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UNITED STATES ATOMIC ENERGY COMMISSION

GRAND JUNCTION OPERATIONS OFFICE

EXPLORATION DIVISION

A RECONNAISSANCE FOR URANIUM IN THE UPPERMOST CRETACEOUS AND EARLY TERTIARY ROCKS OF THE EASTERN SAN JUAN BASIN, NEW MEXICO

by

William L. Chenoweth

May 1957
(Grand Junction, Colorado)

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ABSTRACT

A reconnaissance of some 900 square miles of uppermost Cretaceous and early Tertiary rocks in the eastern San Juan Basin, New Mexico failed to locate any uranium deposits of economic significance.

Sandstones of the Yegua Canyon facies of the Eocene San Jose Formation, a heavy sandstone facies of the Paleocene Nacimiento Formation and the Cretaceous Ojo Alamo Sandstone all appear to be favorable host rocks for additional small deposits.

INTRODUCTION

An aerial and ground reconnaissance of the uppermost Cretaceous and early Tertiary rocks in the eastern San Juan Basin was carried on by the U. S. Atomic Energy Commission from September to December, 1955, and April to September, 1956, to evaluate the potential of these rocks. Up to the time of this investigation the potential of these rocks were unknown although some uranium occurrences had been reported. The fact that uranium ore deposits had been found in early Tertiary rocks in Wyoming prompted this investigation.

LOCATION AND LAND STATUS

The area studied extends from near Cuba, New Mexico northward to the New Mexico-Colorado state line and includes a belt about 15 miles wide marked on the east by the outcrops of the rocks (fig. 1). Included in the area was a large portion of the Jicarilla Apache Indian Reservation. Private land, Santa Fe National Forest and a small amount of public domain comprise the remainder of the area studied in the Cuba-Regina area. A portion of the Carson National Forest is adjacent to the northwest corner of the Reservation. A total of about 900 square miles were covered by this study.

ACKNOWLEDGEMENTS

Acknowledgement is due Allen W. Galbraith, Superintendent, and James S. Reyos, Real Property Assistant, Jicarilla Indian Agency, Dulce, New Mexico, for their cooperation with the Commission during the investigations. The help received from local landowners and personnel of the U.S. Forest Service is also acknowledged. George E. Shaner piloted and maintained the aircraft used in the aerial reconnaissance. Lawrence R. Kittleman assisted in the ground investigations.

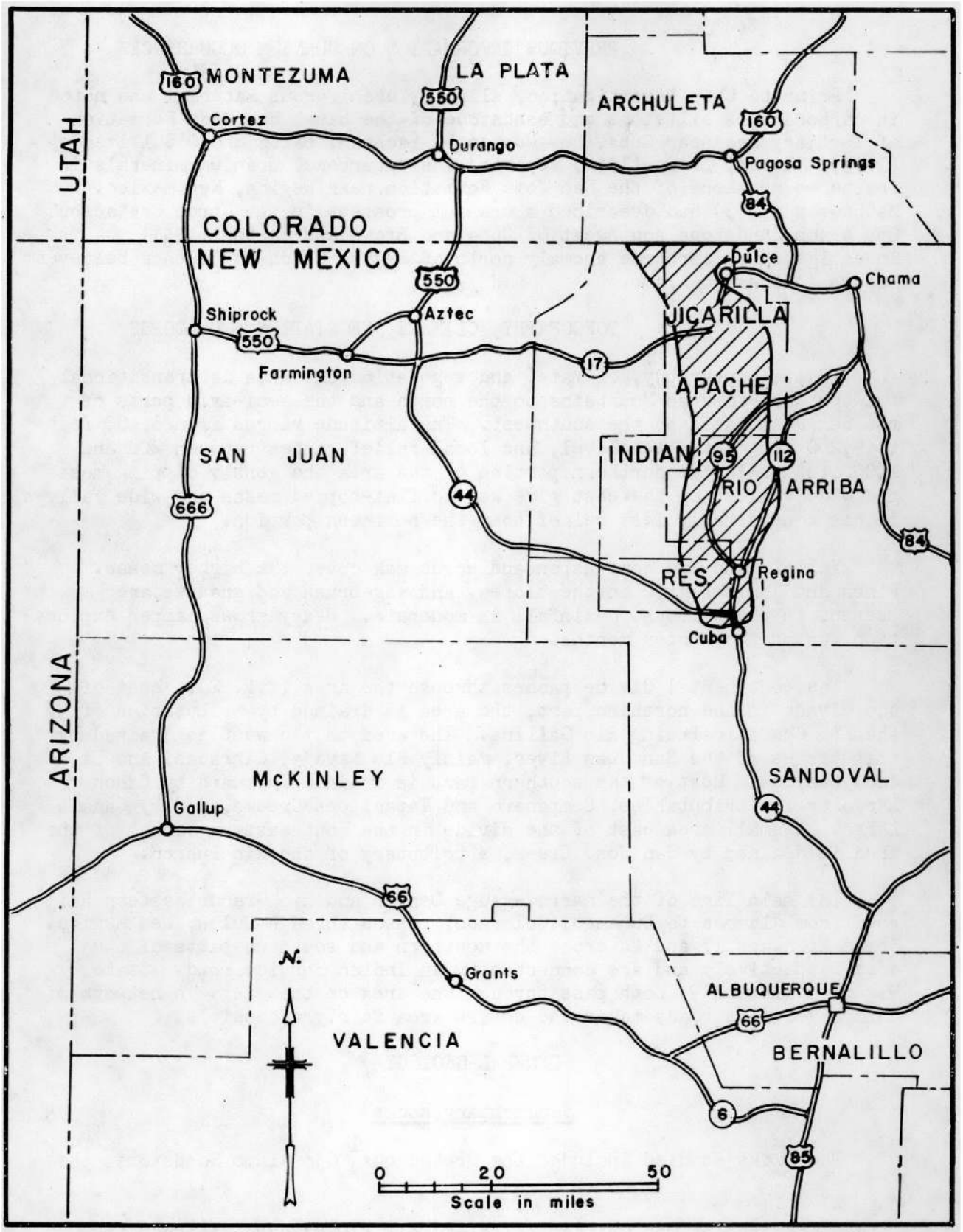


Figure 1. Location map, area of reconnaissance study, eastern San Juan Basin, New Mexico

PREVIOUS INFORMATION ON URANIUM OCCURRENCES

Prior to this investigation, slightly uraniferous material was noted in carbonaceous siltstone and sandstone of the basal San Jose Formation of Tertiary age near Cuba, New Mexico by Bachman, Baltz and O'Sullivan (1953). Later, Brown (1954) reported the occurrence uranium minerals in fractured mudstone of the San Jose Formation near Regina, New Mexico. Mathewson (1953) had described a uranium prospect in the Upper Cretaceous Ojo Alamo Sandstone southwest of Cuba and Brown and Easton (1954) investigated an airborne anomaly north of Regina which the author believes occurs in the Ojo Alamo.

TOPOGRAPHY, CLIMATE, VEGETATION AND ACCESS

In its topography, climate, and vegetation the area is transitional between the San Juan Mountains to the north and the semi-arid parts of the San Juan Basin to the southwest. The altitude ranges from 6,400 feet to 9,200 feet above sea level, and local relief ranges between 200 and 1,000 feet. In the northern portion of the area the gently dipping mesas and wide valleys on the east give way to flat-topped mesas and wide valleys; it has considerably less relief than the northern portion.

Yellow pine and some aspen and scrub oak cover the higher mesas. Pinon and juniper grow on the slopes, and sagebrush and grasses are present in the valleys. Rainfall is moderate. Heavy snows hamper exploration during the winter months.

The continental divide passes through the area (fig. 2). East of the divide in the northern part, the area is drained by tributaries of the Rio Chama including Rio Gallina. The area to the west is drained by tributaries of the San Juan River, mainly Rio Navajo, Carracas, and La Jara Canyons. Most of the southern part is drained westward by Canon Largo or its tributaries, Companero and Tapacitoes Creeks, and by Canada Larga. A small area east of the divide in the southeastern corner of the area is drained by San Jose Creek, a tributary of the Rio Puerco.

The main line of the narrow-gauge Denver and Rio Grande Western Railroad from Alamosa to Durango, Colorado, passes through Dulce, New Mexico. State Highways 17 and 44 cross the northern and southern parts of the area respectively and are connected by an Indian Service road. State Highways 112 and 95 both pass through the area on the east. A network of unimproved dirt roads makes the entire area fairly accessible.

GENERAL GEOLOGY

Sedimentary Rocks

The rocks studied included the Cretaceous[1] Ojo Alamo Sandstone, the

[1]Since this report was written Baltz et. al. (1966) have assigned the restricted Ojo Alamo Sandstone to the Paleocene because it intertongues with the Nacimiento Formation and because it contains a pollen and spore fauna of probable Paleocene age.

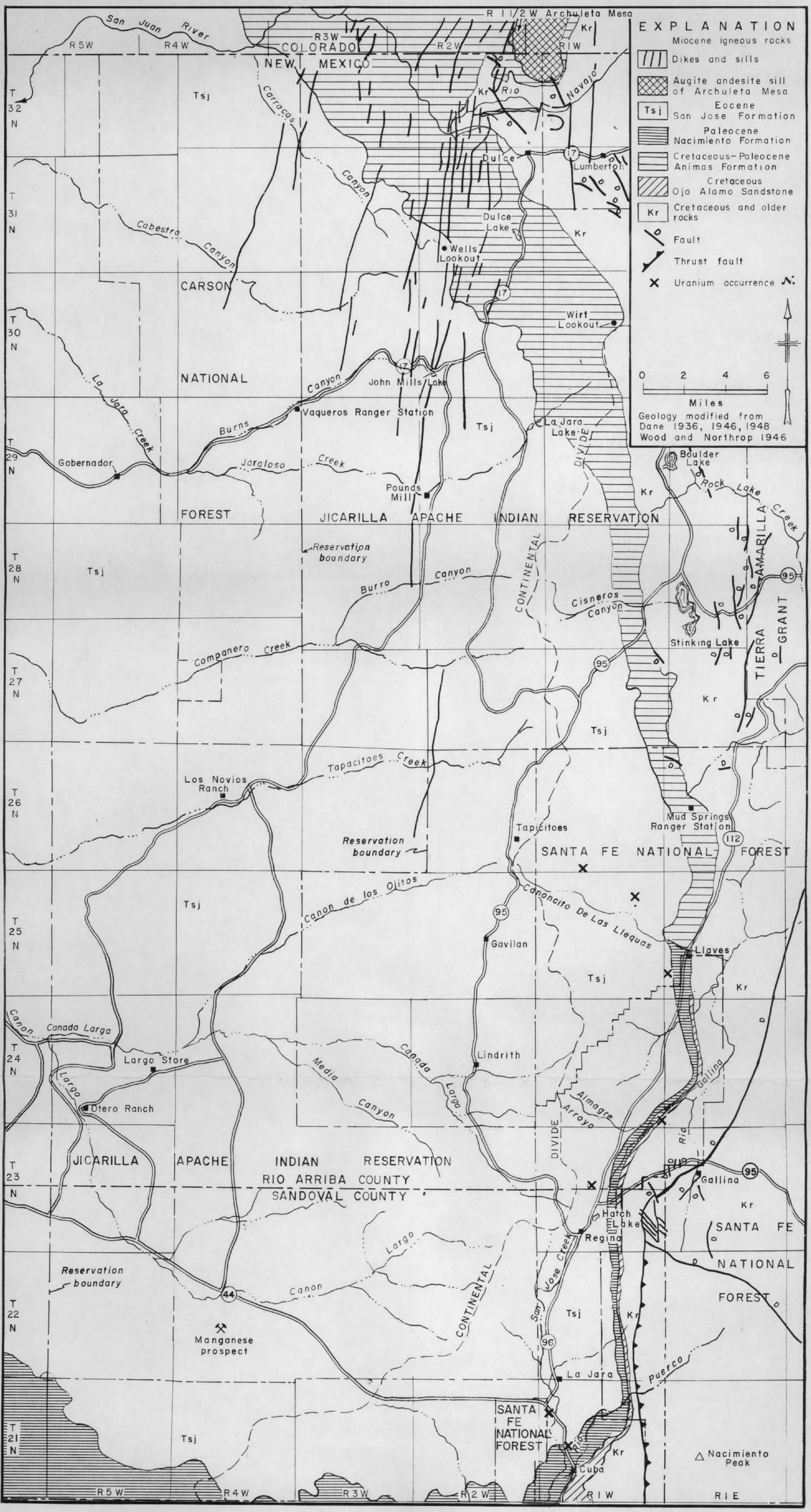


Figure 2. Generalized geologic map, eastern San Juan Basin, New Mexico

Cretaceous and Paleocene Animas Formation, the Paleocene Nacimiento Formation, and the Eocene San Jose Formation. The nomenclature and correlation of these rocks is shown in figure 3.

The general geology of the northern part of the area has been described in detail by Dane (1948). The southeast corner is included in a map by Wood and Northrop (1946). The southwest margin is covered in an earlier report by Dane (1936). The stratigraphic relationships of the Upper Cretaceous, Paleocene and Eocene rocks of the area are given by Dane (1946).

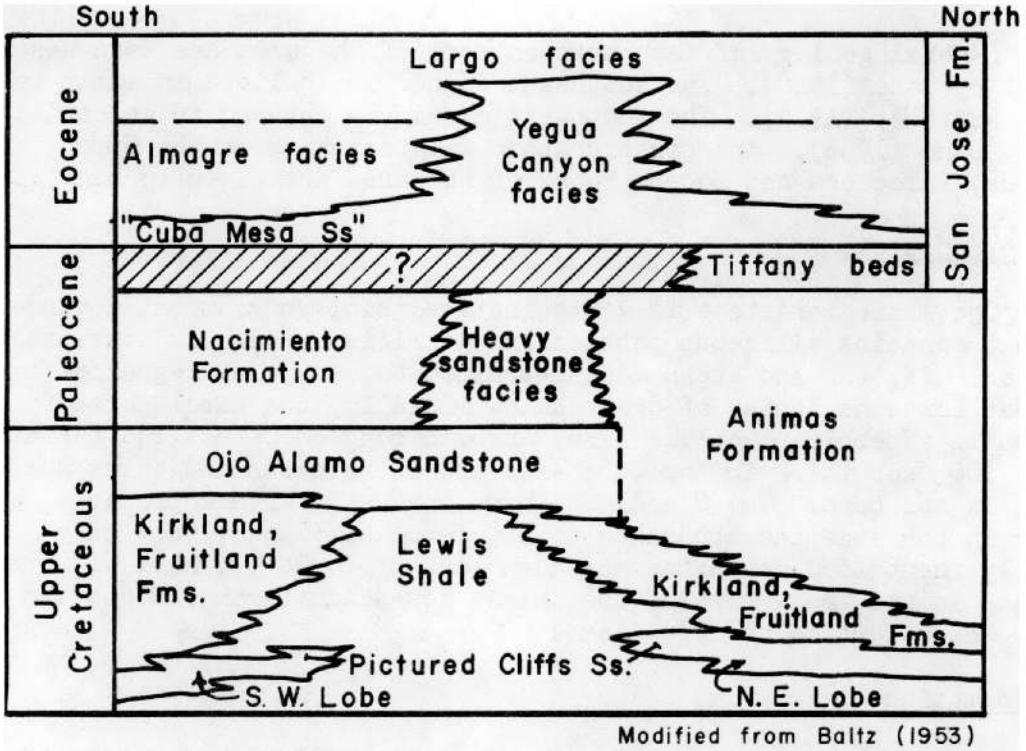
Ojo Alamo Sandstone

The Ojo Alamo Sandstone is a distinctive thin, conglomeratic sandstone that contains siliceous pebbles and petrified wood. It consists of beds of buff, tan and brown medium-grained to very coarse-grained sandstone that contains lenses of drab shale. Locally, the basal part of the formation is a pebble to cobble size, arkosic conglomerate. The formation is 80 to 100 feet thick in the Cuba area and it thickens and thins due to channels in its base. The Ojo Alamo thins northward with a probable decrease in the size and abundance of the pebbles. Dane (1946) only doubtfully identified it in the northern part of T. 24 N., R. 1 W., but sandstones in the basal part of the Animas Formation farther north are probably equivalent to the Ojo Alamo.

Animas Formation

The Animas Formation consists of material largely derived from the erosion of andesite. It is a thick sequence of olive drab clay, greenish-gray andesitic sandstone, yellow and gray sandstone and conglomerate with both siliceous and andesitic pebbles. According to Dane (1946), the Animas is 3,000 feet thick near the New Mexico-Colorado state line and thins southward to about 1,200 feet in T. 25 N., R. 1 E. In the Dulce area, the lower part of the Animas consists of massive beds of conglomerate and sandstone. The upper part of the formation in this area is comprised of less resistant feldspathic sandstone and greenish siltstone and claystone. Generally, sandstones in the lower part of the formation in the vicinity of Dulce appear lighter in color and contain a greater amount of carbonaceous material than any of the other beds in the formation. Thin beds of drab claystone break the sandstone into a series of ledges, some of which are as much as 150 feet thick. This basal unit forms the rim along the canyon of the Rio Navajo north of Dulce and also caps a prominent escarpment from Dulce south to Wirt Lookout (fig. 2).

Well rounded cobbles of andesite are common in conglomerate beds. Coarse-grained sandstones contain grains of quartz, feldspar and quartzite. Clays are commonly greenish but may be gray and red, locally they are carbonaceous. The formation thins rapidly to the south and the predominantly sandstone facies grades into claystone and sandy clay. Farther south in the vicinity of Canoncito de las Lleguas the entire interval of the Animas is composed of a heavy sandstone facies of the Nacimiento Formation. Recognizing that the transition in lithology takes pace over several miles, Dane (1946) arbitrarily designated



Modified from Baltz (1953)

Figure 3. Nomenclature and correlation of uppermost Cretaceous and early Tertiary rocks, eastern San Juan Basin, New Mexico

Canoncito de las Lleguas, in T. 25N., R. 1E., as the point of division between the Animas and the Nacimiento Formations (fig. 2).

Nacimiento Formation

The Nacimiento Formation consists of drab and gray clay and interbedded quartzose sandstone which range in thickness from about 600 to 1,200 feet. The thickening takes place in a general northward direction. Near Cuba the formation consists of banded, light to dark gray clay with minor amounts of fine- to medium-grained, white, gray and buff lenticular quartz sandstone. Dark clay and carbonaceous clay are predominate in the lower part of the formation. The sandstone is thicker and more numerous in the upper half of the formation. Northward the amount of sandstone increases so that north of the central part of T. 24 N., R. 1 E. nearly two thirds of the formation is sandstone (Dane 1946). The northern sandstone facies is generally coarser than the sandstone to the south and contains beds of coarse-grained, arkosic, conglomeratic sandstone. Baltz (1953) referred to these coarse-grained, massive sandstones as the "heavy sandstone facies" of the Nacimiento Formation and this nomenclature is followed in this report. Although beds of arkosic, coarse-grained sandstone and conglomerate occur north of the Canoncito de las Lleguas, in this report they are considered as part of the heavy sandstone facies.

San Jose Formation

The San Jose is the most widely exposed formation in the area (fig. 2). Overlying the Animas Formation to the north and the Nacimiento Formation to the south, the San Jose is a monotonous sequence of sandstone, conglomerate, and claystone that constitutes the youngest unit in the San Juan Basin. The formation reaches a thickness as much as 2,000 feet but is commonly less than 1,000 feet thick due to erosion. A complete section of the San Jose is not present since no rocks younger than it are known in the area. The San Jose Formation was previously called Wasatch by early workers. Simpson (1948) proposed that the term Wasatch be discarded and that the name San Jose Formation be applied to these sediments, as they were deposited in an entirely different sedimentary basin from that of the type Wasatch in southwestern Wyoming and the age spans, though overlapping, were not the same for the two formations. The type locality of the San Jose Formation was designated as the badlands area in the upper drainage of San Jose Creek northwest of Regina (fig. 2). Simpson (1948) distinguished three major lithologic facies here (fig. 3). In the vicinity of Canoncito de las Lleguas (Yegua Canyon) most of the San Jose is composed of thick, massive, arkosic, conglomeratic sandstone and intercalated thin clay and silt beds and has been named the Yegua Canyon facies. This facies grades laterally into predominately clay facies to the north and south. A massive, basal sandstone facies extends southward to the vicinity of Cuba and has been informally called the "Cuba Mesa Sandstone" (V. C. Kelley, personal communication, 1955). The Almagre facies, consisting of variegated pale and gray clays, occurs to the south of the Yegua Canyon facies and grades northward into it. The Largo facies forms the stratigraphically highest part of the San Jose Formation in the type region. The Largo facies consists of variegated red and gray

clays, and the lower beds grade into the upper sandstone beds of the Yegua Canyon facies. North of the Yegua Canyon facies is an unnamed facies which is similar to the Almagre facies. This predominantly claystone facies grades southward into the sandstone and conglomerate facies of the Yegua Canyon. Northwest of the area in Colorado, there is an older clay facies of the San Jose, containing a late Paleocene fauna, to which the name Tiffany beds has been applied. According to Simpson (1948) lateral equivalents of the Tiffany beds are not present at the type locality of the San Jose Formation.

As would be expected, the exposures of the San Jose are better where there is a predominance of sandstone in the sequence. Throughout the southern part of the area broad open valleys and plains occur owing to the presence of the Almagre facies. In the central and northern part, where the Yegua Canyon facies crops out, canyons and mesas are common. Exposures are poor in the northwest, where the soft beds of the unnamed facies form a hilly, rolling topography.

The Yegua Canyon facies is over 1,000 feet thick in the type area. It consists of massive beds of yellow and buff, arkosic, conglomeratic sandstone with intercalated thin beds of variegated shale and siltstone. The main body of the sandstone as well as the massive, basal "Cuba Mesa Sandstone", which is 200 to 250 feet thick, grades into and intertongues with the variegated shale, claystone and siltstone of the other facies.

Northward from the type area of the Yegua Canyon facies, a basal arkosic, conglomeratic sandstone forms an escarpment which is traceable north into T. 30 N., R. 2 W. and northwest into T. 32N., R. 3 W., although it thins northward.

In the Canoncito de las Lleguas area, the contact of the Yegua Canyon facies with the underlying heavy arkosic, sandstone and conglomerate facies of the Nacimiento Formation is rather difficult to pick as both units are lithologically similar. Beds of the Yegua Canyon facies are generally more massive than those in the underlying Nacimiento and contain lighter colored interbedded claystone and siltstone. Both the Yegua Canyon and the heavy sandstone facies probably had a common source of Precambrian rocks in the Brazos uplift to the northeast.

On the northwest side of the San Juan Basin, Baltz (1953) recognized a thick sandstone sequence of the San Jose which he believes is equivalent to the Yegua Canyon facies. Underlying the San Jose, he found a heavy sandstone facies in the Nacimiento Formation similar to that present on the eastern side of the Basin. Baltz (1953) concluded that the Yegua Canyon facies and the underlying heavy sandstone facies of the Nacimiento Formation were deposited in the structurally deeper parts of the San Juan Basin (fig. 4).

Igneous Rocks

Two types of igneous rocks intrude the sediments in the area. Archuleta Mesa, north of Dulce (fig. 2), is formed by a 300-foot sill of augite andesite which intrudes the rocks of the Animas Formation. The contact is

apparently concordant along the base of the sill, and there is almost complete lack of any evidence of metamorphism. Overlying the sill on the south end are a few small knobs of Animas.

A swarm of lamprophyre dikes intrude the sediments in the northern part of the area. The swarm extends from near the Colorado-New Mexico state line southward for about 40 miles and has a width of about 15 miles. The dikes range from 1 to 30 feet in width, and most of them are nearly vertical, although some are inclined as much as 20 degrees from the vertical. In the vicinity of Archuleta Mesa the tops of some of the dikes mushroom and spread out laterally into small sills. The dikes commonly have a coarse-grained central portion and thin, dense chilled borders. Metamorphism is evidenced by bleached, siliceous sandstone and hard, baked, dark shale adjacent to the dikes. The centers of a large number of the dikes are highly fractured, and some are brecciated; post-intrusion movement is indicated. Dane (1948) reported free oil in the vesicles of a dike near Dulce. He considers both the dikes and the Archuleta Mesa sill to be Miocene in age and the dikes to be younger than the sill.

Structure

The area studied is located in the eastern side of the Central basin portion of the San Juan Basin as defined by Kelley (1950, 1951). The axis of the Basin is located north of Lindrith and trends northwesterly through Gobernador (fig. 4). Generally, the sediments north of the axis (fig. 4) dip gently southwest into the Basin and in the area south of the axis the sediments have a gentle regional dip to the northeast. The regional dip is reversed in the vicinity of a few small domes and anticlinal noses that are present in the area.

The central basin is bounded on the east by the north trending Nacimiento thrust fault. This fault separates the basin from the Nacimiento uplift which is composed of San Pedro Mountain and Sierra Nacimiento (Wood and Northrop, 1946). North of the uplift, the basin is bounded by north trending folds and faults of the Gallina uplift and French Mesa anticline. North of the Rio Chama, along the eastern edge of the basin, is a structurally high belt of northwest trending anticlines and domes called the Archuleta anticlinorium. The anticlinorium separates the San Juan Basin from the Chama Basin to the east. It consists chiefly of sharp domal folds, although there are a few broad, low, fairly long anticlines. Some of the anticlines are separated from the adjacent synclines by faults.

Northeast of Cuba in the eastern part of Tps. 21, 22 and 23 N., R. 1 W. rocks of the basal San Jose Formation, Nacimiento Formation and the Ojo Alamo Sandstone are steeply west dipping to vertical to overturned east dipping in the vicinity of the Nacimiento fault. V. C. Kelley (personal communication, 1955) has noted vertical and overturned beds of the Nacimiento and older formations in sections 22 and 27, T. 22 N., R. 1 W. being overstepped by moderately west dipping beds of the "Cuba Mesa Sandstone" of the San Jose Formation. This angular unconformity indicates that the Nacimiento uplift had formed, in part, prior to the deposition of the San Jose Formation.

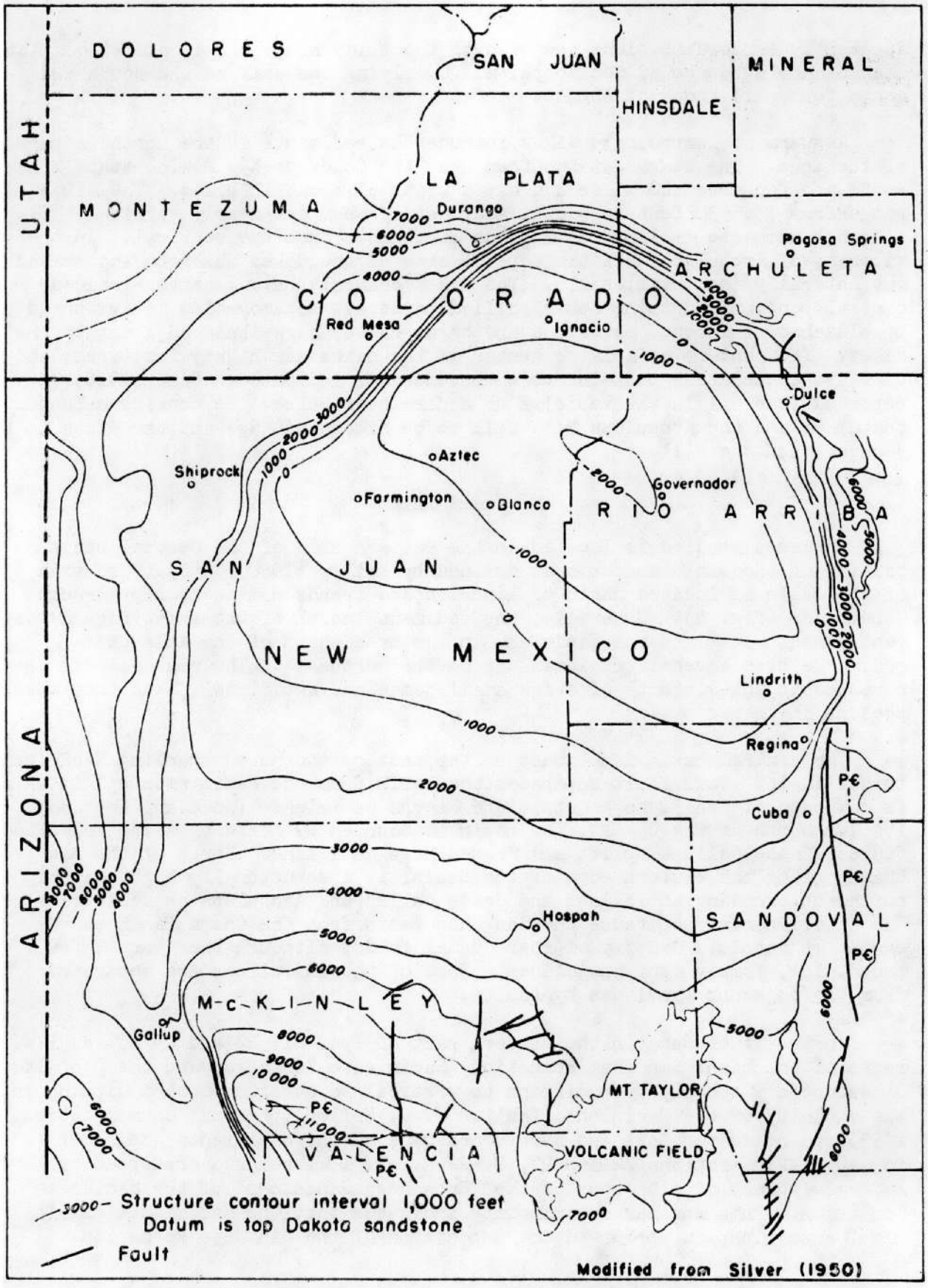


Figure 4. Structure contour map of the San Juan Basin

Faulting is generally absent in the rocks of uppermost Cretaceous and early Tertiary age except near Dulce (fig. 2), where a few small faults are present. The displacement of most of the faults is less than 100 feet.

AERIAL AND GROUND INVESTIGATIONS

A systematic airborne radiometric survey of portions of the Jicarilla Apache Indian Reservation was carried on by the Atomic Energy Commission from November 8, to December 15, 1955 (Chenoweth, 1957). The aerial reconnaissance in this investigation was done in conjunction with that survey. As part of the airborne radiometric survey, the basal rim of the Animas Formation was surveyed by rim flying from the New Mexico-Colorado state line southward to the vicinity of Wirt Lookout (fig. 2), with negative results. South of the Lookout the exposures of the basal Animas are poor and largely covered.

Considerable time was spent studying the lithology from the air in order to pick out areas favorable for ground investigation. Owing to the large amount of vegetation on the Animas there are few good exposures.

Although no systematic airborne survey was made of the San Jose Formation, considerable time was devoted to studying the formation from the air. One of the most striking features noted was a large bleached area in the vicinity of John Mills Lake (fig. 2). This bleaching is probably due to the intrusion of the dike swarm, as the altered area roughly corresponds to the area of intrusion. Radioactivity both in the air and on the ground in this area was the lowest of any encountered in the area.

Outcrops of the Ojo Alamo Sandstone in the Cuba area were covered by an earlier radiometric survey of portions of the San Juan Basin (Chenoweth and Stehle, 1957).

Areas observed from the air showing any unusual coloration were later checked on the ground for radioactivity. Special attention was given to limonite-stained areas.

In the numerous areas of San Jose outcrops examined in the area, no abnormal radioactivity was found. Countless zones appear to be favorable hosts. Sandstones of the fluvial Yegua Canyon facies contain channels, intraformational unconformities, intercalcated claystone seams and galls, and carbonaceous material ranging from fine disseminated flecks to large fossil logs. Several exposures, especially in road cuts in the La Jara Lake area (fig. 2), contain carbonaceous trash, thin gypsum veinlets, jarosite, and limonite staining associated with a zone of gray claystone galls in a fine to medium-grained light yellowish-gray sandstone.

Local prospectors were contacted concerning their activities in the Cuba-Gallina area where uranium is known to occur in older rocks. As the result of these contacts, three new occurrences of uranium in the Yegua Canyon facies of the San Jose Formation were investigated.

DESCRIPTION OF OCCURRENCES

The only significant uranium occurrence in the Ojo Alamo Sandstone is located south of the area studied in E 1/2, SW 1/4, Sec. 3, T. 19 N., R. 2 W. At this prospect, uranium occurs in the lower two to three feet of a gray to brown, coarse-grained to conglomeratic, cross-bedded sandstone which contains greenish-gray clay galls, petrified wood and carbonized plant fragments. Limonite staining is abundant in the uranium-bearing zone and no uranium minerals are visible. Samples collected by Mathewson (1953) assayed between 0.015 and 0.05 percent eU_3O_8. The analyses of samples collected during this study and previous investigations are given in table 1.

An airborne anomally of five times background is located in NE1/4, NE 1/4 Sec. 36, T. 24 N., R. 1 W. is associated with an outcrop of coarse-grained, light yellowish-gray, resistant sandstone. Although Brown and Easton (1954) thought the anomaly was probably in the Nacimiento Formation, the author believes the outcrop is Ojo Alamo Sandstone because of its stratigraphic position and the presence of petrified wood. A selected grab sample of the strongest radioactivity assayed 0.02 percent U_3O_8.

During the study, three uranium occurrences in the type area of the Yegua Canyon facies of the San Jose Formation were brought to the attention of the Commission. At the Carbon and Log claims in the N 1/2, NE 1/4 Sec. 11, T. 25 N., R. 1 W., projected, weak and spotty radioactivity occurs in two sandstone beds which are 40 and 25 feet thick respectively. Separating the sandstones is a ten-foot thick bed of greenish-gray siltstone and claystone. The sandstone is light gray to dark brown, coarse to fine-grained, arkosic, friable, cross-bedded and contains clay galls, interstitial clay and carbonaceous plant material. Jarosite is common and limonite staining is abundant. The radioactivity occurs in a carbonaceous clay gall zone in the middle part and at the base of the upper, and thicker, sandstone and in a clay gall zone in the middle part of the lower sandstone. Stronger radioactivity occurs in fossil wood and plant remains. A sample of an intensely limonite-stained fossil log from the middle zone of the upper sandstone assayed 0.20 percent U_3O_8, although no uranium minerals were visible.

Three miles northwest of the Carbon and Log claims, are the Princess claims, located in the SW 1/4, SW 1/4 Sec. 33, T. 26 N., R. 1 W. Here, spotty and weak radioactivity occurs at the base of 35 foot thick sandstone bed of the Yegua Canyon facies. The host rock is light gray, very coarse to fine-grained, cross-bedded, arkosic, friable sandstone containing carbonaceous plant material, clay galls and interstitial clay. Limonite staining of the sandstone is locally present. Underlying the sandstone bed is a dark green to gray siltstone and claystone bed five to eight feet thick.

Near Llaves, at the Coy claims, located in the NE 1/4, SW 1/4 Sec. 30, T. 25 N., R. 1 W., radioactivity is associated with a 12-inch zone of carbonaceous trash and greenish-gray clay galls in a light yellowish-gray, coarse to fine-grained argillaceous, feldspathic, friable sandstone. The sandstone is about 25 feet thick and is located near the base of the Yegua Canyon facies. The radioactivity is located in a slump block of the sandstone. The radioactive zone and adjacent sandstone are intensely stained with limonite.

Sample Number	Type Sample	Location	%eU$_3$O$_8$	%U$_3$O$_8$	%CaCO$_3$	Remarks
27914	grab	Houston's prospect	0.15	--	--	petrified wood
27915	grab	" "	0.05	--	--	limonitic sandstone
27916	grab	" "	0.05	--	--	carbonaceous shale
27917	grab	" "	0.03	--	--	petrified wood
99A	channel, 1 ft.	State Lease, Sec. 16	0.04	--	--	mudstone, w/uranium minerals
100A	grab	" " " "	0.08	0.12	--	mudstone, w/uranium minerals
38951	grab	Anomaly NA-17	--	0.02	--	sandstone, strongest radioactivity
39302	grab	" " "	0.01	0.004	--	sandstone, average radioactivity
37899	grab	Coy claims	0.03	0.04	0.09	sandstone, float
38984	grab	" "	0.01	--	--	sandstone, lower pit
38985	grab	" "	0.02	0.04	--	sandstone, upper pit
38986	grab	Princess claims	0.01	--	--	sandstone
38987	grab	Carbon & Log claims	Tr	--	--	sandstone, w/clay galls
38988	grab	" " "	0.22	0.20	--	fossil log
BONM-20 *	grab	NW 1/4 sec. 20, T. 20 N., R. 1 W.	0.012	0.002	--	carbonaceous siltstone
BONM-22 *	grab	NW 1/4 sec. 1, T. 20 N., R. 2 W.	0.006	0.003	--	sandstone

* USGS samples, analyses are in %eU and % U. -- indicates no analysis

Table 1, Chemical analyses of samples, uppermost Cretaceous and early Tertiary rocks, eastern San Juan Basin, New Mexico

Assays of this material have indicated 0.04 percent U_3O_8. A similar occurrence is reported in Sec. 28, T. 23 N., R. 1 W., near Regina, but this occurrence could not be located for examination.

Two miles north of Regina, in SE 1/4, SW 1/4 Sec. 16, T. 23N., R. 1 W., a yellowish-green uranium mineral, probably meta-autunite, coats fractures in a gray-green mudstone of the Almagre facies of the San Jose Formation. Associated with the uranium is limonite staining and black manganese minerals. A selected grab sample by Brown (1954) assayed 0.12 percent U_3O_8.

Northwest of Cuba in NE 1/4, SW 1/4 Sec. 7, and NW 1/4 Sec. 20, T. 21 N., R. 1 W., weak radioactivity in the San Jose Formation is associated with carbonaceous shale and siltstone and fossil wood in the "Cuba Mesa Sandstone" of the Yegua Canyon facies. Weak radioactivity has also been reported (Bachman, et. al., 1953) in the "Cuba Mesa Sandstone" in the NW 1/4, NW 1/4 Sec. 1, T. 20 N., R. 2 W. The "Cuba Mesa Sandstone" northwest of Cuba is strikingly stained with limonite, and there are undoubtedly numerous small mineralized zones present in the general area.

Of possible interest, is a small manganese deposit in the Almagre facies of the San Jose Formation near the center of the west line of Sec. 21, T. 22 N., R. 4 W., projected (fig. 2). Psilomelane and probably pyrolusite occur as nodular pellets and fragments in the basal part of a small light gray, very fine-grained, argillaceous, micaceous, sandstone lens which is overlain by red claystone. The zone is at least two feet thick and is exposed in the floor of a small open pit about 175 feet long and 75 feet wide. No abnormal radioactivity was observed at this deposit. According to officials of the Jicarilla agency at Dulce, some shipments have been made in the past from the deposit, and similar occurrences are reported to occur outside the Reservation in the same general area.

On the northwestern side of the San Juan Basin, north of Aztec, New Mexico (fig. 4), Rock (1954) examined a uranium occurrence in the San Jose Formation. This occurrence is similar to the occurrences in the type area of the Yegua Canyon facies, except that the sandstone is finer grained. With the exception of some other minor occurrences in the Aztec area (Chenoweth and Stehle, 1957), no other uranium occurrences are known in the San Jose outside of the area of this study.

SUMMARY AND CONCLUSIONS

A reconnaissance of the uppermost Cretaceous and early Tertiary rocks of the eastern San Juan Basin failed to locate any uranium occurrences with immediate commercial possibilities. Three lithologic units were recognized during the study which appear favorable for uranium deposits. These are the Yegua Canyon facies of the San Jose Formation, the heavy sandstone facies of the Nacimiento Formation and the Ojo Alamo Sandstone.

The Yegua Canyon facies contains widely distributed occurrences of uranium and is judged to be the most favorable host rock in the area. However, because of the large amount of dissection to this resistant facies by the present day erosion cycle, the potential is regarded as low. The

potential of the heavy sandstone facies Nacimiento Formation is unknown because of the lack of surface anomalies and the limited area of outcrops, but is probably low. Although minor occurrences are present, the potential of Ojo Alamo Sandstone is regarded as very low due to the overall thinness of the formation.

Observations at the known occurrences has indicated that limonite staining of sandstone is the best guide to radioactivity in San Jose Formation and the Ojo Alamo Sandstone.

Other parts of the San Juan Basin containing the Yegua Canyon facies of the San Jose Formation and the heavy sandstone facies of the Nacimiento Formation should not be overlooked for additional small deposits.

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