Pessimistic views regarding the liquid hydrocarbon potential in the basin stem from the following common observations. (1) The only exploitable hydrocarbon discoveries to date have been gas. (2) The only known source rocks are of post-Jurassic age and predominantly contain land-derived organic carbon, and hence are considered as gas prone. (3) Today's inferred geothermal gradient is such that the oil window is at least 5,000 m (16,000 ft) deep, and below the "acoustic basement," implying that existing hydrocarbons result from biodegradational processes not conducive to oil generation. (4) Old seismic data did not reveal well-developed structural traps.

However, the recent comprehensive interpretation affords the following conclusions. (1) Significant oil shows accompanying wet gas discoveries suggest that the South Mozambique basin is a mature province, as the hydrocarbon associations imply thermogenic processes. Hence, the geothermal history must have been more favorable than is generally inferred from present-day gradients. (2) Super-Karroo marine Jurassic sequences have been encountered in the Nhamura-1 well onshore, and Triassic marine sequences have been interpreted offshore from the application of seismic stratigraphy and well correlation. Furthermore, extrapolation of the continental character of the older Karroo from intracratonic locations to paleocontinental margins may not be valid, as exemplified by the basinward increase in marine character of the Sakemena and Ecca formations in Madagascar and Natal, respectively. Accordingly, the local presence of oil-prone source rocks is likely. (3) Steeply dipping reflectors truncated by the pre-Cretaceous unconformity testify to significant tectonic activity preceding the breakup of Gondwanaland. Hence, preconceived ideas about the depth of the economic basement and the absence of mature source rocks of pre-Cretaceous age should be revised. (4) Wildcats in the vicinity of ample structural closures have not been, in retrospect, optimally positioned nor drilled to sufficient depth to test the viability of prospects mapped along a major offshore extension of the East African rift system delineated by this new survey.

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Thermo-Mechanical Properties and Evolution of Pull-Apart Basins

Pull-apart basins are generally characterized by two component subsidence; an initial essentially instantaneous isostatic subsidence (S_1) dependent on the ratio of crustal to lithospheric thickness (C_z/l_z) and the stretching factor β, followed by a slower exponentially decaying thermal subsidence (S_t) controlled by the thermo-elastic properties of the continental lithosphere which, in turn, can be characterized by a thermal time constant τ. Rapid short-lived subsidence (Ridge basin) is indicative of either (1) inhomogeneous crustal stretching without major sublithospheric involvement, or (2) extremely small lithospheric diffusivities. The former implies a thin-skinned origin for pull-apart basins and suggests that the spatial and temporal distribution of bounding faults and splays typical of pull-apart basins result from inhomogeneous brittle failure of the upper crust. Crustal, extensional or shear-strength profiles for various geothermal gradients and degrees of wetness adequately explain two-layer extension with intra-crustal decollement. However, the effects of lateral heat flow decrease the thermal time constant by allowing a basin to subside more quickly because of both lateral and vertical cooling. The size of this effect is dependent on the width of the stretched lithosphere. The effective τ of a 100 km (60 mi) wide rift is 36 m.y. and for a 25 km (15 mi) rift is 6 m.y., whereas the actual thermal time constant in both cases is 62.8 m.y. Lateral heat flow amplified rift subsidence while producing complementary uplift in adjacent unstretched regions. However, the flexural rigidity of the lithosphere severely attenuates the deformation caused by the lateral flow of heat. Although the deformation is highly dependent on the mechanical properties of the lithosphere, τ is independent. Diachronous rift shoulders or peripheral uplifts may produce important hydrocarbon gradients and result from various combinations of lateral heat flow, flexural arching, and normal-fault decoupling.

Continental lithospheric rigidities appear to increase with age following an orogenic or thermal event, suggesting that the long-term mechanical behavior of the continental lithosphere is similar to that of the oceanic lithosphere. However, high rigidities (10^{32} dyne-cm) associated with Archean or Proterozoic terranes and modeling of plate deformation suggest that the long-term thermal behavior of continental lithosphere is governed by a cooling plate model with a 200-250 km (124-155 mi) lithospheric thickness, nearly twice the 125 km (78 mi) estimated for the oldest oceanic lithosphere. This has important implications for the evolution of sedimentary basins. A doubling of the lithospheric thickness implies a quadrupling of τ, yet basin subsidence models have assumed that τ for the oceanic and continental lithospheres are similar. A large τ allows basin subsidence to continue over significantly longer times, but lateral heat flow, in addition to vertical, must be included in basin models to obtain accurate subsidence and temperature estimates. In particular, S_1 is highly dependent on the age of the underlying basement.

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Deep Water (200-800 m) Hydrocarbon Potential of United States Gulf of Mexico

Recent active Outer Continental Shelf (OCS) lease sales in the offshore Texas and Louisiana portions of the United States Gulf Coast have emphasized that this will be an arena of vigorous exploration for at least the next decade. Much of the principal prospective acreage on the shelf area (water depth less than 200 m or 660 ft) has been awarded for exploration. As a consequence, there is now a well-established trend toward assessment of deeper water acreage (200-800 m or 660-2,625 ft). For example OCS sale 72, in May 1983, included the award of leases in water depths of over 1,000 m (3,280 ft). This trend is likely to make the United States portion of the Gulf of Mexico the first intensively explored deep-water area in the world.

Geophysical and geologic data have been acquired on a generally ad hoc basis by various research and governmental institutions over the last 15 years. More recently, individual oil companies and geophysical contractors have started more methodical data acquisition programs. This move toward a more systematic evaluation has culminated in extensive regional seismic programs being acquired to evaluate leases available in the April and July 1984 OCS sales 81 and 84.

Acquisition, processing, and interpretation problems can be expected by those attempting to evaluate prospects in the deep water portions of the Gulf of Mexico.

From the geophysical evidence available, broad conclusions can be made concerning the likely hydrocarbon potential of the area.

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Trapping Styles and Associated Hydrocarbon Potential in Norwegian North Sea

The exploration effort in the Norwegian North Sea is only 15-20 years old. The activity has resulted in several major oil and gas finds. Well data and significant amounts of seismic data have implied a thorough geologic understanding.

In the North Sea basin, the hydrocarbon discoveries to date can be assigned to four main forms of traps.

(1) The extensional structures are characterized by tilted fault blocks, or less commonly, rollover anticlines on the downthrown side of faults. The hydrocarbons occur in sub-unconformity, sandy reservoirs of Triassic to Late Jurassic age. (2) Salt-supported structures generally have fractured Upper Cretaceous-lower Tertiary chalk or Jurassic sandstones as a reservoir. (3) Stratigraphic traps are accentuated by drape, compaction, or late structural movements. Sands of Paleocene-Eocene age represent the main reservoir. (4) Anticlinal closures are related to a late phase of wrench movements. Discoveries of this type occur in the southern part of the basin and represent only a minor part of the proven reserves.

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Hydrocarbon Potential of East Coast of India

The east coast of India is considered to be a divergent margin formed during the fragmentation of Gondwanaland during the late Mesozoic. The four sedimentary basins located along this coast—Cauvery, Palar, Krishna-Godavari, and Mahanadi (from south to north)—have their seaward extensions into the Bay of Bengal where some of them have built a 5-6 km (16,000-20,000 ft) thick late Mesozoic to Holocene sedimentary section.