The Viola Limestone (Middle and Upper Ordovician) of the southwest Arbuckle Mountains was deposited on a carbonate ramp within the southern Oklahoma Aulacogen. Depositional environments include (1) anaerobic, deep-ramp setting represented by microfacies RL, CH, CGL, and A, (2) dysaerobic, mid-ramp setting represented by microfacies B, and (3) aerobic, shallow-ramp setting represented by microfacies C and D.

Deposition in the deep- and mid-ramp environments was dominated by bottom-hugging currents produced by off-platform flow of denser waters. These currents moved down a broad slope that was locally incised by gullies. Deposits of the broad slope, microfacies A and B, originated from a line-source and are found throughout much of southern Oklahoma. Primary sedimentary structures include millimeter-size laminations, starved ripples, and concave-up and inclined erosional surfaces. Shelly benthic fauna are rare in A and B; trace fossils are common only in B. Deposits associated with the line-source gully, microfacies RL, CH, and CGL, are laterally confined; they have been observed only in the southwest Arbuckle Mountains. Primary sedimentary structures present in RL include wavy and ripple-cross laminae. Microfacies CH, contained within RL and interpreted as a submarine channel deposit, is present only at one locality. Primary sedimentary structures present in CH include an erosional base and several internal erosional surfaces, lateral accretionary sets, and imbricated, locally derived intraclasts.

Deposition in the aerobic, shallow-ramp setting (microfacies C and D) was dominated by storm processes and intervening periods of bioturbation. An increase in both size and abundance of pelmatazoan fragments is the characteristic feature of these microfacies.

High total organic carbon (TOC) values have been reported for the lower Viola. TOC values of 1% have been reported from microfacies A, and TOC values of 5% have been reported from microfacies RL. These high values suggest that A and RL may act as hydrocarbon source rocks. Recognition of these microfacies in the subsurface will contribute to our knowledge of the Viola Limestone as an exploration target.

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Tectonics, Stratigraphy, and Petroleum Potential of Tripura-Mizoram Folded Belt, Northeast India

The folded belt of the northeast Indian states of Tripura and Mizoram and the adjoining parts of Assam (Cachar district) and Manipur constitute a part of the Assam-Arakan geosynclinal basin and lie between the present-day foredeep of Bangladesh and the hinterland of Burma. This region, with its characteristic succession of synorogenic ridges and valleys, can be subdivided into a frontal subbelt of Tripura and south Cachar comprising narrow, boxlike, and cuspate anticlines separated by wide, flat synclines, and an inner mobile subbelt of Mizoram and west Manipur consisting of tight, linear, commonly isoclinal anticlines and synclines, festooned into salients and reentrants. Passing from east to west, deformation in this belt becomes progressively younger and less intense. The anticlines are commonly bounded on one or both flanks by longitudinal listric reverse faults. The individual structures are internally segmented by cross faults and oblique faults of multiple alignments, some of which have strike-slip components and have offset anticlinal axes and flank faults. These multidirectional trends combine at places to form doglegs and trap doors, disrupting a more general north-south relay pattern, and indicate polyphase deformation with structural styles grading from those associated with basement-involved compressive block-faulting to detached thrust-fold assemblages and further modified by shale flowage. Such compressional tectonic styles are characteristics of areas close to convergent plate boundaries.

The Tripura-Mizoram region exposes mainly Neogene-age clastics of molassic facies, comprising about 6 km (20,000 ft) thick, poorly fossiliferous succession of alternating shales, mudstones, siltstones, and sandstones in varying proportions, which have been lithostratigraphically subdivided from the bottom upward into Surma (Miocene-Pliocene), Tipam (upper Pliocene), and Dupi Tila (Pleistocene) Groups, with conditions of deposition ranging from shallow marine/deltaic at the bottom to fluviatile/lacustrine at the top.

Numerous surface and subsurface manifestations of oil and natural gas in Tripura, Cachar, and Mizoram areas, occurrence of gas fields in the neighboring areas of Bangladesh, and a favorable geologic history indicate the existence of conditions conducive to petroleum generation in this region. On the basis of geochemical studies, it has been concluded that there are good prospects of striking gas in the relatively shallower zones and both oil and gas in the deeper zones in several structures of Tripura and Cachar. The expected hydrocarbon traps include discrete culminations and trap doors in individual anticlines, cross-faulted noses, subsidiary flexures in synclinal areas, subthrust warps against block-bounding faults, and various associated stratigraphic traps, as well as combination traps resulting from clay diapirism. However, on account of logistic constraints, unfavorable subsurface conditions (including steep dips and high pressures), inherent stratigraphic and structural complexities, and a paucity of seismic data, exploratory operations conducted in this region have had limited success. An accelerated exploration program with the help of improved techniques and additional resources is being initiated.

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Lower Eocene Carbonate Facies of Egypt—Paleogeographic and Tectonic Implications

The northern Arabo-Nubian craton witnessed a major Late Cretaceous-early Tertiary marine transgression that culminated in the deposition of widespread shelf-sea carbonates during Early Eocene (Ypresian) time. In Egypt, these Early Eocene strata (the Thebes Limestone and its equivalents) crop out over more than 100,000 km^2 (38,610 mi^2), and reveal a mosaic of carbonate facies consistent with the general model of "epeiric clear water sedimentation" proposed by Irwin in 1965.

"Outer shelf" facies characterize exposures in central Egypt (Assiut, Luxor, Kharga), and are composed primarily of rhythmically interbedded chalk and micritic limestone with minor intercalated marine hardgrounds. To the south (Kurkur-Dungul), these fine-grained lithologies give way to "inner shelf" foraminiferal wackestones and grainstones, typical Tethyan "Nummulitic" facies. Missing in southern Egypt is the restricted dolomitic evaporitic facies predicted by the Irwin model and observed in the lower Eocene of the Sirte basin to the west and the Arabian Platform to the east. The absence of this marginal marine evaporite belt in Egypt is presumably the result of post-Ypresian uplift and removal.

Comparing the areal distribution of these lower Eocene carbonates to coeval facies developed across the remainder of northern Africa and Arabia reveals the presence of a broad marine embayment which extended through central and eastern Egypt into northern Sudan during Ypresian time. The widespread subsidence that resulted in the development of this feature may have been an effect of regional crustal attenuation preceding the rifting of the Red Sea.