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MINERAL RESOURCE SURVEY†
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The information contained in this circular was gathered by a unit of the WPA Mineral Resources Survey of Texas, a project sponsored by The University of Texas, Bureau of Economic Geology. The purpose of this survey is to assemble information concerning mineral products and to gather other geological data and make them available to the public. With this information in the hands of the public, it is reasonable to suppose that industries of value to the State may be developed. The following report is baed on work done in Jeff Davis County by Work Project No. 18940 from April 1, 1942 to August 15, 1942.

PRELIMINARY REPORT ON THE RUTILE AND KAOLIN DEPOSITS OF THE MEDLEY DISTRICT IN JEFF DAVIS COUNTY, TEXAS*

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INTRODUCTION

This preliminary report describes the Medley district in Jeff Davis County, Texas, where kaolin deposits have been found and where rutile has recently been discovered. Baker (2)[1] has already briefly described the Medley Ranch kaolin deposit, but so far nothing has been published on the rutile.

Four months were spent on field work covering reconnaissance, detailed surveying, and excavation. Emphasis was placed on determining the size, relationship, and origin of the rutile and kaolin deposits, and for this purpose over 150 samples were collected throughout the district. The final report will have to await chemical and petrographic analyses of the samples.

The Medley district lies in south-central Jeff Davis County in Trans-Pecos Texas. The district centers in the Medley ranch in the Galveston, Harrisburg & San Antonio Railway Company Survey, Block 1, and covers about 35 square miles. It can be readily reached by county roads from Fort Davis, the county seat, lying to the northeast, from Marfa to the south, and from Valentine to the west. All these towns lie within 20 miles of the ranch headquarters. The nearest railroad connection is at Ryan siding 12 miles to the southwest over a private road running through the Barrel Springs ranch. Valentine, Ryan siding, and Marfa are all on the Southern Pacific Railroad. Valentine is located in Jeff Davis County, Ryan siding and Marfa in Presidio County. (See fig. 1.)

TOPOGRAPHY AND DRAINAGE

The Medley district lies in the southern part of the Davis Mountain physiographic province which occupies central Jeff Davis County. The Davis Mountains culminate in Mount Livermore with an elevation of 8,382 feet which is located about 7 miles north of the district. The Medley district has an average elevation over one mile high with a relief of nearly 1,000 feet.

The present topography is largely the result of erosion which has broached and at places entirely removed the massive lava flows which formerly covered the entire Medley district. The lavas are highly jointed, and when the underlying softer formations, consisting of tuffs and ashes, collapse, they form sheer cliffs whose bases are strewn with talus (3). This type of topography is well developed at Mueller's Red Mountain in the Texas & Pacific Railway Company Survey, Section 23, Block 2, where erosion has reached the stage of leaving a lava-capped outlier.

The distinguishing topographic and geologic features of this district are the mountains, ridges, and knobs capped by massive indurated silicified tuff deposits, with which the rutile and kaolin deposits are closely associated. The hard tuffs are highly jointed into irregular blocks and weather by exfoliation into boulders which range in size up to 10 feet in diameter. The weathered surfaces of the boulders are colored white and contrast sharply with the blocky fragments of the lavas which are a dark brownish red. They are well exposed on Mueller's White Mountain in the Texas & Pacific Railway Company Survey, Section 14, Block 2, and also on Medley's White Mountain in the Galveston, Harrisburg & San Antonio Railway Company Survey, Section 7, Block 1.

The climate is semi-arid with an average rainfall of 15 inches. However, the rains are frequently torrential, resulting in flash floods which cause severe erosion on the flanks of the mountains as well as in the canyons. There are no large springs; consequently, all streams are intermittent. Water can be obtained almost everywhere in the larger gravel-filled valleys in wells less than a hundred feet in depth. The main drainage is in a southerly direction. The closest river is the Rio Grande which flows southeast and which at its nearest point lies 40 miles to the southwest.

HISTORY AND DEVELOPMENT

The early history of the Medley district is centered around attempts to explore for kaolin deposits. Some shallow pits were opened before 1917 on the East Line & Red River Railroad Company Survey, Section 6, Block WJG 3. There followed a period of intermittent

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[1]Figures in parentheses refer to numbered entries in the bibliography.

†Unfortunately the supply of the several maps originally accompanying this circular is exhausted, and it is not possible to replenish the supply.

exploration and development during which the Micolithic Company of Houston opened a pit of fair size on top of a mountain in this same section. This company built an inclined tramway up the side of the mountain, the remnants of which can still be seen. (See Fig. 4).

About 1930, the D'Hanis Brick and Tile Company of D'Hanis opened some pits and adits on the Galveston, Harrisburg & San Antonio Railway Company Survey, Section 6, Block 1, which adjoins the section previously described on the south. This lower section is known as "Lower Six" in contrast to "Upper Six."

In 1940 some pits and adits were opened on Upper Six in a search for rutile but without apparent success. At the present time there is no development work going on in the district.

Rutile was discovered by James H. Parker, E. M., on top of Mueller's White Mountain in the Texas and Pacific Railway Company Survey, Section 14, Block 2, in 1940. This section is on the Mueller ranch south of the Medley ranch. Numerous pits and trenches were opened and an adit with cross cuts and winzes was driven into the flank of the mountain. The underground workings cover over 850 linear feet and the surface workings at least twice that much. A kaolin deposit was discovered during the course of exploration in the adit.

The particular locality referred to as the Mueller prospect has more prospect holes on it over a limited area covering about 50 acres than anywhere else in the district. As it shows both rutile and kaolin deposits on the surface and below ground, and offers ready access for their observation, the Mueller prospect is a favorable locality for the study of these minerals in the Medley district. (See Fig. 3).

Minor exploration work has been done on some of the other sections in the district, and all known explorations are indicated on the accompanying map, figure 2.

IGNEOUS ROCKS

The outcropping rocks are mainly lava flows, tuffs, and volcanic ash. This series is predominately rhyolitic. In the northeastern part of the Davis Mountains the section reaches a thickness of 2000 feet (3). There are some felsites, trachytes, and basalts at the boundaries of the district.

The lavas are massive, jointed, and reddish brown on weathered exposures. Freshly broken surfaces show a gray color, with a bluish cast in some cases. They are all more or less prophyritic, the predominant phenocrysts being feldspars. Some of the lavas are amygdoloidal, others vesicular. Flow structure and banding are not uncommon.

The tuffs, consisting of tuff breccias, agglomerates, and conglomerates, are interbedded with the lavas. They are generally light in color, being white, buff, pink, red, green and mottled. They have also locally undergone considerable weathering and hydrothermal metamorphism and consequently show a great deal of variation in structure and texture. This feature is well seen in the lower trenches (Nos. 1, 4, 5, and 6) in Section 23, on the slope of Mueller's White Mountain.

The hard silicified tuffs are white to grayish white on the outside but show an "oyster"-gray to gray-black color on freshly broken surfaces. This is particularly noticeable underground. Their extreme hardness is characteristic and causes them to ring when struck with a hammer. Some of these tuffs contain a large amount of quartz crystals which are minute but cause them to sparkle in the bright sunlight. There is a gradation into fine hard quartz masses and even into pulverent quartz masses, occurring in and above the Mueller adit.

A marked feature of the hard silicified tuffs, particularly noticeable in massive outcrops, are the cavities. These range in size from pinholes to cavities large enough to accommodate a dozen men. A medium-sized cave is situated on the southwest side of the hard silicified tuff ridge just east of the adit entrance (Fig. 3).

Closely associated with the above, and grading into one another, are the tuffs and ashes which are only slightly silicified. These range from a grayish-white coarse gritty material to a fine white flour-like powder. They are found lining the walls of the cavities and throughout the adit. The coarse gritty material is highly porous and in places contains innumerable solution cavities.

Intrusive syenite porphyries occur on the northeast side of the district. They weather into rounded masses like the granites, and their surface exposures have a brownish color. Freshly broken specimens are colored predominately gray. Their texture varies from fine to coarse. On the mountain at Bloy's Camp Meeting Ground in Section 20, the feldspars are nearly an inch long, and the rock approaches a pegmatite. Not far from this locality the syenite porphry grades into aplite.

The age of the associted lavas and tuffs is considered to be Cenozoic. The complex rests upon Upper Cretaceous sedimentaries found in northwestern Jeff Davis County (6).

STRUCTURE

The Davis Mountains are structurally a part of the Rocky Mountain Front Range and occupy an extensive structural downwarp (1). The present mountains owe their origin largely to the effects of erosion on the lava flows which covered this area. They are the remnants of a broad plateau which was gently folded and severely dissected (3). In the south-central part of the area is the Sawtooth Range extending for about 16 miles from Sawtooth Mountain through Mr. Livermore to Blue Mountain. The backbone of this range is a syenite porphyry stock. The intrusion of this igneous mass has formed a broad anticline (3).

The Medley district is on the southwst flank of the Sawtooth anticline. Here the lavas dip gently (about 2 degrees) to the southwst. The nearest outcrops of syenite porphyry lie about 2 miles northeast of the silicified tuffs and their associated deposits. Although the intrusive outcrops are small and scattered, they are undoubtedly apophyses of the Sawtooth syenite stock.

The general strike of the combined silicified tuff outcrops taken in mass is in a northwest-southeast direction, parallel to the axis of the Sawtooth anticline. Individual ridges trend at right angles to this. The silicified tuff outcrops occur in irregular masses and as dikes, some of the latter being over one-half mile long. Where two dikes meet at right angles, large masses of silicified tuff are found, such as at Mueller's White Mountain. The adit shows over 100 feet vertically of the tuffs and ashes composing the center of a dike.

A ring dike of silicified tuff occurs on the George Jones ranch in the northwestern part of the district in East Line & Red River Railroad Company Survey, Section 35, Block WJG 1. The dike averages 300 feet in width, and the ring it forms is about one-half mile in diameter. It apparently surrounds a volcanic crater. On the northwest outer edge of the ring dike is a large cave, the walls of which are lined with fine-grained siliceous gray tuff. The ring is breached on the south.

The only faulting definitely determined in the district is a shear zone which runs through the northern end of the Mueller adit. The shear zone has a general direction of N. 40° W. and dips 65 degrees northeast. The amount of throw could not be determined. This zone has not been obsrved on the surface except in the pits over the adit. The greatest concentration of rutile follows this shear zone. Jointing, as already pointed out, is common throughout the district. A prominant set of joints runs N. 10° W. and is almost vertical. Another set runs N. 35° E. and dips 55 degrees northwest. A minor set runs N. 35° W. and dips 50 degrees northeast. There is also a horizontal joint system. These joints are most irregular and do not seem to correspond to the regional structural pattern. It is possible that some of them were produced by earthquakes, such as the Valentine earthquake, which affected this district.

ECONOMIC GEOLOGY

Rutile

In the region under consideration, rutile occurs either as minute crystals disseminated in the hard silicified tuffs or as patches or schlieren in the tuffs and ashes. Varying amounts of very fine quartz are usually associated with it. The color underground is predominately bluish gray. On the surface, the color ranges from "powder"-blue to a dark blue-black, depending upon the concentration of the mineral. Exposures of all types are found in the Mueller adit and above it in the trenches and pits.

A report by Dr. V. E. Barnes, of the Bureau of Economic Geology, on a selected sample of ore from the adit states that the color described above is probably caused by reflection. The true color of the individual crystals under the microscope is an almost opaque brown to a deep clear brown. The size of the crystals can be judged by the fact that 80.5 percent passed through a 270-mesh screen. The report concluded that the minus 270-mesh material was the richest in rutile and that the rutile content became less as the material became coarser.

KAOLIN

Kaolin occurs in large masses. When pure it is a dead white color and has an unctuous feel. Some of the kaolins in this district are stained various shades of pink but upon burning turn white. This color is due to iron discoloration and occurs only close to the surface.

Pure Kaolin can be readily cut with a knife and shaved into particles resembling soap flakes. The fresh cut surface has a waxy luster. The picks of the workmen leave distinct indentations which frequently also have a waxy luster and can be readily recognized. When immersed in water, the pure kaolin disintegrates within a few minutes, giving off air bubbles. The underground samples have a damp feel, probably due to combined and absorbed water. If a piece is slightly moistened with the tongue, it will have a strong tendency to stick. Upon exposure to the air, pure kaolin will become indurated. It is then much harder to recognize. Moreover, the kaolin grades both vertically and horizontally into the tuffs, ashes, and powdered quartz grains previously described. There are all grades ranging from pure kaolin on the one hand to pure silica on the other.

These varieties are all grayish-white to white in color and extremely hard to differentiate as they merge imperceptibly into one another and into pure kaolin. Their hardness varies only slightly, and feel is a poor criterion. On and close to the surface, the additional presence of caliche must be taken into consideration. Weight helps a little, as pure kaolin is decidedly heavier than either caliche or tuff, but the best means of rapidly climinating the former is the use of a little dilute hydrochloric acid. The best test is to try a little of the substance between the teeth; pure kaolin contains no gritty material (9).

Kaolin of all degrees of purity can be found in and around the Mueller adit. Pure Kaolin is well exposed in the unroofed chamber at the adit entrance and also in the first cross cut inside the adit. An excellent contact of pure kaolin with silicified tuff is exposed in the northwest corner of lower Section 7 on the Medley ranch. Here a sheer cliff of silicified tuff rising over 100 feet overlies pure kaolin with what is apparently a sharp contact. However, close examination shows that the contact is gradational both vertically and horizontally.

The kaolin in this district has been formed in part at least by alteration of rhyolite tuffs. A transition zone ranging from hard massive red tuffs to pure white kaolin occurs in trench No. 3 just below the adit dump on the west side of the path. From west to east the section shows that the tuffs gradually alter, first showing veins of a waxy white mineral, probably either montmorillonite or beidellite, then becoming pink and more like kaolin, and finally being replaced by pure soft white kaolin. This transition from tuff to kaolin takes place within a distance of 50 feet. Similar transition zones from tuffs to kaolin may be seen on the Medley ranch, particularly in Upper and Lower Section 6.

ORIGIN

The origin of the rutile and kaolin deposits in the Medley district appears to differ from that of generally known deposits. The final answer to this proglem will have to await detailed information, but there is enough evidence at hand to arrive at certain general conclusions.

Baker (2) has suggested that hydrothermal alteration of the original ash by hot waters and vapors given off by the intrusive mass previously described has brought about the formation of the kaolin. Laughlin (5) quoting Lindgren states that some kaolin is attributed to ascending water derived from volcanic sources.

The following hypotheses are suggested: Following the intrusion of the Sawtooth stock, but before it had solidified, tension cracks developed in the overlying lavas and tuffs at the southwesterly end. These tension cracks or fissures ran roughly parallel with the main axis of the anticline formed by the intrusion, but a subordinate system at right angles to the above was also developed. Aqueous solutions and vapors escaping from the stock arose along these fissures. In passing through the overlying formations, hydrothermal alteration occurred which resulted in varying changes in the solutions, as well as the formations through which they passed. Reaching near the surface the liquids began to cool, depositing their loads which may have been carried in suspension, as colloids, or in solution.

The fact that the silicified tuffs, ashes, and kaolin intergrade both vertically and horizontally suggest that they were formed more or less contemporaneously. Furhermore, the absence of kaolin and rutile at some of the massive silicified tuff outcrops indicates that the solutions must have varied in composition. The occurrence of rutile in the shear zone and along small fissures and cracks would indicate that it was deposited last.

ECONOMIC CONSIDERATIONS

The element titanium occurs in more than sixty mineral species and has its largest concentration in the minerals rutile (TiO_2, 60 percent titanium when pure) and ilmonite ($FeTiO_3$), or titaniferous magnetite (8). Rutile is the chief source of the element, but its occurrences in commercial quantities are fw, and so far no deposits have been developed in Texas.

The chief consumption of titanium is in the manufacture of pigments. Its use is important in the production of ferro alloys. A small percentage (0.5 to 2 per cent) when added to steel or cast iron greatly increases the tensile strength of these metals. The addition of titanium brings about a reduction of oxygen and nitrogen which makes the metal more homogeneous and less porous. This degassifying process used in connection with aluminum is the so-called titanium-thermit process. Titanium is used in the production or manufacture of white and yellow pigments in paints, enamels, rubber, and plastics; electric arc welding rods; mordants in dyeing; catalysts in chemical reactions; ceramic glazes, smoke screen in warfare; ferro alloys and tool steel (10).

The chief production of rutile in the United States comes from Virginia and Arkansas, but there is not sufficient for present war demands. In Virginia, rutile occurs as grains and segregations in syenite or as a constituent of dike-like nelsenite bodies. The chief imports before the war come from Norway where rutile is found at Kragero in an aplite dike, either as grains or as schlieren (8).

The element aluminum presents one of the most widespread occurrences in nature, but its extraction as a metal has up to now been limited to that from a few minerals, chiefly bauxite ($Al_2O_32H_2O$), gibbsite ($Al_2O_33H_2O$), and cryolite ($3NaF.AlF_3$). These minerals are listed in order of their economic importance and theoretically contain respectively 39.13, 34.6, and 12.8 per cent of the metal (7).

The mineral kaolin ($H_4Al_2Si_2O_9$) contain 39.5 percent of alumina (21.6 per cent of aluminum), and although not utilized so far for extracting the metal may offer valuable reserves. Various chemical processes for extracting alumina from kaolin are undergoing experimentation. The Tennessee Valley Authority has announced the discovery of a few process which it claims will yield alumina commercially for aluminum production from clay (11).

In addition to its possible use as a reserve for the metal, the uses of which are too widely known to require further comment, kaolin is used chiefly in the ceramic industries — whence the name china clay. It is also used in the manufacture and preparation of printing papers; rubber, cement, paints, linoleums, oil cloths, chemicals, and miscellaneous fillers (11).

Most of the American kaolins come from Georgia and the Carolinas. Formerly a large amount was imported from Europe. especially from the Cornwall district in England. Two occurrences of high-grade kaolin are known in Texas. One is described in this report; the other lies in Real County (2).

So far only one rutile prospect, the Mueller prospect, has been suffuciently developed to warrant any opinion as to its economic possibilities. In the writer's opinion, subject to the results of analysis of the samples, there is not sufficient ore in sight in this prospect to warrant commercial development. However, further exploration in the district may develop such a deposit. Tests made by the U.S. Bureau of Mines have shown that Texas rutile can be concentrated (4).

There are ample kaolin deposits available for development, particularly if the impure as well as the pure kaolin can be profitably extracted. A good-sized body of pure kaolin has already been blocked out on the Mueller prospect, and other can probably be developed at the Medley prospects with a little additional work. The use of a small portable core drill capable of drilling either horizontal or vertical holes to a depth of about 50 feet would greatly facilitate this.

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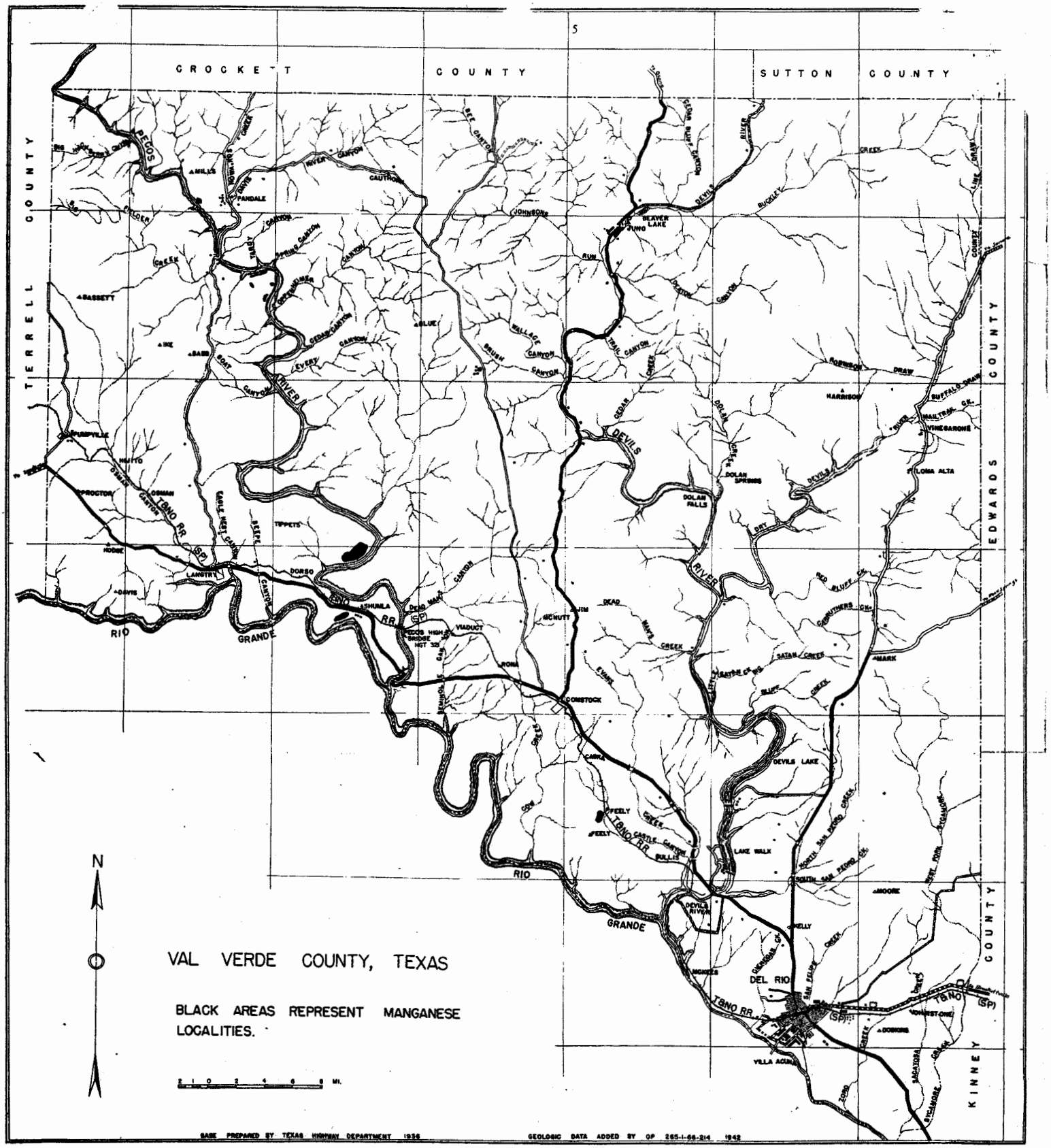
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SUTTON COUNTY
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EDWARDS COUNTY
KINNEY COUNTY
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LANGTRY
DORSO
COMSTOCK
TIPPETT
PANDALE
BASSETT
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VINEGAROON
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LAKE WALK
MOORE
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