RECONNAISSANCE IN THE WESTERN PART OF THE TRANS-PECOS REGION OF TEXAS

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GEOLOGY AND MINERALOGY

The United States Atomic Energy Commission makes no representation or warranty as to the accuracy or completeness of the information herein and makes no recommendation concerning it.
RECONNAISSANCE IN THE WESTERN PART
OF THE TRANS-PECOS REGION OF TEXAS

ABSTRACT

The Trans-Pecos region of southwest Texas is noted for the production of quicksilver, lead, silver, and copper from its several mining districts.

Reconnaissance, which was concentrated in and around these districts, revealed many areas of slightly abnormal radioactivity. Only a few areas, however, showed uranium mineralization.

Mountains and plateaus, separated by intermontaine plains, give way eastward to the broad flats which border the Pecos River. The higher areas expose rocks as old as the pre-Cambrian metamorphic complex, but marine limestones, ranging in age from Paleozoic through Cretaceous, dominate the section. These highly resistant strata hold up many of the highland areas. Older sedimentary rocks predominate to the north, whereas the Cretaceous limestones crop out in the south and east. The youngest, or Tertiary, sedimentary rocks are found only at the southern end of the region. Of the igneous rocks, found mainly in the southern part of the region, the volcanic rocks are more prominent than the intrusives, although few of the younger, basaltic lavas have escaped erosion. Conmagmatic intrusives, ranging from granitic to basaltic in composition, crop out in and near the mining districts. The earlier, and larger intrusive masses tend to be more felsic in composition than the later intrusives. Although the largest mineral deposits occur in sedimentary rocks, the host rocks of many of the relatively small deposits are igneous.

Northwest-trending faults are the dominant structural features and these are reflected in the elongation of the highland areas. Slight variations in this northwesterly trend have been caused by overthrust movements from the southwest. Another normal fault set, of northeast strike and steep dip, is evident throughout the region. These latter faults apparently have most directly influenced the localization of quicksilver, lead, silver, and copper ores in the mining districts. Other, minor faults, caused by local adjustments, also have exerted some influence on localization of these ores.

The hydrothermal deposits show stratigraphic as well as structural controls. All variations between vein and replacement deposits have been found, but the largest of the lead-silver and fluorite deposits are of the latter type. Whereas collapse-breccia and replacement deposits are common to the sedimentary rocks, simple veins are found in igneous and metamorphic rocks. Many of the deposits indicate a low temperature, or epithermal origin. A few, however, have characteristics approaching those of mesothermal deposits.
Small amounts of supergene uranium minerals, and possibly pitchblende in one place, occur in scattered areas within the region. These uranium occurrences are important mainly as guides for future reconnaissance in the region. Apparently, little hope exists for the discovery of important hypogene uranium deposits here, although further traces of uranium may be found. The possibilities for finding other occurrences of supergene uranium minerals are somewhat better. Before any analysis of the region’s uranium potential could be deemed complete, several areas should be surveyed by scintillometer-equipped airplanes. Examination of the supergene deposits in Chihuahua, Mexico, for stratigraphic and structural relations, should, if possible, precede further reconnaissance in the Trans-Pecos region of Texas.

INTRODUCTION

Location and topography

The Trans-Pecos region is the part of Texas that lies between the Rio Grande and the Pecos River, extending from New Mexico southward to the Mexican border (Fig. 1). The mountainous western portion covers much of Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, and Presidio Counties, an area of about 25,000 square miles.

Intermontaine basins separate mountains, plateaus, cuestas, and hogbacks throughout much of the region. In the eastern part, these high areas give way to plains which extend to the Pecos River. Guadalupe, or Signal Peak, which rises to an altitude of 8751 feet, is the higher of two peaks with altitudes over 8000 feet. As far as could be determined, the lowest point of the region lies in the southeastern corner of Brewster County, where the altitude is less than 1500 feet. Accordingly, the maximum relief is more than 7250 feet. The lowlands commonly range from 3500 to 4500 feet in altitude. Rocks are generally well exposed, except in the alluvial filled basins.

Because of structural differences the region is conveniently divided into two parts. The northern part lies in the Basin and Range province, and the southern part lies at the northern edge of the Sierra Madre Oriental, or Mexican overthrust province. The boundary between these provinces is roughly paralleled by the Texas and Pacific Railway, which runs from El Paso eastward through Pecos, Texas (Fig. 2).

Fig. 1--Index map showing that part of the Trans-Pecos region covered in this report
Climate

A semi-arid climate is typical of Trans-Pecos, where the rainfall is reported to average between 8 and 15 inches. Summer rains result in occasional flash floods; except in the higher areas, the resulting streams are generally short-lived. The Rio Grande is the drainage outlet for some of these ephemeral streams, but many drain into intermontaine basins.

The desert-type flora consist mainly of sotol, creosote bush, mesquite lechuguilla, ocotillo, and cacti. Juniper and yucca exist in the higher areas, whereas the highest mountains support forest growths of cypress, fir, maple, aspen, and pine.

Purpose and method of investigation

Geologic and radiometric reconnaissance was carried out in the Trans-Pecos region from June until late September of 1952, to ascertain the possibilities of uranium ores. This region was selected as favorable by the Atomic Energy Commission because of the following factors: (1) the existence of mining districts which have produced considerable quantities of base-metal, silver, and mercury ores, and fluorite; (2) the presence of felsic intrusives throughout much of the region; (3) the several specimens received by, or reported to, the Commission which were found to contain uranium. Further encouragement was given by a report that uranium mineralization had been discovered in Mexico, just across the border from Lajitas, Texas.

Reconnaissance was concentrated in and around the mines of the area. All dumps and accessible underground workings were thoroughly checked, and all leads were investigated, except those for which directions and locations were too vague. In those areas where the prospects were grouped, several of each group were examined unless stratigraphic or structural differences, or both, required examination of the entire group. Where visible uranium mineralization was found, the surrounding area was thoroughly examined. The area included within the Big Bend National Park was not investigated because permission to do so was refused by the Park Service.

Geologic and mine maps were used whenever available, but no geologic mapping was done. Car-borne scintillometer traverses were made wherever feasible. Samples were taken for uranium analyses; also, for laboratory identification of ore and gangue minerals.

No detailed geologic study of the region was attempted. In order to provide the reader with an understanding of the geology, therefore, it has been necessary to borrow heavily from many of the reports listed in the bibliography.

2. F. Miller, Presidio, Texas, oral communication.

- 6 -
Fig. 2--Index map showing the structural divisions of the Trans-Pecos region.

Note: Texas and Pacific R.R. approximates boundary between northern and southern parts of the region.

Acknowledgments

Dr. Russell Gibson, Consulting Geologist, supervised some of the field work of the project, and the writer is indebted to him, also, for criticism of the manuscript. In the field, the writer was ably assisted by T. S. Nye.

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Mr. R. N. Pulliam, Mr. E. Williams, Mr. R. Carr, Mr. F. Miller, and many prospectors and ranchers of the region were extremely hospitable.

GENERAL GEOLOGY

Generally, the rocks of this region may be separated into the older consolidated, and the younger unconsolidated rocks. The older and consolidated rocks, which range in age from pre-Cambrian to Tertiary, are best exposed in the many mountain ranges. The unconsolidated, or bolson, deposits lie in the intermontaine basins, and are in part of Pleistocene age.

The pre-Cambrian rocks, including all of the metamorphics, are exposed in the northern part of the region. Outcrops in the Franklin Mountains reveal 1800 feet 3/4 of quartzite of the Lanoria formation. Overlying this are rhyolitic conglomerate and rhyolite porphyry flows of late pre-Cambrian age. The Carrizo Mountain formation, a complex of quartzite, slate, schists, and metamorphosed igneous rocks, 4/ is exposed in the Carrizo Mountains about 100 miles to the east, near Van Horn (Fig. 2). It is overlain by younger pre-Cambrian red sandstones, cherty limestones, and conglomerates. The presence of quartzite is the only feature common to the pre-Cambrian rocks of both the Franklin and Carrizo Mountains.

Lower Paleozoic strata crop out in several places in the region. Cambrian beds are found around El Paso, Van Horn, in the Marathon uplift, and in the Terlingua region. In the north, the Cambrian sandstones are separated from the pre-Cambrian series by a distinct angular unconformity. Ordovician strata consist of limestones in the northern and chert in the southern portions. Outcrops of the Fusselman limestone in the Franklin Mountains are the only record of Silurian deposition in the entire region. Deposition during Devonian, and perhaps a portion of Mississippian, time

is represented only in the southern part, in the Marathon dome, and in the Solitario and Terlingua regions, by the Caballos novaculite. Excellent exposures of Pennsylvanian limestones are found in the northwest in the Franklin Mountains, to the east in the Van Horn area, and in the southeast in the Marathon, Solitario, and Terlingua regions. Some of these limestones may be of Permian age. Permian limestone, sandstone, and gypsum beds are exposed in the northern part in the highlands northward and eastward from Sierra Blanca, in the south near Shafter, and to the east in the Marathon region.

The only known Jurassic rocks are those of the Malone formation of Upper Jurassic age which crop out in the Malone Mountains. Limestones and sandstones of Cretaceous age are found throughout much of the region. From the north, where thin Middle Cretaceous strata are found, the Cretaceous sequence thickens southward to include the Lower and Upper units, whereas the Lower Cretaceous beds, themselves, become thinner.

The existence of Tertiary sediments in the northern part of the region is uncertain; however, the lower portions of the bolson deposits may be of Tertiary age. Lava and tuffs, with local, interbedded sediments, all regarded by Ross as early Tertiary, are found through much of the southern part. Similar volcanics occur locally in the north. Tertiary intrusives, like the volcanics, are relatively rare in the north, but abound in the southern highlands.

The dominant features of the mountainous part of the Trans-Pecos region are the highlands that trend north to northwest, with intervening lowlands. Topography, in general, reflects the structure; uplifted areas form topographic highlands, whereas the lowlands are the surface expression of structurally depressed areas. The plateaus, hogbacks, and monoclinal slopes of the uplifted areas show the varied degree of deformation of the underlying rocks. The larger igneous masses usually form isolated peaks, or groups of peaks. In the lowlands, a few of which represent broad synclines, bedrock is concealed by the unconsolidated sediments that underlie the plains. Although folding is relatively minor in the northern part of the region, it is intense in many places farther to the south. There, where intrusives and extrusives are abundant, the structure is complicated by tilted and domed strata. The present structures are the result of several periods of deformation.


The northern and southern halves of the region, as defined previously and shown on Figure 2, are structurally very different. Whereas normal faulting, inconspicuous folding, and gently dipping beds characterize the Basin and Range area to the north, steep dips, intense folding, and thrust-faulting predominate in the Mexican overthrust (Sierra Madre Oriental) area to the south.

The major structural features of the northern part are steep-dipping normal faults which border many of the plateau-like highlands. Of the northwest- and northeast-trending fault sets, the former, which parallel the regional elongation, show greater displacement. Both fault sets show chiefly vertical movement. The older, obscurely folded, Algonkian rocks, however, show two different fault trends, northeast and east. Horizontal movement is most important along these older faults.

Although the northwest-trending folds and faults occur throughout the region, in the south they vary locally in strike due to thrusting. Fault blocks, resulting from northwest-trending normal faults, and from thrusts toward the northeast, are the dominant structures. Displacements as great as 2000 feet have been estimated for some of these faults. The thrust faults dip to the southwest and can be followed for distances up to 32 miles. Intense folding is commonly associated with these latter faults, and many smaller northeast-trending faults exist. A few minor east-west faults, with horizontal movement, have been found adjacent to overthrusting.

The Marathon and Solitario domes, in the southern part of the region, are distinctive in that the main structural trend of these two areas is northeast. Those northwest trends common to the rest of the region are also present.

Three pre-Ordovician mountain-building epochs have been recorded in the Van Horn area. The first disturbance resulted in the metamorphism of the Carrizo Mountain formation. Subsequent to erosion and to later deposition of the pre-Cambrian Millican formation, more deformation occurred. Erosive forces again became dominant over mountain-building, and then followed the deposition of the Van Horn sandstone, considered Upper Cambrian or older in age. Deposition of the Lower Ordovician sediments

post-dated the tilting and erosion of the Van Horn formation. The Variscan
deformation of late Paleozoic time caused intense folding in the south, but
the orogeny had little effect in the northern part of the region. The
prominent east-northeast folds and faults of the Marathon and Solitario
domes were developed during this time.

Renewed mountain-building started in late Cretaceous time. Intense
folding and thrusting took place in the Sierra Blanca region, but
defformation was minor in other parts of the Trans-Pecos region. Before
the end of Cretaceous time volcanic activity began; possibly some of the
comagmatic intrusives were contemporaneous with this vulcanism, but most
followed extrusion.

The last period of deformation to affect the region was the
Cordilleran, in late Miocene to early Pliocene time. Folding and faulting
were severe in the south. In the north, where later erosion has been
relatively much less extensive, this orogeny was largely responsible for
the present topography of the region.

ORE DEPOSITS

Since 1880, and perhaps earlier, prospecting in the Trans-Pecos
region has uncovered many mineral deposits. Deposits of iron, mercury,
lead, copper, and silver, as well as small amounts of molybdenum, nickel,
tungsten, and uranium ores are scattered throughout the highland areas.
A few deposits of non-metallic minerals -- fluorite, mica, coal, gypsum,
and sulphur -- have been reported. Only those containing copper, fluorite,
lead, silver, and mercury, have been extensively mined.

Ore deposits of the Shafter, Spar Valley, and Terlingua mining
districts, which have been of considerable economic importance, all lie
within the Sierra Madre Oriental physiographic province. The only area of
similar importance in the northern part of the region is the Van Horn-
Allamoore district, which lies near the southern margin of the Basin and
Range physiographic province. Within each individual mining district,
one or two mines have yielded by far the greater portion of the total ore
production attributed to that district although adjacent areas hold
numerous mineral occurrences. Early in the history of the region these
small deposits incited further prospecting, but interest in them has
since declined.

At least four types of ore deposits are present: vein, replacement,
sink-hole conglomerate, 12/ and collapse-breccia. Veins are common to the

12. Term, "sink-hole conglomerate", suggested orally by W. B. Meek. Accord-
ing to Ross (Geology and ore deposits of the Shafter mining district,
Presidio County, Texas: U. S. Geol. Survey Bull. 928-B, 121-2, 1943),
solution-enlarged openings filled with roughly bedded caliche, which
contains pebbles and boulders; in places these fillings are mineralized.
northern areas where no evidence of thrusting has been found. The lack of replacement deposits there may be due to the existence of the relatively thin shore-line limestone facies. Locations of ore shoots in the veins depend on changes in the strikes and dips of the fissures, and comparatively little disseminated ore occurs. In the southern part of the region, however, where overthrusts exist and where igneous rocks are plentiful, few simple vein deposits are found, and these are enclosed in the intrusive rocks. The thick section of marine limestones contains orebodies formed in collapse-breccias, in sink-hole conglomerates, and by replacement. These deposits show all gradations to the fissure-vein type. Throughout the region, the mineralization is generally characteristic of epithermal deposits, but some is similar to mesothermal mineralization.

In detail, strong structural, and sometimes stratigraphic, controls are exhibited by the ore deposits. It is notable that ore has rarely been localized along the most prominent, northwest-striking, faults. Possibly these, along which greater movement took place, are relatively tight, and thus unfavorable. In the replacement deposits the ore solutions showed extreme selectivity. Whereas fluorite mineralization chose the silty, more permeable limestone and shale horizons, lead-silver mineralization replaced those limestones having higher content of calcium carbonate.

OCCURRENCES OF RADIOACTIVE MINERALS

Many of the ore deposits of the Trans-Pecos region have abnormally high radioactivity but, at most places, it is only slightly above the background reading. Two radioactivity "positive" areas were investigated. One of these, the Rossman prospect, near Allamoore, Texas, has visible secondary uranium mineralization in the form of tyuyamunite. The second locality is in the Franklin Mountains and shows slight abnormal radioactivity. However, it was not possible to identify any uranium or thorium minerals. Both of these occurrences are at the northern edge of the Sierra Madre Oriental, or Mexican overthrust province.

Rossman prospect

This claim, once leased by Mr. W. Rossman, of Pecos, Texas, shows carnotite type mineralization. The minerals are tyuyamunite and an unidentified uranyl vanadate.

This prospect is about 3 miles north-northeast of the Allamoore Post Office in Hudspeth County. Uranium mineralization is limited to one small area of veinlets in an irregular fracture zone which cuts a massive highly silicified limestone of the pre-Cambrian Millican formation. No disseminated minerals were found. One selected chip sample, taken across the veinlets gave 0.025 percent equivalent U$_3$O$_8$, and 0.017 percent U$_3$O$_8$ by chemical analysis.

The higher radiometric assay indicates recent leaching of uranium by meteoric waters. Surveys of the immediately surrounding area failed to detect abnormal radioactivity. Several other prospect pits, however, had been partially filled by wash and could not be thoroughly examined.

**Franklin Mountains**

Small amounts of radioactive material were found in a pegmatitic granite on the east flank of the Franklin Mountains in El Paso County.

Analysis of two select samples gave the following results:

<table>
<thead>
<tr>
<th>Field No.</th>
<th>%U$_3$O$_8$</th>
<th>%U$_2$O$_5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-12863</td>
<td>0.026</td>
<td>0.004</td>
</tr>
<tr>
<td>F-12864</td>
<td>0.019</td>
<td>0.009</td>
</tr>
</tbody>
</table>

The chemical analyses show low uranium content, but the higher radiometric assays indicate that some leaching has been accomplished. The results show merely that there has been slight concentration of radioactive materials in this area.

**CONCLUSIONS CONCERNING URANIUM OCCURRENCES**

Only small amounts of supergene uranium minerals, and possibly some pitchblende, have been found. All other anomalies in radioactivity were apparently due to very small amounts of radioactive material in concentrations of iron oxides or in the host rock. The uranium occurrences are limited to areas along the northern margin of the Sierra Madre Oriental province. Even the deep purple fluorite of the Spar Valley district, a good indicator of uranium in many areas, yielded negative results.

Although alkalic igneous rocks are common, the absence of large or high-grade concentrations of hypogene uranium minerals is not surprising. The hydrothermal deposits of this region are generally of low-temperature, or epithermal origin. Some deposits have
characteristics approaching mesothermal. In most cases, the hypogene minerals of this region are simple oxides and sulfides. Lead-silver ores elsewhere, as in the small deposits of the Colorado Front Range, are associated with some uranium. Similar ores of possibly lower temperature seemingly have none. The complex sulfide and copper ores of deeper origin, with which uranium appears to be so closely related in the larger deposits of certain regions, are apparently absent here. The temperature range between mesothermal and hypothermal appears to be most favorable for the occurrence of uraninite and pitchblende, whereas the Trans-Pecos ores typically appear to be of epithermal origin.

Chemically, limestone might be considered an excellent host for supergene uranium mineralization, and a thickness of thousands of feet of such rock is present. However, permeability is apparently also of considerable importance, and these limestones are generally massive and seemingly with low permeability. Recrystallization, which often results in a considerable increase in permeability \( \frac{14}{14} \) was seen only in the south, in the Terlingua district. There, only those portions of the Devils River limestone in proximity to fractures have been recrystallized. Accordingly, large concentrations of uranium minerals could not be expected in the areas visited.

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Plate 1—Location map showing mines and prospects visited in the Trans-Pecos region, Texas.