The geochemical properties follow similar trends. Outcrop studies show that samples from the San Marcos arch and Sabine uplift have bulk oxygen isotopic values in the range of -2.7 to -4.0 per mil (relative to PDB). In the Rio Grande embayment of south Texas and northern Mexico, these values have shifted to -5.0 to -7.0 per mil, whereas in the northeast Texas embayment they range from -3.5 to -5.0 per mil. In downdip sections near the San Marcos arch, the oxygen isotopic values shift from about -2.8 at the surface to about -8.0 at 4,500 m. Average Sr trace element values for the Austin Group on the San Marcos arch are 350 to 975 ppm, whereas in the Rio Grande embayment and the northeast Texas embayment, they range from 950 to 1,775 ppm.

All chalk undergoes both mechanical and chemical compaction (pressure solution and reprecipitation) when subjected to sufficient differential stress. This stress is generally induced by addition of overburden but can also be influenced by tectonic stresses and pore-fluid pressures. The presence of fresh (Mg-poor) water in chalk, in conjunction with elevated differential stress has been shown, both theoretically and in nature, to accelerate chemical compaction greatly. Thus, the lateral and downdip variations in the petrophysical and geochemical properties of the chalk of the Austin Group presumably reflect differences in original thickness of overburden or proximity to zones of major deformation. The noted reduction in porosity between the San Marcos arch and the Rio Grande embayment could have been produced, in the presence of Mg-poor fluids, by about 500 m difference in maximum overburden between the two areas. Greater overburden differences would have been required had marine (or other Mg-rich) pore fluids been present; less overburden difference would have been needed if differential tectonic stresses were important.

The isotopic and trace element values listed previously are compatible with these conclusions but do not uniquely distinguish among the possible explanations. The smooth shift of isotopic values, as a function of present burial depth in downdip sections and of probably paleoburial depths in lateral outcrop sections, indicates that maximum burial depth is the critical factor in porosity loss or retention. Only the *rate* of porosity loss is affected by water chemistry. Carbon isotopic analyses also rule out vadose diagenesis as having influenced porosity reduction in the Austin to any significant degree.

Oil production from the Austin Group is concentrated in the areas of the San Marcos arch and the Sabine uplift in a belt that is parallel to the outcrop trend and that ranges in depth from 200 to 2,000 m. Cumulative production from all fields in the Austin Group in Texas totals about 25 million barrels (as of January 1976). Production of oil and gas from chalks other than the Austin has been significant both on the sabine uplift and from areas on the eastern side of the Mississippi embayment. Some of these reservoirs, however, may include sandy, calcarenitic, or other impure chalks.

Wells completed in the Austin have a long history of production at rates far lower than initial production. Indeed, the initial discovery well of the Pearsall field, drilled in 1936, was still producing at a rate of more than 200 barrels per month as of 1976. Most recently drilled Austin wells have initial production rates of 200 to 500 bbls of oil per day, which decline within months to about 40 bbls per day. These production histories indicate that most oil production from the Austin is from fractures. Yet, the concentration of production in areas of least diagenetic alteration, in association with the long histories of slow production, indicate that extended production is probably the result of very slow drainage of oil from the rock matrix. Artificial fracturing, a completion method used on virtually all current Austin wells, enhances both initial and long-term production by allowing shorter drainage paths through a larger number of fractures.

The best future oil and gas discoveries in the Austin and equivalent lithologies will probably be concentrated in three types of areas:

(a) where the chalks may have had any type of pore fluid but have not been deeply buried (that is, between 0 and 2,000 m);
(b) where marine pore fluids were retained and fresh water was excluded. In such areas, significant matrix porosity can be retained to as much as 3,000 m deep;
(c) where abnormally high pore fluid pressures have reduced effective compressive stresses. Under this condition, burial depth is no longer the controlling factor in porosity loss, and porous chalks can be found at depths from 0 to greater than 4,000 m.

Other production may come from areas that have low matrix porosity but intense fracturing (as along sharp flexures or faults) or from areas of abnormal lithology (e.g., bioherms, intrusive volcanic rocks, calcarenites).

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LOWER CRETACEOUS DEPOSITIONAL SYSTEMS, WEST TEXAS

R. W. Scott and E. J. Kidson[1]

ABSTRACT

Two surface stratigraphic cross sections of Lower Cretaceous rocks in West Texas contain four depositional systems: coastal plain, carbonate shelf, platform-shelf margin, and shelf basin. These systems consist of lithofacies, megafossil paleocommunities, and palynomorph assemblages that represent specific environments. The vertical succession of deeper and shallower, or low- and high-energy facies indicates depocenter cycles of subsidence and progradation. The diversity and abundance of palynomorph morphotypes seem to be reliable environmental tools because they vary with other environmental indicators.

These depositional systems comprise depositional sequences, which are transgressive-regressive stratigraphic units bounded at least in part by unconformities: the Trinity, Fredericksburg, lower Washita, and the Upper Cretaceous upper Washita sequences. Some of the sequence boundaries are synchronous within the limits of a paleontologic zone, but others are clearly time-transgressive. These sequences can be correlated in cross sections from a detailed measured section at Fort Stockton to Big Bend National Park and to the Southern Quitman Mountains.

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INITIATION OF LOWER CRETACEOUS REEFS IN SABINAS BASIN, N.E. MEXICO

Colin L. Stabler[1] and Benjamin Marquez D.[2]

ABSTRACT

Coral-algal and rudist reefs were initiated in the center of the subsiding Sabinas basin during the Hauterivian.

It is speculated that the reefs may have grown along a hinge line, or perhaps over salt or shale anticline. The reefs, together with their associated lagoon and sabkha, mark the beginning of a vast carbonate-evaporite platform sequence, equivalent to the Sligo, which prograded eastward and built out over nearly all of the former basin.

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[2]Petroleos Mexicanos, Reynosa

A LOWER CRETACEOUS SHELF MARGIN IN NORTHERN MEXICO

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ABSTRACT

In seven sections in the Monterrey-Saltillo area of Mexico the 800 to 500 m thick Lower Cretaceous Cupido Limestone and the underlying Taraises Formation of shale and black lime mudstone of about the same thickness have been studied petrographically. These units apparently represent in part complementary facies of carbonate bank and basinal environments. Isopach maps should include both formations if used for paleotectonic interpretation. The formations record a marine transgression in earliest Cretaceous time over a positive element in central Mexico which furnished sands and muds to the east. This was followed in Barremian time by eastward progradation of a carbonate bank out from the positive element. The fully expanded late Cupido bank is overlain by the transgressive La Pena black shale and limestone of Late Aptian age. The bank, as developed around Saltillo, consists almost wholly of cyclic grainstone and tidal flat sediments showing progressive upward shoaling. To the east around Monterrey a bank edge appears, marked by more than 100m of rudists and corals. This facies migrates eastward and rises in the section as the bank expands. The downslope facies in this area (Taraises Formation) is thick and well-developed, contains litho-clastic conglomerates in black micritic matrix, and also has tumbled remains of corals and rudists. An eastern edgeline of the bank occurs at Saddle Mountain, Monterrey and the Sierra Minas Viejas 50 km north east of the city. Still farther east and south of Monterrey in the Sierra de la Silla basinal micritic limestone occurs through the total Lower Cretaceous section.

The extension of this trend northeast into Texas is as yet difficult to follow. From outcrop studies around Monterrey-Saltillo and north at Sierra de la Gavia and Bustamante it is possible to predict that the bank margin has a gentle slope over some tens of km. Initial porosity and brecciation, vuggy and cavernous secondary voids, and dolomitization in the bank edge are encouraging signs for subsurface reservoir development.

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