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 underly-