limestones. Uranium was produced here in the 1960s, but work was discontinued in favor of the larger deposits of Pena Blanca.

The limestones of Sierra Gomez have undergone folding and thrusting. Tertiary volcanics were deposited and subsequently eroded from most of the area. Later faulting of the Basin and Range province left Sierra Gomez as a horst bounded by bolsons.

The uraniun deposits are in massive, sometimes fossiliferous or cherty limestones overlain by thin-bedded, fossiliferous limestones. Structurally the core of Sierra Gomez is a syncline bounded by anticlinal structures. Low-angle thrust faults are present in several mines in the area.

Hexavalent uranium is present along fractures and faults. Carnotite and tyuyamaunite have been identified. There is widespread calcite, silicification, hematization, and some fluorite, gypsum, and limonite. These replace limestone, either along low-angle faults, or in solution cavities.

Trace-element data available at this time indicate anomalous values for fluorine, vanadium, arsenic, molybdenum, mercury, chromium, nickel, copper, and zinc, in mineralized zones.

The uranium apparently was diagenetically leached from overlying volcanics and moved into the limestones, primarily along fault zones, until conditions favorable for precipitations were reached. Although evidence is supportive of a leaching hypothesis, it can neither be proven or disproven at this time.

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Trace-Element Content of Northern Great Plains Subbituminous Coal and Gulf Coast Lignite, 1979

A total of 453 coal samples from Northern Great Plains subbituminous coal beds, and 92 samples from the Gulf Coast lignite beds were chemically analyzed and studied from 1975 to 1979. These samples were analyzed for major, minor, and trace elements by the U.S. Geological Survey. In addition, ultimate, proximate, and Btu analyses were performed by the Coal Analysis Section of the U.S. Department of Energy.

Of the 18 elements reported in the summary, the geometric means for F, Zn, and S are as much as two-fold higher in ligite, compared with subbituminous coal. The elements Mn, Cr, and Se are more than four-fold higher in lignite than in subbituminous coal. All other reported elements are two to four-fold higher in lignite than in subbituminous.

About 8 metric tons (8 Mg) of Gulf Coast lignite are required to produce 1 billion Btu; in contrast, approximately 6 Mg of Northern Great Plains subbituminous coal are required to produce the same quantity of Btu. According to these comparative tonnages, 1.7 Mg of ash will be produced by combusting 8 Mg of lignite and 0.5 Mg of ash by 6 Mg of subbituminous coal. During the production of 1 billion Btu from lignite, 27,000 g of sulfur will be mobilized and a similar Btu production from subbituminous coal will mobilize 76,000 g of sulfur. Approximately 2,700 g of the other elements will be mobilized during the combustion of lignite and about 730 g will be mobilized from the combustion of subbituminous coal.

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San Andres Formation, East-Central New Mexico

The lower part of the San Andres Formation in east-central New Mexico consists of three cyclical zones, commonly known as the P-3, P-4, and P-5 porosity zones. Each of these, typically, consists of a thin, widespread evaporite at the top, followed by carbonates in the middle and a thin shaly carbonate zone at the base. Locally, halite may replace anhydrite. The rest of each zone consists of carbonates; dolomite normally underlies the upper anhydrite and may be as much as 100 ft or more thick. The dolomite may contain one or more layers of anhydrite and is underlain by limestone.

Lithofacies studies of the lower San Andres indicate that where the carbonate consists entirely of dolomite, there is an above-average amount of evaporites. Lithofacies studies also indicate that porosity trends are mappable and help to determine favorable areas for petroleum exploration.

The lower San Andres of east-central New Mexico was deposited along a north to northeast-trending coast that prograded southward and eastward except during the deeper water beginning of each cycle when shale or limestone typically was deposited. The north and west limits of traceable San Andres zones seem to be gradual limits where the San Andres becomes more evaporitic. Porosity in the P-4 and P-5 zones persists farther north than in the P-1, P-2, and P-3 zones, demonstrating the general southward shift of facies with time.

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Geologic Processes in Evaporites in Northern Delaware Basin

Permian evaporites of the northern Delaware basin have been studied in detail for the Waste Isolation Pilot Plant (WIPP). The WIPP is proposed for the disposal of defense radioactive waste in the Salado Formation about 30 mi (48 km) east of Carlsbad.

Boreholes in the northern part of the WIPP site confirm unusual bed thicknesses and attitudes in the Castile Formation. The Castile is ordinarily nearly flat and consists of three anhydrites and two interbedded halites with a total thickness of about 1,350 ft (411 m). WIPP 13 encountered 900 ft (274 m) between the top of Castile and total depth about 50 ft (15 m) into the lower anhydrite. The upper anhydrite dips as much as 40° and contains a small recumbent fold. The thinning and structure also occur in the lower Salado. The same stratigraphic interval in WIPP 11 is 1,230 ft (575 m) thick. The upper anhydrite at WIPP 11 is very thin (< 80 ft or 24 m) and arches; the halite below it is over 900 ft (274 m) thick. the lower Salado beds arch over the Castile. The top of the Salado Formation is not arched at either borehole. Other Castile beds in each hole vary in thickness to lesser degrees.

The major hypotheses for the origin of these features are deposition, dissolution, and halokinesis. Laminated anhydrite does not form on 40° dips. Dissolution residues do not account for thin halite beds. Delicate primary halite structures in the upper Castile in WIPP 13 should not survive later massive halokinesis. Synsedimentary deformation is invoked as a possible explanation. Investigations continue.

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Early Cretaceous Stratigraphic Sequence in Chihuahua Trough, Presidio County, Texas

Various shallow-water marine facies are recognized in four exposures of upper Neocomian to lower Aptian strata on the eastern side of the Chihuahua trough. These facies display characteristics of a fluctuating carbonate-clastic shoreline with hypersaline, normal marine, and brackish water in nearshore, subtidal, supratidal, and lagoonal environments.