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Uranium in West Texas--Paper Delivered June 3, 1975, AAPG-SEPM Rocky Mountain Section Meeting, Albuquerque, New Mexico

By

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This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards and nomenclature.

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Introduction

In west Texas, the part north of the Pecos River, anomalous uranium concentrations occur in the Tecovas and Trujillo Formations of the Dockum Group of Late Triassic age, the Edwards Limestone of Early Cretaceous age, the caliche caprock of the Ogallala Formation of Pliocene age, and the Pleistocene Blanco and Tule Formations, Rita Blanca lakebed deposit, and Bandelier and Pearlette ashes. The occurrences in Pleistocene rocks are a mere curiosity at this time, except the Rita Blanca lakebed deposit is large and of higher grade than the rest. Several occurrences of low-grade rock in the caliche caprock of the Ogallala Formation southeast of Lubbock are of interest because of the recent discoveries of large deposits in calcrete (caliche) in Western Australia. The single occurrence of ore-grade material in Cretaceous limestone is probably insignificant. Most of the ore-grade material is found in the Dockum Group, chiefly in the Trujillo Formation and mainly near Post. I plan to briefly describe the geographic and geologic setting of each group of deposits and to assess each group's resource potential.

Let us look at the very generalized north-south geologic section from Amarillo to Midland shown on figure 1. This cartoon shows several interesting regional features. First, the Pliocene Ogallala Formation rests unconformably with great erosional relief on the Triassic Dockum Group in the north and on Lower Cretaceous rocks in the south. Rocks of Jurassic and Late Cretaceous ages are absent in west Texas. Figure 1 also shows that the Tecovas Formation laps up on to the Matador arch, locally pinching completely out, and that the basal Camp Springs Conglomerate of the Tecovas occurs only to the south of this arch. Finally, it shows that the Dockum Group lies on progressively older Permian rocks from north to south, Guadalupe in the north and Ochoa in the south. Please keep these regional features in mind as I describe the uranium occurrences. Before leaving this slide, note that the Pleistocene deposits deposited in small and shallow basins were too thin and localized to show on the slide, and note too the location of the Post district--where most of the uranium ore has been produced.

Uranium in Triassic rocks

Triassic rocks of west Texas are in the eastern half of the "Southwest Triassic Basin" that is separated from the Colorado Plateau by the Rio Grande trough and also lies east of Rocky Mountain Front. In west Texas the outcrop belt of Triassic along the Canadian River on the north (fig. 2), the southern High Plains escarpment on the east, and the Pecos River on the south is essentially along the eastern and southern depositional edges of the "Southwest Triassic Basin." The Triassic in the outcrop ranges from a couple hundred to about 600 feet thick but thickens to more than 2,000 feet in the subsurface near the Texas-New Mexico border.

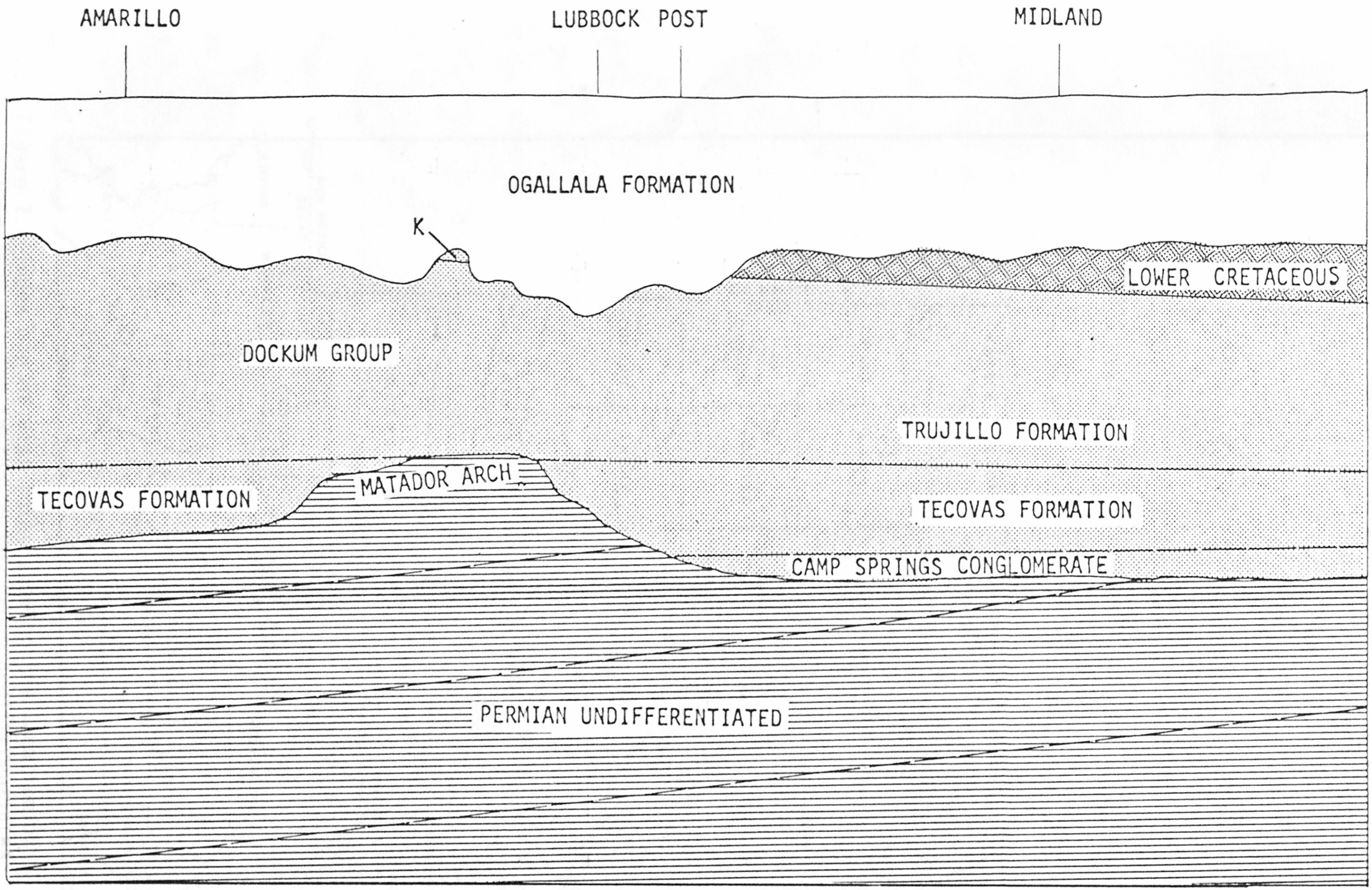

Figure 1.--Highly generalized north-south geologic section from Amarillo to Midland, Texas.

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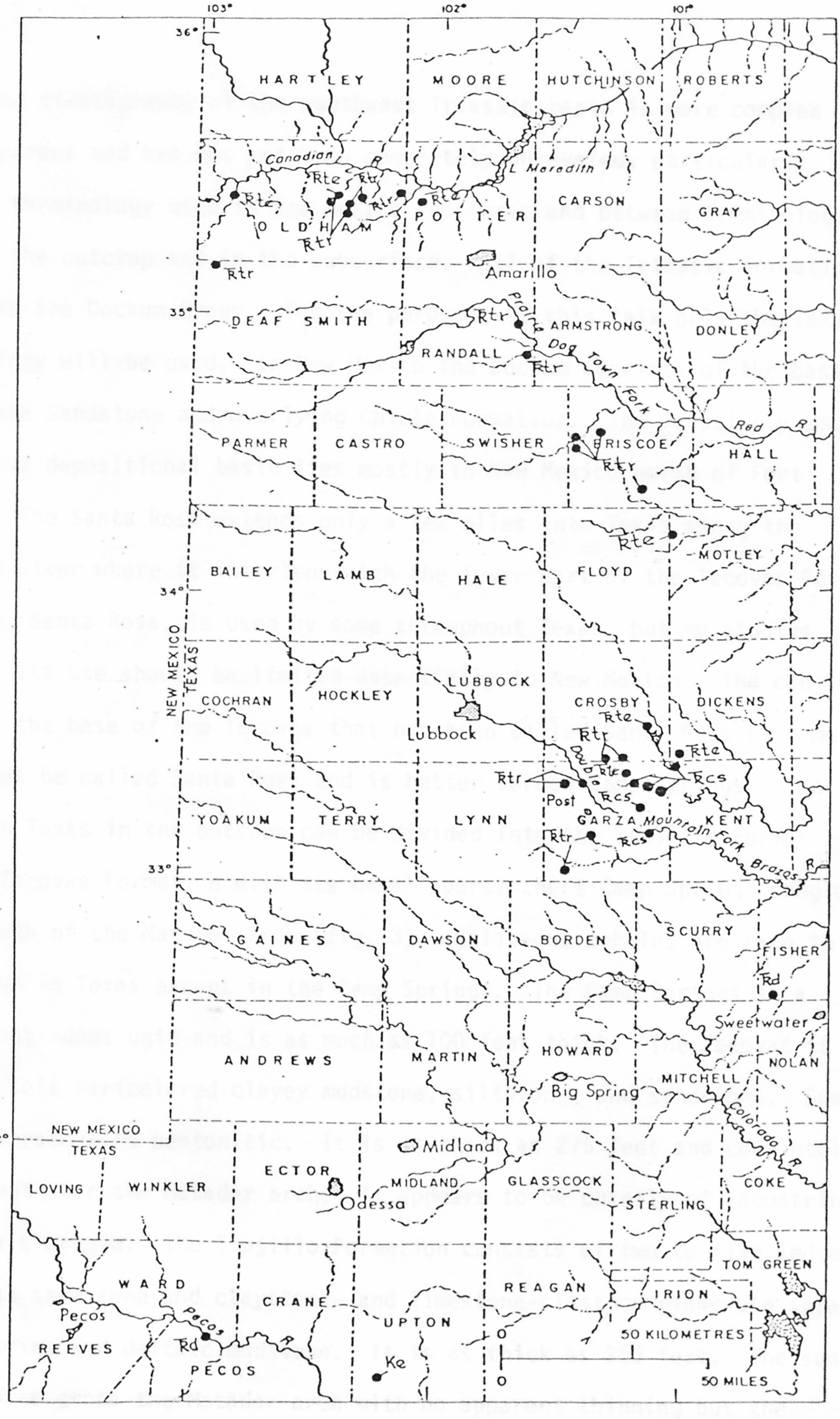
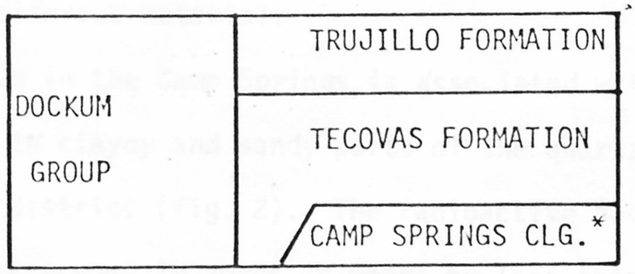


Figure 2.--Index map of west Texas showing the location of anomalous uranium in the Dockum Group undifferentiated (Ꞧ d), Camp Springs conglomerate of Beede and Christner (1926) (Ꞧ cs), Tecovas Formation (Ꞧ te), Trujillo Formation (Ꞧ tr), and Edwards Limestone (Ke).

Revised

The stratigraphy of the southwest Triassic basin is more complex than apparent and has not yet been completely unraveled, particularly between terminology used in New Mexico and Texas and between terminology used at the outcrop and in the subsurface. All of the Triassic formations belong to the Dockum Group. For the purposes of this talk only the Texas terminology will be used. In New Mexico the Dockum consists of the basal Santa Rosa Sandstone and overlying Chinle Formation. The relatively small Santa Rosa depositional basin lies mostly in New Mexico north of Fort Sumner. The Santa Rosa extends only a few miles into Texas along the Canadian River where it interlens with the lower part of the Tecovas Formation. The term, Santa Rosa, is used by some throughout Texas, but my studies indicate its use should be limited essentially to New Mexico. The conglomerate at the base of the Tecovas that has been called Santa Rosa by some should not be called Santa Rosa and is better termed Camp Springs. The Dockum in Texas in the outcrop can be divided into the Trujillo Formation and the Tecovas Formation with its basal quartz-chert Camp Springs conglomerate south of the Matador arch (fig. 3). Siliceous pebbles are rare in the Dockum in Texas except in the Camp Springs. The Camp Springs is a fairly continuous unit and is as much as 100 feet thick. The Tecovas is mostly a soft varicolored clayey mudstone, siltstone, and sandstone. Some of the claystone is bentonitic. It is as thick as 275 feet and completely pinches out over the Matador arch. It appears to be chiefly of lacustrine and deltaic origin. The Trujillo Formation consists of two to five ledges of fluvial sandstone and claystone- and limestone-clast conglomerate separated by lacustrine and deltaic mudstone. It is as thick as 250 feet. The sandstone bodies cross the Matador arch with no apparent thinning but the



*BEEDE AND CHRISTNER, 1926

Figure 3.--Stratigraphic chart of the Late Triassic Dockum Group in west Texas.

Revised

interleaved mudstone bodies thin and even pinch out over the arch. At the Narrows of Tule Creek the Trujillo consists entirely of sandstone several hundred feet thick.

Now let us turn to the distribution of uranium in the Dockum Group.

Small anomalous areas with radioactivity of 2 to 5 times background are widespread in the Dockum Group generally in grayish and greenish rock and carbonaceous material. Some spots show 10 times and more uranium over normal background amounts. Two-thirds of the occurrences shown on the map contain less than 0.10 percent U_3O_8 and are small, containing only a few tons of uraniferous material.

Uranium in the Camp Springs is associated with carbonized and silicified fossil wood in clayey and sandy parts of the quartz-chert conglomerate only in the Post district (fig. 2). The radioactive pockets are generally a metre or less across in zones, a metre or less thick, and 100 metres across. Tyuyamunite was identified in one occurrence. The grades range from 0.003 to 0.08 percent U_3O_8. Trial shipments of 33 tons of conglomerate from the MacArthur ranch in northwest Kent County assayed only 0.01 percent U_3O_8 and 13 tons of pebbly claystone from the Adams prospect in Garza County assayed 0.08 percent U_3O_8.

Uranium in the claystone of Tecovas is associated with either carbonaceous plant material or cuprous spherules and nodules from Post district northward into the Canadian River valley (fig. 2). Grades range from 0.003 to 0.03 percent U_3O_8. The most noteworthy cuprous deposit is on Negro Hill in Crosby County where sparse nodules that average about 1 cm across are scattered through a nearly 2 metre thick zone for about 15 metres along the outcrop. An analysis of a nodule showed 0.03 percent U, 7 percent Cu, and 0.1 percent V.

Uranium in the Trujillo Formation occurs from the Post district northward into the Canadian River valley (fig. 2). The only production of ore-grade (>0.1 percent U_3O_8) from the Dockum in Texas has been from the Trujillo. It totals about 780 tons averaging about 0.20 percent U_3O_8. Of this, all but 12 tons was from the Post district. This 12 tons of ore was produced from the Rattlesnake mine on the Saul ranch in southern Briscoe County.

The most common host rock in the Trujillo Formation is limestone-pebble and pellet conglomerate particularly in and near concentrations of carbonized plant pockets and where the conglomerate contains microscopic humic impregnations. Calcareous sandstone also contains uranium. The grades of samples range from 0.003 to several percent U_3O_8. The mineralogy is simple. Several attempts to identify uraninite and coffinite in high-grade samples failed so it is concluded that primary ore consists of a urano-organic compound. Tyuyamunite and metatyuyamunite are the most common secondary minerals. Others identified are autunite, meta-autunite, bayleyite, liebigite, and cuprosklodowskite. The deposits generally consist of small pockets less than one metre long in zones one-third metre thick and as much as 250 metres long near the base of fluvial channels in the Post district. The channels form a system that trends westward and northwestward. Some drill exploration has been done along extensions of these trends in the area southeast of Lubbock, but apparently no large deposits were found.

The largest deposit in the Post district is on the Eubank ranch which yielded about 450 tons. This deposit is in the basal sequence of limestone-pebble conglomerate and thin interbeds of sandstone of the Trujillo. The deposit consists of irregular discontinuous bodies a few centimetres to two-thirds metre thick in a single horizon about 15 metres wide and 30 metres long exposed in an open cut and a 25 metre long drift. Primary ore consists of sparse uraniferous carbonized plant remains but mostly of uraniferous microscopic organic (humic) impregnations as rims in calcareous mudstone cement around limestone pebbles, pellets, and grains. Oxidation has produced sparse amounts of tyuyamunite and metatyuyamunite, chiefly coating joints and bedding surfaces.

The potential for finding large resources in the Trujillo in west Texas is thought to be only moderate because of the sparsity of volcanic and granitic source rocks. The larger deposits range from a few 100 tons to about 1,000 tons of ore. Most of these are in tight impermeable limestone-pebble conglomerate that weathers and leaches less readily than permeable sandstone. Poor conditions for preservation of uranium deposits is one factor that lessens the potential for finding larger deposits if they ever did exist. The Dockum in west Texas has undergone a long period of leaching for it is deeply dissected by the Pliocene Ogallala; evidence indicates that Jurassic and Cretaceous rocks may never have been deposited over some parts of the Dockum (particularly in the northern part of the area), and the general eastward flow of oxygen-bearing ground water from the recharge area of the Pecos River in New Mexico to the escarpment in west Texas has leached some or all of the uranium from pre-existing deposits. Exploration for finding large deposits should be in areas where favorable Triassic rocks have been protected from leaching.

Uranium in Cretaceous rocks

The only known occurrence of uranium in Cretaceous rocks is near the top of the Edwards Limestone of Early Cretaceous age at King Mountain in Upton County (figs. 2 and 4). According to Eargle (1956) uranium vanadates coat joint surfaces and fill cavities as much as 2 m below the ground surface. A channel sample of jointed limestone contained 0.002 percent U and 0.004 percent eU. A small select sample of weathered limestone containing abundant uranium vanadate contained 8.52 percent U. The uranium was most likely deposited from ground waters issuing through joints near the surface of the ground in recent time. This prospect and the Edwards has little potential.

LOWER CRETACEOUS UNITS	GEOGRAPHIC DISTRIBUTION
Duck Creek-Kiamichi shale	Post & southward; locally absent due to pre-Ogallala erosion
Edwards limestone	Floydada & southward- mostly absent N. of Post
Comanche Peak limestone	Post and southward
Walnut Formation	Post and southward
Antlers sand	Post and southward

Figure 4.--Stratigraphic chart of Lower Cretaceous formations in west Texas.

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Uranium in the Ogallala Formation

Anomalous radioactivity occurs in the caprock caliche of the Ogallala Formation at two localities--Clark Wood Ranch (fig. 5, loc. 6) and Benson Lake area (fig. 5, loc. 7), both southeast of Lubbock and on the Double Mountain Fork of the Brazos River. On the Wood Ranch, the upper 10 metres of caliche is anomalous for about 30 metres along the outcrop. Channel samples of "hot spots" showed 0.0023 and 0.0025 percent U. From Benson Lake upstream for 1500 metres to Lake No. 3, anomalous radioactivity is noted near the top of the caliche. At Lake No. 3, radioactivity in one place is uniformly distributed throughout a conical hill of caliche about 6 metres high and 80 metres in diameter. Grab samples of caliche here showed 0.014 to 0.017 percent U, in near radioactive equilibrium. These occurrences in caliche are of some economic interest because of recent discoveries of large high-grade vanadate uranium deposits in calcrete (caliche) at Yeelerie, Western Australia. The depositional history of the Ogallala has some analogies to that of the host rocks at Yeelerie. Explorationists ought to be alert to the caliche caprock and to younger caliche exposed intermittently from west Texas to the Gulf of Mexico.

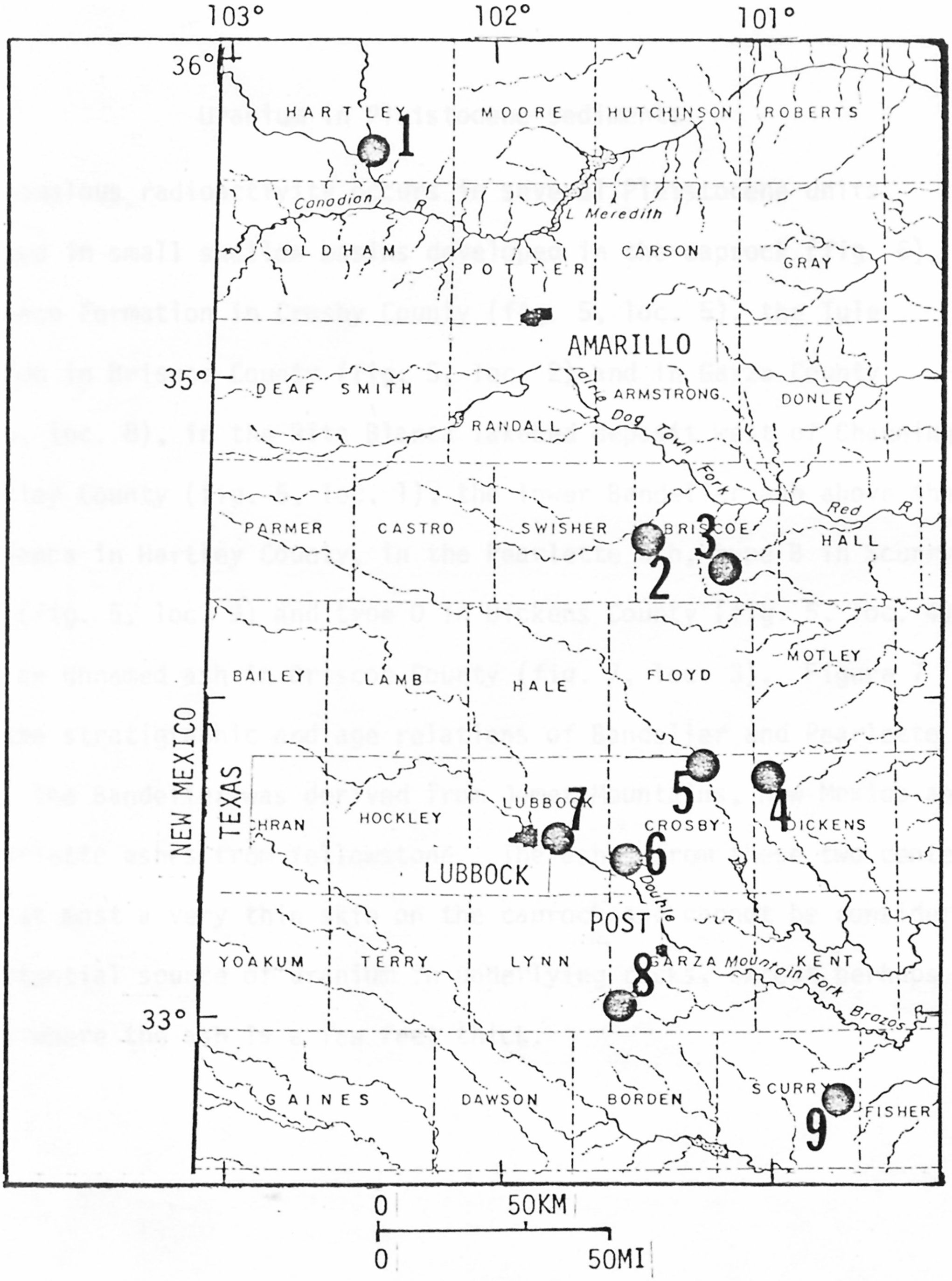

Figure 5.--Index map to anomalous radioactive localities in Cenozoic rocks of west Texas.

Revised

Uranium in Pleistocene sediments

Anomalous radioactivity occurs in several Pleistocene units deposited in small shallow basins developed in the caprock (fig. 6), the Blanco Formation in Crosby County (fig. 5, loc. 5), the Tule Formation in Briscoe County (fig. 5, loc. 2) and in Garza County (fig. 5, loc. 8), in the Rita Blanca lakebed deposit west of Channing in Hartley County (fig. 5, loc. 1), the lower Bandelier ash above the Rita Blanca in Hartley County, in the Pearlette ash, type B in Scurry County (fig. 5, loc. 9) and type O in Dickens County (fig. 5, loc. 4), and in an unnamed ash in Briscoe County (fig. 7, loc. 3). Figure 7 shows the stratigraphic and age relations of Bandelier and Pearlette ashes. The Bandelier was derived from Jemez Mountains, New Mexico and the Pearlette ashes from Yellowstone. The ashes from these two centers formed at most a very thin skin on the caprock and cannot be considered as a potential source of uranium in underlying rocks, except perhaps locally where the ash is a few feet thick.

PLEISTOCENE UNITS	GEOGRAPHIC DISTRIBUTION
Pearlette ash	Widely scattered
Bandelier ash	Widely scattered
Rita Blanca lake bed deposit	West of Channing
Tahoka formation	South of Lubbock
Tule formation	Tule Canyon & SE of Lubbock
Blanco formation	Blanco Canyon

Figure 6.--Stratigraphic chart of uranium-bearing Pleisotocene rocks.

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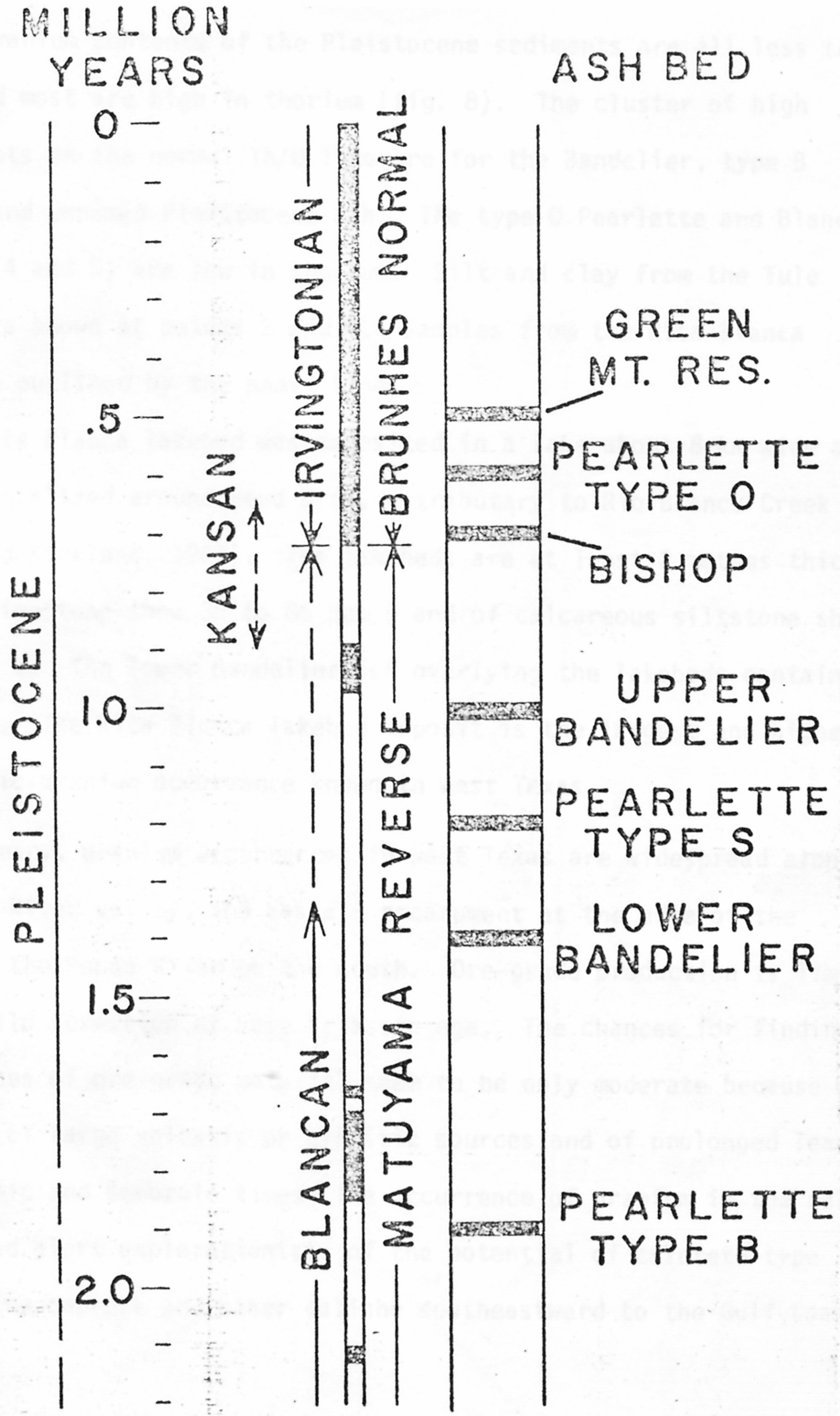

Figure 7.--Stratigraphic relations of Pearlette, Bandelier, and other Pleistocene ashes.

AFTER IZETT AND OTHERS, 1972

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The uranium contents of the Pleistocene sediments are all less than 100 ppm, and most are high in thorium (fig. 8). The cluster of high thorium points on the normal Th/U line are for the Bandelier, type B Pearlette, and unnamed Pleistocene ash. The type O Pearlette and Blanco ash (points 4 and 5) are low in thorium. Silt and clay from the Tule Formation are shown at points 2 and 8. Samples from the Rita Blanca lakebeds are outlined by the heavy line.

The Rita Blanca lakebed was deposited in a lake about 8 km wide and 13 km long localized around Sand Draw, a tributary to Rio Blanco Creek (Anderson and Kirkland, 1969). The lakebeds are at least 2 metres thick. Samples of limestone show 35 to 86 ppm U and of calcareous siltstone show 13 to 38 ppm U. The lower Bandelier ash overlying the lakebeds contains 6 to 8 ppm U. The Rita Blanca lakebed deposit is the largest and highest grade Cenozoic uranium occurrence known in west Texas.

In summary, uranium occurrences in west Texas are widespread along the Canadian River valley, the eastern escarpment at the edge of the caprock, and the Pecos River on the south. Ore-grade production is limited to the Trujillo Formation of Late Triassic age. The chances for finding large resources of ore-grade material seem to be only moderate because of the sparsity of large volcanic or granitic sources and of prolonged leaching during Mesozoic and Cenozoic times The occurrence of uranium in the caliche caprock should alert explorationists of the potential of calcrete-type deposits in the caprock and other caliche southeastward to the Gulf Coast.

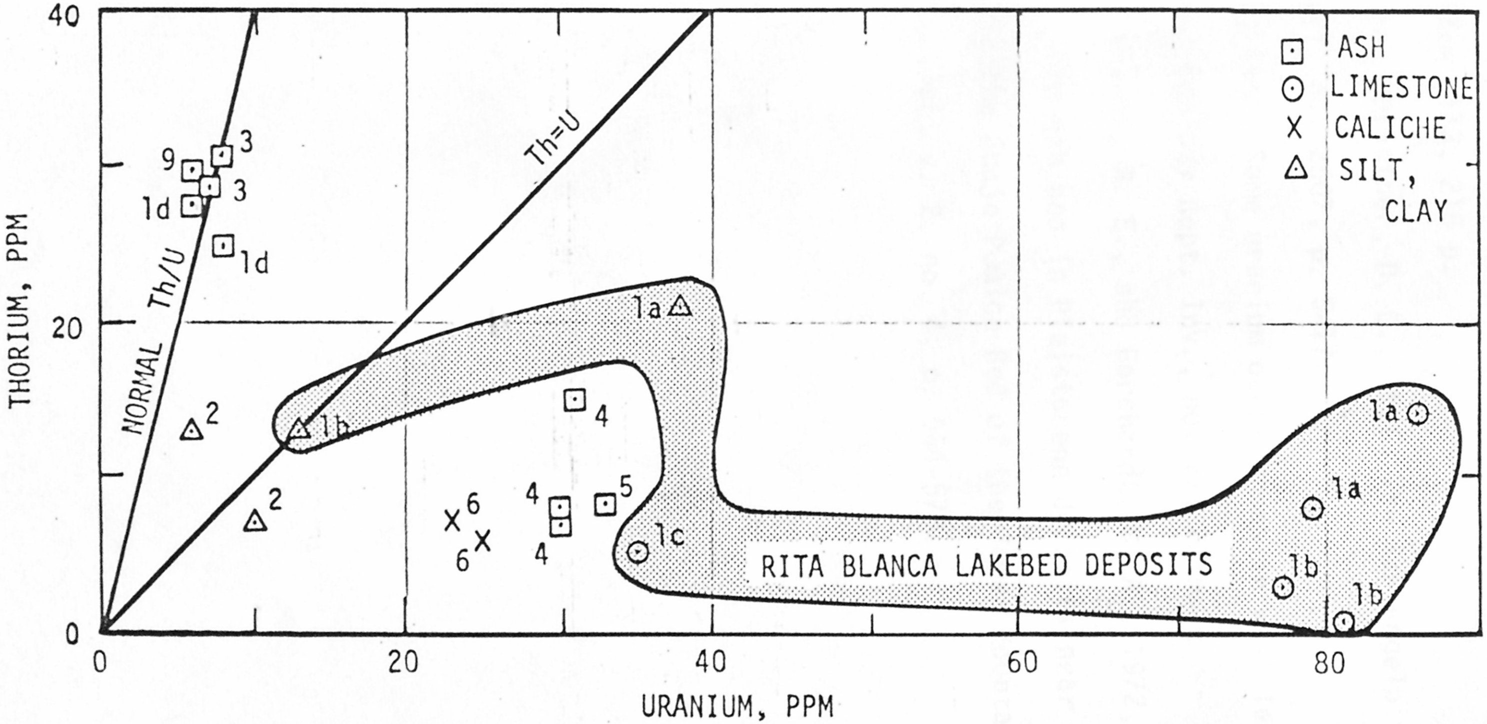

Figure 8.--Graph of the Th and U in various samples of Cenozoic rocks (numbers are keyed to localities shown on figure 5.

Revised

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