CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

The following file is part of the Grover Heinrichs Mining Collection

**ACCESS STATEMENT**

These digitized collections are accessible for purposes of education and research. We have indicated what we know about copyright and rights of privacy, publicity, or trademark. Due to the nature of archival collections, we are not always able to identify this information. We are eager to hear from any rights owners, so that we may obtain accurate information. Upon request, we will remove material from public view while we address a rights issue.

**CONSTRAINTS STATEMENT**

The Arizona Geological Survey does not claim to control all rights for all materials in its collection. These rights include, but are not limited to: copyright, privacy rights, and cultural protection rights. The User hereby assumes all responsibility for obtaining any rights to use the material in excess of "fair use."

The Survey makes no intellectual property claims to the products created by individual authors in the manuscript collections, except when the author deeded those rights to the Survey or when those authors were employed by the State of Arizona and created intellectual products as a function of their official duties. The Survey does maintain property rights to the physical and digital representations of the works.

**QUALITY STATEMENT**

The Arizona Geological Survey is not responsible for the accuracy of the records, information, or opinions that may be contained in the files. The Survey collects, catalogs, and archives data on mineral properties regardless of its views of the veracity or accuracy of those data.

REPORT ON THE MITCHELL-GILLETTE PATENTED GROUP OF MINING CLAIMS.

By T.E.Lewis,Marched 20th,1938. Addressed to F.A. Mitchell, Marfa, Texas.

## Abstract.


Location.- 5 patented claims,Section 44,Block G.12,Brewster Co., Texas. By road to Alpine 96 mi.;to Marathon 107; to Marfa via Casa Piedra and Fresno Canyon 97 mi. Nearest RR point Casa Piedra on Presidio branch of Sta. Fe,57 miles over poor roads. From Mariposa, via Black Mt. road.

History.- The five claims:Maggie,Mahattie, Jimachee,Kimbercy and Minnie were first survey early in 1900;patents granted,1905,to The Texas Cinnabar Co.

Topography.- Terrain higher than to the S,E,W. Tres Cuevas peak,just S of claims,3635;elevation on claims, 3400-3500'.

Geology.- The Maggie,Mahattie,Jamachee (according to Stovell land map;Jimacha according to Lewis) and Kimbercy (according to Stovell, Kimberly according to Lewis) are on a local anticline, whose axis trends SE from NW corner Maggie to SE corner Kimberly. In N part flanks dip steeply to the WSW,more gently to the NE. Symmetry of axis broken by series of faulted blocks between NE vein-faults; these form successive steps downward and small subsidences or synclinal depressions across the axis. See accompanying NW-SE section.

Mineralization.- Claims traversed by a number of strong to weak veins from N15E to N70E;at least 20 of these are strong and continuous. System shows many crossings and junctions. In addition,NNW fractures cross the NE system,some NNW fractures strong,rest weak;some show slipping,faulting, shearing. NE veins all mineralized,usually calcite with aragonite,iron and manganese oxides;barite fairly prevalent; quartz very sparse. Small amounts cinnabar usually found on breaking with pick. Bitumen in calcite.

Caliche between beds and along veins. Interbed movement has caused brecciation of limestone;breccia fragments cemented by caliche forming impervious "gouge".

Former Del Rio shale cover above limestone has been completely eroded,except for small residual pockets in depressions. Most of the limestone exposed is thick-bedded Edwards;remnants of thin-bedded Georgetown exist in some parts.

Cinnabar deposition controlled by two caps: Del Rio shale and breccia-gouge along bed slips in the limestone. Slippage caused by doming,which also produced the vein fractures. Bed slip breccia offers hope for low-level, undiscovered ore bodies. Such bedding ore bodies in horizontal Eagle Ford limey shales formed at the Chisos mine. Also in San Luis Potosi,according to Schuette,where cinnabar was found in brecciated limestone bedding planes in conjunction with ordinary veins similar to the Terlingua veins.

When the doming and bed slipping took place, the Del Rio clay moved over the limestone floor across the veins. One vein wall or the other was just enough higher to impede movement, brecciating the soft clay over the veins, and causing a slumping into depressions between vein walls or between two veins (similar to the synclinal depressions of Sec.44). This brecciated stuff was altered to joboncilla (as at California Mt.). Jaboncilla has been the source of the richer ores of Mariposa, the Rainbow and the Chisos mines in recent years.

Judging by Mariposa and Chisos, the NNE or cross fractures should serve to concentrate cinnabar at their intersections with NE ore-bearing veins. Further, areas where fault displacements along the veins and along the NNW crossfractures are small are usually favorable for ore concentration (as I explained to Gard-fissuring better than faulting-E.W.) In the property, displacements along the veins usually slight (the steps and synclinal depressions mentioned). Between Station B on the S and G on the N this combined series of steps aggregates a total drop of 100' in a distance of 1000'. Displacements down to the W on the NNW faults are greater.

While no igneous rocks are seen on the property, the doming and intense fracturing suggest igneous rock below. In SW corner Sec.41 (near SE corner of 44) igneous float suggests proximity of a sill or dike. Elev. here about 100' lower than general surface along higher part of claims.

More on influence of cross fractures: In Chisos and Mariposa mines ore occasionally deposits in chimneys at intersections of NE ore veins, and at junctions of NE veins with NW cross fractures. These chimneys descend into the massive Edwards below the more generally favorable Georgetown.

## Detailed Features.

Maggie Claim.- A sink 500' x 100-200' occurs in the NW corner (major dimension east-west). Sink bounded by faults-Lewis thinks it a subsided roof to a cave. Jumbling: Eagleford, Buda, Del Rio stand on end and are jumbled at the surface. Similar underground sink or cavern at Chisos source of large ore body. Minor cinnabar found at E and W ends of Maggie Sink.

West Cut: just S of E end of Sink. Brown and yellow iron oxide ores mined here. Sorted, retorted. Cut walls show minute specks cinnabar SW of cut, cinnabar in a number of veins. Here are several favorable junctions, with crossings of ore veins and NW fractures.

North Cut: mostly N of the N line. Ore mined. Two strong intersections shortly SW.

South Cut and Station E vein: Some jaboncillo. Vein strong and continuous. 300' NE, at a junction, four threads of cinnabar found in the aragonite vein filling. Farther E vein lost, but thought to continue under Georgetown ls. cover.

SE Corner: Small cut, shallow water-filled winze. Stringer cinnabar in cut.

Mahattie Claim:

West End: Strong continuous vein,S15W,from just east of Maggie sink ,west of Maggie W cut,near Stations G,X,L,across NW corner Jamacha (3rd way to spell it) claim,across canyon and back into Minnie,where it is lost in the 2nd fracture and shear system in E end of Minnie. 2000'. Minor cinnabar in several places,evidences of strong geyser action.

NE Corner. Strong veins,several junctions. Small syncline.

Jamacha Claim.(He seems to have settled to this spelling). Each of the 3 Jamacha cuts yielded ore. The step-faulting, in general down to the NW,seems best developed here. Succession of such steps,commencing with vein just S of Sta.B. Drop from bluff at B to the S cut surface is 27';from S to N cut.34';from N cut to Sta. E,27';Sta.E to arroyo at road crossing.16'. Total downthrow from A to divide,104'. See NW-SE sec.

N Jamacha cut has 43' shaft with 25' water;S cut, shaft about equally deep. E cut 20' deep,on intersecting veins at a crossing of NW fractures;gave ore;shows cinnabar stringers in bottom. Jamacha tunnel a disappointment. Cut obly two of the veins exposed by the cuts,one at its portal. Tunnel followd water course with caves;some ore apparently mined.

Below the Jamacha cuts,near Sta. C,syncline worth prospecting.

Kimberly Claim. Jamacha veins persist SW into Kimberly. Promising showings W of Sta.A in several of the Jamacha veins. One syncline passing N of Sta. A,reveals farther SW a little altered Del Rio and jaboncillo where the sink is increased by cross-fracturing.

Main Cut. Near SE corner. Driven on one of the few E-W veins seen. Apparently a branch from one of the regular SW veins at E end of cut. Shaft 57',sunk on junction with NW fractures at a point where the E-W veins jogged. Dump shows traces ore. Fine HgS stringers in shallow cut W of shaft.

Minnie Claim. Little worked. Vein,cut and shaft at E end. Called W Kimberly shaft and cut;done on one of the few veins from Jamacha claim strong enough to persist across the shear zone;shaft sunk at 2nd zone crossing. Sallow cut made just east the shaft;wide here a/o junction of vein with cross-fractures/ Ore found in shaft and cut:coarse ore pile. Veins in general scrace and weak in Minnie.

Samples; Panning Results. Panning of fines,visual study of coarse usually enough;sampling not feasible.

| No. | Location. | Result. |
|---|---|---|
| 1. | N side Maggie N cut. | Bedding plane caliche. Faint trace. |
| 2. | Red soil,near E vein, E center Maggie. | Few minute colors in pan. |
| 4. | Same. | Specks HgS in boulders. |
| 5. | Fines fromred waste dump, SE Maggie near S line. | 20 minute colors in pan. |
| 6. | Jamacha.FeOx chunks,cut dump W Sta.C. | N.G. |
| 7. | Soil fines over B vein.40' E Sta.B. | Large sample showed tail. |

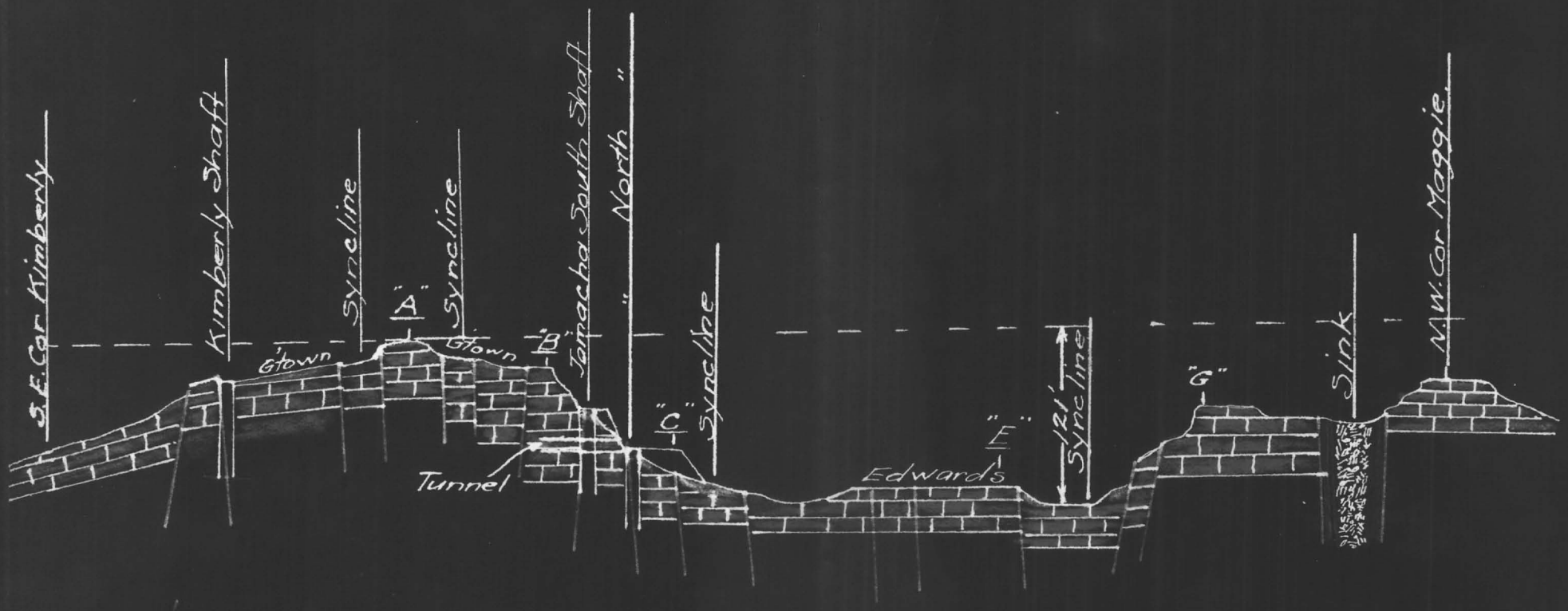
| No. | Location. | Result. |
|---|---|---|
| 8. | SE Cor. Jamacha. | Fines from vein; 30 small colors. |
| 9. | Sink, west end Maggie. S face 6' hole. | Small am't Terlinguaite, HgS, free Hg. |
| 10. | Same, shorter cut under HW. | Same results. |
| 11. | Maggie, strong vein at junction SE fractures. | Trace in pan. |
| 12. | W of Maggie, S of W end of Sink. | Fair pan, slight free HgS. |
| 13. | E end Kimberly. Del Rio, jaboncillo, caliche on downthrow. | Few minute colors. |
| 14. | Kimberly E. E end main cut; S wall, soft. | Nothing. |
| 15. | Maggie, Sta. F cut. | Fines from brown ore dump. Panned 3rd-2nd clas |
| 16. | Same, yellow ore dump. | Poor. |
| 17. | Kimberly pit, in depression 250' SW Sta. A. S wall. | A few fine colors. |
| 18. | Ditto, N wall. | 50-100 fine colors. |
| 19. | Kimberly main cut; fines, waste dump, S shaft. | Specks Hgs in pebbles; fines pan fair tail. |
| 20. | Same, same. | |
| 21. | Jamacha N cut, upper bench waste dump. | Slight HgS. |
| 22. | Jamacha N cut. Lower waste dump near C. | Small tail. |
| 23. | Jamacha S or upper cut. Waste dump near shaft. | HgS --/ |
| 24. | To west along cut; tail, but waste. | |
| 25. | Kimberly west. Red-brown cut 275' E Sta. N/ | Sample an 8' cut, this large volume of fines yielded 100 fine colors. |
| 26. | Ditto. Small cut on W side; small tail | very fine HgS. |
| 27. | W Kimberly shaft, E end Minnie. Small waste dump. | N.G. |
| 28. | Small dump E side shaft. | 50 fine colors. |
| 29. | Maggie N cut. Waste dump. | Fines: 25 minute colors. |
| 30. | NW Mahattie, 50' NE Rock House. Bedding plane caliche breccia, at junction with NW fractures. | 27 minute colors. |
| 31. | Maggie center. 30" cut caliche bed-plane vein. | Few minute colors |
| 32. | Jamacha tunnel. Waste dump west. | "Slite, very slite, HgS". |
| 33. | Ditto; waste dump nearer tunnel approach cut. | Slite am't as coarse particles; fines, barite plus and 100 plus minute colors |
| 34. | E wall tunnel, 22' fro portal; 2' cut above floor. | Some HgS in calcite. |
| 35. | Vein sample, tunnel, W wall, 15' from portal. | Large sample, but only small tail. |

Samples should be crushed befow panning for true results. HgS clings to gangue minerals, does not disintegrate readily.

Former Work. Done 30 years ago, with windlasses, hand steel, wheelbarrows etc.

Recommendations. Deeper exploration, probably starting with Jamacha Cuts Vein Systems: shaft between veins, 5 1/2 x 7 1/2 in clear to allow placing of stulls to give hoist compartment 4' wide, ladderway 2'.

Cost Estimate. Shaft sinking, size outlined. $12.50 per foot maximum; 4'x 7' cross cuts, 4'x 8' drifts, $4-5 per ft. 4'x5' raises, $3 per ft. 5'x5' winzes, $5 per ft.




N.W. - S.E. SECTION

Vertical Scale Exaggerated

Georgetown L.S

Edwards Limestone

Del Rio Buda and Eagleford on edge.

Horizontal Scale 1 ins = 300 ft.

Vertical 1 ins = 100 ft.

Veins and faults in red.

F.E. Lewis 3/24/38

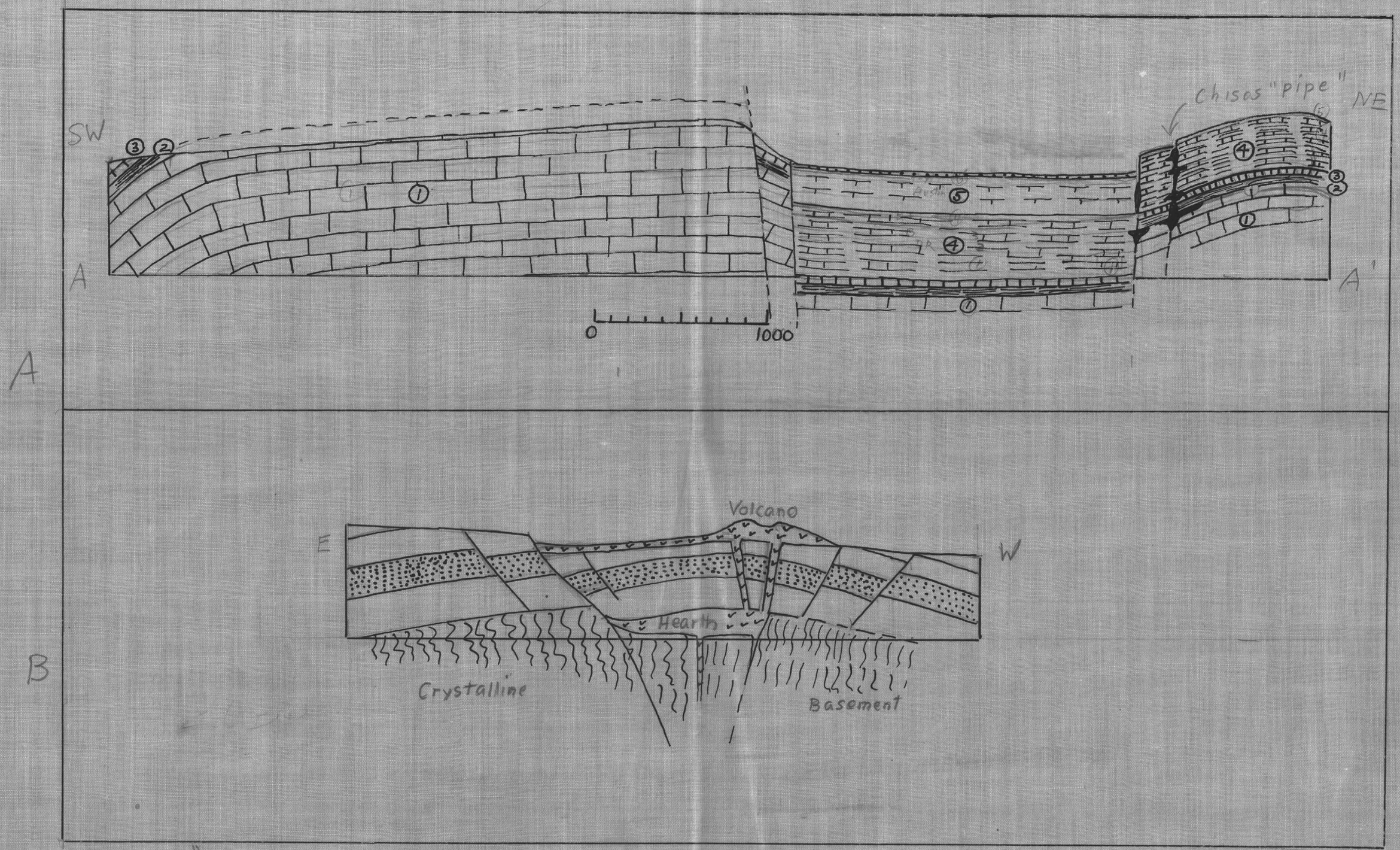
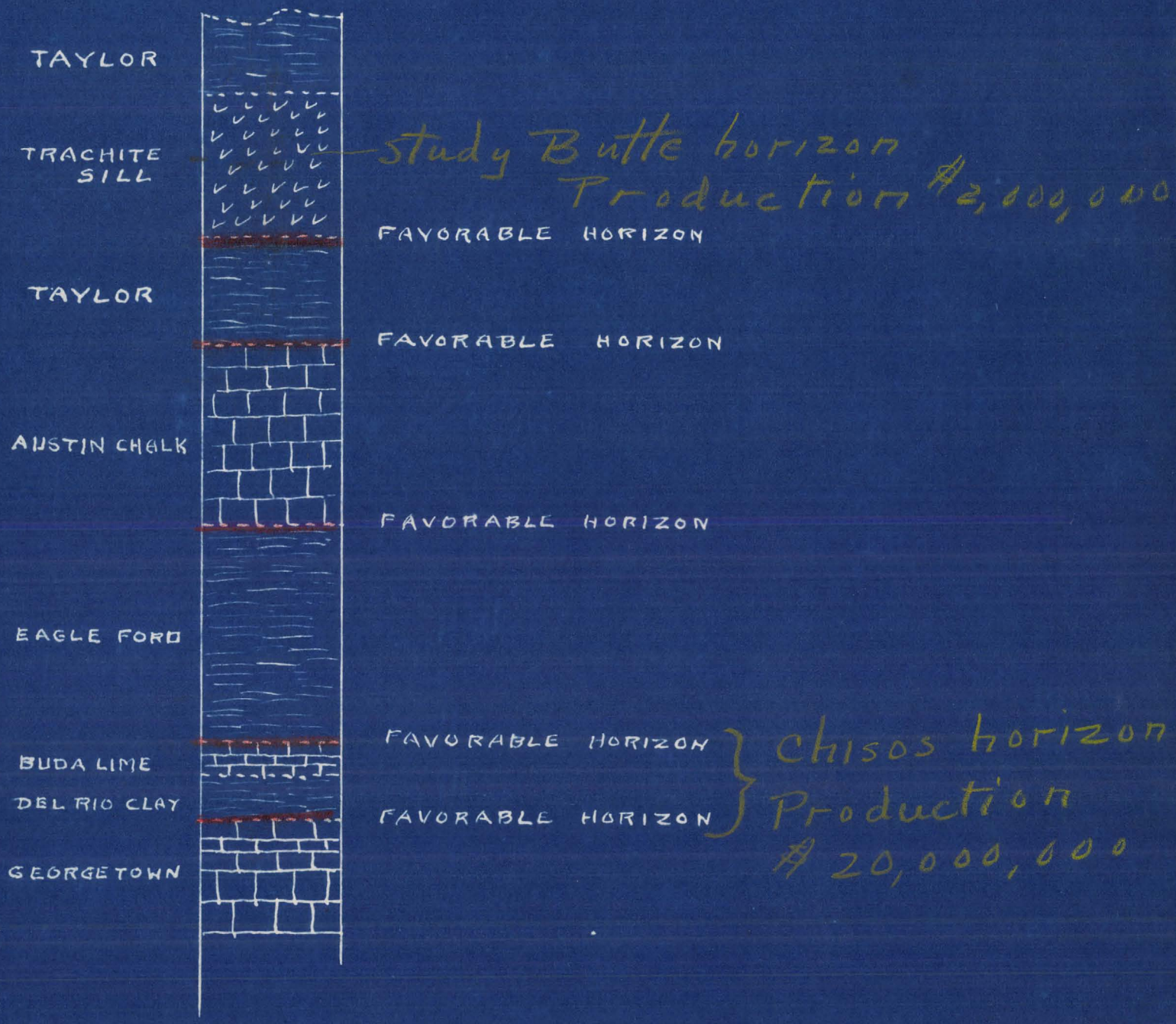

SW
NE
Chisos "pipe"
A
A'
0
1000
Volcano
E
W
Hearth
Crystalline
Basement
A
B

FIG. 26




GEOLOGIC COLUMN

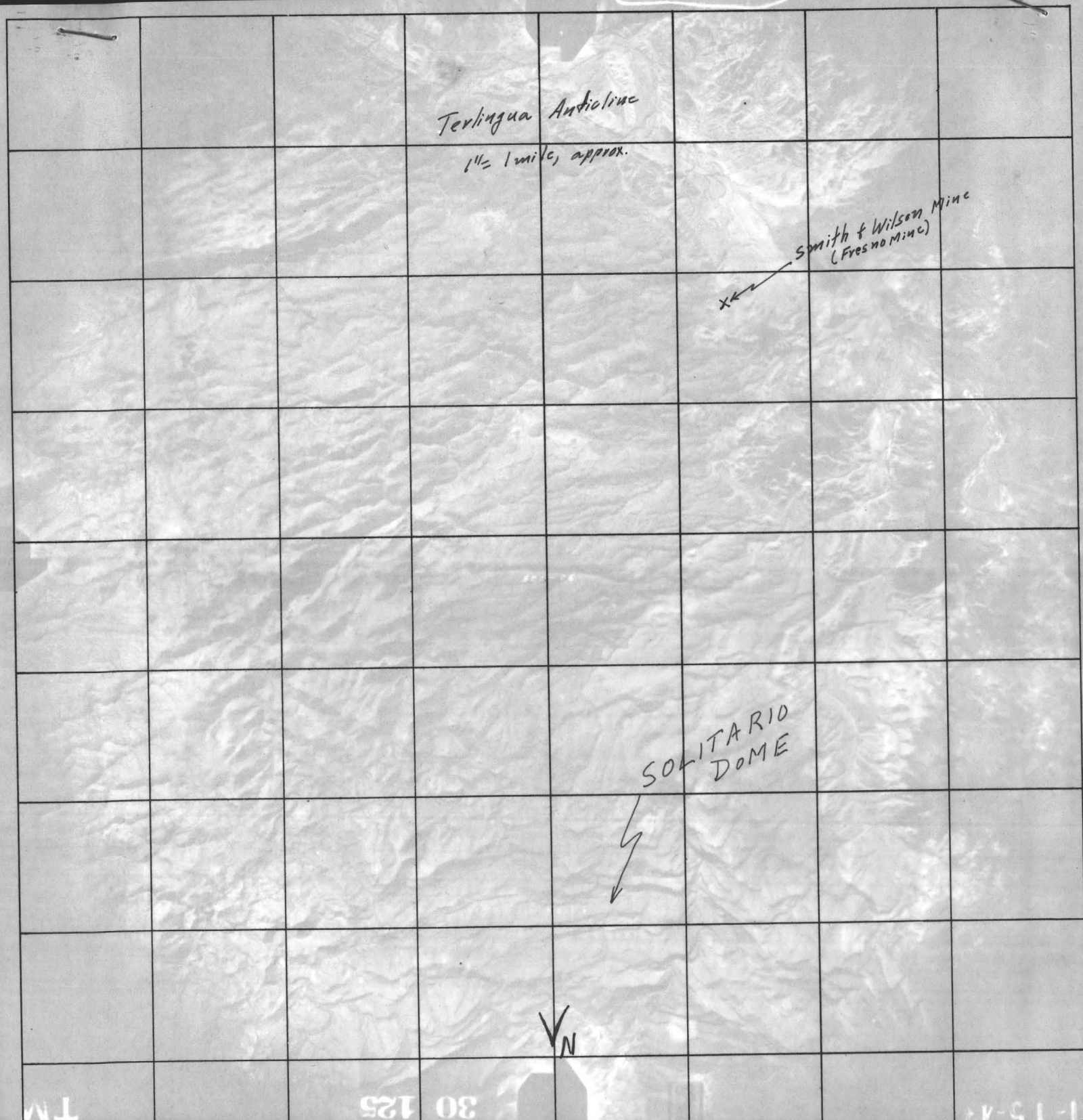
TERLINGUA DIST.

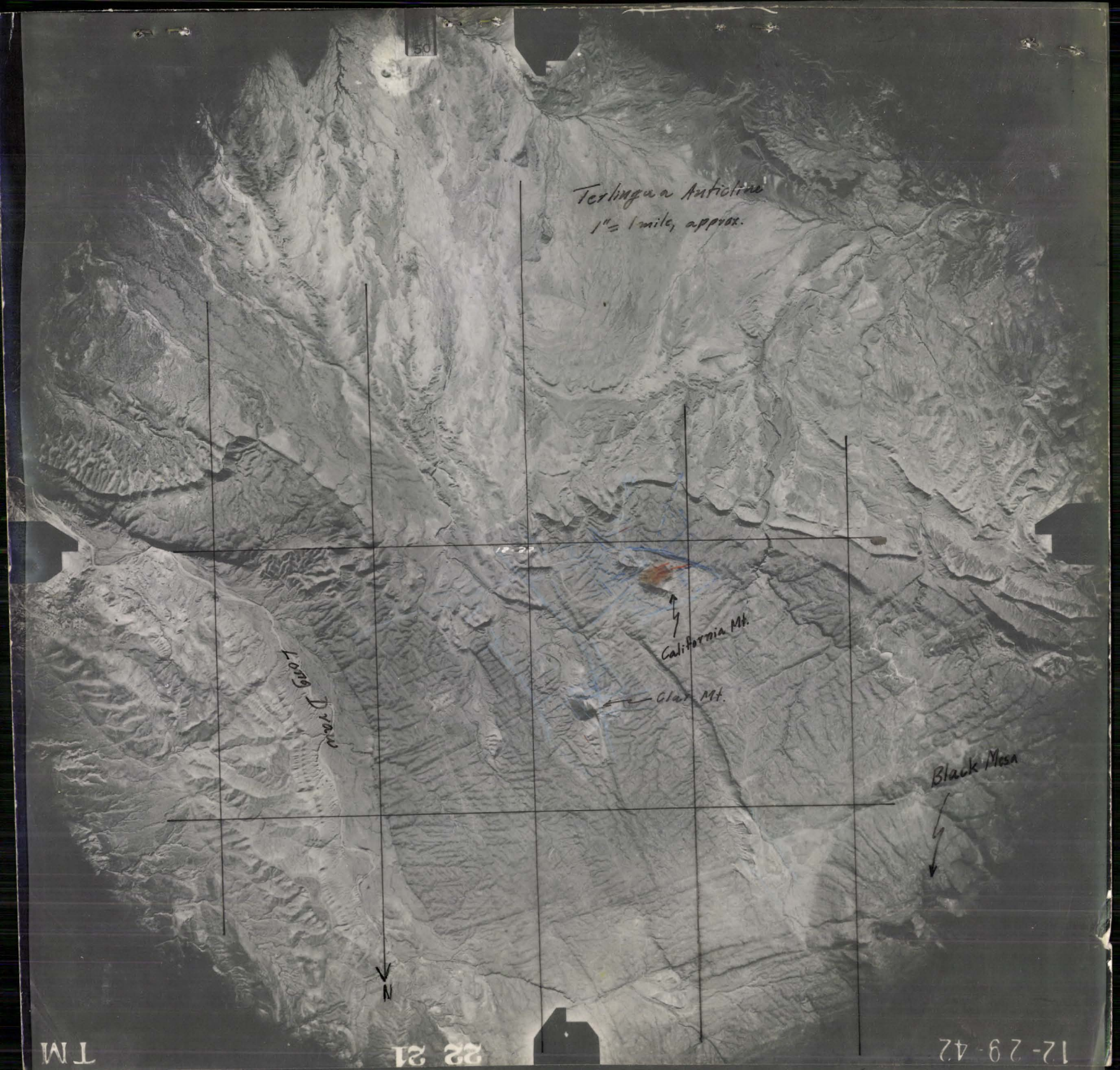
BREWSTER CO TEXAS

Scale - 1" = 400'

Terlingua Anticline
1" = 1 mile, approx.
Black Mesa
Smith + Wilson (Fresno) Mine
SOLITARIO DOME
N

1- 1-43 27 42 TM


Terlingua Anticline
1" = 1 mile, approx.
Smith & Wilson Mine
(Fresno Mine)
SOLITARIO
DOME
N


Terlingua Anticline
1" = 1 mile, approx.
California Mt.
Clay Mt.
Long Draw
Black Mesa
N
12-29-42
22 21
TM

EDWARD WISSER
MINING GEOLOGIST
533 CALL BUILDING
SAN FRANCISCO
TELEPHONE GArfield 4676

March 16th, 1942.

Natural Resources, Inc.
Covington, Kentucky.

Gentlemen:

Pursuant to your request, I have examined your holdings in Sections 58 and 60, Terlingua quicksilver district, Texas, spending the period from February 7th to February 19th, 1942, in the field, and the time since compiling data on the district and preparing the report herewith submitted.

I wish to extend my appreciation for aid during the examination to Mr. Earl F. Metcalfe and Mr. A.J.Gard of your company.

Yours very truly,

Edward Wisser

# REPORT ON PROPERTIES OF NATIONAL RESOURCES INC., TERLINGUA QUICKSILVER DISTRICT, TEXAS.

## SUMMARY STATEMENT.

The Terlingua quicksilver district, in the Big Bend of the Rio Grande in west Texas, came into production about 1896 and has produced somewhere between 130,000 and 200,000 flasks in the period 1896-1934. The district is still producing from mines scattered over some 50 square miles; but it has never been intensively developed owing to a number of local causes. Study of the geology reveals certain very definite reasons for localization of the quicksilver ore bodies; many promising localities are still unexplored.

Among such promising localities is the Natural Resources Inc. ground in Section 60, Block G-12. Exploration of this ground is recommended, by means of a 200' shaft and workings from it, together with diamond drilling. Natural Resources Inc. ground in Section 58, about a mile and a half west of their holdings in Section 60, is thought to hold less promise ultimately, but to afford a more immediate chance for quickly opening up shallow furnace ore. Continuation of the present surface work there is recommended.

The Terlingua district in general is thought to offer exceptional opportunities for entry into the quicksilver business by an organization capable of applying modern methods of exploration and mining to a district in which such methods have been religiously neglected.

## CONTENTS.


| | Page |
|---|---|
| Summary Statement..... | i |
| Introduction..... | 1 |
| Location. Communications. Topography..... | 2 |
| History. Production. Working Conditions..... | 4 |
| General Geology of Terlingua District..... | 9 |
| Rock Formations..... | 9 |
| Structure..... | 10 |
| Mineralization. Quicksilver Deposits.... | 13 |
| Properties of Natural Resources Inc..... | 18 |
| In Section 58..... | 18 |
| In Section 60..... | 20 |
| Conclusions..... | 28 |
| Appendix A. Royalty paid State of Texas..... | 30 |
| Appendix B. Equipment, Natural Resources Inc. | 31. |


## ILLUSTRATIONS.


| | |
|---|---|
| Photo 1. Crest of Main Uplift..... | At end of report. |
| Photo 2. South Scarp of Main Uplift..... | " " " " |
| Photo 3. " " " " " ..... | " " " " |
| Photo 4. The Long Draw..... | " " " " |
| Photo 5. Smith & Wilson Property..... | " " " " |
| Photo 6. Section 60..... | " " " " |
| Photo 7. " "..... | " " " " |
| Photo 8. " "..... | " " " " |
| Photo 9. Section 58, Main Cut..... | " " " " |
| Photo 10. " .Diamond Drill..... | " " " " |
| Photo 11. " Compressor..... | " " " " |

## ILLUSTRATIONS CONT.

### Maps and sections in pocket.

Claim and Sketch Geologic Map, Terlingua District. 1"= 2000'.

Geologic and Claim Map, Section 60. 1"= 200'.

Plan of Workings in Section 58. 1"=100'.

Sections A-A',B-B', Section 60, and geologic section through Chisos Mine. Scale for A-A' and B-B', 1"= 100'.

# REPORT ON PROPERTIES OF NATIONAL RESOURCES INC., TERLINGUA QUICKSILVER DISTRICT, TEXAS.

## INTRODUCTION.

The following report is based on a stay of 13 days in the Terlingua district, from February 7th to February 19th, 1942. During that period, Section 60 and a portion of Section 58, Block G-12, were mapped geologically (see Claim and Sketch Geologic Map, scale 1" = 2000', in pocket). The district as a whole, from Study Butte on the east to the Smith & Wilson mine on the west, was looked over as thoroughly as time would permit, with the object of finding out what structural or other features served to localize known ore. A considerable body of data on Terlingua, published and unpublished, was made available to the writer by his associate C. N. Schuette, who has been familiar for the past twenty-three years with developments in the district. The accompanying Claim and Sketch Geologic Map is largely a compilation from all available sources.

The object of the work was to evaluate the National Resources Inc. holdings in Sections 58 and 60 in terms of their possibilities as quicksilver producers, and, if chances seemed good, to lay out exploration designed to find ore. Since the habits of known ore occurrence in a district must be the guides by which unexplored ground is judged, a description of the Terlingua district as a whole, with emphasis on ore occurrence, properly forms the first portion of this report, followed by a description of the Company holdings and a discussion of their possible value in the light of the facts set forth on ore control in the Terlingua district.

## LOCATION. COMMUNICATIONS. TOPOGRAPHY.

The town of Terlingua, center of the quicksilver district of that name, lies in extreme southwestern Texas, deep within the Big Bend of the Rio Grande, and only some ten miles in a straight line north of that river. Terlingua lies 86 miles due south of Alpine, a trading center of some importance on the Southern Pacific Railroad and U.S.Highway 90. The road from Alpine to Terlingua is mainly unimproved, but owing to the flat or gently rolling nature of the country,this road is passable by the heaviest truck-loads in dry weather,but becomes impassable for a time after heavy rains in the rainy season (July-September). A similar but longer road connects Terlingua with Marathon, 30 miles east of Alpine on the railroad and Highway 90. The driving distance from El Paso to Terlingua via Alpine is about 300 miles.

The Terlingua district, defined as the area containing the productive mines, is a long and narrow east-west strip, extending five miles east of Terlingua to the Study Butte mine,and twelve miles west of Terlingua to the Smith & Wilson mine. (See Claim and Sketch Geologic Map). The maximum width of this strip is only three miles.

The topography of this country has a direct relation to the geology (see below). Where the resistant Georgetown and Edwards limestone lie flat and have had their softer cover stripped off by erosion,the topography is that of a mesa or table-land. Such mesas are commonly studded with isolated buttes,which may be remnants of the cover,in which case they are usually capped by resistant Buda limestone overlying soft Del Rio clay .(Photos 6 and 7,where the bluff is Buda limestone,the gentler slope below,Del Rio clay). Or the buttes may be dome-like uplifts with igneous cores (Black Mountain, Photo 1, extreme left, sky-line).

The central portion of the district is one great limestone plateau (main area colored azure, Claim and Sketch Geologic Map, and Photo 1). Within this plateau, which trends northwest, is a major valley walled by cliffs (Photo 1; large triangular area colored green near Section 40 on the map). This valley, and others like it in the district, was originally a dropped block or graben;soft formations overlying the hard Georgetown-Edwards limestone have been dropped below the top of the surrounding limestone;stream erosion has carved out the valleys and formed cliffs along the faults bounding the dropped block. These graben or rift valleys complicate transportation in the district; roads must avoid the vertical cliffs.

The main plateau is bounded on the southwest by a sharp,straight mountain front, caused by the bending of the hard formations down to the southwest beneath the flat plains to the south (Photo 2). The main plateau is bounded on the northeast by the Long Draw, a narrow, deep rift valley (Photo 4 and map). East of the Long Draw, the country lies in general lower and is more rolling (Photo 4, background).

Such a topography, other than the rift valleys with their cliffs, lends itself to road building. East of the Long Draw the rocks are soft and relief gentle; upon the main plateau, while roads are initially rough on the hard limestone, they improve with use.

Being a limestone country with limited rainfall concentrated in the late summer months, the district suffers from a scarcity of water. Water for domestic purposes is at present supplied by the Chisos Mining Company at 25 cents a (gasoline) drum. It is pumped from the mine. An ultimate source of water for a large community would be the Rio Grande.

## HISTORY. PRODUCTION. WORKING CONDITIONS.

Active exploration began in the late 'nineties, near California Mountain in Section 59 (see map). The first production was from retorts. By August, 1900, a ten ton Scott furnace was working on ore from showings in Sections 38 and 58. The Chisos Mining Co. began work in Sections 295 and/or 70, near the present town of Terlingua, in 1902. This company has been in almost continuous operation ever since, although at present its main production is coming from the Marfa & Mariposa mine at California Mountain in Section 59.

Operations at Study Butte, at the east end of the district, began in 1903. The latest discovery is the Smith & Wilson mine at the west end of the district, production from which started within the past year or two. Production at the present day is limited to the Chisos, Study Butte and Smith & Wilson companies.

Total production of the Terlingua region is unknown; through 1934, and for the Terlingua district proper plus the Mariscal Mountain minor district 30 miles southeast of Terlingua, total production is said to be somewhere between 130,000 and 200,000 flasks.[1]

---

1. C.P.Ross: Preliminary Report on the Terlingua Quicksilver District, Brewster Co., Texas. The Geology of Texas, vol.II, Univ.Texas Bulletin 3401, 1934, p.562.

---

Whichever figure lies closest to the truth, the Terlingua region has produced one-fourth of the quicksilver produced in the United States since 1899, when production at Terlingua began. The Chisos mine has been the major producer. The only mines in the United States whose total production exceed that of the Chisos are about 6 in California, all much older.

Working Conditions.- Present furnace capacity is as follows:

Chisos Mining Co.

| | | |
|---|---|---|
| Rotary furnace..... | 60 tons ore per day | |
| Herreshoff " ..... | 15 | |
| Scott..... | 6 | |
| | | 81 tons per day |

Study Butte.

| | |
|---|---|
| Rotaries..... | 90 |

Smith & Wilson

| | |
|---|---|
| Rotary..... | 20 |
| | 191 |

Above is active capacity;there is an idle 10 ton rotary on Section 44 (Darcy claims); a 6 ton Scott furnace at the Waldron mine, Section 38, is also idle, although well maintained.

Terlingua ore bodies are very high grade,judged by California standards. In 1937 total district monthly production is said to have reached as high as 1000 flasks,with total furnace capacity 118 tons of ore per day. Grade of ore furnaced was therefore 21 lbs.Hg/ton. The Chisos mine when its furnace capacity was 66 tons per day produced as much as 900 flasks per month, equivalent to a grade of 35 lbs. Hg/ton. Smith & Wilson with a 6 ton rotary produced up to 150 flasks per month, according to report;the grade of their ore must have been 38 lbs./ton.

Combined selective mining and sorting is universal practice;but the ratio waste mined to ore extracted is only 1:1,so the original grade of the ore bodies manifestly is high. The grade of ore furnaced has a direct bearing on the cost per flask produced. Assume a crew of 50 men mine 100 tons of material per day, half of which is ore, making 50 tons of ore. Assume daily total cost of this operation as $ 500. If the furnaced ore averages 10 lbs.Hg/ton,daily production is 500 lbs.Hg,or 6.6 flasks. At $500 cost per day,cost per flask is $76. With 20 lb. ore however, daily production is 1000 lbs. Hg.

or 13.2 flasks;and since the total cost per day is likewise $500, cost per flask is $38.

No such costs, however, are attained in the district,owing to inefficient labor and archaic working methods. Labor is Mexican and sparse, recruited chiefly, I think, from the "aborigines" of the region. Miners and common labor receive 30 cents per hour;gang bosses, 32 1/2 to 35 cents;truck drivers and mechanics, 40 cents. Forty hours are worked per week. The labor problem is a serious one,especially for an enterprise starting operations in the district. At $12 per week, the men are underfed and underclothed. All surface work stops when a cold "norther" blows,because the men have no warm clothing. On the other hand, doubling their wages so that theoretically they could buy enough food and clothing would without doubt merely result in their working 20 hours a week,and at the same listless pace. The answer probably lies in imported labor,which would almost certainly have to be Mexican. The right type of man,Mexican or American, given the proper incentive,and with enough experience of good food and clothing to know their value,will work well. The problem of labor at Terlingua needs thorough study,and I make no attempt to answer it here.

Poor working methods, poor engineering, are another matter. Cinnabar deposits are erratic the world over; ore can seldom be blocked out much in advance of exploration, so that sound planning of work to provide a minimum ultimate cost of ore extraction can seldom be done. Most of the present ore production at Terlingua is being hoisted to the surface by windlasses;and while many of such operations may be excused on the ground of shallowness, spottinness and isolation of ore bodies,the impression gained by the writer is that this "haywire" mining is overdone,and that important savings

in cost, and increase in production could be obtained by a certain amount of planning, and the use of modern portable and semi-portable hoists and compressors. These thoughts apply to the scattered, surficial mining now going on in the region of California Mountain. Deep mining would necessarily be concerned with more regular and larger ore bodies, for it would not pay to go after small sporadic ore shoots at depth; in the case of a deep mine that had succeeded in developing a large, tolerably regular ore body such as the famous "pipe" in the Chisos mine (see below) there would be no excuse for "haywire" methods at all.

Mining Property.- Conditions under which mining land is held in Texas are complicated and archaic; full information on these conditions is not at hand. In a rough and incomplete way, the situation is as follows.

The country is laid out in sections of one square mile each, in the manner of the U.S. Public Land Survey, but without townships and ranges. Instead, a number of sections are grouped into a "Block". I am unable to discern any system whatever in the grouping and numbering of the blocks, and very little in the numbering of the sections within a block. Title to many of these sections is held by various railways; some are patented to private parties; perhaps the greater part are held by the state. State land falls into two categories: common state land, and University land.

In the case of sections patented to private parties, I take it the aquisition of mining land might be by purchase or lease, as elsewhere. I believe it is the custom of the railways to lease mineral rights in their sections. For the state lands, the following procedures now govern:

1. If the land has no mining claims staked on it, two procedures are possible. (1). A prospector's permit may be secured, permitting one year's exploration and closing the ground for that period to outsiders. The permit is renewable, but since outsiders also may apply for it whenever it expires, it is useful only as a stop-gap pending other arrangements. There is at present no fee for a prospector's permit. (2). The land may be leased from the State at 50 cents an acre per annum, the lease to run as long as rental is paid, as I understand it. Beside the rental, royalty (see below)* must be paid the State for all ores exploited.

2. If the land has unpatented mining claims on it, the area covered can only be taken up by relocating them, if they are open to location. Such claims are restaked, and recorded within 30 days after staking; 100 days after recording a survey must be submitted, together with check for 50 cents an acre for the first year's lease. This rental is paid annually for 5 years; assessment work, presumably $100 per claim, must be done also during that period. At the end of the five years, patent may be secured on payment of $7.50 per acre.

Ore taken from mining claims is also subject to royalty to the State.

3. If the land has patented mining claims on it, these claims may be aquired like any parcel of real estate, as I understand it, unless they have reverted to the State through non-payment of taxes. I do not know the procedure in that case.

The mineable area is bounded by vertical planes through the boundaries of the property, for all classes of mining land in Texas. There is no "extra-lateral right."



* Appendix A

## GENERAL GEOLOGY OF THE TERLINGUA DISTRICT.

Rock Formations.- Cretaceous limestones, shales, marls etc. make up the great bulk of rocks exposed. Intruded into these sediments are many laccoliths, plugs and sills, with some dikes;these are andesitic or rhyolitic and of Tertiary age. Tertiary lava flows and tuffs fringe the district.

Stratigraphic Section, Sedimentary Rocks.

| Age | | Formation | Description | Thickness |
|---|---|---|---|---|
| Upper | Cretaceous | Rattlesnake | Sandstone,clay | 600' |
| " | " | Taylor | Marls | 400 |
| " | " | Austin | Chalk | 250 |
| " | " | Eagle Ford | Flaggy limestone,clay | 600 |
| Lower | " | Buda | White dense limestone | 50 |
| " | " | Del Rio | Clays,clay-shales | 60 |
| " | " | Georgetown | Limestone, thin-bedded | 70? |
| " | " | Edwards | " , massive. | 1000' plus. |

3130

Areas of Rattlesnake, Taylor and Austin were not examined by the writer. The Eagle Ford formation consists mainly of flagstones, usually light-brown on the surface,and which weather out like stone shingles, often only paper-thick. The Buda limestone is somewhat thin-bedded toward its top, but in the main forms a prominent bluff perhaps 30' high (Photos 2,3,6,7). The Del Rio clay,being soft and underlying the Buda bluff, is the reason for this bluff,through erosional sapping or undercutting. It may seldom be seen itself,usually being covered by talus from the overlying Buda, except in downfaulted blocks, where the Del Rio has been protected from erosion (Photo 7, foreground).

It is hard to distinguished uppermost Edwards from Georgetown, and the two have been colored as one formation on the general district map and on the map of Section 60. The Georgetown is however decidedly thinner-bedded than most of the Edwards. (Photo 2, center,shows Georgetown lying on Edwards;beds may be distinguished in the George-

town, but the Edwards is a massive cliff).

The intrusive rocks were not examined in detail; those seen were shallow-type intrusives, i.e, they were intruded under relatively shallow cover.

Structure.- The dominant feature of the district structure is uplift. The Cretaceous beds have been pushed upward, by vertical forces, into anticlines and domes. Areas between such domes are less synclines than passive areas, where there has been no uplift. The kind of structure resulting from uplift is well shown by Photo 2.

The uplifted areas have been faulted as well as flexed,and the faults, to be described, have a direct connection with the uplift. Fissures, or tension cracks, formed also in that connection. These carry most of the district ore.

The major uplift of the district has been called the Main Uplift. It's southern portion is shown on the left of Photo 2. Photo 1 shows the very crest of this broad whale-back. The uplift trends NW, and Black Mt. lies almost along its center-line, while the Black Peak graben valley lies somewhat east of that line. On the district map, the Main Uplift is roughly co-extensive with the major area of Georgetown-Edwards limestone. The Main Uplift as shown on the district map extends NW past the north edge of the map, and culminates in the Solitario dome, some miles NW of the district. While the uplift trends NW, its southern border,marked by the great flexure of Photo 2, trends almost E-W. This is because the uplift plunges down to the south.

The uplift is really whale-back in shape: i.e. bending upward of the beds would be obvious in a vertical section taken across the major flanks of the uplift (NE-SW),and in a section along the axis of the elongated uplift (NW-SE). Thus the uplift is a dome elongated NW-SE.

A layer of rock bent upward tends to fracture, just as a beam of any brittle material will break into fractured blocks if bent beyond its ability to deform plastically, as clay does. With rock layers flexed upward, resulting fractures may be either faults or fissures. With a fault, one wall moves past the other, with resulting displacement of the block on one side the fault with respect to that on the other side. Faults are commonly characterized by a minimum of open spaces, unless broken rock rubble fills the fault, in which case interstices between the fragments may provide openings. With a fissure, movement is in a direction perpendicular to the fissure walls, i.e. the fissure gapes open. Fissures provide a maximum of open spaces, hence they are more likely to contain ore deposits than faults. Many fissures not only gape, but suffer slight fault movements as well.

Where extensive faulting accompanies uplift or upward flexing of rock layers, the faults are apt to bound dropped blocks or graben. Further, the dropped block is usually elongated parallel to the major axis of the uplift. If upward pressure is exerted on a brick arch with a keystone at its apex, the keystone will drop down because the tangential or arch pressure exerted on its sides is released and gravity is free to act:

This is exactly what happens where graben faults accompany uplift. As the sides of the keystone dip inward, so the bounding faults of a graben dip inward toward the graben.

At Terlingua, NW -trending grabens accompany the NW uplifts. Referring to the district map, the Black Peak graben lies nearly along the crest of the Main Uplift, with a smaller, parallel graben to the east. The Long Draw, a typical graben, may be taken as bound-

ing the Main Uplift on the NE;but considered more broadly, the Main Uplift extends to the NW fault about 1 mile west of Cigar Mt.;viewed in this light, the Long Draw lies within the Main Uplift.

A number of minor faults and fractures parallel the major faults that bound these graben; some are shown on the map of Section 60.

The graben faults have taken care of the bending in the Main Uplift along the NW axis of the uplift,and visible in a NE-SW vertical section. But the axis of the uplift itself is bent,in the Terlingua district, down to the SE,because the uplift plunges to the SE. This phase of the bending was taken up by NE-SW fissures. That these fissures have an origin closely connected with that of the NW graben faults is shown by the fact a closely-spaced pair of NE fissures sometimes bounds a narrow NE graben (see map of Section 60, narrow Del Rio clay graben in Georgetown limestone,along the border between Santiago and Emma G claims).

Many of these NE fissures are shown on the district map; an especially strong zone of them is shown in detail on the map of Section 60. While NE fissures are widely distributed in the district,they seem concentrated along zones of sharp flexing of the Cretaceous beds. (Section A-A', and especially,the NE-SW section through the Chisos mine,on the same print).

East and west of the Main Uplift, symmetrical domes prevail, notably the Contrabando dome on the west and the large dome in and near Section 247 on the east. Study Butte is a small dome, and there are many others. These domes, too, are fractured, especially the Contrabando dome. Minor domes like Black Mt. occur studded along the backbone of the Main Uplift.

Mineralization. Quicksilver Deposits.- Most of the NE fissures, and many of the NW fractures, especially those with little or no faulting along them, have been mineralized and are now veins. The principal vein mineral is calcite, which usually shows a crustified banded texture suggesting deposition in an open fissure. Minor gangue minerals are aragonite, barite, dolomite and fluorite, with very rare chalcedony. The almost complete absence of silica in a limestone country is notable, and suggests derivation of most of the vein-matter from the Cretaceous limestones. Nevertheless, the great bulk of the calcite in the Terlingua veins was not deposited by surface waters, but came up in solutions from below. These solutions carried also mercury and sulphur, and deposited these elements in the combined form of cinnabar. This is shown by the intimate association of calcite with cinnabar everywhere in the district. The only other important metallic minerals carried by the veins are hematite and pyrite, the former far more abundantly than the latter.

The Terlingua quicksilver ore bodies occur typically in veins filled for the most part with calcite and clayey material, "jaboncillo". These veins, however, are far from the sharply defined fissure veins of non-limestone districts. Where fissures cut limestone, solution cavities, many of them pre-mineral, have been formed by circulating waters in the fissure walls, and often extend considerable distances from the parent fissure. Further, in the particular district, flexing of the rock layers by uplift has caused one bed to slide over another, especially where, as in the Georgetown limestone, hard beds of limestone are separated by soft, narrow layers of marl. Surfaces of strong slipping of this kind are marked by "caliche-breccia", impervious layers between brittle, fractured, pervious beds. Far more imp-

ortant than these caliche-breccia surfaces, in its effect on the localization of ore in the district, is the Del Rio clay. Here is a soft, impervious, essentially fractureless layer over 60' thick, lying directly above the brittle, easily fractured Georgetown limestone. Brittle rock next to soft, squeezy stuff fractures especially well; further, such soft stuff acts as a trap which serves to concentrate material from ascending solutions, as has been repeatedly pointed out by C.N. Schuette and others. The result has been, as impressed on the writer by Schuette, a "regional Concentration" of cinnabar beneath the Del Rio clay. The cinnabar arrived at this horizon by ascending fissures, principally NE fissures, and joints; but often such channelways are inconspicuous, and the observer sees mainly cinnabar ore bodies scattered promiscuously through the Georgetown, and sticking close to the present surface in those areas from which the Del Rio has but recently been swept away by erosion.

This is shown to a remarkable degree on the great platform of Georgetown limestone that forms the present top of the Main Uplift (Photos 1 and 2"). Shallow "pothole" stopes are scattered almost everywhere upon this platform, although the major ore was concentrated along certain definite zones of NE fissuring to be described. The platform marks almost the exact top of the Georgetown, as is evidenced by the presence of Del Rio remnants in scattered places. With major ore bodies of this class, the governing NE fissure can be plainly seen (Photo 8); but on examining such mines in detail, the stopes, while they line up along the course of the fissure, are exceedingly irregular, making away from the fissure along zones of caliche-breccia and jaboncillo. The base of the Del Rio has largely been converted into jaboncillo, and ore tends to make in this material far from its parent fissure and even extending to and joining, ore derived from an adja-

cent fissure.

From the standpoint of production to date, the most important zone of NE fissures crossing the Georgetown platform of the Main Uplift starts on the SW in Section 58, passes by the general area of California Mt., and probably continues across the Black Peak graben into Section 38. (See district map). On the south side of this zone the limestone beds plunge steeply into the plain to the south;on the north side of the fissure zone, the beds lie at very gentle angles. It must be apparent from what has been said on page 12 that this NE fissure zone corresponds with a zone of relatively sharp bending of the beds, a "hinge-zone". Study of Photo 6 may make this notion clearer. It was taken on Georgetown limestone,from the central,nearly flatlying platform of the Main Uplift,toward the NW corner of Section 60. It looks SE across the hinge-zone,and therefore about at right angles to the zone of NE fissures that parallels the hinge zone. The rocks, lying almost flat near the camera,plunge increasingly away from it, toward the valley in the distance. This bending has cracked the bent strata and formed a strong zone of NE faults and fissures which trend parallel to the warp, and are localized along the zone of sharpest warping. Two of these NE faults are shown in the Photo. Photo 7 shows the same faults, but fails to show the "nose-dive" performed by the strata just to the right of the picture. Fig.3,however, shows this "nose-dive" from outside the uplift, in the flat plain south of it.

The Marfa & Mariposa mine, the pioneer and one of the major producers of the district, lies along this NE fissure zone. Schuette[2]

---

2. C.N.Schuette: The Occurrence of Quicksilver Orebodies. Trans.A.I.M.E.,vol.96,1931, Fig.7a, p.434.

---

shows a vertical section through this mine, which lies around California Mt. The ore-bearing NE fissures are found just to the north of the hinge zone or zone of maximum warping. Ore made along these fissures and spread out from them along the base of the Del Rio clay.

The Waldron mine, and Mine 38, both in Section 38, appear to lie within the NE continuation of the same zone of NE fissures. Both were important producers, especially the former. The Waldron mine lies beyond the Scott furnace shown at the right in Photo 1. This photo shows plainly the warping of the beds down and to the right. The warping here is gentle, but it must be emphasized that comparatively gentle warping, if on a grand scale, suffices to fissure brittle limestone.

The value, from the standpoint of ore, of violent warping is nevertheless illustrated in the Chisos mine, the major producer of the district. (Section from NE to SW, below my vertical section A-A'). The Chisos mine lies on the sharp south flank of a local anticline just NE of the Long Draw. The anticline may represent in part drag connected with the formation of the Long Draw by graben faulting; but it is not wholly a drag-anticline for it has a syncline bordering it on the NE. A fault paralleling the Long Draw border fault formed near the point of sharpest flexure in the Chisos anticline; this fault has only 40' displacement compared with over 1000' for the Long Draw main fault; the small fault was mainly a fissure, but it was so strong that it managed to persist upwards through the soft Del Rio clay into the overlying Eagle Ford flagstones; and it became the seat of deposition of the major ore body so far found in the district; it carried ore in the Eagle Ford as well as in the Georgetown. (Chisos "pipe")

At Study Butte in the east end of the district, an andesitic flat dike or sill lies in soft Taylor marls. The igneous mass is brit-

tle. From its outcrop on top of the Butte it dips north at 45°, then flattens out horizontally to the north; it is therefore flexed or bent, but in the opposite way to the limestone beds near California Mt.;i.e. the flexure is concave upwards instead of convex. The result however was the same: at the point of greatest flexure the dike fractured along east-west lines. These fractures, minor individually but forming an intensely fractured zone, were filled with cinnabar to form an important ore body. Ore formed likewise on top of the dike, below the soft marl, and apparently below the dike as well.

The Smith & Wilson or Fresno Mine, at the present west end of the district, seems to form no exception to the rules for ore illustrated above. The property lies along the SW flank of the Main Uplift, but in an area where erosion has cut deeper into the heart of the uplift than farther SE. (Photo 5 and district map). The beds dip to the SW in general, but are broken up into blocks by NW faults (graben faults) and NE fissures which are also minor faults. Ore is found along these NE fissures, and notably beneath the Del Rio clay, precisely as elsewhere. Strong tension seems especially prevalent in this deformation, for down-faulted blocks show Del Rio, Buda and even Eagle Ford standing almost vertically, as if the block had tilted nearly 90° in trying to fill by its descent the void beneath. This mine is now the major district producer, and has the brightest prospects of any mine there.

Concentrating the information above into a general ore-guide: ore so far found at Terlingua has been found in areas of abnormal tension and fissuring. Since tension is most readily caused by sharp flexing of the beds, such sharply-flexed areas offer the best chances for ore bodies. Within such areas, a brittle rock, whether limestone or igneous, underlying soft stuff should contain the major portion of

any ore that may exist in the area.

PROPERTIES OF NATURAL RESOURCES INC.

The properties of this company discussed in this report lie in Sections 58 and 60. Refer to district map, map of Section 60, and partial map of Section 58.

Section 58.- The district map shows all claims held, the map of part of 58, those near the present workings. The claims have been staked and are two years along toward patent according to the procedure outlined on page 8. In addition to these "G claims", the Linton, Pilkington and Hoover claims, shown on the district map, are under lease.

The rock exposed is Georgetown and uppermost Edwards. The property lies on the platform of the Main Uplift, and laps over the flexure bounding the uplift on the south, extending down to the plain below. (District map). Work so far has been confined to the platform or plateau.

Quicksilver showings occur along rather poorly-defined fractures with northeast, northwest and north-south trends. The most promising showings lie along a northeast fissure or fissure zone crossing diagonally the G No.3 claim. (See plan of workings, or partial map of Section 58). Photo 9 looks SW along this zone and shows the main cut on it. This zone, together I think with the workings on the NW fracture shown at the south end of the road on the map, has produced 20 flasks of quicksilver from a 6-pipe retort.

Twelve samples were cut under my direction on this property. Location, widths, and results are shown on the Plan of Workings. Most samples are very low-grade, but the relatively high ones are all from the main NE zone. Such samples serve only as indications; at Terlingua, as elsewhere with cinnabar, you either have it or you don't, and if

you have it there is no need for sampling. Where cinnabar indications only exist, it is wise to concentrate exploration on the structure combining maximum strength with maximum showings. The NE zone is undoubtedly that structure in this area.

I am informed in a recent letter from Mr. Earl F. Metcalfe of Natural Resources Inc. that 30 6 foot drill holes have been put down in the floor of the main cut on the NE zone; a composite sample of the cuttings from these holes was sent to the College of Mines & Metallurgy at El Paso for assay, and gave 3.31 % mercury ( 66 lbs. Hg per ton). The drill holes were spaced in an area 30' long and 3' wide along the course of the NE fissure. While retort ore in a few holes may have salted the composite sample to some extent, the assay, together with the promising appearance of the fissure during my visit to the cut a week or so before the drill holes were put down suggests the possibility of a sizable ore body beneath the cut. Further work, since my visit, in the pit of Sample 10 is said to have opened up some near-retort ore, suggesting a possible extension of the ore body from the main cut several hundred feet northeast.

Recommendations.

In view of this encouragement, I recommend continuation of the work now in progress, to take the form of deepening the main cut, further work in the pit of Sample 10, and deepening of the shallow cuts between that pit and the main cut.

The segment of the great flexure (Photo 2) covered by claims G No.5 to G No.8 holds speculative interest for possible ore. The flexure is so sharp that it may have served as a channel for ore solutions; there is quite likely some faulting connected with the flexing and paralleling it. Further, NE fissures approach very close to

the flexure, and they may persist beneath it and under the flat plain to the south. Such fissures would not be seen, for the rocks exposed on the plain are Eagle Ford and higher formations. It is recommended that a detailed geologic study be made of the vicinity of the great flexure where covered by the G claims, with a view to laying out exploration, probably by diamond drilling, if favorable chances appear.

Judging by developments to date, the writer regards the Natural Resources holdings in Section 58 as a possible source of feed for a furnace probably to be erected elsewhere, provided ore found can be sorted to commercial grade. Ore found will probably be shallow and cheaply mined. Developments along the NE zone may change this notion. A vertical drill hole has been put down 209' from the point shown on the map; two holes from the same set-up, inclined to the north and south respectively, are down lesser distances. These holes show persistent calcite stringers, nearly vertical, some of which "smoke" when heated under a fluorescent lamp and held against a willemite screen indicating the presence of quicksilver. The fact that the principal hole, the vertical one, does not show ore does not necessarily militate against the chances for the NE zone at depth (collar of hole lies along general course of zone), for the hole may have either followed a particular seam in the zone, or gone straight and avoided the ore-bearing seam, if any.

Section 60.- The ground held is shown on the map of Section 60. The unstaked portion has been held under prospector's permit but I understand has been changed to a lease from the State at 50 cents an acre per annum. The staked ground held (M claims) is awaiting survey as outlined on page 8.

Section 60 lies along the south flank of the Main Uplift, at a sharp reentrant in the flexure that marks the flank, a reentrant lead-

ing to the mouth of the Black Peak graben valley. The northwest quarter of the section is largely Georgetown limestone lying nearly flat (part of the platform of the Main Uplift) and is traversed, for the most part in ground not held by the company, by NE fissures of the California Mt. zone, some of which have produced considerable high grade ore. Buda limestone outcrops in a belt, extending roughly from the SW to the NE corner of the section. Toward the northwest side of this NE belt, the Buda lies nearly flat,but its dip increases into a "nose-dive" toward the south and southeast. This is the hinge-zone described on page 15 and shown in Photo 6;the nose-dive itself is best seen in Photo 3. This sharp flexing of the beds has resulted in a well-defined, rather narrow zone of NE fissures and faults,the dominant feature of Section 60. A more widely-spaced zone of NW faults of greater displacement crosses the NE zone nearly at right angles. The NW faults, as may be seen from the district map, are intimately connected with the Black Peak graben. The dropped or graben block becomes less well-defined toward Section 60,and the graben-fault system starts to dissipate into a zone of NW faults of far less displacement than the major NW faults bounding the main graben to the NW.

All the NE faults and fissures, and probably all the NW faults as well, are mineralized, largely with banded calcite and limonite. In places they are veins up to 10' wide. Cinnabar is notably exposed as indicated on the map, in the NE fissure on the Emma G claim (outside-owned). Other, lesser showings exist. Cinnabar is sparse in general, however, along fissures in the ground held by the company. Rocks outcropping on practically all of this ground, however, lie above the Georgetown limestone, and no ore would be expected at such horizons. The writer considers the Natural Resources Inc. holdings

in Section 60 an excellent prospect, for the following reasons:

1. All conditions for ore outlined on pages 17-18 are fulfilled:

Section 60 is an area of abnormal tension and fissuring, and the cause of such tension is a sharp flexure in the beds (Section A-A'), combined probably with tensional faulting along the NW faults connected with the Black Peak graben. A brittle rock, the Georgetown limestone, exists at depth within the area; not only is this rock fractured by the NE fissure zone and by the NW faults, but the locally sharp flexing especially shown in Section A-A' probably has caused interbed slipping in the Georgetown, forming "caliche-Breccias" and offering additional chances for ore beside the usual major control exerted by the Del Rio clay.

2. That portion of the NE fissure zone contained within the company holdings in Section 60 shows parallels with both the Chisos mine and the Smith & Wilson mine. Compare vertical section A-A'with the section of the Chisos mine underlying section A-A'. The deformation at the Chisos mine is of course on a far larger scale than that in Section 60 shown on section A-A'; but certain fundamental similarities exist. In both cases the formations fall away sharply to the right, to the SE in Section 60, to the Sw in the Chisos away. In both cases fractures are connected with local sharp flexures: in Section 60, with a hump or anticline near the proposed shaft; at Chisos, with a sharp anticline on the NE side of the Long Draw. Such fractures carried great quantities of ore in the Chisos mine. Finally, just as the ore at the Chisos mine lay in fractures closely connected with the graben faulting of the Long Draw, so the promising NE fractures in Section 60 fault, and are faulted by, graben faults of the Black Peak graben.

Similarities between the fractured area of Section 60 and that of the Smith & Wilson mine are probably even greater. There a zone

of NE fissures is crossed nearly at right angles by more widely-spaced NW faults. Small blocks have been dropped by tension, bounded by the NW and NE fault sets. Ore occurs along the NE fissures, and spreads from these along the base of the Del Rio clay, especially in the down-faulted blocks, of precisely similar nature to the dropped block shown in vertical section A-A', near the proposed shaft.

3. The N E fissure zone in Section 60 carries cinnabar, where it is diminishing in strength to the SW (Emma G claim) but where Georgetown is exposed on the surface; and it lines up, to the N E, exactly with the productive zone of NE fissures at the 38 mine in Section 38. (See district map).

Recommendations.

Since the expected ore horizon lies at the base of the Del Rio, and since this horizon lies some distance below the surface in the promising part of Section 60, exploration of the NE fissure zone at this horizon must be either by shaft or drill-holes, since the topography does not lend itself to tunnels. While the intense and complicated fracturing seems favorable for ore by its very complexity, such fracturing is unfavorable for exploration by drilling. This is because the exact structure cannot by worked out from surface mapping alone; holes put down in the most fractured part of the area (east of the road) would run into complications probably unexplainable, and leave the driller as much in the dark as before. This portion of the NE fissure zone looks good enough to me to warrant a shaft, and the position of the proposed shaft is shown on vertical section A-A' and on the map. The exact position of the collar will have to be spotted in the field, for my map is without topography. The shaft should be east of the road for several reasons. First, that is the more promising

segment of the NE fissure zone. Second, west of the road the Buda hill rises rapidly in the area of the NE zone, so that to get far enough away from the road to get dump room the shaft would be forced up the hill, and this would mean useless extra sinking. True, the ground is rather flat east of the road, but the shaft collar may easily be elevated with limestone walls to provide head room for an ample dump.

The shaft should be sunk in the footwall of the fault shown just SE of it, on the plan, and section A-A', in order to avoid crossing that or any other fault. The shaft should afford an unfaulted section of the rocks traversed so that the structure may be better understood. Section A-A' indicates that a 200' vertical shaft is needed to reach the Georgetown limestone not far below the base of the Del Rio clay. With the shaft spotted as shown, errors in this estimate may be corrected by measuring the thickness of the formations traversed, such as the Buda limestone, and comparing measurements made in the shaft with those made on the surface, for the Buda limestone and Del Rio clay. If the shaft should cross a fault, this control of exploration might be lost.

When the shaft reaches the top of the Georgetown, crosscut NW a short distance as shown on Section A-A', and SE about 100', to explore the entire width of the NE fissure zone. If no ore is found in this crosscut, pick the most promising fractures and drift NE and SW on them. At suitable intervals along these drifts, repeat the crosscutting of the fracture zone. In any case, drifting SW should go far enough to cross the strong NW fault that parallels the road and explore the NE zone in the upthrown block west of that fault. No further recommendations concerning this shaft work may be made here; work actually done will differ somewhat from these suggestions, for

it will depend on results as the work proceeds.

It is 2000' along the strike of the NE fissure zone, from the proposed shaft SW to where the zone leaves company ground. The zone appears less complex in this segment. Exploration by diamond drilling is indicated. The first hole suggested is shown on the map of Section 60 and on Section B-B'. The exact location of this hole must be spotted in the field, because the draw in which I have started the hole is probably not where I show it. Object of the hole is to cut the fissure zone in Georgetown limestone not far below the base of the Del Rio clay.

The hole as spotted is 650' SW of the proposed shaft, in order to avoid scattering exploration work. Information from the hole may have a direct bearing on work from the shaft, especially on the proposed drift SW from the shaft into the upthrown block explored by the hole.

This 2000' segment of the NE zone will doubtless be explored by a number of further holes, their spacing depending on results in each successive hole, and perhaps on work from the shaft. No further holes can be laid out now.

I recommend that shaft and drill-hole be started at once. The greater the amount of exploration data coming in, the more intelligently can the ultimate scheme of exploration be worked out.

It is impossible to give a close estimate of the cost of the work outlined. Efficient labor imported into the district might materially reduce costs. In the exploration of a prospect from scratch, speed is far more important than cost; this is the main reason good miners are essential. According to local report, the following costs obtain:

Shaft, 5'x7'.....$13 per ft.
Crosscuts, drifts,5'x7'... 6 " "

Since practically no timber is required,and the limestone,while standing perfectly, is soft to drill, these costs may be about right. Timber however will doubtless be needed where the shaft traverses Del Rio clay. 200' of shaft at $13 = $2600;add $500 for timbering,headframe and incidentals gives $3100 for the shaft. 150' of crosscut at $6 gives $900 for the crosscut,making a total of $4000 to reach this stage of the work. Further cost will depend entirely on the way the fissure zone looks in the cross cut;but if it looks at all encouraging, drifting and further crosscutting will be done. In order to make certain that no ore body justifying a plant exists in the NE fissure zone tributary to the shaft, I would guess that at least 1500' of drifting, crosscutting,raising etc. must be done. At $6 this would cost $9000.

Guessing the cost of the drill-hole at $4 per ft., a 400' hole would cost $1200. With 3 more holes,total cost would be about $5000.

Summary.- Shaft.....$3100
Drifts etc10000
Holes.... 5000
$18100

This does not include machinery, nor a camp site. The company has recently purchased an air hoist capable of pulling 1200 lbs. at high speed 350'. This should serve for the shaft sinking and initial exploration. The company has also a large Ingersoll-Rand compressor, capacity unknown;with some overhauling this should serve. Four jackhammers are at hand;these would serve for the shaft and some could be mounted and used in drifting and crosscutting.

The above estimate,based on exploration of the NE zone mainly east of the road, with drilling of the zone west of the road,approaches, counting in a camp site, $25,000. If however, the drill holes are en-

couraging, extensive drifting SW may be indicated, enough perhaps to double the total cost of exploration and bring it to $50,000.

Such a figure, for exploration of the NE fissure zone in company ground, at the horizon of the base of the Del Rio clay, about 200' beneath the surface, may be considered a maximum. With ordinary luck, ore should be found long before this program is completed, and it would be a question of judgement, if no ore were found when the project say, was half completed, whether the project should be carried out to the bitter end. Once enough ore is found to justify a plant the proper way to explore a quicksilver mine is by mining; charges to exploration proper are then greatly reduced.

## CONCLUSIONS.

This report has covered, in an incomplete way, the Terlingua district as a whole, and in more detailed fashion, the holdings of Natural Resources Inc. there and their possible value. The writer concludes that ground held by the company in Section 60 forms a very attractive prospect worthy of exploration, and that the holdings in Section 58 offer possibilities of additional furnace feed to a plant whose building would have to be justified by ore found elsewhere.

The desire of Natural Resources to enter the Terlingua district has a sound basis. That district seems to the writer the most favorable place in the United States for an entry into the quicksilver industry. Some reasons for thinking so follow.

First, Texas mining laws permit the cheap aquirement and holding of whole sections, by for instance the payment of 50 cents per acre per annum on leasehold. It is common for a single individual to hold a number of sections idle for many years. The very ease of holding ground has long held back development of the district up to its

potential capacity to produce quicksilver. Individuals sit tight forever, waiting for the right deal or for a neighbor to develop an ore body at their end line.

Second, the lack of aggressive enterprise combined with abundant rich ore available near the surface on the Georgetown limestone platform of the Main Uplift has resulted in surficial mining to the almost complete exclusion of deep mining. Almost no one except the Chisos Mining Co. has tried out the district at depth. Surface miners failed even to follow productive NE fissures by tunnels under hills of Del Rio clay that remain as buttes above the Georgetown platform. Not only do extensive areas of Del Rio clay and upper formations, showing strong NE fracturing (as on Section 60) remain unexplored, but no serious effort has ever been made to follow a strong fissure any real distance below the Del Rio clay. There may be other productive horizons.

The Smith & Wilson discovery has extended the known productive district within the past year 5 miles west of any previously known ore. Other "fringe" discoveries appear extremely probable.

Third, the high grade of the ore found makes possible repayment of capital investment quickly, once exploration is successful, and with efficient labor should result in a low cost of quicksilver per flask produced. By the same token, high grade ore should be mineable after the present emergency price of quicksilver is gone, so that a successful operation today should go on many years after the war.

Fourth, for the present emergency, the government should see fit to encourage in every possible way the proper development of the Terlingua district, for it is the greatest potential source of quicksilver in the United States today. Production in California has reached more or less stability, with little prospect for material change.

Oregon and Nevada, on the other hand, appear to have passed their peak, so that unless Texas production is immediately stimulated, United States production of quicksilver is bound to decline. The Terlingua district offers unique opportunities to offset this expected decline.

San Francisco,
March 16th, 1942.

Edward Wisser

## APPENDIX A.

Royalties to State of Texas on Ore Mined.-In the case of land leased from the State, or staked and as yet unpatented, royalty is paid the State at the rate of 6 1/4% on the value of contained quicksilver in ore delivered at the mouth of the mine. From the gross receipts from quicksilver sales, the following costs of handling and treatment other than mining are deducted: sorting. hauling to furnace, furnacing etc. 6 1/4% of the balance is then due the State. This is best understood from an actual example.

| | | |
|---|---|---|
| Receipts from 6 flasks of quicksilver from 40 tons ore.. | | $1120.00 |
| Sorting on surface @ $3.00 per ton..... | $120.00 | |
| Hauling to furnace @ $2.00 " " ..... | 80.00 | |
| Furnacing @ $96.00 per flask..... | 576.00 | |
| Wires to buyers..... | 6.60 | |
| Transport to railway..... | 6.00 | |
| | $788.60 | 788.60 |
| | | 331.40 |
| State Royalty | | 6 1/4% |
| | | $ 20.71 |

This figures out only 1.85 % royalty on sales receipts.

## APPENDIX B.

### Partial List of Equipment of Natural Resources Inc.-

The following list is incomplete. Most of the equipment is in operation on Section 58.

1 large Ingersoll-Rand compressor, capacity unknown.
1 105 cu.ft. I-R compressor mounted on truck (Photo 11).
1 Sullivan No.22 Diamond Drill. (Photo 10). Gas-powered.1000' rods.
2 I-R jackhammers.
2 Sullivan jackhammers.
230' air hose.
1000' of 1" and 2" pipe.
Hand drills, picks, shovels etc. for 15 men.
1 Chevrolet 1 1/2 ton truck.
1 " 3/4 ton pickup.
1 oil-fired 6-pipe testing retort. 360 lbs. heavy ore per charge.
1 9" D-retort, worth $1200. Would cost another $1200 for fire-brick, fire-clay, labor etc. to set up.

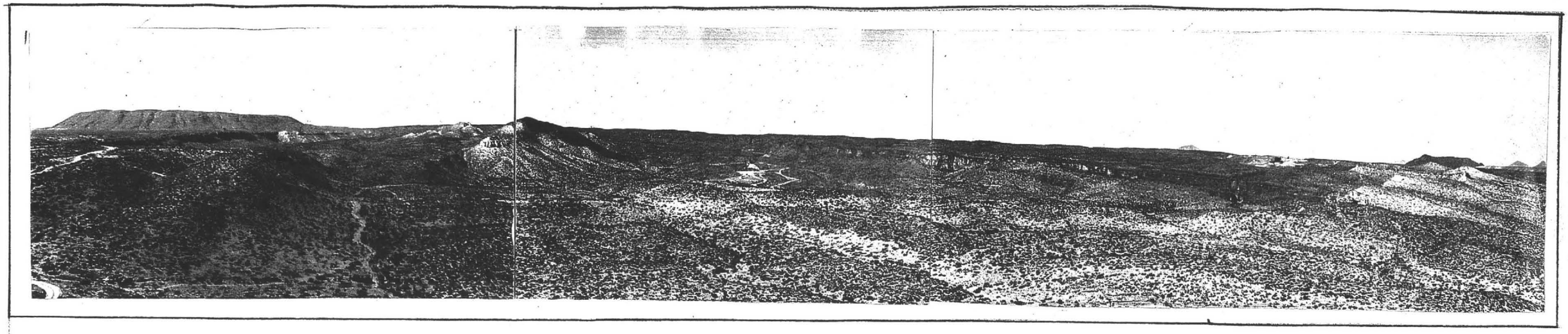


Photo 1. Looking NW up Black Peak graben valley, from point on ridge in north portion of Section 60. Black Mt., extreme left, skyline. Cliff in front of Black Mt. marks fault bounding graben on the SW. Black Peak, to left of center, within the valley. Dark rock is intrusive; horizontal bluff, Buda limestone; lower slopes of Black Peak, and entire valley floor are Del Rio clay. Long cliff, center and right background, marks NE boundary fault of graben. Light-colored rock dipping to the right (east and southeast) near right-hand edge of picture is mainly Buda limestone. To left of this rock is Scott furnace at Waldron mine.

Photo looks NW along crest of Main Uplift. Rocks to left dip gently SW; those in center, beyond valley, dip east; those to right dip SE, and beyond right-hand edge of picture, south, because the uplift or anticline plunges to the south.

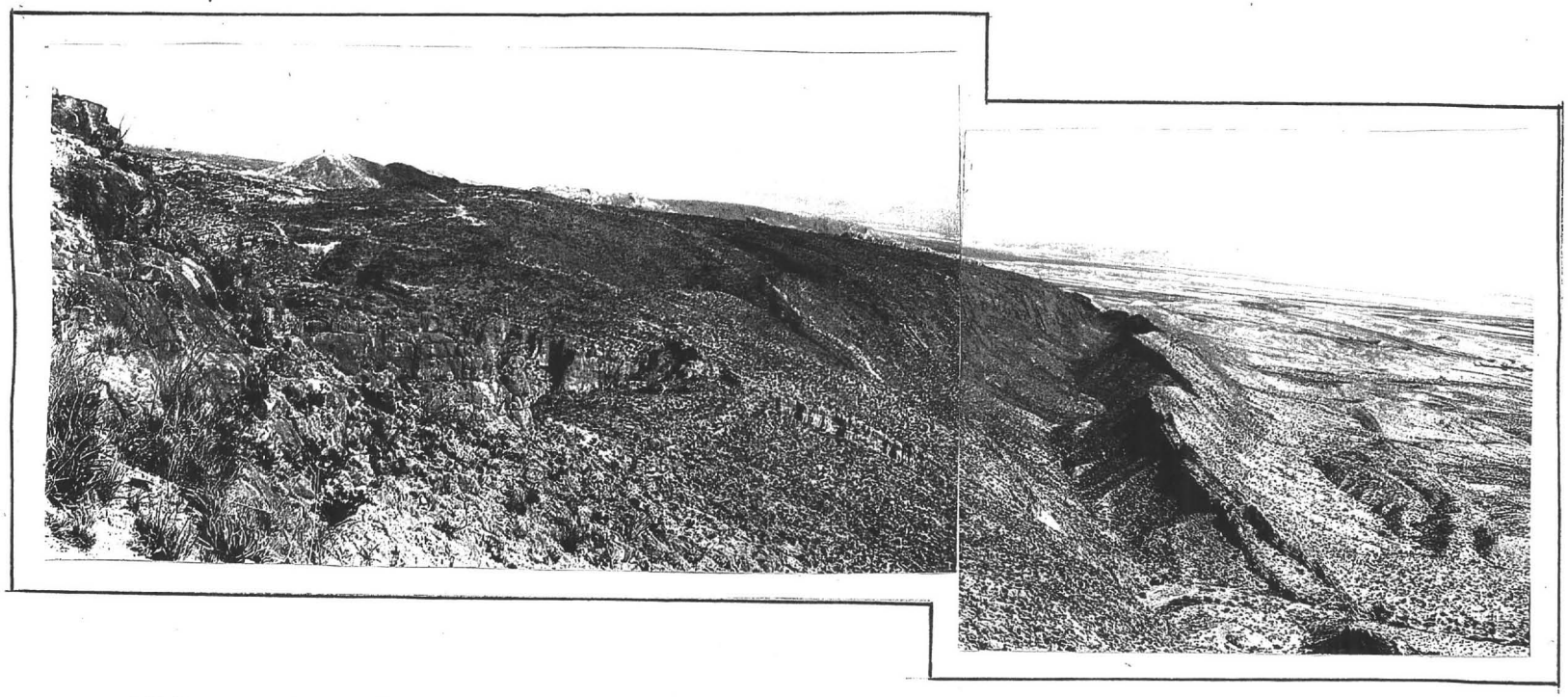


Photo 2. Looking east along south scarp of main uplift.(See also Photo 3).Shield-like bluff formation plunging south into plain at right edge of picture is Buda limestone. Longitudinal valley to left of this, Del Rio clay. To the left of this valley, thin-bedded Georgetown limestone overlies massive Edwards limestone.

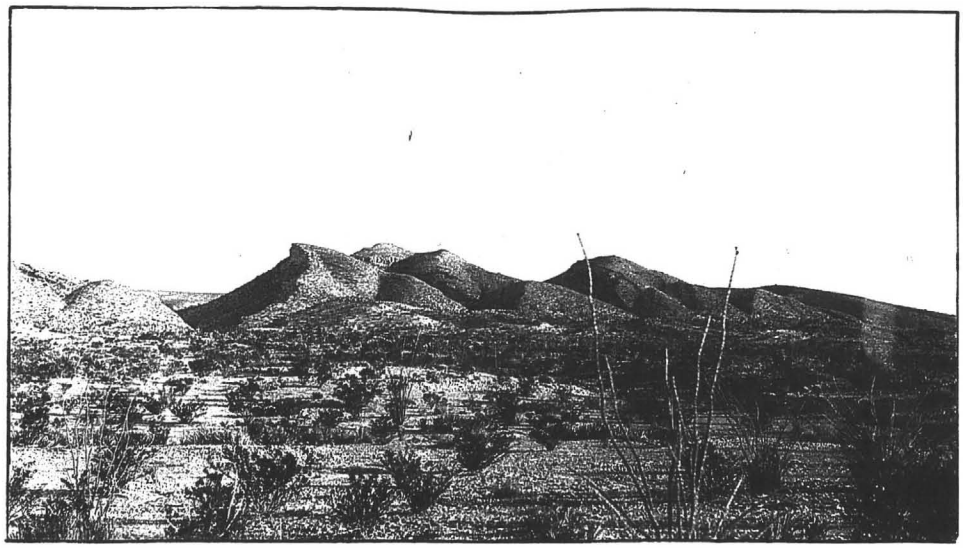


Photo 3. South scarp of main uplift (Photo 2), viewed from the plain south of it. Notched reef dipping toward observer is Buda Limestone; softer stuff beyond and below it, Del Rio Clay.

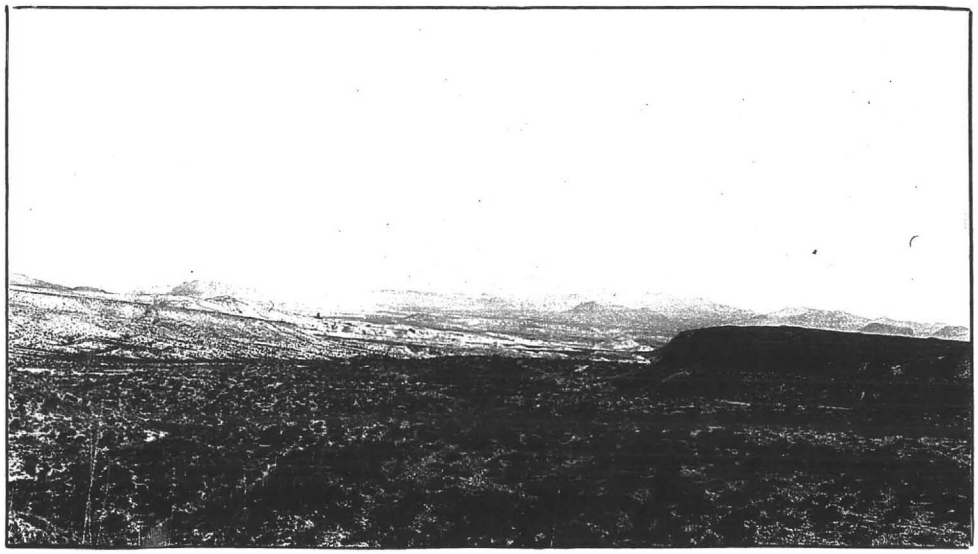


Photo 4. The Long Draw, viewed from Main Uplift Mesa. Reed Plateau on right; Chisos headframe, left center; Chisos Mts. on horizon. Butte to left of Chisos headframe is Maverick Mt., just east of Study Butte.

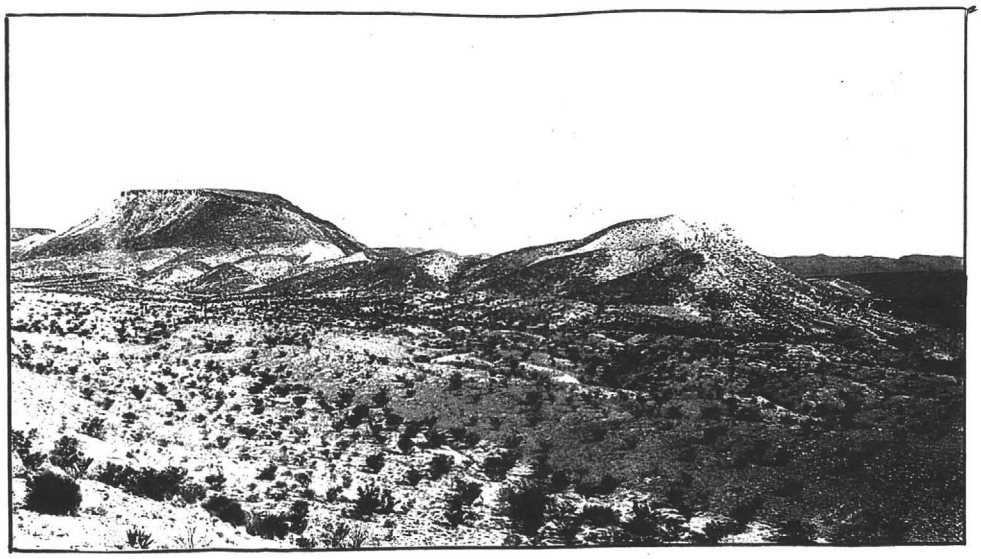


Photo 5. Smith & Wilson property, viewed from the south. Mine lies back of right-hand hill. White rock dipping west capping this hill is Buda Limestone underlain by Del Rio Clay. Left-hand hill is Upper Cretaceous, lying flat on left, dipping east on right. Northwest fault probably passes between the two hills.

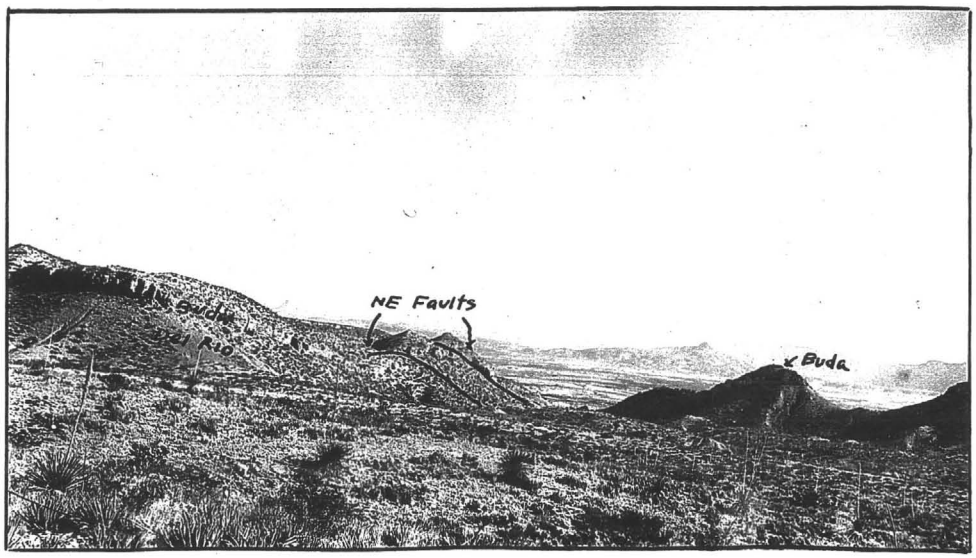



Photo 6. Section 60; looking south from Zoe claim (see map, Section 60). Bluff is Buda Limestone, which is underlain by Del Rio Clay. Buda bluff on ridge to left broken by several of the NE faults shown on the map. Foreground flat-lying Georgetown ls.; Dip increases to south, where all rocks plunge below plain in background.

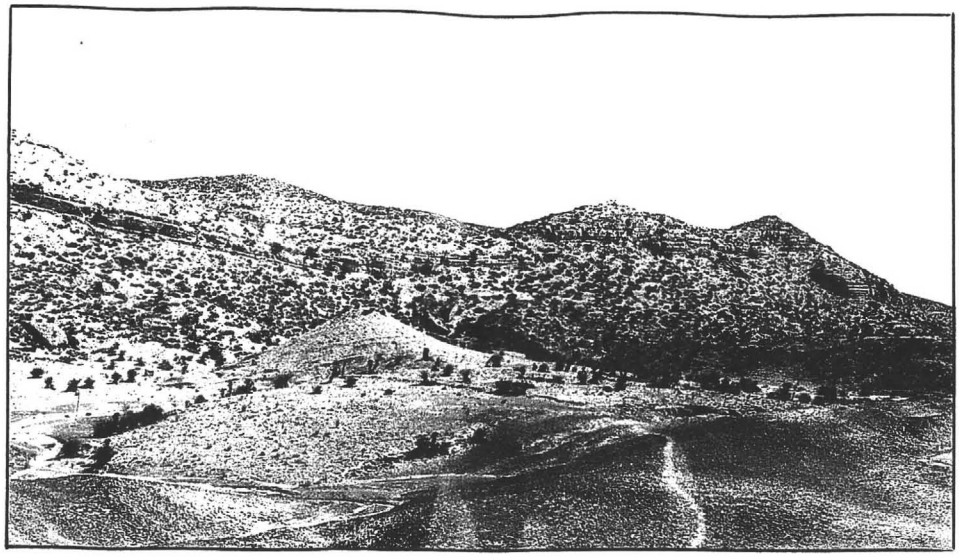


Photo 7. Section 60. Buda ridge mentioned under Photo 6. Looking east. Del Rio Clay overlying Georgetown Limestone, foreground.

Photo 8. Stope along NE fissure; NW corner, Section 60. Produced considerable Terlinguaite.

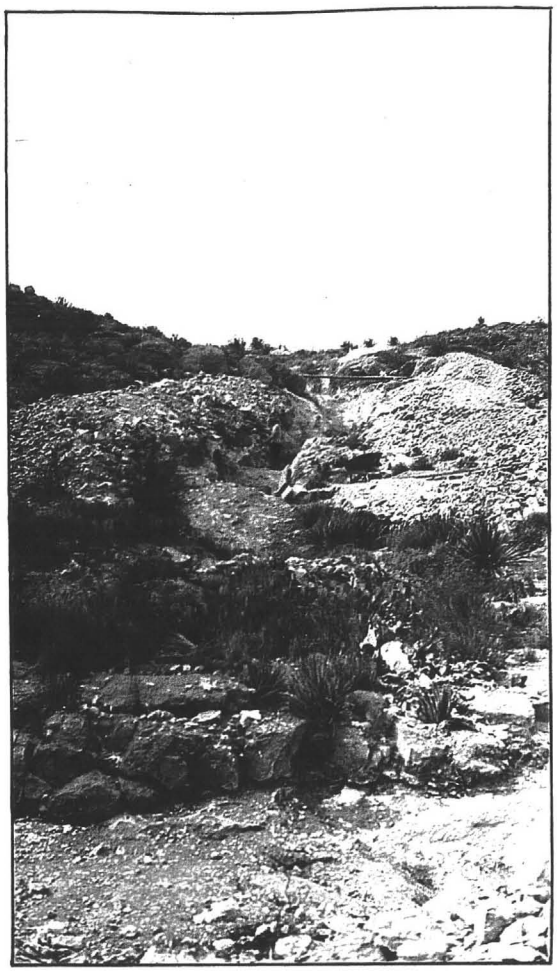


Photo 9. G Claims, Sec. 58. Main cut, Natural Resources Inc. operations.

Photo 10. Sullivan Diamond Drill, G Claims.

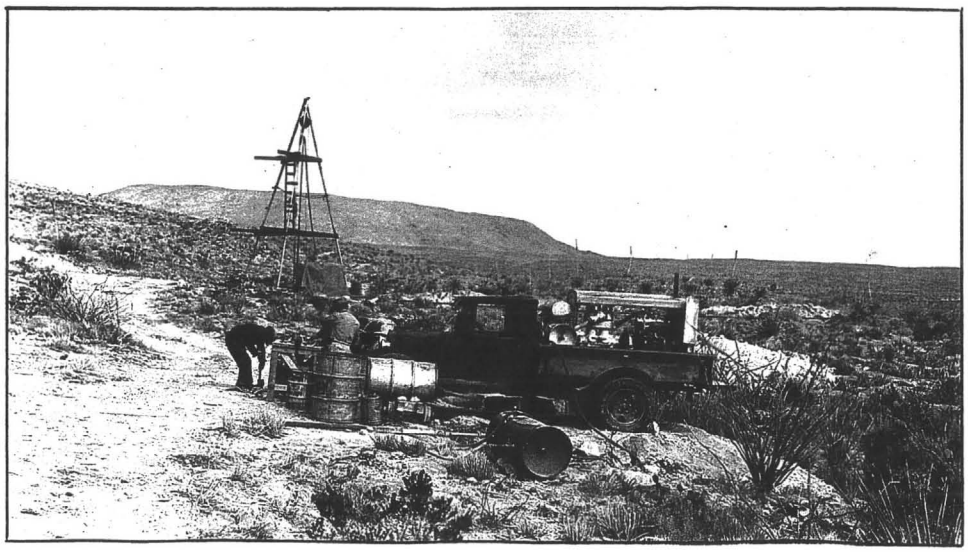
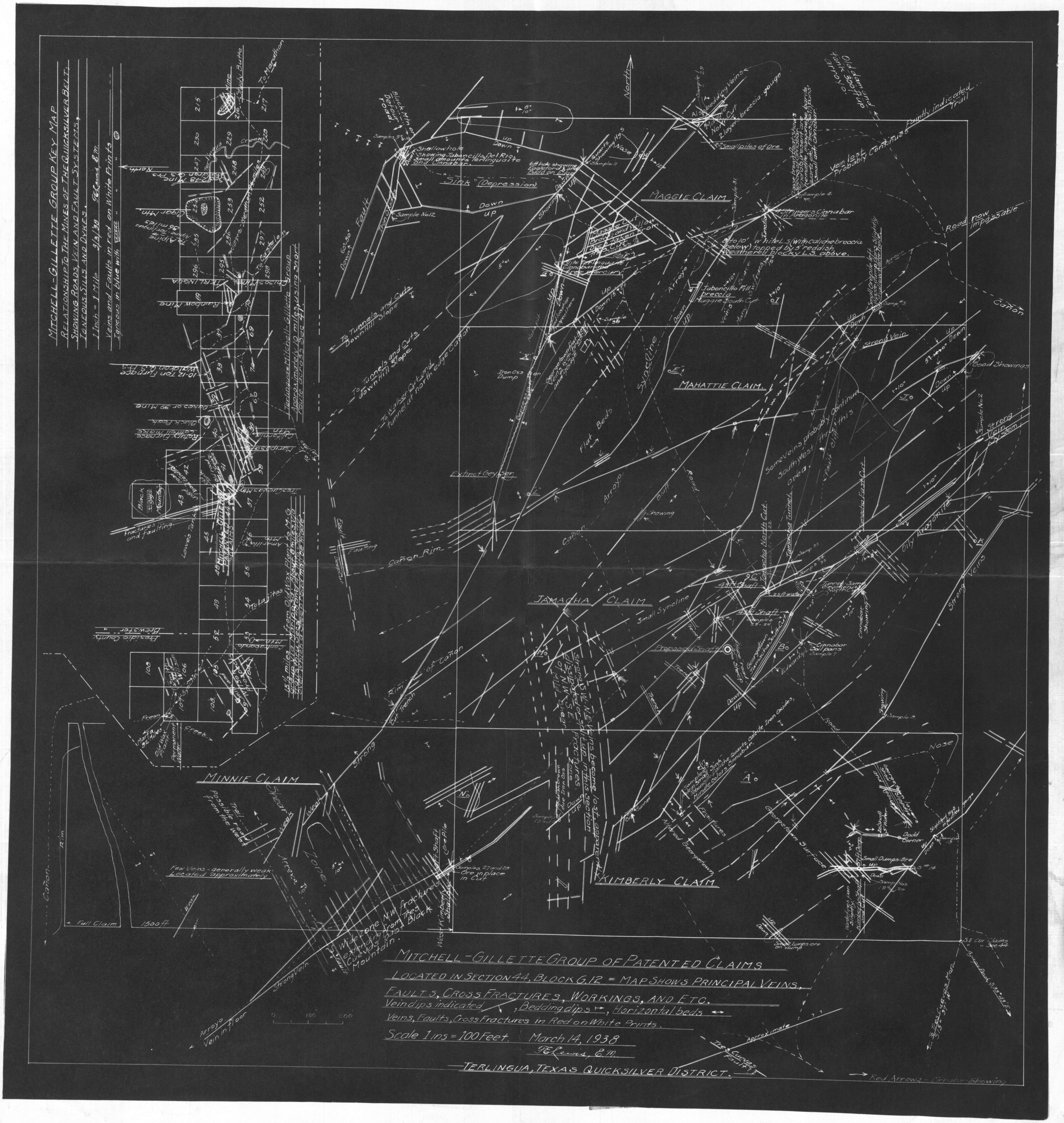
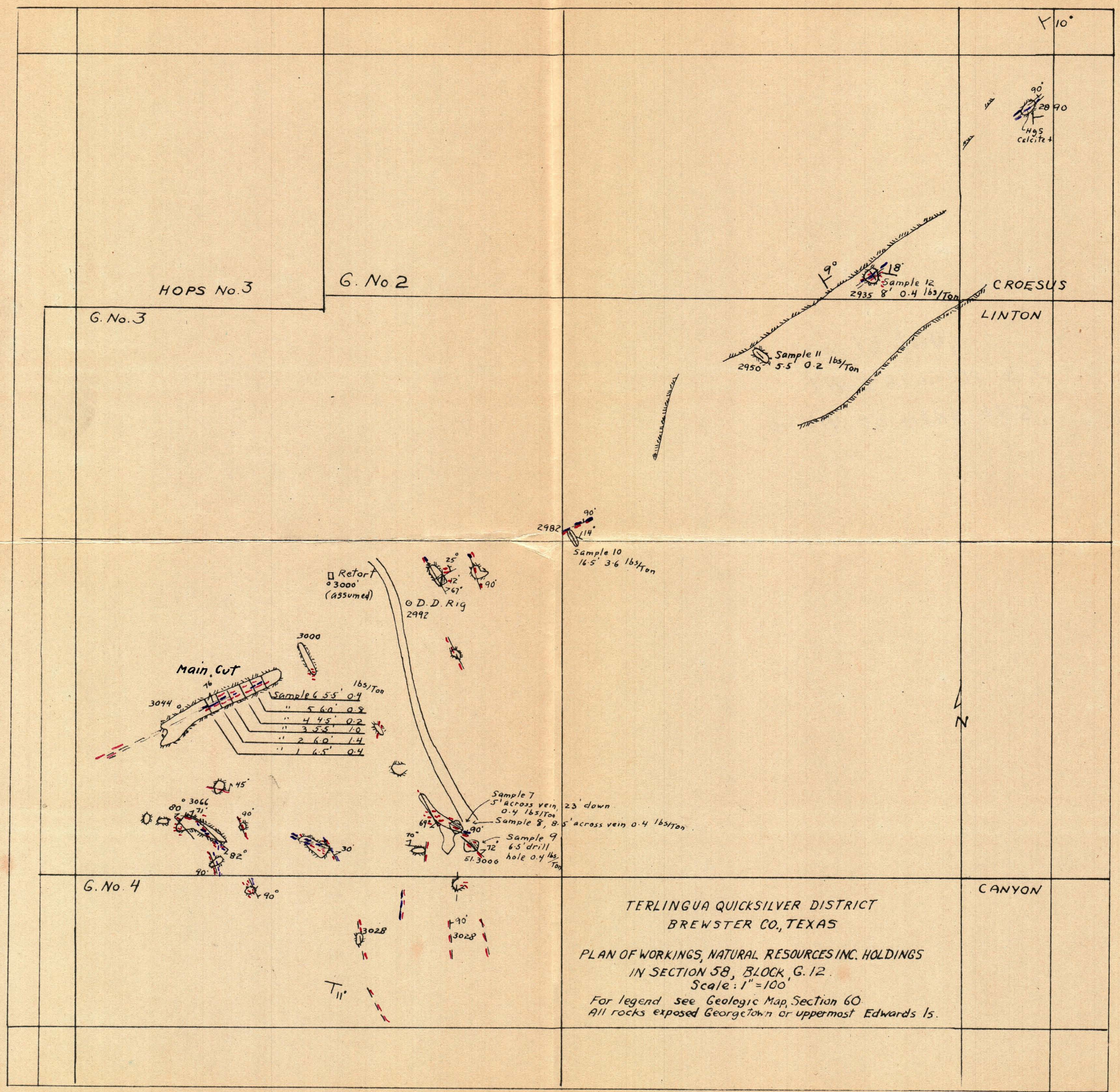


Photo 11. Portable compressor in use on G Claims.


MITCHELL-GILLETTE GROUP KEY MAP
RELATIONSHIP TO THE MINES OF THE QUICKSILVER BELT.
SHOWING ROADS, VEIN AND FAULT SYSTEMS.
TENEQUIS, SILLS AND DYKES.
1 Inch = 1 Mile 3/3/38 T8 Lewis 8 m.
Veins and Faults in red on White Prints
Tenequis in blue with " " "
Terlingua-Mitchell-Gillette Group
Approximately 10 miles using short route across Sec 41.
MAGGIE CLAIM
MAHATTIE CLAIM.
JAMACHA CLAIM
MINNIE CLAIM
KIMBERLY CLAIM
Sink "(Depression)
Fault
Cañon
Cañon Rim
Extinct Geyser
Road now impassable
Vein lost. Probably Continues Faintly indicated Trail
Strong Vein
Good Showings
Small Syncline
Flat Beds
Arroyo
Bluff
Nose
Few Veins - generally weak
Located approximately
Full Claim
1500 ft
Strong Vein
Arroyo
Vein in Floor
Approximate
Tres Cuevas Fault
Tres Cuevas Mtn
Red Arrows - Cinnabar Showing
MITCHELL-GILLETTE GROUP OF PATENTED CLAIMS
LOCATED IN SECTION 44, BLOCK G.12 = MAP SHOWS PRINCIPAL VEINS,
FAULTS, CROSS FRACTURES, WORKINGS, AND ETC.
Vein dips indicated, Bedding dips, Horizontal beds
Veins, Faults, Cross Fractures in Red on White Prints.
Scale 1 ins = 100 Feet. March 14, 1938
T8 Lewis, 8 m.
TERLINGUA, TEXAS QUICKSILVER DISTRICT.




TERLINGUA QUICKSILVER DISTRICT
BREWSTER CO., TEXAS

PLAN OF WORKINGS, NATURAL RESOURCES INC. HOLDINGS
IN SECTION 58, BLOCK G. 12.
Scale: 1" = 100'

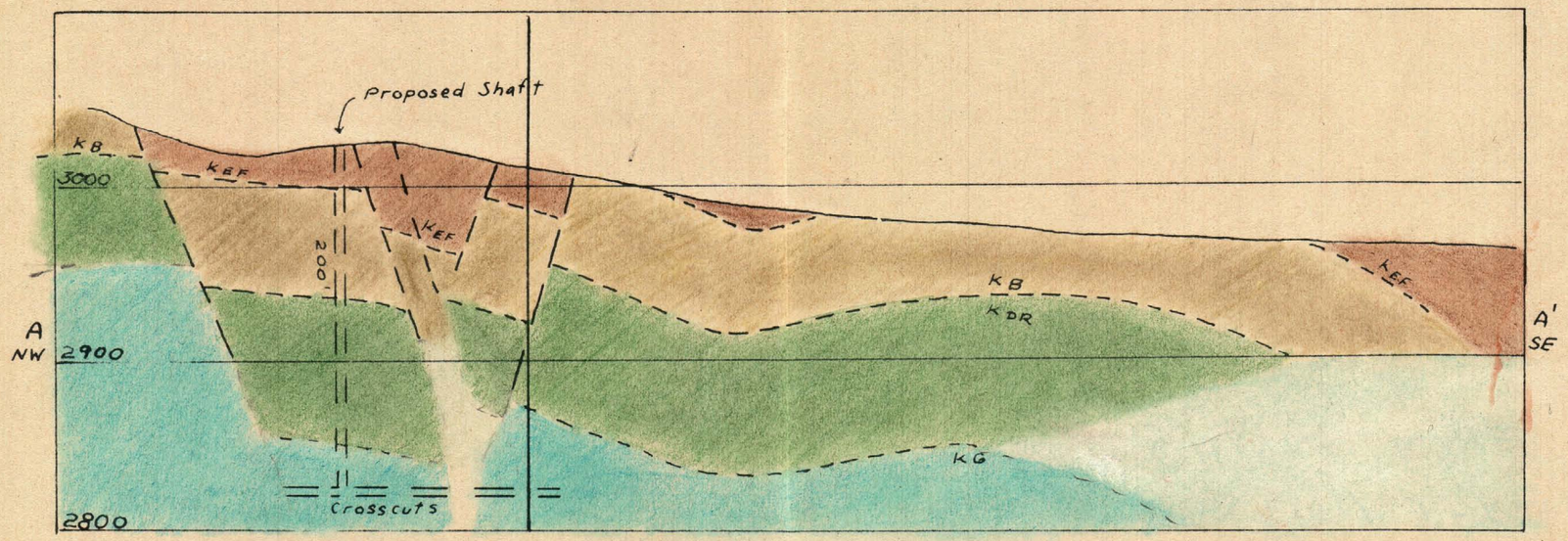
For legend see Geologic Map, Section 60
All rocks exposed Georgetown or uppermost Edwards ls.

PLAN OF WORKINGS
IN SECTION 58
1" = 100'

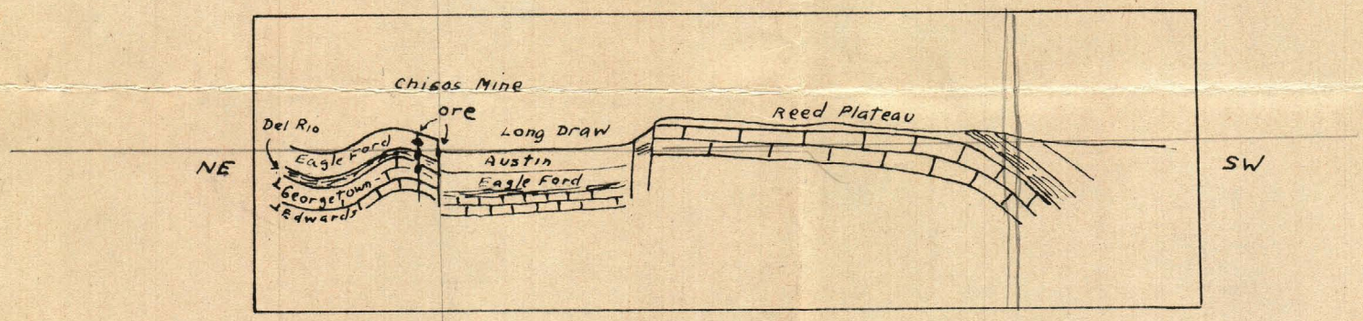
TERLINGUA QUICKSILVER DISTRICT, BREWSTER & PRESIDIO COS., TEXAS.
CLAIM AND SKETCH GEOLOGIC MAP.
Scale: 1" = 2000'
0
1000 varas
2000 varas
LEGEND
ROCK FORMATIONS
Rattlesnake Upper Cretaceous 7 KR
Taylor " " 6 KT
Austin " " 5 KA
Eagle Ford " " 4 KEF
Buda Lower Cretaceous 3 KB
Del Rio " " 2 KDR
Georgetown & Edwards " " 1 KG
Igneous Probably Early Tertiary I
Dip & strike of beds 30°
FAULT, FISSURE 70°
CONTACT (other than fault contact)
QUICKSILVER SHOWING AND/OR PROSPECT HOLE X
BLOCK 341
BLOCK G.12
BLOCK 341
BLOCK G.4
MAIN UPLIFT
UPLIFT
UPLIFT
CONTRABANDO DOME
Black Peak Graben

CLAIM & GEOLOGIC MAP
TERLINGUA DISTRICT
1" = 2000'

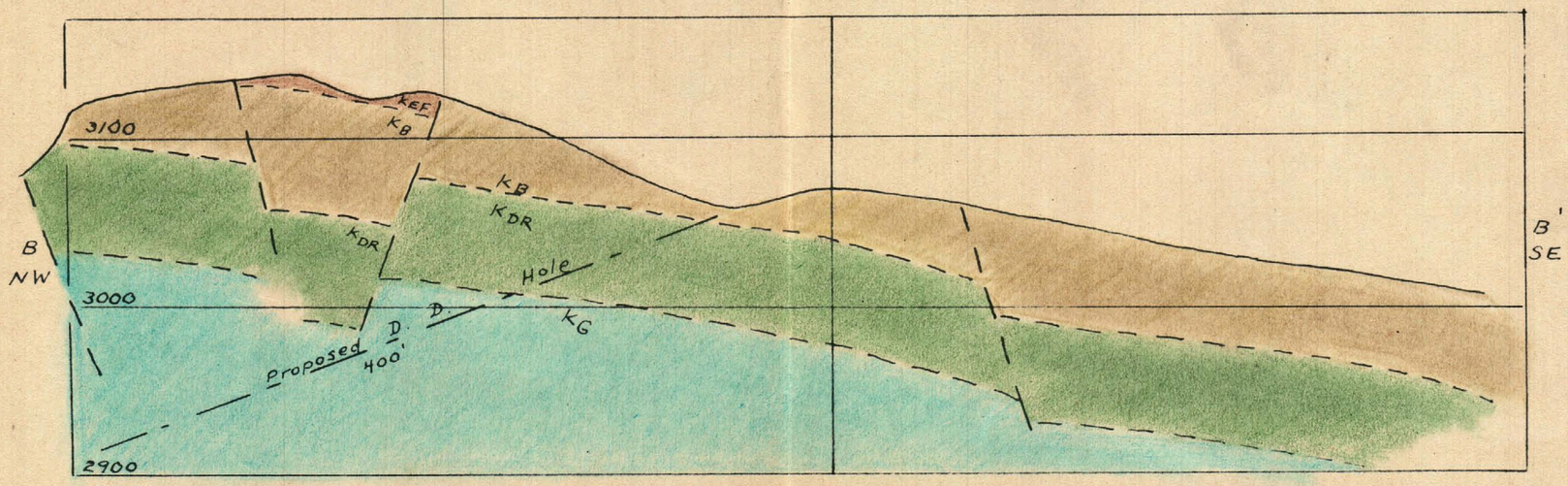
4




SECTION A-A' (For position see Geologic Map, Section 60).
Scale 1" = 100'



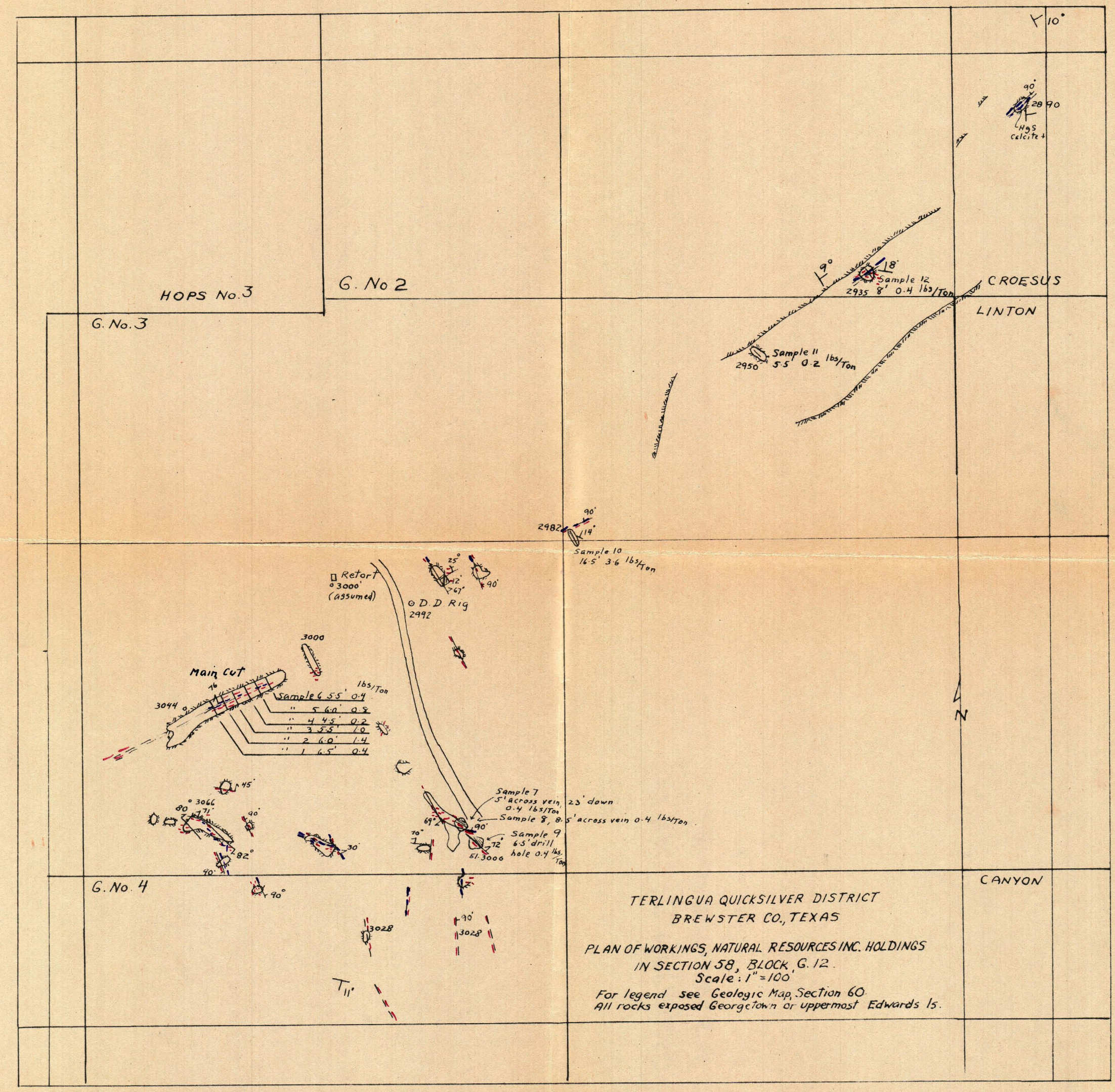

NE-SW SECTION thru CHISOS MINE




SECTION B-B'. (For position, see Geologic Map, Section 60).
Scale: 1" = 100'

SECTIONS A-A'
B-B'

SECTION THROUGH
CHISOS MINE



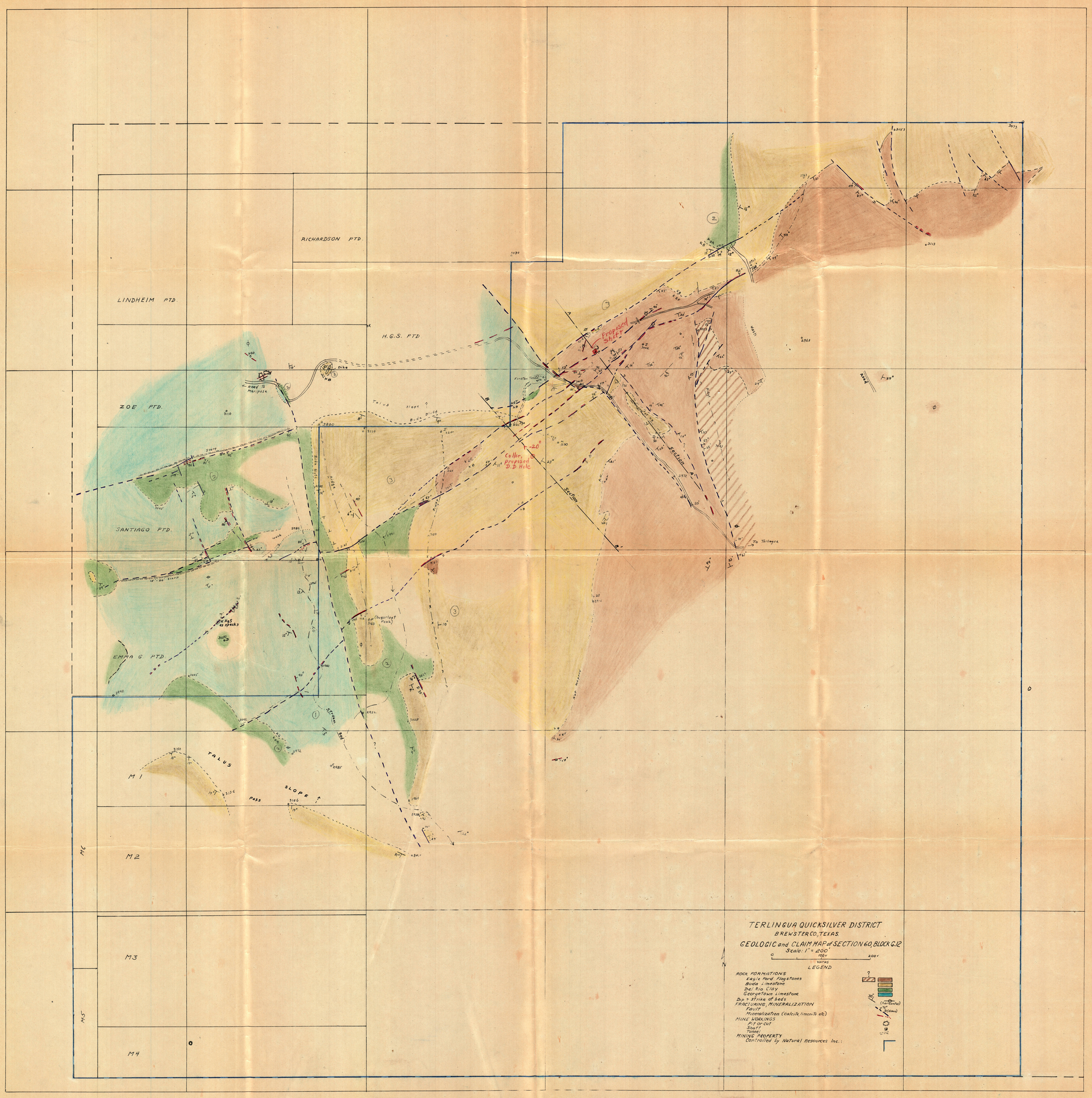

TERLINGUA QUICKSILVER DISTRICT
BREWSTER CO., TEXAS

PLAN OF WORKINGS, NATURAL RESOURCES INC. HOLDINGS
IN SECTION 58, BLOCK G. 12.
Scale: 1" = 100'

For legend see Geologic Map, Section 60.
All rocks exposed Georgetown or uppermost Edwards ls.

PLAN OF WORKINGS
IN SECTION 58
1" = 100'

Wisser


RICHARDSON PTD.
LINDHEIM PTD.
H.G.S. PTD.
ZOE PTD.
SANTIAGO PTD.
EMMA G. PTD.
M1
M2
M3
M4
M5
M6
Proposed Shaft
Collar, Proposed D.D. Hole
Section A-A'
Section B-B'
Dike
Road to Marfa
Talus slope
Buda Bluff
Steep
Wash
Ridge
Stream Bed
Talus Slope Pass
Sugarloaf Peak
To Terlingua
Road
TERLINGUA QUICKSILVER DISTRICT
BREWSTER CO., TEXAS.
GEOLOGIC and CLAIM MAP of SECTION 60, BLOCK G.12
Scale: 1" = 200'
0 100' 200'
Varas
LEGEND
ROCK FORMATIONS
Eagle Ford Flagstones
Buda Limestone
Del Rio Clay
Georgetown Limestone
Dip + Strike of beds
FRACTURING, MINERALIZATION
Fault
Mineralization (Calcite, limonite etc)
MINE WORKINGS
Pit or Cut
Shaft
Tunnel
MINING PROPERTY
Controlled by Natural Resources Inc.:

GEOLOGIC + CLAIM MAP
SECTION 60
1" = 200'

E.W.