STATUS OF MINERAL RESOURCE INFORMATION FOR THE JICARILLA INDIAN RESERVATION, NEW MEXICO

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SUMMARY AND CONCLUSIONS

Mineral commodities presently being produced on the Jicarilla Reservation include natural gas, petroleum, and sand and gravel. A small amount of manganese ore was produced in 1957 and 1958.

The region is one in which accumulations of petroleum and natural gas occur. Increased prices for natural gas might prove a stimulus for closer spaced drilling in presently productive areas as well as accelerated exploration in other parts of the reservation.

Coal bearing formations underlie the reservation but are too deep to be economically mined; shallower and thicker coal beds occur in the western part of the San Juan Basin. Sometime in the future, however, the deep coal on the reservation might become competitive.

Titaniferous sandstone has been identified in sec. 3, T. 28 N., R. 1 E. Detailed mapping and sampling are needed to determine the extent and grade of the deposit.

Small occurrences of uranium are east of the southern part of the reservation. The host rocks for these extend on to the reservation and might contain additional small deposits.

INTRODUCTION

This report was prepared for the U.S. Bureau of Indian Affairs by the U.S. Geological Survey and the U.S. Bureau of Mines under an agreement to compile and summarize available information on the geology, mineral resources, and potential for economic mineral development on certain Indian lands. Source material consisted of published and unpublished reports, as well as written communications. Important sources of geologic information are a geologic map of part of eastern San Juan Basin (Dane, 1948) and verbal communications from C. W. Spencer, U.S.G.S. (February, 1977).

Geographic Setting

The Jicarilla Indian Reservation is in north-central New Mexico adjacent to the Colorado border (Figure 1). The reservation boundary encompasses an area about 25 miles east to west by about 66 miles north to south; in general, the townships extend from T. 22 to 32 N., and from R. 1 E. to R. 5 W. Total area within the reservation is 742,954.26 acres. Division of reservation land is as follows: tribal trust land, 743,315.42 acres; tribal surface ownership (excluding minerals), 320.00 acres; Indian fee land, 160.35 acres; and non-Indian fee land, 478.49 acres (Vigil, 1966) (Table 1). Most of the non-tribal land is within 6 miles of the town of Dulce, site of the tribal headquarters.

Two paved highways, U.S. 64-NM 17 and NM 537, cross the reservation (Figure 1). New Mexico Highway 537 provides excellent, all-weather access to the reservation in a north-south direction. The road (J-15) from NM 537 to Stone Lake is paved, and the one from Dulce to Burford Lake (.J-8) is partly paved with work in progress (as of October 1976) on the remainder. Gravel roads maintained by the tribe and dirt and gravel roads maintained by oil and gas companies provide access to most parts of the reservation.

Dulce (1970 population 900), the only town on the reservation, is the center for most tribal activi-

ties. The nearest large town is Farmington (pop. 21,979) about 84 miles west of Dulce. Santa Fe (pop. 41,167) is about 125 miles southeast of Dulce.

Physiography

The Jicarilla Indian reservation is on the eastern flank of the San Juan basin in Rio Arriba and Sandoval Counties, northwestern New Mexico (Figure 2).

Much of the northern half straddles the Continental Divide, which is here much lower and less rugged than in nearby Colorado; the Divide also crosses the southeast corner of the reservation. Mesas and broad shallow valleys characterize most of the terrain; locally, there are narrow

canyons and steep escarpments. Altitudes range from 6,600 feet above sea level along Canyon Largo, in the western part of the reservation, to 8,400 feet, along the Continental Divide in the eastern part. Drainage to the west is into the San Juan River and to the east into the Rio Chama, a tributary of the Rio Grande. All of the streams in the reservation are intermittent except the Navajo River, a tributary of the San Juan.

Map Coverage

Most of the reservation has been topographically mapped by the U.S. Geological Survey on 7-½ minute quadrangles (scale 1:24,000), dated 1963 and 1966. That part of the reservation east of longitude 107° W. is included on two 15-minute quadrangles (scale 1:62,500), dated 1955. The following is a list of the quadrangles with publication dates. All are available from the U.S. Geological Survey, Branch of Distribution, Building 41, Denver Federal Center, Denver, Colo. 80225.

Arroyo Chijuillita (1963)
Billy Rice Canyon (1963)
Bixler Ranch (1963)
Boulder Lake (1955), 15-min .
Carracas Canyon (1963)
Cement Lake (1963)
Counselor (1966)
Deer Mesa (1966)
Five Lakes Canyon NE (1963)
Five Lakes Canyon NW (1963)
Gonzales Mesa (1963)
John Mills Lake (1963)
Lapis Point (1963)
Leandro Canyon (1963)
Leavry Canyon (1963)
Lindrith (1963)
Lumberton (1955) 15-min.
Mule Dam (1966)
Ojito (1963)
Otero Store (1963)
Pine Lake (1963)
Santos Peak (1963)
Schmitz Ranch (1963)
Tancosa Windmill (1966)
Tayfoya Canyon (1963)
Taylor Ranch (1963)
Vigas Canyon (1963)
Wirt Canyon (1963)

GEOLOGY

Outcropping Units

General

Rocks ranging in age from Late Cretaceous to Miocene are exposed within the reservation boundaries. Seven map units in which these rocks occur are shown on Figure 3. Alluvium, which occurs sparingly in some valleys, is not shown. Older unexposed units which underlie the tribal lands are described briefly in the discussion of oil and gas possibilities.

Late Cretaceous Sedimentary Rocks

General.--The oldest rocks exposed in the reservation are of Late Cretaceous age. They have been assigned in order of decreasing age to the Mancos Shale, Mesa Verde Formation, Lewis Shale, Pictured Cliffs Sandstone, Fruitland Formation, Kirtland Shale, and Animas Formation. Four of these formations have been combined into a single unit, designated "Kpl" in Figure 3. Also, the Animas Formation includes rocks of Tertiary, as well as Late Cretaceous age.

Mancos Shale.--The Mancos Shale, of early Late Cretaceous age, crops out along the eastern edge of the northern half of the reservation. The unit, as mapped by Dane (1948) on the eastern side of the San Juan Basin, consists of five members: the Graneros Shale, 120-130 ft thick; the Greenhorn Limestone, 40-60 ft thick; the Carlile Shale, about 600 ft thick; the Niobrara Shale, 250-350 ft thick; and the Upper Shale Member of the Mancos, 500-700 ft thick. Probably only the Upper Shale Member is exposed in the reservation; this member becomes increasingly sandy toward the top. Regionally, petroleum occurs in fractured rock of the Greenhorn Limestone Member.

Mesaverde Formation.--The Mesaverde Formation, of Late Cretaceous age, conformably overlies the Mancos Shale. Exposures of the map unit within tribal lands are limited to the eastern edge of the reservation. The Mesaverde Formation, as mapped by Dane (1948) in the eastern San Juan Basin, includes three members. In order of decreasing age these are the Hosta Sandstone Member, 100-240 feet thick; the Gibson Coal Member, 80-250 ft thick; and the La Ventana Sandstone Member, 30-80 ft thick. According to Bingler (1968, p. 26) the Mesaverde Formation consists of about 300 ft of sandstone and shale. Coal beds of the middle member are mined at Monero, just outside the northeast part of the reservation.

Lewis Shale and Overlying Cretaceous Rocks.--The Lewis Shale conformably overlies the Mesaverde Formation, and is in turn overlain by the Pictured Cliffs Sandstone and the Fruitland Formation, all of Late Cretaceous age, and shown as a single map unit, Kpl, on Figure 3. The overlying Animas Formation, partly of latest Cretaceous age, is a separate map unit. The Lewis Shale, about 2,000 ft thick, the Pictured Cliffs Sandstone, about 100 ft thick, and the Fruitland Formation 85-175 ft thick, crop out in the northeastern part of the reservation. About 5 mi southeast of Dulce the Pictured Cliffs and Fruitland lense out completely

and the Animas Formation rests on the Lewis Shale. The Fruitland Formation contains thin coal beds.

Transitional Cretaceous-Tertiary Rocks

The youngest Mesozoic and also the oldest Tertiary rocks in the region were mapped together by Dane (1948) in the Animas Formation, of Late Cretaceous and Paleocene age. In general, the formation is conglomeratic and sandy in its lower part, sandy and clayey in its upper part. The two parts are probably divisible lithologically, but it has not been determined whether the Cretaceous-Paleocene boundary is in the upper or lower part. The Animas Formation ranges in thickness from 3,000 ft in the northwestern corner of the reservation to 1,600 ft west of Stinking Lake.

Tertiary Rocks

General.--In addition to an undetermined thickness of the Animas Formation, the Tertiary rocks of the area include the San
Jose Formation, a large andesite sill, and lamprophyre dikes, in order of decreasing age.

San Jose Formation.--The outcropping rock of about 75 percent of the Jicarilla Indian Reservation is conglomerate, sandstone, and claystone of the San Jose Formation, of early Eocene age. This formation, mapped as "Wasatch Formation" by Dane (1948), was named by Simpson (1948) for exposures in San Jose Valley, at the southeast corner of the reservation (Figure 3), and redefined by Baltz (1967). The total thickness ranges from 1,200-1,300 ft in San Jose Valley to over 2,000 ft toward the northwest.

Andesite Sill.--Archuleta Mesa, at the northeast corner of the reservation, is underlain by a resistant sill of augite andesite over 300 ft thick which has intruded the Animas Formation. The intrusive is believed to be of Miocene age (Dane, 1948).

Lamprophyre Dikes.--A swarm of biotite hornblende lamprophyre dikes is in the northern part of the reservation. These dikes, which are 1 to 30 ft thick and mostly vertical, are shown in a generalized way in Figure 3. Locally some of the dikes spread out in sills; one, northeast of Dulce, contains free oil in vesicles (Dane, 1948). Age of the dikes is probably Miocene but somewhat younger than the augite andesite sill.

Structure

The Jicarilla Indian Reservation lies on the east flank of the San Juan Basin (Figure 2). Structure contour lines on the base of the Cretaceous (base of the Dakota Sandstone) are drawn at +1,000 ft and -2,000 ft in Figure 2; datum is sea level. The low spot is along the San Juan River, about 20 mi west of the tribal lands. The crest of the north-striking Archuleta Anticlinorium is along and near the eastern edge of the reservation (Figure 2). The crest of the Horse Lake Anticline (Figure 3) is at the highest part of the anticlinorium. The Monero, Dulce and Garcia Domes, the Horse Lake Anticline, and the Gallina Uplift are along or near the crest of the Archuleta Anticlinorium. The Barella Dome, near the northwest corner of the reservation, is west of the anticlinorium.

The sedimentary rocks dip gently westward

throughout much of the area. They steepen in the east-central and northeastern parts to 20° or more; there, the bedding attitudes change and dip northwest and northeast around the domes and plunging anticlines.

Numerous steeply dipping, north- to northwest-striking faults are present in the northeastern corner of the reservation (Figure 3). These faults continue into Colorado, near Pagosa Springs, for a total distance of 25-30 mi. Displacements are down-dip, and range from less than 100 ft to a few hundred feet. The major fault of the region, the Nacimiento-Gallina Fault, is outside the reservation and is not shown on Figure 3.

The age of most of the folding is believed to be latest Eocene; that of the faulting, late Miocene (Dane, 1948).

MINERAL RESOURCES

General

Known mineral resources of potential value in the Jicarilla Indian Reservation include petroleum and natural gas, coal, titanium, manganese, and possibly uranium. Petroleum, natural gas, and sand and gravel are the only mineral commodities now being produced.

Energy Resources

Petroleum and Natural Gas

General.--By far the greatest economic mineral potential of the reservation is in reserves and resources of petroleum and natural gas which are known to occur in the southern and central parts where billions of cubic feet of gas and hundreds of thousands of barrels of oil are produced annually from over 20 gas and oil pools. Productive formations range from the Dakota upward through the Pictured Cliffs.

These formations are productive in the reservation because of stratigraphic factors (porosity of beds or their susceptibility to fracturing), rather than structural factors (domea or anticlines). (C. W. Spencer, USGS, 1977, oral commun.) Production of gas and oil is from the South Blanco Basin (Figure 1) which is an eastern extension of the vast San Juan Basin. The pools listed in Table 2 and Table 3 are parts of or closely related to the South Blanco field. Productive formations in these pools are, in order of decreasing age, Dakota, Mancos, Mesa Verde (which includes the Chacra, now known as the Cliff House Sandstone, and the Gallup), and the Pictured Cliffs. Gas and oil production from all of these formations except the Mancos is from porous beds (sandstone). Oil production of the Boulder and Puerto Chiquito pools is from fractured calcareous siltstone beds of the Niobrara interval of the Mancos Formation.

At greater depth than the Dakota Sandstone are the Todilto Limestone and the Entrada Sandstone, both of Jurassic age, which have possibilities for oil and gas accumulation (Dane, 1948)--the Todilto because of possible solution cavities, the Entrada because of porosity. "The most significant possibilities for oil and gas production in pre-Dakota rocks, however, appear to be in wedge edges of the Permian and Pennsylvanian rocks that are believed to underlie at depth much of the western part of this area and to be overlapped eastward by the

Triassic and Jurassic rocks" (Dane, 1948).

Structures.--The Barella Dome, in the northwest corner of the reservation, is a small structural high which lifts the base of the Cretaceous to 1,000 ft above sea level, well to the west of the l,000-ft contour which encircles the San Juan Basins (Figure 2 and Figure 3). The structure was drilled to Mesaverde(?) without shows of oil and gas (Barnes and Arnold, 1950, p. 93). The Animas Formation occurs at the surface.

The Dulce Dome, near the edge of the reservation about 5 mi southeast of the town of Dulce, is a small faulted dome near the crest of the Archuleta Anticlinorium (Figure 2 and Figure 3). In 1940 "Jicarilla Apache No. 1" was drilled in the Dulce Dome to a depth of 2,363 ft, encountering the base of the Mesaverde at 400 ft and the top of the Dakota Sandstone (basal unit of the Cretaceous) at 2,340 ft. There were no shows of oil or gas, but water was encountered in the Dakota Sandstone (Dane, 1948). The Mesaverde Formation crops out over much of the dome but at the well site there is some Lewis Shale, too small to be depicted in Figure 3. A dry hole was drilled nearby in 1930; the depth attained was 2,536 ft, but other data are unavailable.

The faulted Monero Dome, a few miles northeast of the Dulce Dome, and just outside the reservation, was drilled in three places during 1925-26, to depths of 350(?)-1,515 ft. Martinez No. 1, the deepest, reached the top of the Dakota at 1,407 ft (Dane, 1948). Only water was found in the drill holes. The outcropping rock there is Mancos Shale.

The Garcia Dome, a small doubly plunging anticline straddling the boundary of the reservation a few miles south of the Monero Dome (Figure 3) has not been tested by drilling. Mesaverde Formation is at the surface there.

The next structure along the Archuleta Anticlinorium is the breached Horse Lake Anticline. Mancos Shale crops out along the crest outside the reservation, but the axis plunges northwest, so that the Mesaverde Formation is the surface rock at the eastern edge of the reservation. Two dry wells have been drilled in the structure, one of them bottomed in Entrada Sandstone (Late Jurassic age) at 1,195 ft (Barnes and Arnold, 1950, p. 93). Mancos Shale is at the surface.

Production.--The tribe received $8.7 million in royalties from oil and gas from 1971 through 1975; $6.86 million (78.7 percent) came from natural gas (D. Garcia, USGS written commun. 1976). Total royalty income increased almost 65 percent over the 5-year period. The marked increase in average production value of both petroleum and natural gas since 1973 is apparent in Table 4.

The reservation is on the eastern edge of the large Ignacio-Blanco gasfield that occupies the northern part of the San Juan Basin. Most of the gas producing area has been designated by the New Mexico Oil and Gas Commission and the New Mexico Oil and Gas Engineering Committee as the Blanco, So. Blanco, and Basin gasfields, and a further breakdown is made by producing formation. Figure 1 shows the gas and oil producing areas plus the names of well-defined areas.

Statistics from the New Mexico Oil and Gas Engineering Committee for 1975 production on the reservation, combined Table 2 and Table 3, show that a total of 39.6 billion cubic feet of gas and 468,600 barrels of oil were produced within the

reservation. Discrepancies between the State figures and those of the U.S. Geological Survey (Table 3) probably are because of the complex land ownership patterns in T. 26 N., Rs. 4 and 5 W. State records list production in those townships from leases that apparently are not Indian owned, whereas ownership data supplied by the Indian agency show all but 80 acres in these townships as owned (mineral and surface) by the tribe (Vigil, 1966). Table 2 and Table 3 include all production from these townships.

The free world market value of crude oil is $13.00 per barrel (end of 1976) or about $2.24 per million Btu's, whereas domestic natural gas is $1.52 per Mcf for new gas (one Mcf contains approximately one million Btu's). A value for natural gas generally equivalent to oil on a Btu basis might provide a stimulus for closer spaced drilling in presently productive areas as well as accelerated exploration elsewhere.

Coal

There is no record of coal production on the Jicarilla Reservation, but coal has been mined near the town of Monero east of the reservation in T. 31 N., R. 1 E. (Gardner, 1909). In the Monero area, where the Gibson Member of the Mesaverde Formation is 80-130 ft thick, one-half to one-third of the unit is sandstone and the rest is shale, sandy shale, carbonaceous shale, and coal (Dane, 1948). The Member thickens southward toward Cuba (Figure 3); however, in the Gallina Uplift area, east of the east-central part of the reservation, coal occurs only as very thin beds of lignite in a 10-15 ft unit of carbonaceous shale. The coal there "does not occur in sufficient quantity nor is of high enough grade to merit mining" (Lookingbill, 1953, p. 93).

Coal resources of the Fruitland Formation (Upper Cretaceous) are described by Fassett and Hinds (1971). Their study includes the entire San Juan Basin and is based on measurements from surface outcrop samples, drill cores, and oil- and gas-well logs. A similar study of the deeper Menefee coals has been made by the New Mexico Bureau of Mines and Mineral Resources (Shomaker and Whyte).

The study of Fruitland Formation coals shows a general thinning of the beds along the eastern side of the basin in the townships in R. 1 W. (also the site of the eastern outcrop of the formation). Total thickness of the combined coalbeds ranges up to 47 feet in the reservation (Fassett and Hinds, 1971, fig. 21). Maximum thickness is in the W ½ Ts. 26-27 N., R. 3 W., and T. 26 N., Rs. 4-5 W. This area also contains the thickest individual coalbeds--up to 27 feet (Fasset and Hinds, 1971, fig. 22).

The Fruitland coals are too deep to mine under present economic conditions. Fassett and Hinds (1971, fig. 27) show the coals to be at a depth of 1,000 to more than 3,500 feet in the reservation. The thickest coal is at 3,000 to 3,500 feet depth. Coal resources of the Menefee Formation are still deeper than those of the Fruitland. Shomaker and Whyte (in press) shows a significant thickness of Menefee coal only in the extreme southern part of the reservation; in this area, coalbeds range up to 18 feet thick. A total of 149.9 million short tons of coal has been estimated for the area. (Table 5). Depth ranges from 3,500 to 4,000 feet.

TABLE 5. Estimated coal resources by township, southern Jicarilla Apache Indian Reservation (Shomaker and Whyte)

Township	Coal, million short tons
T. 22 N., R. 3 W	6.0
T. 22 N., R. 5 W	25.1
T. 23 N., R. 2 W	21.4
T. 23 N., R. 3 W	36.0
T. 23 N., R. 4 W	28.9
T. 23 N., R. 5 W	32.5
Total	149.9

According to Shomaker and Whyte, the underground mining of Menefee coals in northwestern New Mexico is not economically feasible at the present time. They suggest the possibility of in situ gasification or liquefaction of the coals as a means of utilizing the resource.

Uranium

There are known occurrences east of the southern part of the reservation. One of these is in claystone or shale of the San Jose Formation 2.5 mi north of Regina and a little west of Highway 112 (fig. 3; Hilpert, 1969, pl. 1). Other known occurrences of uranium are in sandstone of the San Jose Formation 7 mi northeast of Regina and a little east of highway 112; 3 mi east of Gavilan, on the Continental Divide; 7.5 mi east-northeast of Gavilan, on a tributary of the Rio Gallinas; and 9 mi east of Gavilan and a little west of Highway 112 (fig. 3; Hilpert, 1969). These occurrences are relatively minor; samples contained about 0.02 percent U_3O_8 or a little more. None of these occurrences are on tribal lands, but they are along the strike of San Jose beds exposed in the north half of the reservation. Uranium possibilities thus exist in the Tertiary rocks that are exposed throughout most of the reservation.

Better possibilities may exist in the subsurface, but they may be too deep. Where older rocks are exposed 2 ½ to 8 mi east of Regina there are at least six known uranium occurrences, five of them in Permian sandstone, and one in Pennsylvanian sandstone (Hilpert, 1969, pl. 1). These closely spaced occurrences are shown with a single symbol in Figure 3.

The Dakota Sandstone is a possible host for uranium, and its depth below the surface is much less than that of the Permian and Pennsylvanian beds. However, the nearest known uranium occurrence in the Dakota Sandstone is 48 mi west of Regina (Hilpert, 1969, pl. 1).

Metallic Mineral Resources

Titaniferous Sandstone

In 1955, an airborne radiometric reconnaissance by the Atomic Energy Commission revealed a deposit of titaniferous sandstone northeast of Burford Lake in sec. 3, T. 28 N., R. 1 E. (Bingler, 1968). The deposit occurs as lenses along the top of a sandstone sequence of the Mesaverde Formation (Figure 4). It consists of thin layers of heavy mineral concentrations interlayered with quartz sandstone and is as much as 80 feet thick.

Heavy minerals in the deposit include zircon, garnet, tourmaline, rutile, magnetite, and ilmenite. Bingler points out that detailed mapping would be required for an estimate of quantity and grade of the deposit but suggests there may be 5 million tons of lense material. He cites a selected sample that contained 5.73 percent titanium oxide.

Manganese

Manganese was mined from the Jicarilla Indian Reservation in 1957 and 1958 (Farnham, 1961). Production totaled 276 long tons of concentrates averaging 36 percent manganese. The deposit was in the NW ¼ of unsurveyed sec. 21, T. 22 N., R. 4 W., (Figure 1) and was depleted by the Fall of 1958.

The ore occurred as a flat-lying deposit of concretionary nodules of pyrolusite and wad about 160 feet long by 75 feet wide. Reportedly, the ore zones ranged from a few inches to 4 feet in thickness. Mining was by open cut with a bulldozer and front-end loader. Overburden apparently was minimal.

No other occurrences of manganese have been reported on the reservation. When the mining site was visited in October 1976, it appeared that most of the Tancosa Wash valley west and north of the deposit would be stratigraphically lower than the manganese-bearing horizon. It is possible, however, that the stratigraphically higher small buttes and mesas east of the site may contain deposits.

Nonmetallic Mineral Resources

Sand and gravel resources on the reservation are plentiful, both as terrace gravels and as alluvium. Use of the commodity has been limited to road building, and little or no record of production has been kept.

MINERAL LEASING

Leasing of minerals on the Jicarilla Indian Reservation is controlled basically by the Omnibus Mineral Leasing Act of 1938, with implementing regulations in 25 CFR part 171. However, because the Jicarilla Apache Tribe is organized under the provisions of the Indian Reorganization Act of June 18, 1934 (48 Stat 984; 25 U.S.C. 461-479), the tribal council's action (authorized under their constitution, by law, or charter) may supersede the regulations in 25 CFR part 171.

Regulations governing mineral leasing on Indian lands allow considerable flexibility in determining specific terms and procedures. This flexibility permits the tribal governments to make changes that best serve the tribes' needs (U.S. Federal Trade Commission, Bur. of Competition). The general provisions that follow were extracted from "American Law of Mining" published by the

Rocky Mountain Mineral Law Foundation (1966); they provide a base on which specific lease terms may be established.

Leases may be made by the Jicarilla Apache Tribal Council, with approval by the Secretary of the Interior or his authorized representative. Leases are for 10 years or as long thereafter as minerals are produced in paying quantities. Oil and gas leases must be sold by public auction or sealed bids, but leases for other minerals may be negotiated and approved without public notice and sale.

The acreage of a single lease may not exceed 2,560 acres except for coal leases, in which case larger areas may be approved by the Commissioner of Indian Affairs if in the interest of the tribe and necessary. Annual rentals are fixed at $1.25 per acre for oil and gas leases and not less than $1.00 per acre, plus annual development expenditures of not less than $10.00 per acre, for other minerals.

Royalties on mineral production vary depending on the mineral involved. For most minerals, the minimum royalty is 10 percent of the value of the mineral at the nearest shipping point. Royalties for oil and gas and natural gas liquids are a minimum of 16.67 percent (U.S. Federal Trade Commission, p. 70). The minimum coal royalty is 10 cents per ton of mine-run coal.

Prospecting permits may be issued by the Superintendent of the Agency with the consent of the tribal council.

MINERAL MARKETS AND TRANSPORTATION

The local market for mineral commodities is limited to sand and gravel. The national market is the potential outlet for most of the mineral commodities on the reservation. Petroleum and natural gas and coal require complex processing plants; these, in turn, require sufficient supplies of raw materials to assure a constant, longtime flow through the processing system.

Rail transportation is not readily available to the reservation. The nearest rail outlet is the Denver & Rio Grande Western Railroad (D&RGW) at South Fork, Colo., 90 miles north of Dulce over 10,850-foot Wolf Creek Pass. The mainline of the Santa Fe Railway is at Lamy, N. Mex., 145 miles southeast of Dulce.

Petroleum and natural gas reach national markets through pipeline systems. An intricate system of gathering lines on the reservation moves gas to trunk lines linking the San Juan basin to West Coast markets. Oil from isolated wells is moved by trucks to pipeline terminals.

RECOMMENDATIONS FOR FUTURE WORK

It is recommended that the titaniferous sandstone deposit near Burford Lake be studied by detailed mapping, sampling, and metallurgical testing.

A reconnaissance should also be made for manganese deposits in the eastern part of T. 22 N., R. 4 W., and the western part of T. 22 N., R. 3 W. It is expected that any deposits found would be small, but they might be profitable as small scale operations.

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TABLE 1. - Land ownership status, Jicarilla Indian Reservation, New Mexico

(Source: Vigil, W. D., 1966, Resources Jicarilla Indian Reservation, Rio Arriba County, N. Mex.)

Ownership	Acres	Acreage
Tribal trust lands		742,315.42
Indian fee land:		
Henry L. Vicenti		160.35
Lot 1, SE 1/4 NE 1/4, E 1/2 SE 1/4 Section 6 T. 31 N., R. 2 W.		
Non-Indian fee land:		
J. E. Gomez	158.00	
S 1/2 NW 1/4, N 1/2 SW 1/4, (less 2 acres) Section 12 T. 31 N., R. 2 W		
Toby Montoya	240.49	
Lots 13 and 14 Section 22 SW 1/4 (Lots 11, 12, 13, 14) Section 23 T. 32 N., R. 2 W.		
T. D. Burns Estate	80.00	
SW 1/4 NE 1/4 Section 31 SW 1/4 NE 1/4 Section 32 T. 26 N., R. 5 W.		478.49
Total area within reservation		742,954.26
Mineral rights (Tribe owns surface):		
R. B. Ortiz land	160.00	
SE 1/4 SE 1/4 Section 11, SW 1/4 SW 1/4 Section 12, E 1/2 NE 1/4 Section 14, T. 31 N., R. 2 W.		
Reuben Cordova land	160.00	
NE 1/4 NE 1/4, S 1/2 NE 1/4 Section 35, SW 1/4 NW 1/4 Section 36, T. 31 N., R. 2 W.	320.00	

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TABLE 2. - Production from gaspools, Jicarilla Indian Reservation, 1975

(Adapted from Annual Report of the New Mexico Oil and Gas Engineering Committee, Volume II, 1975)

Pool, formation	Production	
	Gas, Mcf	Oil, barrels
Basin, Dakota	12,266,577	127,366
Blanco, Pictured Cliffs, South	7,428,213	0
Blanco, Mesaverde	5,487,202	14,826
Tapacito, Pictured Cliffs	4,535,415	36
Ballard, Pictured Cliffs	1,979,382	0
BS Mesa, Gallup	414,422	3,819
Choza Mesa, Pictured Cliffs	36,048	0
Gavilan, Pictured Cliffs	826,620	3,826
Gonzales, Mesaverde	899,969	6,689
Otero, Chacra	1,544,231	4,035
Wild Horse, Gallup	1,527,676	8,592
Undesignated	16,540	1,295
Total	36,972,295	170,484

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TABLE 3. - Production from oilpools, Jicarilla Indian Reservation, 1975

(Adapted from Annual Report of the New Mexico Oil and Gas Engineering Committee, Volume II, 1975)

Pool, formation	Production	
	Gas, Mcf	Oil, barrels
Boulder (Burford Lake), Mancos	2,684	16,197
Lindrith, Gallup-Dakota South	39,440	4,944
Lindrith, Gallup-Dakota West	1,087,774	87,899
Otero, Gallup	463,705	44,934
Parlay, Mesaverde	18,773	7,618
Puerto Chiquito, Mancos	47,638	100,329
Rincon	10,960	86
Sleeper, Pictured Cliffs	29,863	3,203
Tapacito, Gallup	805,566	11,143
Venado, Mesaverde	0	3,864
Wild Horse, Dakota	59,673	1,369
Undesignated	92,660	16,570
Total	2,658,736	298,156

TABLE 4. - Mineral production and royalties from tribal lands, Jicarilla Indian Reservation 1971-1975

Year	Petroleum		Natural gas		Total	Average production value	
	Production, barrels (42 gals.)	Royalty, dollars	Production, MMcf	Royalty, dollars	Royalty, dollars	Petroleum, dollars/bbl	Natural gas, dollars/Mcf
1971.....	722,626.07	$262,844.51	51,330.95	$945,728.14	$1,208,572.65	$2.868	$0.146
1972.....	780,400.09	293,556.81	54,676.14	1,238,078.66	1,531,635.47	2.942	.180
1973.....	514,800.11	252,671.62	44,073.75	1,299,947.80	1,552,619.42	3.849	.234
1974.....	786,505.35	609,834.29	45,679.71	1,762,790.20	2,372,633.49	6.115	.306
1975.....	411,752.52	414,823.28	36,715.92	1,576,833.86	1,991,657.14	7.876	.340
5-year total	3,216,084.14	1,833,739.51	232,476.47	6,823,378.66	8,657,118.17	-	-

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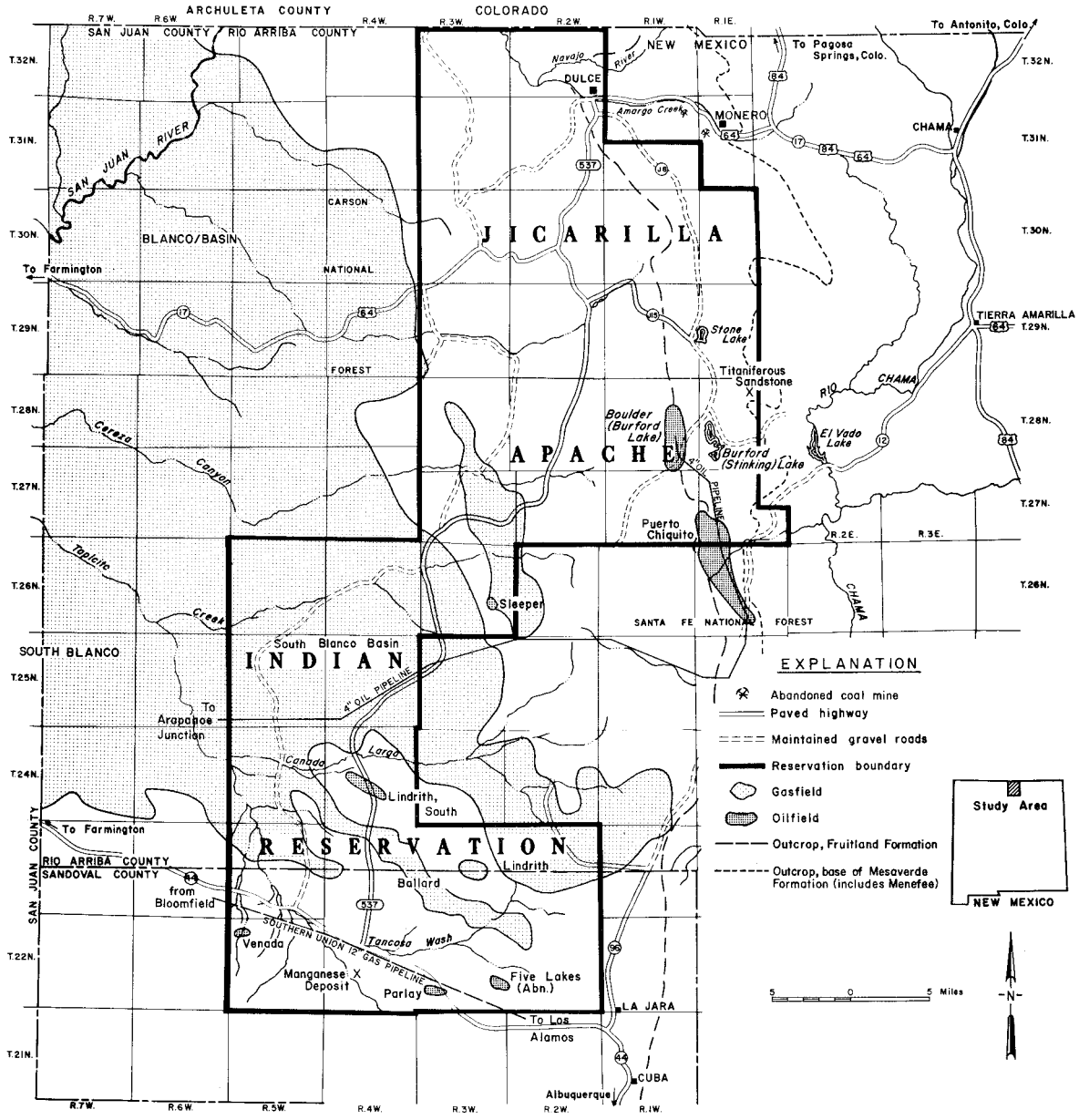

Figure 1. Index map, Jicarilla Indian Reservation, showing gasfields and oilfields.

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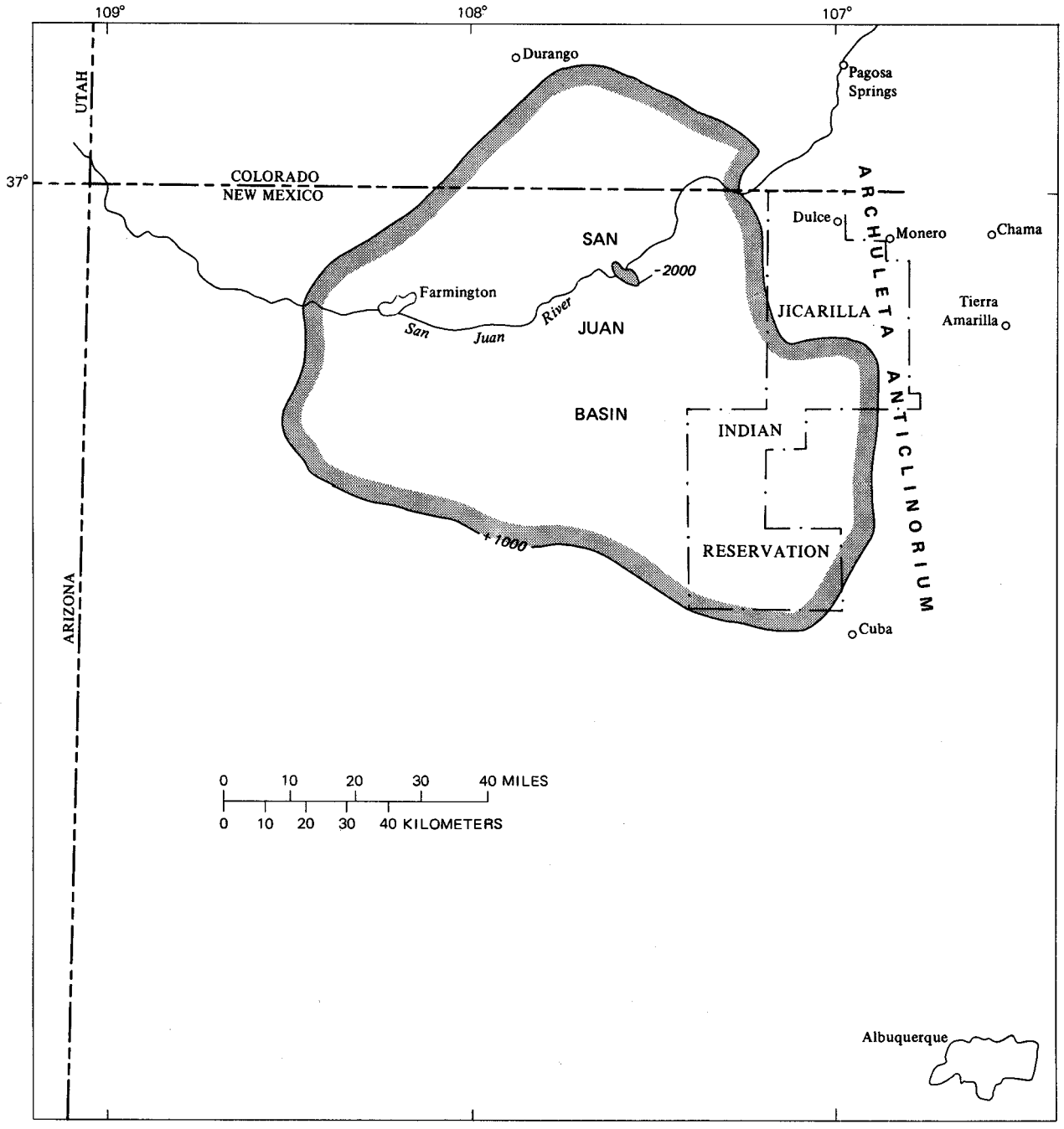

Figure 2. Map showing regional structural settings of Jicarilla Indian Reservation.

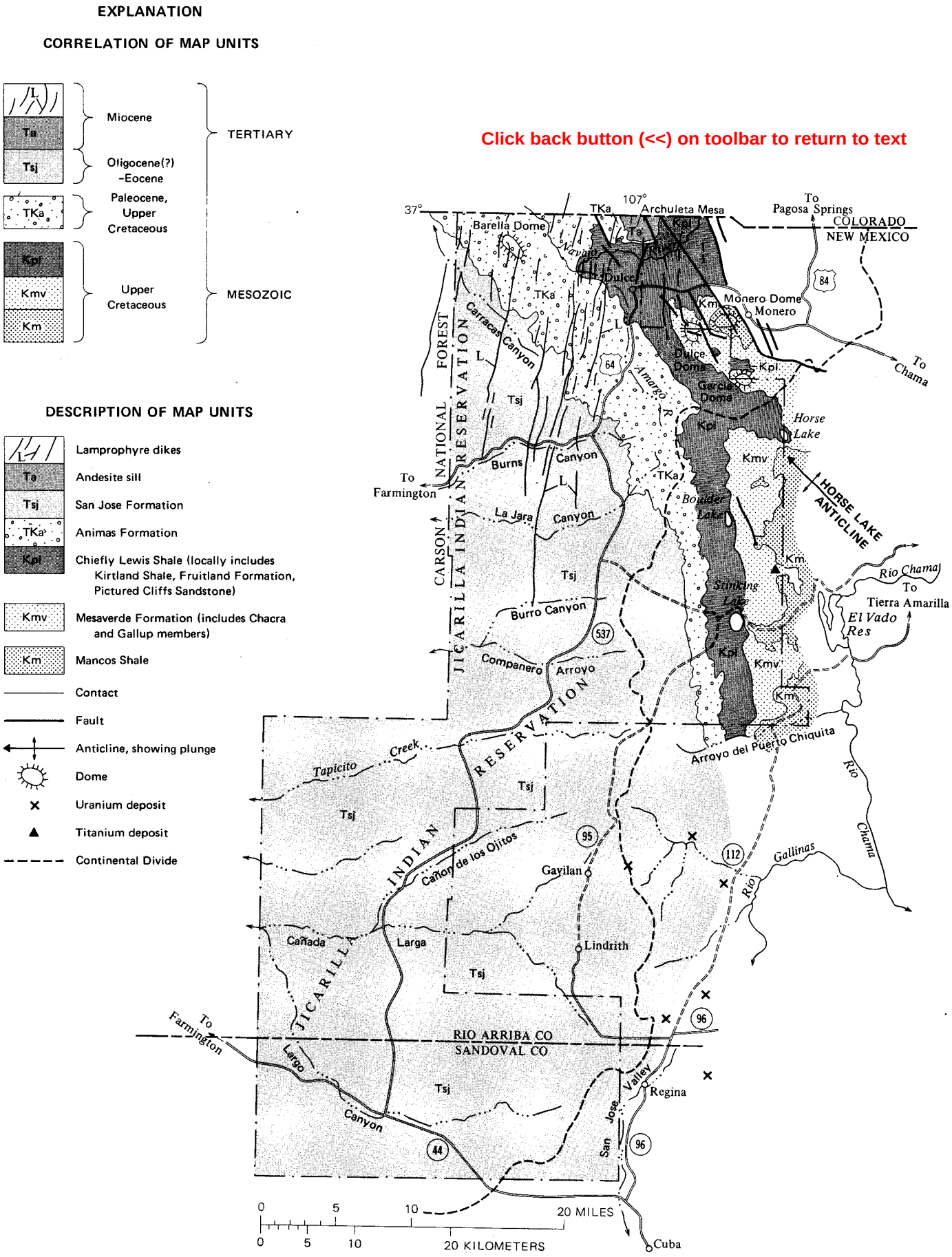

Figure 3. Geologic map of Jicarilla Indian Reservation showing location of uranium and titanium deposits (adapted from Dane, 1948).

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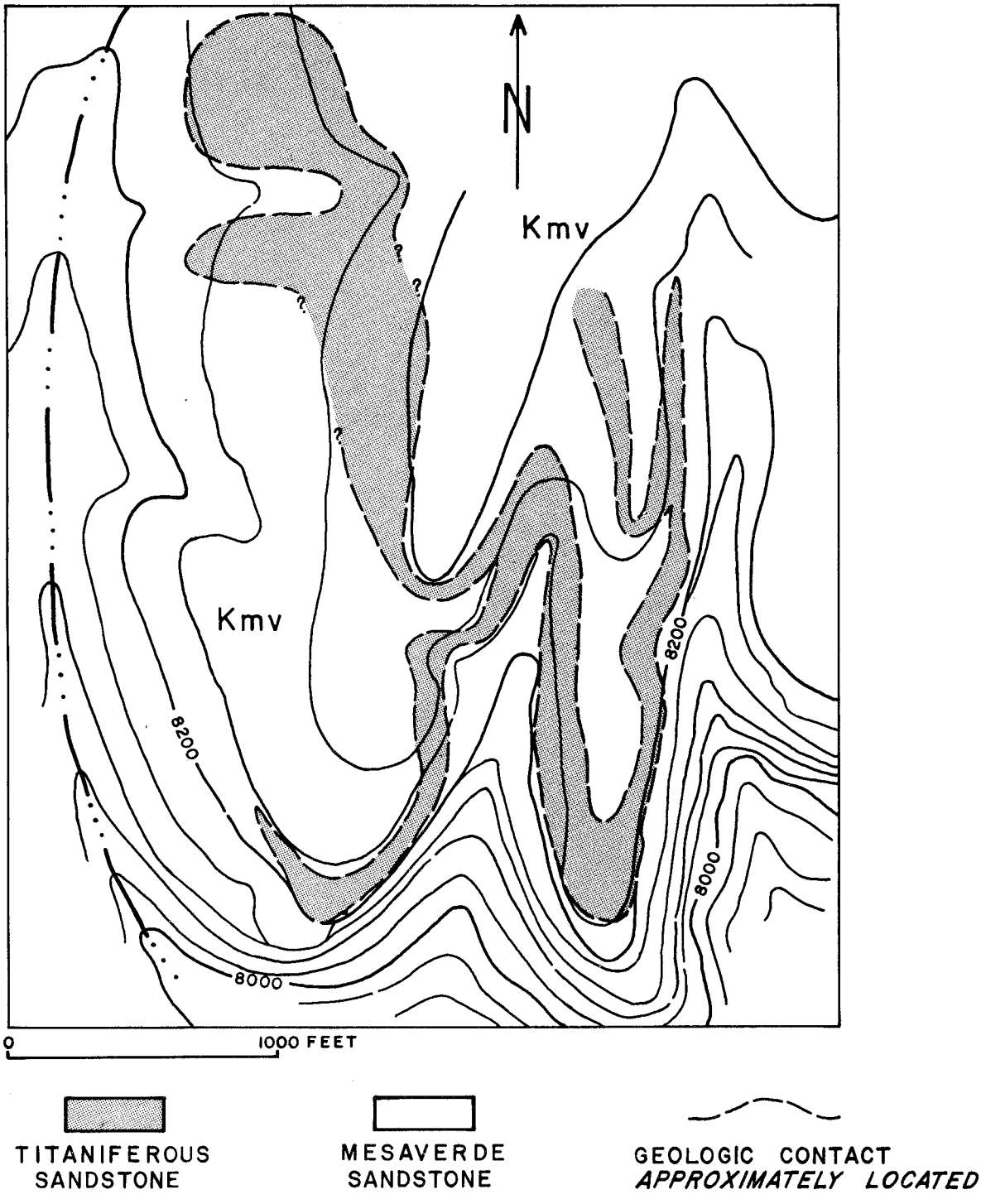

Figure 4. Map showing titaniferous sandstone near Burford Lake