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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

OIL AND GAS INVESTIGATIONS
PRELIMINARY MAP 2

SIERRA DIABLO REGION, HUDSPETH AND CULBERSON COUNTIES, TEXAS

STRUCTURE MAP OF SIERRA DIABLO REGION, SHOWING TRENDS OF FAULTS AND JOINTS

EXPLANATION OF JOINT DIAGRAMS

The rosettes on the inset map summarize the trends of vertical joints in the nearly flat-lying rocks of the Sierra Diablo region. They are based on 6,175 measurements of individual joints at 855 localities. For purposes of the summary, the region has been divided into 19 areas of different structural character, whose boundaries are shown by heavy dotted lines. The information on each area is further divided according to the age of the rocks in which the joints occur. Stippled rosettes summarize joints in the Cretaceous rocks; black rosettes summarize joints in the Permian rocks (including Wolfcamp series); unshaded rosettes summarize joints in the older Paleozoic rocks (Pennsylvanian and older, including Van Horn sandstone). Numbers opposite rosettes indicate amount of information on which rosettes are based: the first indicates number of localities at which observations were made, and the second the number of measurements on individual joints.

EXPLANATION

- Alluvial deposits
- Bed rock formations (pre-Cambrian to Tertiary)
- Faults (D, on downthrown side; dashed where concealed. Faults of pre-Cambrian age not shown)

For explanation of joint diagrams, see below

EXPLANATION

QUATERNARY
- Undifferentiated alluvial deposits (Mostly fine-grained, forming surface of pediments, bolsons, and bajadas. Includes coarse conglomerate along east face of Sierra Diablo, and unconsolidated gypsum in Salt Basin)
- Qls — Landslide deposits (On Sierra Prieta)
- Qt — Terrace deposits (Gravels on surfaces above present drainage)

UNCONFORMITY

TERTIARY
- Tb — Extrusive basalt (Small remnants on Cox Mountain and west of Victorio Peak.)
- Intrusive igneous rocks (Granite, syenite, trachyte, phonolite, and intrusive breccia.)

UNCONFORMITY

CRETACEOUS — Comanche series
- Kkw — Mari and clay of Washita age (Includes beds of Kiamichi age on Cox Mountain, and beds of Duck Creek to Fort Worth age on Sierra Prieta.)
- Kf / Kfs — Finlay limestone (Rudistid limestone and interbedded marl; Kfs sandstone member in northwest part of area.)
- Kcx — Cox sandstone (Thick-bedded, pebbly sandstone; of Trinity age to south, but including beds of Finlay and Kiamichi age on Sierra Prieta.)
- Kc — Campagrande limestone (Thin-bedded limestone and marl to south; varicolored conglomeratic limestone to north)
- Kby — Sandstones and limestones (Bluff and Yucca formations of some reports; in part equivalent to, and in part older than Campagrande limestone; present only in southwest corner of area)

MAJOR UNCONFORMITY

PERMIAN — Guadalupe series
- Pgs — Goat Seep limestone (Thick-bedded, dolomitic limestone)
- Psc — Sandstone tongue of Cherry Canyon formation (Fine-grained sandstone)

UNCONFORMITY

Leonard series — Bone Spring limestone
- Pcf — Cutoff shaly member (Thin-bedded, shaly, barely limestone)
- Pbv — Victorio Peak gray member (Thick-bedded, light gray limestone; becomes dolomitic to west)
- Massive limestone (Cf reef facies; in part dolomitic; equivalent to black limestones of lower part of formation)
- Pbb — Black limestone (Thin-bedded, in part shaly, grading laterally into massive limestone; forms part or all of lower half of formation)

LOCAL UNCONFORMITY

Wolfcamp series — CARBONIFEROUS OR PERMIAN
- CPhc — Hueco limestone (Thin to thick-bedded, gray, cliff-making limestone; CPhc basal clastic member of marl, red shale, and conglomerate)

MAJOR UNCONFORMITY

Pennsylvanian — CARBONIFEROUS
- Cm — Magdalena limestone (Thick-bedded, gray limestone; of middle Pennsylvanian age)
- Cb — Bend formation (Shale of Smithwick age, underlain by limestone)

Mississippian
- Helms formation (Blue and black shale, of Chester age)

UNCONFORMITY ?

DEVONIAN (?)
- Chert, limestone, and siliceous shale

UNCONFORMITY

SILURIAN
- Fusselman limestone (Massive, white, crystalline, dolomitic limestone, passing locally into gray fossiliferous limestone)

UNCONFORMITY

ORDOVICIAN — Upper Ordovician
- Montoya limestone (Thick-bedded, cherty limestone, with persistent sandstone member at base)

UNCONFORMITY

Lower Ordovician
- Oes — El Paso limestone (Thin to medium-bedded limestone, with marly limestone at top; Oes-beds of calcareous sandstone at base)
- Ob — Bliss sandstone (Thin-bedded, non-calcareous sandstone, cut by worm tubes)

UNCONFORMITY

CAMBRIAN (?) OR PRE-CAMBRIAN
- Cv — Van Horn sandstone (Red sandstone and arkosic conglomerate; cross-bedded and unfossiliferous)

MAJOR UNCONFORMITY

PRE-CAMBRIAN — Hazel sandstone
- pCh / pCht — Red sandstone (Fine-grained and thin-bedded; forms upper part of formation; pCht-tuffaceous member, interbedded in the sandstone in one area)
- pChc — Conglomerate (Composed of pebbles, cobbles, and boulders, largely of limestone and volcanics from the underlying Allamoore limestone; forms lower part of formation, and also interbedded with red sandstone above)

UNCONFORMITY

Allamoore limestone
- pCv — Volcanic rocks (Lavas, tuffs, breccias, and phyllites, forming thin to thick members interbedded in the limestone; one small mass in Hazel sandstone included)
- pCl — Limestone (Thin to thick-bedded, cherty, in part marmorized)

SEQUENCE CONCEALED

Carrizo Mountain schist
- pCs — Limestone and slate (Some chert and volcanics)
- pCq — Quartzite (Thinly laminated, in part cross-bedded)
- pCgs — Greenstones intrusives (In part massive, in part schistose; smaller areas not shown)
- pCr — Metarhyolite (Mostly cataclastically altered and with pronounced linear structure; some mylonite)
- pCc — Chlorite schist (Fine-grained, green schist)

CONTACT METAMORPHIC ROCKS
- Cm — Hornfels and marble (Contact metamorphosed near larger intrusives of Tertiary age)

STRUCTURAL SYMBOLS

- Normal fault (D, downthrown side)
- Reverse fault (T, upthrown side; includes some low-angle overthrust faults)
- Tear fault (Arrows indicate relative movement; on structure sections, A indicates relative movement away from observer and T toward observer)
- Hypothetical and concealed faults
- Strike and dip of strata
- Horizontal strata and vertical strata
- Strike and dip of schistosity
- Trend and dip of linear features
- Anticlinal and synclinal axes
- Edges of wide flexures

ECONOMIC GEOLOGY

- Mine shaft (Worked for copper and silver)
- XXX — Mine or prospect openings (Mostly opened for copper and silver)
- Water supply (W, well; S, spring; t, earth storage tank)

NORTHERN SIERRA DIABLO

SOUTHERN SIERRA DIABLO

FOOTHILLS EAST OF SIERRA DIABLO

FOOTHILLS SOUTH OF SIERRA DIABLO

Scale 1/62500
1 0 1 Miles

Base from Geological Survey maps of Van Horn, Sierra Blanca, and Salt Basin quadrangles and from reconnaissance surveys by P. B. King in 1936 and 1938

Geology by P. B. King and J. B. Knight
Surveyed in 1928, 1931, 1933, 1936, 1938, and 1939
Extreme southwest corner from published map of J. Fred Smith, 1940

CULBERSON COUNTY ROLLED SKETCHES
No. 41
GEOLOGICAL MAP SHOWING THE SIERRA DIABLO
FILED FEBRUARY 7, 1945

CULBERSON COUNTY ROLLED SKETCHES NO. 41.
Geological Map Showing Sierra Diablo
Filed Feb. 7, 1945

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Geological Survey
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EXPLANATION OF GEOLOGIC MAP OF THE SIERRA DIABLO, HUDSPETH AND CULBERSON COUNTIES, TEXAS

By Philip B. King

Introduction

The accompanying map of the Sierra Diablo covers an area 39 miles long and 32 miles wide in the western part of the State of Texas. The map area includes the whole of the Sierra Diablo, a lofty, plateau-like range, whose summits exceed 6,000 feet in altitude. The surface of the range slopes gently westward from its crest, but to the east, north and south it breaks off in abrupt escarpments as much as 2,000 feet high. To the southeast and south, the range is flanked by lower foothills, beyond which are the intermontane desert basins of the Salt Basin and Eagle Flat.

In its broader outlines, the Sierra Diablo resembles block mountains elsewhere in the Basin and Range province. In detail, its geological features are complex, for it is made up of rocks of many ages and types, which have been deformed during several periods. The names of the units in the rock sequence, and their lithology, are given in the map legend. The relation of these units to the geologic history, and the geologic structure, are summarized below.

Pre-Cambrian rocks

The oldest rocks of the area, of pre-Cambrian age, are exposed in the foothills south and southeast of the Sierra Diablo. These include ancient meta-igneous and meta-sedimentary rocks (Carrizo Mountain schist) and younger, unmetamorphosed sedimentary rocks (Allamore limestone and Hazel sandstone). The Carrizo Mountain schist has been overthrust across the younger rocks, and for some miles north of the trace of the overthrust the younger rocks have been intensely deformed (sec. S-S'); farther north they lie nearly flat (sec. L-L'). The thickness of the pre-Cambrian rocks cannot be determined, but it is probably many thousands of feet.

The deformation of the pre-Cambrian rocks took place before the deposition of the Van Horn sandstone, which lies on their deeply eroded edges (sec. U-U'). The Van Horn is a coarse clastic deposit as much as 700 feet thick. As it contains no fossils, its age cannot be determined, but it is probably of late pre-Cambrian or of Cambrian age. The Van Horn was tilted and eroded before the succeeding Bliss sandstone was laid down over it.

Older Paleozoic rocks

Older Paleozoic rocks crop out in the southeast and northeast parts of the area, and form a few inliers in the Sierra Diablo; their most conspicuous outcrops are on Beach Mountain. They include the Bliss sandstone, El Paso limestone, and Montoya limestone of Ordovician age, the Fusselman limestone of Silurian age, and chert, limestone, and shale that may be of Devonian age. Their total thickness is about 2,000 feet.

Carboniferous rocks

In the northeast part of the area, the older Paleozoic rocks are overlain by rocks of the Carboniferous system (sec. F-F'). These include the Helms formation of Mississippian age, and the Bend formation and Magdalena limestone of Pennsylvanian age. Because of the disconnected exposures, the thickness of the Carboniferous cannot be determined, but it probably does not exceed 1,000 feet.

The older Paleozoic and the Carboniferous rocks were broadly folded and deeply eroded in late Pennsylvanian time, so that the succeeding Hueco limestone overlies them with marked unconformity (secs. H-H', M-M', and others). In parts of the area, the Hueco lies directly on the pre-Cambrian, erosion having removed the intervening beds (sec. L-L').

Permian rocks

The most extensive outcrops in the Sierra Diablo are those of the Hueco limestone (Carboniferous or Permian) and the Bone Spring limestone (Permian). These two formations, which have an aggregate thickness of about 3,000 feet, lie at the surface over wide areas on the summits, and are well exposed on the bordering escarpments. The formations are traversed by two prominent monoclinal flexures, the Victorio and the Babb, one near the middle and one near the north end of the range. These trend west-northwest and dip northward. South of the Victorio flexure, only the Hueco is present; to the north the Bone Spring comes in above it (secs. H-H' and I-I'). North of the Babb flexure, the main body of the Bone Spring is overlain by its upper member (Cutoff) and by younger Permian formations (sec. B-B').

At the base of the Hueco, lying unconformably on the older rocks, is a clastic member, but the main body is an evenly bedded limestone. The Bone Spring is more varied. In the northeast part of the range it consists of a thin-bedded, slope-making black limestone member below, and of the cliff-making limestones of the Victorio Peak gray member above (sec. G-G'). Southwestward, especially near the flexures, the black limestones of the lower member give place to massive limestones of reef origin (secs. D-D' and I-I'). In these areas, the Bone Spring is unconformable on the Hueco.

North of the Babb flexure, near the north edge of the map area, the Cutoff shaly member of the Bone Spring limestone is overlain by two younger Permian formations (sandstone tongue of Cherry Canyon formation and Goat Seep limestone). These are unconformable on the Bone Spring, as indicated by the absence of the Brushy Canyon formation that comes in below them in the Delaware Mountains east of the map area.

Cretaceous rocks

Cretaceous rocks overlie the Permian and older rocks on the west slope of the Sierra Diablo and form smaller remnants elsewhere. They are separated from the older rocks by a marked unconformity. In the southwest part of the map area, they lie directly on the pre-Cambrian, with the intervening strata missing by erosion (south ends of secs. K-K' and L-L'). The surface on which they were laid down was a peneplain; exhumed remnants of this peneplain form the summits of the mountains in many places where all traces of the Cretaceous rocks themselves have been removed.

The Cretaceous rocks exhibit a northward overlap from a geosyncline to the south. The geosynclinal facies appears in the southwest corner of the map area, southwest of the Devil Ridge thrust, where there are outcrops of the sandstones and limestones that have been termed the Yucca and Bluff formations. These two units, which have a combined thickness of more than 2,000 feet, are of early lower Cretaceous age. They are not represented elsewhere in the area, unless the Campagrande limestone is equivalent to their topmost beds.

Elsewhere in the southern half of the map area, the Cretaceous is represented by the Campagrande limestone, 100 feet thick, the Cox sandstone, 400 to 600 feet thick, and the Finlay limestone, 50 to 100 feet thick. The Campagrande is of Trinity ago and the Finlay of Fredericksburg age; the boundary between Trinity and Fredericksburg groups probably lies within the Cox. On Cox Mountain, the Finlay is overlain by the Kiamichi, or basal formation of the Washita group.

Farther north, the Cox sandstone apparently replaces both the Finlay and Kiamichi, for on Sierra Prieta, in the northwest corner of the map area, it is overlain directly by the Duck Creek formation, the next unit above the Kiamichi in the Washita group. On Sierra Prieta, as much as 350 feet of beds of Washita age are present above the Cox, the highest being perhaps of Fort Worth age.

Tertiary igneous rocks

The sedimentary rocks of the Sierra Diablo are cut by intrusive igneous rocks of probable Tertiary age. These are most abundant near Mine and Marble Canyons in the northeast part of the range, where there are two plugs, and numerous minor dikes and sills (sec. F-F'). A great variety of igneous and contact metamorphic rocks are present in this area. Sierra Prieta, in the northwest part of the map area, is a thick, sill-like intrusive of alkalic composition, probably a phonolite (sec. A-A'). Extrusive basalt forms a few small remnants in the central part of the area.

Cenozoic diastrophism

The Sierra Diablo was given its present form and outlines by disturbances that took place during Cenozoic time. There were several periods of movement. The rocks near the Devil Ridge thrust, in the extreme southwest corner of the map area, were strongly folded and faulted in late Cretaceous or early Tertiary time. Most of the deformation to the northeast, in the Sierra Diablo, probably took place in the late Tertiary. During this period, the Sierra Diablo was uplifted to nearly its present height and was broken by faults. The faults belong to two systems: A fairly regular set that trends west-northwest, and a less regular set with a general northward trend. Faults of the first system are paralleled by the dominant joints of the area, as indicated by the inset map. Faults of the second system follow the east base of the Sierra Diablo and Baylor Mountains. During Quaternary time, faults of this system moved again, and in some places the alluvial deposits were faulted.

Cenozoic unconsolidated deposits

The lower areas surrounding the Sierra Diablo are extensively covered by unconsolidated deposits of Cenozoic age, formed during the erosion of the uplifted mountain blocks. The deposits at the surface are probably all of Quaternary age, but late Tertiary deposits may underlie them in the deeper intermontane basins.

Economic geology

The economic products of the region are varied. The rocks in some areas are mineralized and have been extensively prospected. One mineralized area is in the outcrops of pre-Cambrian rocks in the south part of the area, where copper and silver have been mined at the Hazel and Blackshaft mines and many smaller workings. Another mineralized area is near the Tertiary intrusives at Mine and Marble Canyons in the northeast part of the range. One of the plugs contains small quantities of tungsten minerals. Near these plugs, and near the sill of Sierra Prieta, the metamorphosed Hueco limestone, originally dolomitic, has been changed to a mixture of calcite and brucite. The latter is a possible source of metallic magnesium.

At a locality 6 miles west of Van Horn, meta-igneous rocks of the Carrizo Mountain schist have been quarried for many years for use as crushed stone, for road metal and other purposes.

The most needed resource in the area is ground water. The best and most abundant supplies in the area are obtained in wells at Van Horn. Elsewhere the occurrence, amount, and quality of water varies.

The region probably has no prospects of containing reservoirs of oil or gas, for ancient rocks lie too close to the surface in most of the area. The region is, however, of interest to petroleum geologists, for the rocks here exposed at the surface are similar in age, character, and structure to the rocks in the oil fields farther east that are known only from drilling.

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