ft (415 m) thick and consists largely of micrite and fossiliferous limestones with abundant chert in many beds. Depositional cycles, consisting of grainstones, packstones, and wackestones, occur throughout the interval.

The upper Horquilla (Desmoinesian to Wolfcampian) is 1,867 ft (569 m) thick and consists of limestones and dolostones; chert is less abundant than in the lower Horquilla. Phylloid algal biostromes are present in some upper Horquilla limestone intervals. Six laterally extensive dolostone units range in thickness from 48 to 154 ft (15 to 47 m).

In both upper and lower Horquilla limestones many grainstones were subjected to intertidal and subtidal cementation within marine environments. Micritization of ooids and skeletal grains, which also developed in the marine environment, is abundant in most Horquilla limestones.

Nearly all Horquilla limestone intervals bear two or more of the following evidences of having stabilized within fresh-water diagenetic environments: (1) selective dissolution of aragonitic shells and formation of hollow micrite envelopes; (2) precipitation of meteoric vadose and phreatic calcite cements; (3) recrystallization of original lime mud matrix; (4) replacement by silica which first nucleated within ooids, shells, and peloids and then invaded the surrounding matrix to form nodules or discontinuous layers. At one stage most Horquilla limestones contained large volumes of primary and/or secondary porosity, all or virtually all of which has been occluded by subsequent precipitation of marine or meteoric cements.

All upper Horquilla dolostones were formed by neomorphic dolomitization of originally unstable carbonate sediments. At one stage considerable secondary intercrystalline and moldic porosity existed in most dolostone intervals; much of this was subsequently obliterated by epitaxial dolomite cements on original rhombs and by coarse recrystallization. Gravitational calcite cements partly filled many of the larger voids, and outer tips of many of these microstalactites subsequently became paramorphically dolomitized.

In the upper Horquilla, anhydrite porphyroblasts and nodules were emplaced in many limestone and dolostone intervals by hypersaline groundwaters to form tertiary (third order) stairstep molds, many of which are still open in dolostones.

The only preserved porosity is in dolostones and these may represent potential hydrocarbon reservoirs in the subsurface.

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Cyclic Hydrologic and Diagenetic Events in San Andres Formation: Geologic Implications

In the San Andreas Formation in Roosevelt, Curry, Quay, and DeBaca Counties, New Mexico, cyclic hydrologic and diagenetic events reflect rhythmic fluctuations in sea level, climate, and sedimentation.

Depositional cycles in the San Andres record: (1) rapid transgressions which accompanied eustatic rises in sea level; (2) seaward progradations of subtidal, intertidal, and supratidal (sabkha) facies during stillstands of sea; (3) subaerial exposure during lowstands of sea level; and (4) continuous subsidence of the area. Effects of fluctuation in sea level, climate, and sedimentation were transmitted to San Andres carbonates through changes in hydrology which produced distinctive diagenetic overprints.

The following cyclic hydrological events are recorded in many San Andres intervals: (1) dolomitizing fluids dolomitized initially unstable carbonates; (2) hypersaline brines emplaced anhydrite as partial to nearly complete replacement of carbonate (anhydritization) and as cement; and (3) low-salinity ground waters dissolved much anhydrite, brought about replacement of anhydrite by gypsum, hemihydrate, calcite, and silica and also caused dedolomitization. Many San Andres carbonate intervals bear evidence of having been subjected to overprints of two cyclic fluid invasion sequences.

Nearly all primary and secondary porosity in dolostone has been occluded by dolomite, anhydrite, and calcite cements. In limestones (exclusive of dedolostones) nearly all primary and secondary porosity has been occluded by calcite and anhydrite cements. Many San Andres limestones were formed by paramorphic replacement of dolomite by calcite (dedolomitization). Secondary intercrystalline and moldic porosity in the original dolostone have been preserved after dedolomitization.

Diagenesis and porosity relations within the San Andres reflect the relative flux of dolomitizing, anhydritizing, and low-salinity fluids within a given interval. Tertiary porosity is extensively preserved in intervals in which the low-salinity stage of a "hydrologic cycle" has not had its overprint superseded by dolomitizing or anhydritizing fluids of a subsequent "cycle." The most highly porous intervals contain both secondary intercrystalline and anhdrite moldic porosity.

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Application of Basin Analysis to Exploration Strategy Determination

To model the exploration environment of the Permian basin and to consider available strategies for each plan a computer model was developed using network (decision trees) designed to simulate the environment. Monte Carlo simulation was used to evaluate the variability of the data.

Statistical and engineering techniques were used with commercially available data bases to provide forecasts of remaining potential for each play. Additional input such as drilling cost, seismic cost, and lease availability were obtained from company and commercial sources.

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Integrated Geophysical and Geologic Study of Deep Structure and Tectonics of Permian Basin

An integrated geophysical and geological study of the deep basement structure and tectonics of the Permian basin of west Texas and southeastern New Mexico was made using gravity, magnetic, and subsurface data. Over 6,000 gravity and 13,000 magnetic readings from different sources were used to construct gravity and magnetic maps of the area. The Central Basin platform is reflected by prominent positive Bouguer gravity and magnetic anomalies. However, both the gravity and magnetic maps show an east-west trending saddle in the Central Basin platform region which must be due to a deep-seated intrabasement structure. The West Platform fault zone which separates the Central Basin platform from the Delaware basin is reflected by a steep gravity gradient. By combining gravity and abundant well data in two-dimensional computer modeling, earth models were derived for two profiles crossing the area. These earth models show that the gravity relief between the Central Basin platform and the Delaware basin is far too large (± 40 mgal) to be explained simply by the thickness of the sedimentary section of the Delaware basin. These models indicate a deficiency of mass in the basement underlying the Delaware basin or an excess of mass under the Central Basin platform. The West Platform fault zone is basement controlled. The seismic activity recently recorded in the area may be related to these deep-seated basement structures. The geophysical and geologic similarities between the southern Oklahoma aulacogen and the Permian basin suggest that the latter may be related to a late Precambrian aulacogen.

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Evidence for Deltaic Environment of Deposition for Aguja Formation (Upper Cretaceous), Southwest Texas

The Aguja Formation consists of approximately 650 ft (200 m) of claystones, calcareous concretions, sandstones, ironstone concretions, humate-bearing shales, and seams of humate material, in an area 8 mi (13 km) northwest of Big Bend National Park, Texas.

Three informal members of the Aguja Formation are based on the varied lithology. The lower member is gradational with the underlying Pen Formation and is composed of approximately 200 ft (60 m) of yellow and light to dark-brown massively bedded claystones, lenticular beds of calcareous concretions, and thin to massive-bedded and cross-bedded channel sandstones. The lenticular beds of calcareous concretions and cross-bedded channel sandstones occur near the top of this member. Massive claystones dominate the lower member and contain a wide variety of forams, and a restricted fauna of gastropods and pelecypods. The relation of claystone to sandstone, within the lower member, reflects a coarsening-upward sequence and suggests a gradational change from a prodeltaic to a lower delta-plain environment.

The middle member of the Aguja Formation is gradational with the underlying lower member. The middle member is composed of approximately 300 ft (90 m) of lenticular, thin to massive-bedded, and cross-bedded sandstones, dark-gray massive claystones, and interbedded claystones and sandstones. Lenticular beds of ironstone and ironstone concretions, humate-bearing shales, and seams of humate material also are present in this member. The wide variety of gastropods and pelecypods within the channel sandstones and vertebrate and wood remains in the massive claystones in the middle member suggest both marine- and brackish-water conditions typical of a delta-plain environment.

The upper member of the Aguja Formation unconformably overlies the middle member and is composed of approximately 150 ft (45 m) of cross-bedded and massive-bedded sandstones, lenticular beds of limestone-pebble conglomerate, and minor amounts of claystone. Marine fossils are associated with some lenticular sandstones and include cephalopods, pelecypods, and gastropods. Vertebrate remains and petrified wood are present throughout the upper member. The upper member probably reflects a prograding upper delta-plain environment. Marine fossils associated with the lenticular sandstones may represent intermittent destructive phases during progradation.

The Aguja Formation was deposited within a deltaic environment as is indicated by the geometry of the claystones, channel sandstones, and humate-bearing units. The lower member represents a prodeltaic to lower delta-plain environment. The source area for the Aguja was probably on the west, northwest, and southwest as is suggested by paleocurrent indicators in the channel deposits.

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Volcanogenic Uranium Deposits and Associated Gold-Bearing Mineralization in U.S.S.R.

No abstract available.

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Shallow-Seated Dissolution of Bedded Evaporites in Northern Delaware Basin

Studies of boreholes penetrating the Dewey Lake, Rustler, and uppermost Salado Formations in the northern Delaware basin (southeastern New Mexico) have investigated subsurface dissolution of bedded evaporites in the vicinity of Nash Draw, a depression 5 to 10 mi (8 to 16 km) wide and about 250 ft (75 m) deep. The thickness of the section between the top of the Salado Formation and the base of marker bed 103 ranges from an intact 210 ft (64 m, east of Nash Draw) to a residual 45 ft (14 m in the Draw), where gypsification of Rustler anhydrite and removal of Rustler halite are virtually complete. The uppermost Permian halite has been previously described as a dissolution zone (the "brine aquifer"). Within 130 ft (40 m) below this zone are halite-filled fractures, cubic-shaped cavities, and gypsum after anhydrite. Above are remnant "islets" of halite and anhydrite, gypsum replacing anhydrite and polyhalite, and dissolution breccia. The mineralogy and stratigraphy suggest that the shallow-seated "dissolution front" is a series of "fingers" moving laterally along bedding planes, rather than a single surface migrating downward. The sequence of alterations appears to be: (1) fracture of brittle rock, (2) dissolution of halite adjacent to the fracture rock, (3) gypsification of interbedded polyhalite and then anhydrite, and (4) dissolution of gypsum. Waters of higher salinity and lower flow rate in the "brine aquifer" east of Nash Draw show an oxygen isotope enrichment with respect to meteoric waters, indicating that the low fluid-to-rock ratio there has thus far precluded significant alteration of rock by water.

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Magnetostratigraphy of Upper Cretaceous Deposits in Southwestern Arkansas and Northeastern Texas

Interpretation of preliminary paleomagnetic (a.f. demagnetized) and biostratigraphic data from Upper Cretaceous deposits suggests that the Nacatoch Sand (Navarroan) and the Brownstown Marl (Austinian) of southwestern Arkansas correlate with Guffio (Italy) reversed polarity zones E- and A-, respectively. Other Austinian, Tayloran, and Navarroan Upper Cretaceous deposits (Tokio Formation, Ozan Formation, Annona Chalk, Marlbrook Marl, Saratoga Chalk, Arkadelphia Marl, Gober Chalk, Sprinkle Formation) possess a weak remanent magnetization of normal paleomagnetic polarity. We assume the normal polarity to be primary magnetization, and interpret deposition of the Tokio Formation during the Gubbio long normal zone (Santonian and older), and that of the other units in Gubbio normal polarity zone B+ (Campanian to early Maestrichtian); this is consistent with previous assignments of the units to stages on the basis of biostratigraphic data.

We conclude that the boundary between the Austinian and Tayloran provincial stages approximates the boundary between the Gubbio reverse polarity zone A and the Gubbio normal polarity zone B+. The Tayloran-Navarroan boundary is probably within the upper part of Gubbio normal polarity zone B+.

The magnetostratigraphic approach for refinement of the