After this initial carbonate buildup the volcano subsided and the facies onlapped the volcano as a result of the changing relative sea level. Subsidence continued until the volcano was completely submerged. Faults reflecting readjustments of strata over the plug are recorded in sediments as young as the Navarro Group.

Porosity in Elaine Field carbonates occurs in areas where, a fresh-water lens developed in association with subaerial exposure. In these areas dissolution of grains and limited cementation produced excellent quality hydrocarbon reservoirs.

[1]Mobil Exploration and Production, Dallas, Texas

LOWER CRETACEOUS SEDIMENTARY FACIES AND SEA LEVEL CHANGES, U. S. GULF COAST

Edward McFarlan, Jr.[1]

ABSTRACT

In the northern U.S. Gulf Coast, Lower Cretaceous sediments form an arcuate prism which thickens from a few hundred feet updip to more than 10,000 feet along the ancient shelf margin 100 to 300 miles downdip. This prism was divided into eleven time-stratigraphic units using hundreds of control wells with lithologic and faunal data. This information led to the recognition and mapping of major depositional facies including alluvial valley, delta, prodelta, inner shelf, middle shelf, outer shelf and basin within each time-stratigraphic unit. During continuous deposition in Early Cretaceous time these major facies units have transgressed and regressed many times across the broad subsiding shelfal areas. The transgressions in Upper Cotton Valley, Lower Hosston through James, and Mooringsport through Washita times are thought to be controlled primarily by eustatic relative rise in sea level. Regressions in Upper Hosston, Rodessa, Glen Rose, and Paluxy times are probably controlled by a decreased rate of subsidence and an increase in the supply of clastic sediments from rising uplands inland.

[1]Exxon Company, U.S.A., Houston, Texas

DIAGENESIS AND GEOCHEMISTRY OF A GLEN ROSE PATCH REEF COMPLEX, BANDERA COUNTY, TEXAS

Timothy J. Petta[1]

ABSTRACT

Rigid reef framework for the Pipe Creek patch reef complex (lower Glen Rose Formation) was produced by syngenetic rudist accretion, internal sedimentation, and submarine cementation of the reef frame and internal sediment. Clionid sponges bored the reef framework during accretion and produced cavities, calcareous silt, and peloids that can be easily mistakened for vadose features. Local pholad-bored surfaces developed on the reef crest(s) when vertical framework accretion exceeded local subsidence so that truncation and extensive bioerosion of the reef crest(s) occurred in the littoral zone. Small forereef beaches contain littoral cementation features. Submarine diagenesis of backreef beds included peloid induration and grain micritization.

Epigenetic diagenesis that affected the sequence at Pipe Creek is divided into three distinct phases: phase I — marine connate — closed, phase II — early fresh water — open, and phase III — late fresh water — open. During phase I, partial incongruent dissolution of magnesian calcite submarine cements and internal sediments in the caprinid reefs effectively raised the Mg/Ca ratio of the interstitial marine water. This water composition change stimulated dolomitization of clay-rich backreef lime muds by cloudy, 8 to 10μm anhedral to subhedral dolomite.

Fresh water began to displace marine connate water either during late Glen Rose or latest Fredericksburg time (phase II). The change from a closed marine to an open fresh-water system caused the final incongruent dissolution of magnesian calcite, partial dolomitization of the sediments by clear, 50 to 60μm, euhedral dolomite, inversion of some aragonitic mollusks to calcite, and conversion of lime mud to lime mudstone (micrite). As the water became progressively enriched in CO_2, megascale dissolution of aragonitic allochems occurred. Moldic porosity developed during this phase has been preserved by the precipitation of intergranular equant sparry calcite. Clay-rich beds have recrystallized, indicating that clay materials have acted as nuclei for microspar and pseudospar. At the end of this phase, the rocks had been converted from predominately metastable (aragonite and magnesian calcite) to stable (calcite and dolomite) minerals.

Phase III is characterized by changes in rock fabric rather than mineralogy. Fractures and vugs that have developed through the Holocene epoch have been partially filled by bladed to micritic calcite cements that were precipitated in the meteoric phreatic and vadose zones.

Present-day values of some elements, notably Sr, in calcite cements and micrite are relatively low but do reflect original mineralogy. Higher Sr values within internal sediments (micrite), backreef micrite, and recrystallized mollusk fragments indicate an original high-Sr aragonite mineralogy. In addition, lower permeabilities of micrite prevented effective removal or flushing of Sr from the rocks by the modern ground-water system.

All the early fresh-water diagenetic features at Pipe Creek are thought to have evolved during burial. The small amount of diagenesis is attributed to subaerial exposure during deposition only affected perireef lime grainstones. Because of pervasive submarine diagenesis, reef beds appear to have much lower permeability than adjacent grainstones, although vuggy porosity is well-developed in the reefs. Many features in Cretaceous rudist reefs that have been attributed to syndepositional meteoric water diagenesis may have been developed during burial. Waters responsible for diagenesis may have flowed downdip from emergent land areas, or in an updip direction preceding or in conjunction with hydrocarbon migration.

[1]Shell Oil Company, Houston, Texas

CARBON AND OXYGEN ISOTOPIC EVOLUTION OF WHOLE ROCK AND CEMENTS FROM THE STUART CITY TREND (LOWER CRETACEOUS, SOUTH-CENTRAL TEXAS)

D. R. Prezbindowski[1]

ABSTRACT

The Stuard City Trend consists of a shelf-margin buildup of Middle Cretaceous carbonates, now buried to depths of 10,000 to 18,000 ft in south central Texas. Whole rock analyses of 92 samples from 16 wells along a 250 mile stike section show a δO^{18} range of -5.9o/oo to -2.7o/oo and a δC^{13} range of -.7o/oo to +5.1o/oo relative to PDB. Oxygen isotopes become lighter toward the southwest. Whole rock values of δc^{13} indicate that vadose diagenesis was not volumetrically important.

Individual cements were also analyzed. The two predominate cement sequences are: 1) fibrous crust, 2) inclusion-rich radiaxial, and 3) clear spar; or 1) fibrous crust, 2) inclusion-rich spar, 3) clear spar. Inclusion-rich radiaxial cements show δO^{18} values closely grouped about a mean of -2.6o/oo PDB and δC^{13} values between -29.1o/oo to +3.2o/oo PDB. Inclusion-rich spar cements likewise show δO^{18} values closely grouped about the mean of -2.8o/oo PDB and δC^{13} values ranging from -7.4o/oo to +3.8o/oo PDB. In contrast, the clear blocky spars exhibit a wider range of O^{18} values, from -6.6o/oo to -2.3o/oo with a mean of -5.2o/oo PDB; δC^{13} values range from -5.5o/oo to +4.5o/oo PDB. No significant isotopic differences were observed in the final generation of clear blocky spar cement, between depths of 10,300 and 20,400 ft.

The whole rock and cements are not in oxygen isotopic equilibrium with sampled formation fluids. Individual cements maintain an isotopic memory of successive cementation events during burial.

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DIAGENETIC PATTERNS OF THE AUSTIN GROUP AND THEIR CONTROL OF PETROLEUM POTENTIAL

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ABSTRACT

The chalk of the Austin Group shows striking regional variations in porosity, permeability, and trace element and isotopic geochemistry. Porosities and permeabilities are highest across the San Marcos arch, where average values of 15 to 30 percent porosity and 0.5 to 5 md (millidarcies) matrix permeability are measured. These values decrease slightly to the north (into the northeast Texas embayment). In northern Mexico, the Austin and its equivalents have about 3 to 8 percent porosity and permeabilities of 0.01 md or less. Porosity and permeability also decrease in downdip sections of the Austin when traced from outcrop to about 4,500 m deep.