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## *Mineral resources of the San Juan Basin*

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*This is one of many related papers that were included in the 1951 NMGS Fall Field Conference Guidebook.*

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MINERAL RESOURCES OF THE SAN JUAN BASIN

Robert A. Bieberman

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The mineral fuels constitute the prime resource of the San Juan Basin. The original reserves of subbituminous and bituminous coal are estimated by the U. S. Geological Survey as almost 54 million tons of which only a minor fraction has been mined. Petroleum reserves figures are not available, but proved gas reserves are estimated to be 2,288,000,000 M. C. F. Some nonmetallic materials, such as gypsum occur in large quantity; but are too far from markets for profitable exploitation now. Others such as pumice and fluorspar, have been and are being actively mined. Uranium deposits are being explored and their commercial feasibility is being determined. As shown on the accompanying map, deposits and occurrences other than those of the mineral fuels are distributed around the margins of the Basin and might be more properly assigned to the adjoining structural provinces. Pertinent data are summarized in this chapter; more complete discussions are given in papers listed in the bibliography.

Mineral Fuels and Helium

Coal.— Approximately 11,000 square miles of northwestern New Mexico and southwestern Colorado are included in the San Juan River Coal Region. Coals of subbituminous rank occur in the Mesaverde and Fruitland formations over most of this area. In the northwestern and northeastern parts, the coals of the Mesaverde formation are of bituminous rank. The most extensive development of coal in the San Juan Basin has been in the vicinity of Gallup. Coal production over most of the area has been limited to scattered small mines supplying local markets. Accumulative production figures for the San Juan Coal Region are unavailable, but production for the period 1941-1948 is shown below:

Coal Production in the San Juan Coal Region  
1941-1948 ( in short tons) by counties

New Mexico	
McKinley	2,860,274
Rio Arriba	160,270
Sandoval	36,950
San Juan	54,284

Colorado	
Archuleta	3,551
La Plata	373,361
Montezuma	18,387
	<u>3,507,077</u>

Loss of markets has caused coal production to decline during the past two years. No immediate prospects for increased production are apparent and production may continue to decline. Total original coal reserves for the New Mexico portion of the San Juan Coal region are shown below:

Total Original Reserves of Coal in the New Mexico Portion of the San Juan Coal Region  
(in millions of short tons)

Subbituminous	
Fruitland coal	19,666.0
Mesaverde coal	29,815.0
Bituminous	
Mesaverde coal	<u>4,489.9</u>
	<u>53,970.0</u>

Oil and Gas - Oil and/or gas is being produced from 28 fields in the San Juan Basin, the majority of which are located in San Juan County, New Mexico. Producing formations of the basin are the Kirtland shale including the Farmington sandstone member, Pictured Cliffs sandstone, Cliff House and Point Lookout members of the Mesaverde group, Mancos shale, and Dakota sandstone, all of Upper Cretaceous age, the Hermosa and Paradox formations of Pennsylvanian age, and the Ouray limestone of Devonian age. Accumulative production to 1951 of the New Mexico fields has been 24,992,936 barrels of oil and 43,931,216 M. C. F. of gas. Proved gas reserves for the basin are estimated to be 2,288,000,000 M. C. F.

Sandstone permeated with a paraffin-base oil occurs over a relatively large area twenty miles northeast of Gallup on the north fork of the Rio Puerco. The sandstone is coarse-grained and hard, and has a saturated thickness of not over forty feet. The oil content is as high as 24 percent. The sandstone is reported to belong to the Dakota sandstone. No economic use for this sand has yet been developed.

Helium - Helium, which was discovered in the Rattlesnake Oil Field in 1942, occurs in the Ouray limestone at a depth of 6950 feet. The two helium

gas wells are under government control and the helium plant is maintained in stand-by condition. Production from these wells has amounted to 2,234,414 cubic feet of helium. Reserves are estimated at 12 billion cubic feet of gas from which 788 million cubic feet of helium can be extracted.

#### Nonmetals

**Alum** - Alum in the form of the mineral alunogen has been reported from three localities in the San Juan Basin. Non-commercial deposits are located near Gallup in McKinley County, in the northwest part of Sandoval County, and in springs ten miles northwest of Farmington in San Juan County, New Mexico.

**Building Stone** - Stone suitable for building occurs at numerous localities in the basin. The quarrying of stone for building has never been an important industry although many communities have utilized small quantities of local stone for various purposes. McKinley County has an abundance of sandstone suitable for building. The pink sandstone at the top of the Gallup sandstone member of the Mesaverde formation has been quarried at several places near Gallup. A quarry in the Wingate sandstone furnished stone for several government buildings at Black Rock. Granite, limestone, and sandstone have been used for building purposes in Durango, Colo.

**Clay** - Large deposits of clay shales, plastic clays, and fire clays occur in the Cretaceous and Tertiary formations of the San Juan Basin. Crude clay, bricks, and tile have been produced from Cretaceous deposits in the Gallup coal district for over 50 years. Crude and ground fireclay has been shipped to Arizona smelters for refractory uses. Common, face and fire brick and tile are being made from the clays of the Gallup sandstone member of the Mesaverde at Gallup.

Upper Cretaceous shales and residual clays have been exploited at several places in San Juan County for making brick. Brick plants have been operated at Aztec, Farmington, Fruitland, and Shiprock at various times during the past 50 years.

**Fluorspar** - Many fluorspar veins occur in the granitic complex in the southeastern portion of the Zuni Mountains in Valencia County. Some of these veins extend into the overlying Pennsylvanian and Permian rocks. Barite, calcite, aragonite and iron oxides occur in minor amounts as accessory minerals and quartz is the chief gangue mineral. Fifteen mines

and prospects are located in this area. The Zuni Mining and Milling Company is the main fluorspar producer. Over 30,000 tons of fluorspar were mined in the 1946-50 period.

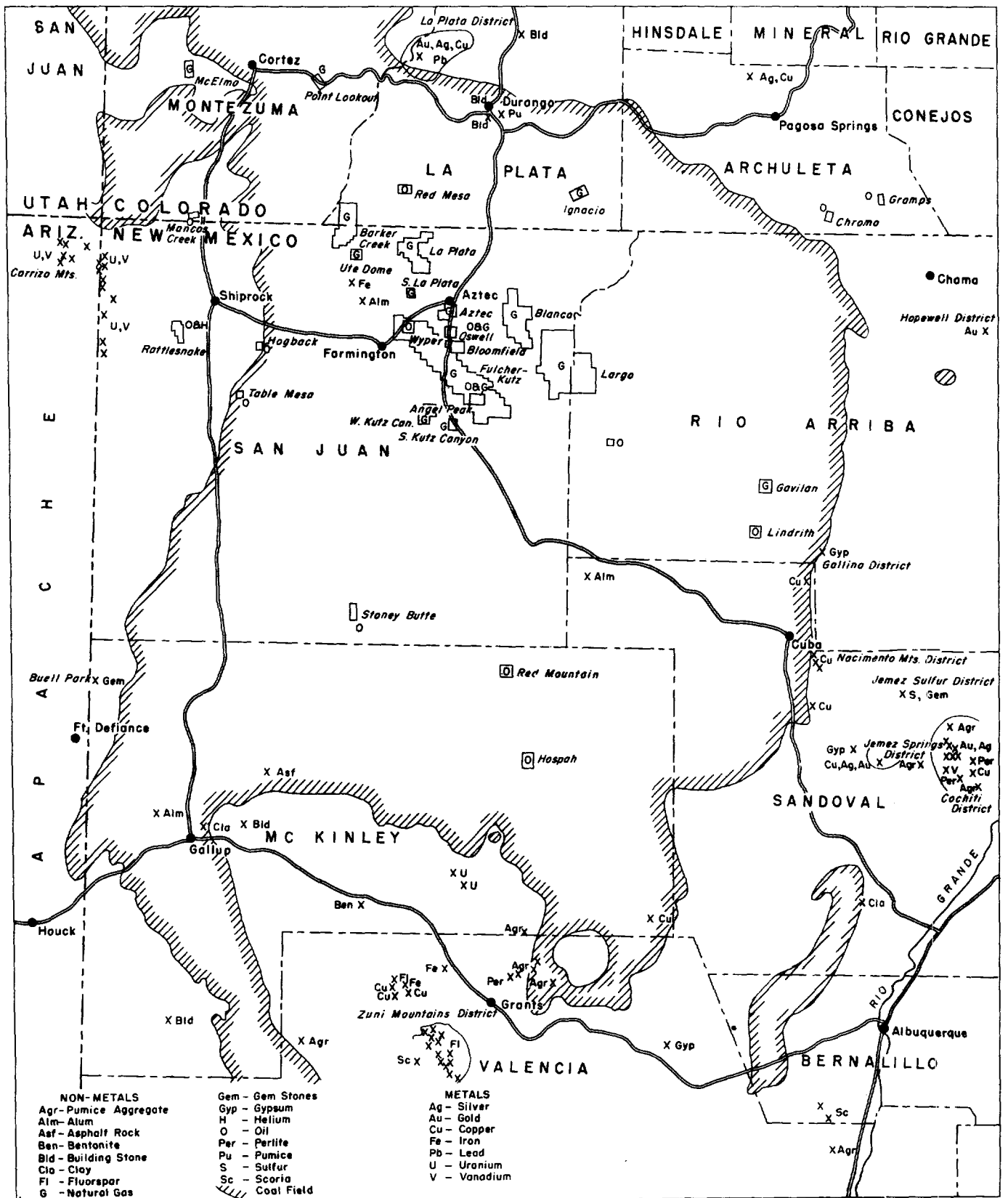
**Gem Stones** - Stones of gem quality have been reported from several localities in the San Juan Basin. Garnet and peridot (olivine) are found as water worn pebbles in the gravel and alluvium on the Navajo Indian Reservation in New Mexico and Arizona and are used by the Indians in native jewelry. The gravel slopes at the southeast base of Peridot Ridge in Buell Park contain a high percentage of peridot fragments. Stones weighing one or two carats are abundant. The stones are found in place in a large mass of agglomerate on Peridot Ridge. Associated minerals include pyrope (garnet), diopside, calcite, limonite, ilmenite, enstatite, augite, biotite, and serpentine. No organized production of gem stones exists in this region but casual finds and sales to tourists passing through Gallup amount to a few hundred dollars annually. Pyrope garnet is also reported from McKinley County at Thoreau and in the Red Lake volcanic field. The gem minerals originally came from volcanic eruptions.

Brevoort, (1874), reported topaz, sapphire, zircon, and spinel from ant hills east of Fort Defiance. This report is unconfirmed. Zircon is present in the volcanics of the Jemez Plateau of Sandoval County. Spinel occurs as microscopic grains in andesite fifteen miles south of Osier in Rio Arriba County.

A few specimens of precious opal have been reported from the Cochiti District in Sandoval County. Hyalite opal and wood opal are found in the Cochiti District and near Battleship Rock in the Jemez Sulfur District. Hyalite opal occurs as stalactites in fissures of lava and wood opal in volcanic ash or tuff.

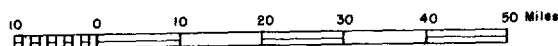
Agate, agatized wood, chalcedony, and jasper are common throughout Apache, McKinley, Sandoval, San Juan, and Valencia counties. Amethyst quartz is reported east of Ft. Defiance and from the Zuni Mountains.

**Gypsum** - Gypsum is widespread throughout the San Juan Basin. The most notable deposit is the great gypsum bed of the Todilto formation which ranges in thickness from fifty to one hundred feet and crops out in Bernalillo, Rio Arriba, Sandoval and Valencia counties. Gypsum was formerly quarried at Gallina, Rio Arriba County, for local use.



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by Robert A. Bieberman



**Perlite** - Perlite, a natural glass of late volcanic origin, occurs nine miles northeast of Grants in Valencia County and in the Cochiti Mining District of Sandoval County. Perlite, when heated to a temperature of 1400° F. to 2300° F., expands as much as four to ten times its original volume. The resultant synthetic pumice is usually white, very porous and light. The expanded material has excellent insulating properties and can be used as aggregate for lightweight concrete. The deposits on the margin of the San Juan Basin have not as yet been developed.

**Pumice** - Pumice is extensively used as an aggregate in lightweight building blocks and as an abrasive. Deposits occur northeast of Grants in Valencia County and in the Jemez region of Sandoval County. The Pumice Corporation of America Mine at Grants produced 29,362 tons of pumice from July 1947 to July 1950. A small amount of pumice has been produced from the east slope of Florida Mesa east of Durango, Colorado.

**Scoria** - Scoria deposits of commercial size are located in the Zuni Mountains of Valencia County and Bernalillo County. The Bernalillo County deposits are a source of aggregate for lightweight building blocks.

**Sulfur** - Native sulfur is found at Jemez Sulfur Spring in Sandoval County. A small amount of sulfur has been extracted and marketed from this deposit, but the quantity available is too small to be of any real commercial importance.

**Sand and Gravel** - Deposits of sand and gravel are widely distributed throughout the San Juan Basin. Practically every community has an ample supply easily available for local use.

#### Metals

**Silver** - Silver in the LaPlata District of Colorado occurs in veins and replacement deposits of silver-bearing telluride ores, veins of mixed base metal sulfides, and as veins of ruby-silver ore. Over 2,000,000 ounces of silver have been recovered from the district.

Sandoval County has produced over 33,000 fine ounces of silver from the Cochiti and Jemez Springs Districts. Silver was recovered from siliceous sulfide ore in the Jemez Springs District and from quartz veins and lodes in shattered and brecciated zones in the

Cochiti District. The principal ore mineral in the Cochiti District is finely divided argentite.

Archuleta County, Colorado and the Hopewell District of Rio Arriba County, New Mexico, have yielded a slight amount of silver.

**Gold** - The most valuable product of the La Plata District of Colorado is gold. Altogether, the district has yielded almost six million dollars worth of gold, but has been relatively dormant since 1938. Native gold and gold telluride ores occur in a variety of types of deposits, the most important of which are veins and replacement deposits.

Gold placer deposits have yielded approximately \$300,000 worth of gold in the Hopewell District in Rio Arriba County. A small quantity of gold has been recovered from siliceous sulfide ore in the Jemez Springs District and from quartz veins and lodes in the Cochiti District in Sandoval County. Pre-Cambrian granitoid gneiss contains gold in the Zuni Mountain District of Valencia County.

**Copper** - The copper deposits of the Nacimiento Mountains District of Sandoval County occur in Permian and Triassic sandstones, conglomerates, and shales. The principal ore mineral is chalcocite, but considerable bornite, azurite, malachite and chrysocolla are present. The ore minerals are generally associated with wood and plant remains which they have replaced. Accumulative production amounts to about 6,300,000 pounds. This district has been idle for many years.

Gold has always been the most valuable product of the LaPlata District in Colorado, but 300,000 pounds of copper have also been recovered. The principal copper ore mineral in the district is chalcocite.

The copper deposits in the Zuni Mountain District occur in the pre-Cambrian rocks and in the Abo "Red beds". The ores in the pre-Cambrian rocks occur along shear zones in tourmaline granite and granite porphyry. The ore minerals are malachite, azurite, chalcocite and small amounts of native copper and chalcopyrite. The Abo deposits are of the usual "Red bed" type and the best ore occurs in shale. About 14,000 pounds of copper have been produced from this district.

A number of non-productive copper prospects occur in the Gallina District of Rio Arriba and Sandoval counties.

The copper deposits occur in micaceous sandstone and conglomeratic grit of Permian and Triassic age. The ores consist principally of copper carbonates although some bornite is present. A few shipments of copper-silver ore have been made from the district.

The Jemez Springs District has produced a small amount of siliceous sulfide ore containing copper and silver. Small amounts of chalcopyrite occur in the Cochiti District of Sandoval County and a few weak copper showings have been reported from southeastern McKinley County.

Iron - An iron-pigment deposit is located ten miles north-northwest of Farmington in San Juan County. The material occurs as streaks in clay and as cement in the Farmington sandstone member of the Kirtland shale. Iron pigment is mined for a local market.

Several low-grade iron deposits occur in pink granite gneiss and schist in the Zuni Mountains of Valencia County. The ore minerals are largely supergene in origin, although magnetite is present. No concentrations of minable ore have been found.

Lead - The only lead production in the San Juan Basin comes from the LaPlata District in Colorado. Galena is widely distributed throughout the district, but is abundant in only a few of the deposits. The galena commonly occurs as small grains associated with sphalerite, tetrahedrite, and the tellurides. In some

ores it fills open vugs and fissures in a gangue of quartz and barite but more commonly it replaces sphalerite, tetrahedrite, and chalcopyrite. Accumulative lead production of the district amounts to 750,000 pounds.

Uranium - Extensive deposits of uranium-bearing minerals have been found west of Shiprock in the Carrizo Mountain area of Arizona and New Mexico and at Haystack Mountain in McKinley County. The carnotite deposits in the Carrizo Mountain area were discovered in 1918, but, until 1948 were mined chiefly for their vanadium content. The deposits occur in the Salt Wash sandstone member of the Morrison formation. The Haystack Mountain uranium deposits in McKinley County were discovered in 1950. The uranium minerals, carnotite and tyuyamunite, as well as a small amount of uraninite, occur in the Todilto limestone. These deposits show promise of making an important contribution to the mining industry of the San Juan Basin.

Vanadium - Vanadium is being produced in the Carrizo Mountain area of Arizona and New Mexico. Vanadium-bearing mica, calcium vanadates, and vanadium oxides are associated with the carnotite deposits in the Salt Wash sandstone member of the Morrison formation. These deposits yielded about 22,000 tons of ore between May 1942 and February 1944. In 1949, vanadium was mined for the first time in the New Mexico portion of the area. Approximately 2500 tons were produced in the period July 1949 to July 1950.

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