bedding, telescoping of mudcracks, and anastomosing wispy argillaceous seams. Pervasive compaction in peloidal grainstone is evidenced by warping and cracking of internal layers that are outlined by wispy seams. Ooid and skeletal grainstones and algal bioherms do not show these compaction features.

Time lines in these Cambrian-Ordovician carbonates converge across depositional strike from east to west, and this coincides with a change in facies from shelf-margin algal bioherms and grainstones showing little compaction to lagoon-peritidal mudstones with abundant compaction features. Volume reduction by compaction is clearly facies controlled and also has influenced the geometry of the time lines.

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Initiation and Reactivation of Proterozoic Aulacogen, Northern Mexico

Geochemical and petrologic affinities of late Proterozoic (~1Ga) bimodal igneous rocks of the Franklin Mountains, west Texas, suggest a rift origin. Scattered occurrences of similar rocks southward into the state of Chihuahua, Mexico, indicate a southerly trend for the feature. The feature is bounded by stable blocks: the stable craton of west Texas to the east and northeast, and the Sierra del Nido block to the west and southwest. Separation of the Sierra del Nido block from the craton occurred about 1 Ga. Gravity gradients mark the boundaries of the blocks, and a northwest-trending Bouger gravity high may mark the axis of the aulacogen. The aulacogen and the Sierra del Nido block are truncated to the south by the Mesozoic Mojave-Sonora discontinuity.

The aulacogen was reactivated, at least in part, in the late Paleozoic as the Pedregosa basin and in the Mesozoic as the Chihuahua trough. These reactivations were apparently not full-fledged rifting events, but did result in basin development. The Sierra del Nido block was a paleographic high throughout the Paleozoic, and the Aldama platform developed on this block during the Cretaceous. The most recent reactivation of the aulacogen is as the southern extension of the Rio Grande rift, as evidenced by trends of high heat flow, recent mafic magmatism, and regional extensional faulting.

GRABOWSKI, GEORGE J., JR., ROBERT M. KICK, and DONALD A. YUREWICZ, Exxon Production Research Co., Houston, TX

Carbonate Dissolution During Late-Burial Diagenesis of the Terumbu Limestone (Miocene), East Natuna Basin, South China Sea, Indonesia

The Terumbu Limestone is the reservoir for 200 tcf of gas (72% CO_2) in the Esso D-alpha block, offshore Indonesia. During the middle to late Miocene, 5,000 ft (1,500 m) of platform-reef carbonates were deposited. These limestones have a complex diagenetic history determined from study of 960 ft (290 m) of core from 3 wells.

Partial marine cementation and micritization of grains occurred in platform environments during deposition. Freshwater diagenesis followed, presumably below subaerial unconformities within and at the top of the Terumbu. Aragonitic grains were leached, high-magnesium calcite grains were converted to low-magnesium calcite, and pores were partially cemented by low-magnesium calcite. Pressure solution and further cementation during burial of the Terumbu to 10,000 ft (3,000 m) left only minor amounts of preserved primary and moldic porosity.

During late burial, grains that were originally high-magnesium calcite were leached, forming "interpenetrating" pores and stylolites "floating" within pores. Ferroan-calcite and dolomite cements line these pores and fluorite crystals occlude many pores. Whole-rock stable isotopes are depleted in O^{18} (-8.0 $^0/_{00}$ δO^{18} PDB, 0.0 $^0/_{00}$ δC^{13} PDB), suggesting high-temperature alteration of carbonate. The isotopic composition of the CO_2 in the reservoir is similar (-0.8 $^0/_{00}$ δC^{13} PDB), suggesting this CO_2 is derived from dissolved Terumbu Limestone. We envision that fluoride-bearing hydrothermal fluids, derived from the underlying granitic basement, selectively dissolved constituents in the deeply buried Terumbu.

GRACE, L. M., Schlumberger Well Services, Graham, TX

Stratigraphic Dipmeter Interpretation—Fort Worth Basin Submarine-Slope Systems

Submarine-slope systems pose several exploitation problems. Previous Dipmeter interpretation techniques using the standard Dipmeter with CLUSTER (mark of Schlumberger) processing are highly successful in fluvial to deltaic sequences, but lack accuracy in the anastomosing depositional environment associated with submarine-slope systems. Both the delineation of individual depositional units and the precise trend determination of each are essential for optimum exploitation. A new interpretation technique has been devised to provide accurate and consistent answers to these problems. The technique involves the use of multiple logging passes and detailed stratigraphic correlation to provide a paleocurrent and depositional analysis.

GRADY, MICHAEL T., Univ. Idaho, Moscow, ID

Correlating Organic Facies and Turbidite Facies in a Hoh Turbidite Sequence (Miocene), Western Olympic Peninsula, Washington

The distribution of organic facies is a function of the environment of deposition. Within each turbidite facies, diverse depositional regimes are present that affect both the preservation and dispersal of organic matter. Proper identification of turbidite facies can lead to a proper prediction of organic content within a particular turbidite facies or turbidite facies association.

The type section of the Brown's Point formation, a turbidite sequence within the Hoh rock assemblage, demonstrates the correlation between organic facies and turbidite facies, as defined by E. Mutti and F. Ricci-Lucchi. Turbidite facies can be matched to organic facies throughout the entire 4,000 ft (1220 m) thick vertical section. Outer and middle fan turbidite associations have been analyzed and correlated for organic facies lateral continuity.

Distribution of organic carbon concentrations and organic carbon types suggests a dominance of terrestrial input. TAI and R_0 analyses reflect a marginally mature thermal maturation level ($R_0 = 0.5$-0.6). Visual kerogen inspection reveals a mixed to structured kerogen with a predominance of type III/IV over type IV kerogen. Overall, maturation indices suggest a gas source with poor source potential for oil. Individual turbidite facies display a significant relationship to the amount, type, and level of maturation of organic matter present within each facies and facies association.

Frontier basin analysis of turbidite sequences can be expedited by proper field identification of turbidite facies and subsequent geochemical analysis of the content, type, and maturation level of the organic matter present within each turbidite facies.

GRAMMER, MICHAEL G., Texaco, Inc., Denver, CO

Diagenetic Destruction of Primary Reservoir Porosity in Viola Limestone, South-Central Oklahoma

The Viola Limestone in south-central Oklahoma is a Middle and Upper Ordovician carbonate unit interpreted as being deposited on a carbonate ramp within and peripheral to the Southern Oklahoma aulacogen. Depositional environments within the study area ranged from anaerobic deep ramp through aerobic middle and shallow ramp. TOC analyses of the lower anaerobic deep-ramp facies suggest that, at least locally, the Viola is a potential hydrocarbon source rock. Detailed petrographic examination of the Viola indicates that primary porosity in the shallow-ramp skeletal packstones and grainstones was initially quite high. This combination of source potential and original porosity should make the Viola an attractive target for hydrocarbons in southern Oklahoma. The Viola, however, has been subjected to a complex sequence of diagenetic events that have extensively altered the sediments and occluded much of the primary porosity. A thorough understanding of the timing and nature of these events can be critical in evaluating the economic potential of the Viola.

Petrographic evidence combined with the use of cathodoluminescence indicates that several generations of calcite cementation occurred within the shallow-ramp packstones and grainstones. An initial phase of very early, possibly synsedimentary, marine cementation is evidenced by cloudy, inclusion-rich syntaxial cements on echinoderm fragments. This early phase of cementation was followed by several generations of clear syntaxial calcite, prismatic calcite, blocky mosaic calcite, and bladed mosaic calcite, all of which indicate changes in the pore-water chemistry after precipitation of the inclusion-rich cements. This phase of meteoricphreatic cementation occurred soon after the marine cementation and occluded virtually all remaining primary porosity.

GRANTZ, ARTHUR, and STEVEN D. MAY, U.S. Geol. Survey, Menlo Park, CA

Implications of Offshore Northern Alaska Geology for Origin of Canada Basin, Arctic Ocean

Geologic mapping and petroleum exploration in northern Alaska and seismic surveys offshore suggest that 2 pulses of rifting created the Canada basin. Mississippian to Triassic miogeoclinal rocks in northern Alaska, derived from a now-displaced northerly source land, correlate with similar strata in the Canadian Arctic Islands. Underlying Ordovician and Silurian argillite and graywacke may correlate with the clastic succession in Heezen trough of the Arctic Islands. Closing Canada basin about a Mackenzie delta pole would rejoin these correlative rocks and recreate a unified pre-Jurassic Arctic paleogeography. Rifting began in earliest Jurassic time, creating a west-northwest-trending trough beneath the Beaufort Shelf and probably the southern Canada basin. The main rifting pulse, however, began in late Neocomian time, and the main post-rift progradational sedimentary prism off Alaska is Aptian or Albian and younger.

Apparently both late Neocomian and Laramide rifting thinned the crust beneath North Chukchi basin. Marked basinward thickening of Cretaceous strata records the earlier event, and extensional faulting and basinward thickening of Tertiary strata record the later one.

The high-standing, north-trending ridges and troughs of the Chukchi borderland, which trend into the North Chukchi basin from the north, may represent localized Laramide(?) crustal extension subparallel to that which created the Laramide(?) and Cenozoic Makarov and Eurasia basins of the Arctic Ocean. This model requires crustal shortening between the Chukchi borderland and Canada basin and transform faults north and south of the borderland. North of our seismic lines, the southern transform may be buried by Tertiary sediment of the North Chukchi basin.

GREEN, MARY L., Stephen F. Austin State Univ., Nacogdoches, TX

Paleoenvironmental and Diagenetic Analysis of Wichita Group, Palo Duro Basin, Texas Panhandle

The Wichita Group in the Palo Duro basin represents the Wolfcampian-Leonardian transition from carbonate to predominantly evaporite deposition. An interbedded series of dolomitic, anhydritic, and terrigenous clastic lithofacies reflect deposition in inner shelf and evaporitic tidal flat environments. An arid setting and restricted marine circulation over the broad expanse of the basin were conducive to the onset of early diagenesis, which masked much of the Wichita depositional framework.

Petrographic analyses revealed diverse lithofacies in the Wichita Group. Dolomitic lithofacies include (1) pyritic to argillaceous mudstones, (2) organic wackestones, (3) algal-intraclastic wackestones and packstones, (4) skeletal-peloid packstones, (5) coated grain-ooid grainstones, and (6) pisoid grainstones. Nodular-mosaic and massive to laminated anhydrite and terrigenous shales and siltstones complete the sequence. Noncyclic relationships are characterized by rapid vertical change, laminated to thin bedding, and gradational to sharp, commonly erosional contacts.

Wichita subfacies reflect deposition in a complex patchwork mosaic of evaporative supratidal, intertidal, shoal, and subtidal environments rather than a normal shelf to tidal flat transition. Close lateral association of these subenvironments in a low topographic setting yielded rapid facies migration in response to periods of increased terrigenous influx, storm erosion and redeposition, and normal tide and sea-level fluctuations.

Subaerial exposure and hypersaline brines initiated penecontemporaneous sulfate deposition and dolomitization. Two to three stages of dolomite cements were deposited. Primary sulfates provided a source for late poikilitic, blocky, and bladed anhydrite cement. Pseudocubic and bladed anhydrite replacement of dolomudstone is common.

GREEN, W. R., J. C. SCHLUETER, and D. R. GLENN, Energy Reserves Group, Inc., Midland TX

Fusselman-Cisco Play, Roosevelt Positive, Roosevelt and Curry Counties, New Mexico

The Roosevelt positive is bounded on the south by the petroliferous Northwest Shelf province; the Tucumcari basin lies to the north.

The current Fusselman-Cisco play was ignited in June 1978, by discovery of South Peterson-Fusselman field by Enserch in T5S, R33E. The discovery well had produced over 560,000 bbl of oil to January 1, 1984. In 1981, Energy Reserves Group extended Cisco production into T6S, discovering the East Tanneyhill-Cisco field, now part of South Peterson-Penn (Associated) field.

Present structural trends in the southern Roosevelt positive are northerly and contain all presently discovered oil and gas fields. Structures in the northern province trend westerly where shows have been encountered in the San Andres and Cisco. A paleostructural high projecting from the ancestral Central Basin platform trends across Roosevelt County to the northwestern part of Curry County. All known major fields producing from units below the San Andres are on the crest or flank of this paleohigh.

Pre-Pennsylvanian Paleozoic rocks are truncated around the edge of Precambrian knobs by an Early Pennsylvanian unconformity. Primary objectives are Fusselman Dolomite and Cisco limestone. Fusselman reservoirs in intercrystalline and vuggy porosity produce from truncation or anticlinal traps. Secondary porosity in the Cisco is created by leaching of forams and algal plates. Traps have been found on flanks and crests of anticlinal trends.

The province is considered a good seismic recording area. Although objective formations are relatively thin, high resolution seismic, synthetics, and modeling make reasonable stratigraphic interpretations possible.

GREENE, ALLEN L., Texaco U.S.A., New Orleans, LA

Influence of Basement Islands and Ridges on Smackover Deposition, Southwest Alabama

Pre-Jurassic basement highs, composed of igneous and/or metamorphic rocks, have influenced the deposition of Jurassic Smackover sediments in Clarke, Monroe, Conecuh, and Escambia Counties, Alabama. These basement islands and ridges provided a structural fabric on which Smackover sediments were deposited.

The following 3 basic structural settings illustrate the thickness variations and lithofacies distribution of Smackover sediments on the flanks and crests of these basement highs. Emergent features were never covered by Smackover seas, resulting in nondeposition of Smackover sediments over their crests. Flanking these features are finely crystalline and anhydritic dolomites capped by bedded nodular-mosaic anhydrite. The anhydrite grades upward into Haynesville continental sediments that also overlie the crests of these features. Semi-emergent features were above sea level for most of Smackover deposition. It was not until near the end of Smackover transgression that these islands and ridges were inundated. As the seas regressed, shoaling occurred on the flanks of these features depositing predominantly grain-supported limestones that were later dolomitized. The crests of these basement highs are covered by thin, low-porosity, grain- and mud-supported dolomites capped by bedded nodular-mosaic to distorted mosaic anhydrite. Nonemergent features were submerged through most of Smackover deposition. This enabled carbonates to accumulate as thick organic buildups and shoals over crestal portions of the basement highs. These thoroughly dolomitized and highly porous and permeable crestal sediments grade upward into nonporous, mud-supported dolomites capped by bedded nodular-mosaic anhydrite.

GREGORY, PHILLIP G., Texaco, U.S.A., New Orleans, LA

Facies Relationships and Diagenesis in Smackover Formation—Huxford Field, Southwest Alabama

Huxford field, Escambia County, Alabama, was discovered in late 1982 by the Texaco 2 ATIC 35-6 well. Production was established from the upper Smackover Formation with an initial gauge of 1,070 BOPD