stratigraphy and structure of the Devil Ridge Area, Texas: Geol. Soc. America Bull., V. 51, no. 4, p. 597-637.

_______________, 1941, Geology of the Eagle Spring area, Eagle Mountains, Hudspeth County, Texas: Field and Lab., V. 9, no. 2., p. 70-79.

Sample, R.D., and Gould, E.E., 1945, Geology and ore deposits of the Allamoore-Van Horn district, Hudspeth and Culberson Counties, Texas: U.S. Geol. Survey, open-file report.

Strain, W.S., 1966, Blancan fauna and Pleistocene formations, Hudspeth County, Texas: Texas Memorial Museum, Bull. No. 10

Steeruwitz, W.H. von, 1890, Geology of Trans-Pecos Texas; Texas Geol. Survey, 1st Ann. Rept. (1889).

__________________, 1891, Report on the geology and mineral resources of Trans-Pecos Texas: Texas Geol. Survey, 2nd Ann. Rept. (1890).

Twiss, P.C., 1959, Geology of Van Horn Mountains, Texas: Univ. Texas, Bur. Eco. Geol. Quad. Map No. 23, Text.

Underwood, J.R., 1963, Geology of the Eagle Mountains, Texas: Univ. Texas Bur. Eco. Geol., Geol. Quad. Map 23, Text.

Wasserburg, G.J., et al., 1961, Ages in the pre-Cambrian in Texas (abst.): Program abstracts, Amer. Geophys. Union western national meeting, December 27-29, 1961.

GUIDEBOOKS - West Texas Geological Society

Field Trip No. 1 - Marathon region, Big Bend region, Green Valley-Paradise Valley region, Sierra Blanca region, Texas. November 6-9, 1949.

Field Trip No. 4 - The Permian rocks of the Trans-Pecos region. November 6-9, 1949.

1950 Field Trip - Sierra Blanca region, Franklin Mountains, Texas. October 7-8, 1950.

1953 Fall Field Trip - Sierra Diablo, Guadalupe and Hueco areas of Trans-Pecos Texas. November 6-7, 1953.

Society of Economic Paleontologists and Mineralogists - Permian Basin Section

1958 Field Trip - Cretaceous platform and geosyncline, Culberson and Hudspeth Counties, Trans-Pecos Texas. April 10-12, 1958.

1970 Field Trip - Geology of the southern Quitman Mountains area, Trans Pecos Texas, April 24-25, 1970.