Tulsa, OK

Depositional Systems on Upper Jurassic Smackover Carbonate Ramp: Sedimentology of South Texas Frontier Play

The Smackover Formation, which is economically significant throughout the Gulf Coast region, is virtually untested in south Texas. The Smackover and lower part of the Buckner formations comprise a thick regressive sedimentary sequence deposited on a carbonate ramp. Four major depositional systems are recognized: (1) basinal, (2) open shelf, (3) shoal, and (4) sabkha. High-energy grainstone facies were concentrated landward; muddy low-energy facies were deposited seaward.

Basinal facies are dominated by laminated carbonate mudstones, deposited from suspension, and irregularly laminated carbonate mudstones, the product of sediment reworking by oscillatory bottom currents. The outer *shelf* facies is characterized by burrowed carbonate mudstones containing crustacean pellets and a pelagic fauna. The inner-*shelf* facies is composed of burrowed wackestones containing a benthic fauna. Burrowed oncolite and pellet packstones characterize the outer-*shoal* facies and cross-bedded mixed-allochem, oolite-intraclast, and oolite grainstones compose the high-energy, inner-*shoal* facies. The *sabkha* system consists of cyclic subtidal to supratidal facies. Subtidal units are burrowed gastropod-pellet wackestones and oolite wackestones to grainstones, whereas the intertidal facies is characterized by cross-laminated sandstones and algal-laminated dolomite mudstones. The supratidal facies consists of anhydrite intercalated with carbonate and terrigenous mud, and siliciclastic sand and silt.

Reservoirs as thick as 33 ft (10 m), with porosity ranging from 4 to 26% and permeabilities ranging from 0.1 to 6.5 md, have been cored at depths below 18,000 ft (5,486 m). Nearly complete dolomitization has resulted in the development of intercrystalline porosity in inner-shelf wackestones and shoal-complex grainstones. In addition, some grainstones have subsurface-derived secondary oomoldic porosity.

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Pre-Cretaceous Geologic History of Deep Southeastern Gulf of Mexico

Analysis of seismic data and the results of DSDP Leg 77 reveal a complex pre-Cretaceous, pre-rift to post-rift geologic history for the deep southeastern Gulf of Mexico that is probably related to the early opening of the North Atlantic. The area is underlain by an extensive rifted and attenuated continental crust or transitional crust formed mainly in Late Triassic through Jurassic time owing to large-scale translational motions as the Yucatan-South American block pulled away from North America. Shallow holes drilled into the tops of tilted basement blocks encountered examples of this transitional crust (early Paleozoic metamorphic rocks intruded by Mesozoic diabase). The rifted basement is infilled and covered by an extensive syn-rift sequence of probable Jurassic age and nonmarine origin (up to 2 km thick). Interpreted within this sequence is a narrow north-south-trending salt basin, which may be equivalent to the Louann salt in the northern Gulf basin and the salt in Cuba. Rifting mainly occurred during Late Triassic through Jurassic time, although in one broad area faulting and collapse of the basement apparently continued into the Early Cretaceous. The syn-rift sequence is overlain by a thick post-rift section of marine sedimentary rocks. DSDP Leg 77 drilled the upper part of the sequence and encountered a complete section of Lower Cretaceous deep-water carbonates. The lower part of the sequence lying below the deepest horizon drilled (Berriasian) has a similar character and is inferred to represent Upper Jurassic marine rocks, probably equivalent to the Late Jurassic (post-Louann) marine transgression observed around the periphery of the Gulf.

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Facies, Fabrics, and Porosity, Duperow Formation (Upper Devonian), Billings Nose Area, Williston Basin, North Dakota

The Duperow is a substantial hydrocarbon-producing formation in the "Billings Nose" area. Included in the Billings Nose are the TR (Theodore Roosevelt), Big Stick, Whiskey Joe, Four Eyes, White Tail, Fairfield, Elkhorn Ranch, and Tree Top fields.

Duperow rocks consist principally of dolomites, limestones, and anhydrites. Most of the dolomites appear to be of diagenetic origin although some primary dolomites do occur. Primary dolomites are parallel and wispy laminated mudstones, deposited principally as part of the supratidal facies in association with stromatolites. Secondary replacement dolomites occur throughout the section, but seem to selectively replace the matrix in the stromatoporoid zone of the shallow subtidal facies and intraclasts in the intertidal facies. Included in the supratidal facies are anhydrites. Anhydrites range in habit from the typical replacive nodules to the less common "chickenwire" and layered forms. Layered types appear to be associated with ephemeral hypersaline ponds in the supratidal. In general, porosity is poor in this facies.

The intertidal facies consist of intraclastic wacke-packstone. Intraclasts and fragmented brachiopods and mollusks are the principal allochems. Bioturbation has destroyed most laminations. Apparent selective replacement of intraclasts constitute the majority of the porosity in this facies.

The subtidal facies includes stromatoporid and bioturbated zones. Sparsely fossiliferous wackestones are the predominate fabric, but stromatoporid boundstones and coral, brachiopod packstones are common. Good intercrystalline porosity occurs in the matrix of the stromatoporid zone.

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Facies, Fabrics, and Porosity of Kaskaskia Rocks in Williston Basin, North Dakota

Kaskaskia rock sequences in the Williston basin, North Dakota, comprise most major carbonate facies, fabrics, and porosity types. Stratigraphic units discussed are the Mission Canyon, Ratcliffe, Frobisher Alida, Bakken, Birdbear, Duperow, Winnipegosis, and the Ashern formations. All of these have produced substantial amounts of hydrocarbons except the Ashern Formation. Slabs of cores show different facies, fabrics, and some porosity types associated with each.

Kaskaskia sequence deposits represent a period of waxing and waning sedimentation during overall transgression and regression of the late Paleozoic. Facies represented, except for the Ashern, are cyclic, composed of supratidal, intertidal, and subtidal depositional settings. Ashern facies are supratidal to highest intertidal. Some facies can be further subdivided into

high/low or shallow/deep. Special facies types include stromatoporoid and evaporite, both supratidal and deep. Facies and fabrics vary considerably throughout the sequence, both interformationally and intraformationally. Mudstones, wackestones, and packstones are most common although grainstones and boundstones also occur. Within textural constraints, each fabric contains their respective amounts of skeletal and nonskeletal allochems. Because of frequent and sharp facies changes, it is important to discriminate among different facies that superficially have similar fabrics. Examples are deep/shallow evaporites, or supratidal/subtidal oolites and pisolites. Peloidal wackestones/grainstones, skeletal wackestones/packstones, and mottled mudstones are the prevalent fabric types. Significant sedimentary structures include burrows, flat pebble interclasts, desiccation cracks, bird's-eye structures, and collapse breccias.

Porosity types common to all, except for the Ashern and Bakken, are intercrystal, interparticle, moldic, vuggy, and breccia. Significant porosity in the Ashern and Bakken formations is from fractures.

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Computer-Assisted Prospect Generation in a Frontier Basin

Limited time and personnel resources often justify the utility and integration of computer techniques into exploration efforts in frontier basins. A large percentage of the exploration staffs of geologists and geophysicists have little comprehensive computer training. In addition, computer programmers and analysts have only limited experience using exploration data. To improve communication, it is often necessary to coordinate and "cross-educate" the two staffs. This enables computer applications to be used as an important tool by exploration personnel.

Computer techniques were used by Pennzoil in the exploration and evaluation of the Santa Barbara channel basin in offshore southern California. Regional computer mapping including computer contouring located certain prospective areas permitting early concentration on the areas of interest. This effort resulted into the acquisition of Lease OCS P-0315 in Sale 48, June 1979.

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Structural Development of Upper Magdalena Valley, Colombia

The Neiva and Girardot basins of the upper Magdalena Valley are en echelon late Cenozoic structural depressions between the Central and Eastern Cordillera of the Colombian Andes. The basins contain three depositional sequences up to 9,000 m thick resting on Paleozoic crystalline basement: (1) a Triassic-Jurassic nonmarine clastic and minor carbonate sequence, (2) a middle Cretaceous to Paleogene marine to nonmarine clastic and minor carbonate sequence, and (3) a thick Neogene nonmarine molasse sequence.

The Andean orogeny in the upper Magdalena Valley occurred in two phases: (1) late Oligocene–early Miocene (Neiva basin), and (2) late Miocene–Pliocene (Neiva and Girardot basins). The first phase was dominated by basement-cored domes and basement-driven thrusts displaced toward the east from the Central Cordillera, while the second phase was dominated by basement-driven thrusting toward the west from the Eastern Cordillera. The basement-rooted thrusts splay upward within the Cretaceous and Paleogene strata and form complex shallow to moderate-dipping thrust sheets or terminate within the sedimentary cover to form a series of tight folds. From middle Miocene to late Pliocene, a thick molasse sequence accumulated on the earlier structures in both basins. During the younger phase of deformation, the molasse was deformed by continued movement on basement-rooted faults.

The basement-driven structures in the upper Magdalena Valley are probably the result of transpressional movements along the eastern margin of the Andean volcanic arc in the Central Cordillera.

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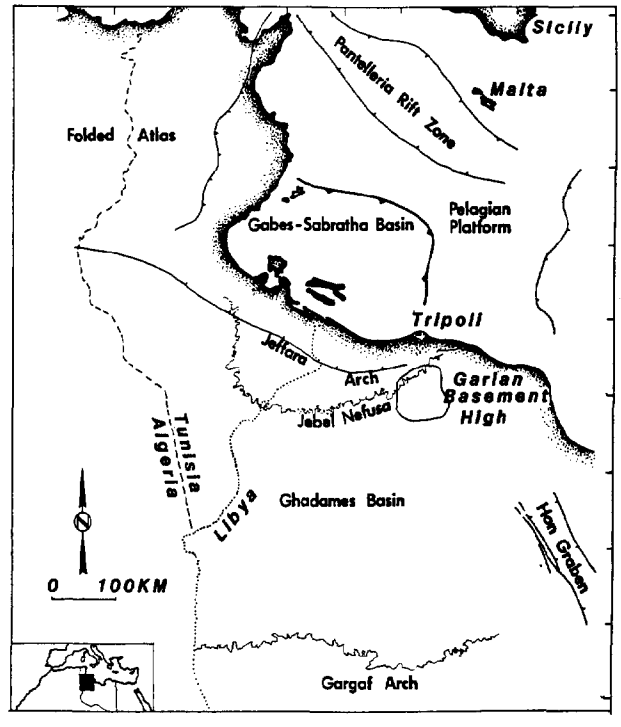
Lower Cretaceous Braided Stream–Fan Delta Deposition, Northwest Libya: A Future Petroleum Exploration Target, Offshore Gabes-Sabratha Basin

The southern margin of the present Gabes-Sabratha basin roughly parallels the coastline of northwest Libya and southeast Tunisia and is contiguous to the northern margin of a Lower Cretaceous subaerial delta platform. The Lower Cretaceous Chicla and Cabao formations, exposed along the Jebel Nefusa escarpment and in the subsurface of the onshore Ghadames basin in Libya, represent a thin (0 to 200 m), laterally extensive, fluvio-deltaic sequence. A detailed study of 15 measured outcrop sections indicates each formation is a transgressive fluvio-deltaic package. A complete package can be subdivided into three major sedimentary facies from base to top: (1) braided fluvial delta plain (facies 1) or braided fan delta plain (facies 1a), (2) delta front–prodelta slope (facies 2), and (3) prodelta shelf (facies 3).



The Chicla and Cabao fluvio-deltaic packages were derived from two sediment source areas: (1) a large, undetermined area far to the south, and (2) a smaller, proximal area, 50 to 100 km inland of the Libyan coast.