Extraction Not Creation: The History of Offshore Petroleum in the Gulf of Mexico

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Offshore development is one of the most important but least analyzed chapters in the history of the petroleum industry, and the Gulf of Mexico is the most explored, drilled, and developed offshore petroleum province in the world. This essay examines offshore oil and gas development in the Gulf of Mexico, highlighting the importance of access and how the unique geology and geography of the Gulf shaped both access and technology. Interactions between technology, capital, geology, and the political structure of access in the Gulf of Mexico generated a functionally and regionally complex extractive industry that repeatedly resolved the material and economic contradictions of expanding into deeper water. This was not achieved, however, simply through technological miracles or increased mastery over the environment, as industry experts and popular accounts often imply. The industry moved deeper only by more profoundly adapting to the environment, not by transcending its limits. This essay diverges from celebratory narratives about offshore development and from interpretations that emphasize the social construction of the environment. It challenges the storyline of market-driven technology and its miraculous ability to expand and create petroleum abundance in the Gulf.

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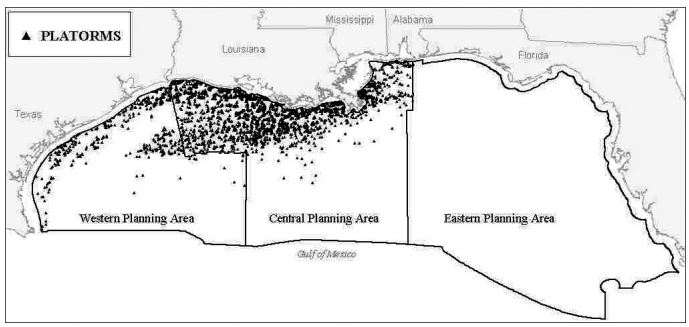
The search for oil and gas offshore is one of the most important but least analyzed chapters in the history of the petroleum industry. From negligible production in 1945, offshore now produces about 34 percent of the world's crude oil and about 25 percent of the world's natural gas. These percentages will likely climb over the next decade.[1] Of all offshore provinces in the world, the Gulf of Mexico is the most explored, drilled, and developed. Today, in the continental shelf waters off Louisiana and Texas, there are nearly 4,000 active platforms servicing 35,000 wells, and 29,000 miles of pipelines. Output from the Gulf, providing close to one-third of U.S. oil and gas production, already exceeds Texas's onshore output and will soon surpass Alaska's.



The ongoing and fruitful search for oil in the Gulf paradoxically has been a function of the long-term decline of the lower-48 United States as a petroleum province. Oil discoveries in the United States peaked in 1930; oil production peaked in 1970. By the end of the Second World War, the most obvious onshore oil already had been found. To replace diminishing reserves, new kinds of structural traps had to be found using new exploration technologies in higher-cost environments. Petroleum exploration in the postwar United States essentially became a race against depletion. From the 1950s through the 1970s, production from offshore Gulf of Mexico helped stave off the rapid exhaustion of U.S. oil and gas reserves. Since then, even

1. In 2003, total worldwide production of offshore crude oil and natural gas reached 26 million barrels/day and 685 billion cubic meters/day, respectively. Darius Sniekus, ''Offshore Production Rocket on the Launchpad,'' *Offshore Engineer* (1 April 2004), available at www.oilonline.com/news/features/oe/20040401.

with the new deepwater discoveries of the 1990s and 2000s, the overall trend in the Gulf has been declining reserves and production.[2]

Modern journalistic coverage of offshore oil, reflecting an image cultivated by the industry, eschews the themes of depletion and decline in favor of growth and abundance. Not only can offshore oil reduce U.S. dependence on overseas sources, many press stories imply, it can even liberate extractive enterprise from the limits imposed by the material world. According to Daniel Yergin, an oil industry consultant and author of *The Prize*, a popular history of oil, ''the ultimate amount available to us is determined both by economics and technology.''[3] In other words, it is not determined by nature. From that perspective, the offshore petroleum industry does not extract finite resources from the earth, but rather it manufactures them through entrepreneurial invention acting on a stubborn but yielding environment. The Gulf has been written off as a ''dead sea'' time and again, the refrain goes, yet technology always has brought it back to life by enabling the industry to find and produce oil and gas more cheaply. The success of offshore technology is often invoked in political debates to dismiss the urgency of promoting energy conservation. In recent years, articles in popular journals have cited the promise of offshore technology to proclaim ''why we'll never run out of oil,'' ''oil forever,'' and ''the reinvention of the earth.''[4]

The fable of technology-generated abundance belies the fact that the Gulf of Mexico is an oil province in terminal decline. Technology indeed has helped reduce costs and increase the productivity of oil and gas extraction in the Gulf. But these innovations represented adaptations to the Gulf environment, not transcendence of its physical limits, and the specific historical conjunctures that produced these adaptations are unlikely to be repeated. Innovation was not strictly a market response to the imperative to reduce production costs.[5] The political terms of access to offshore public lands and the unique

2. For a historical examination of the company recognized as the leader in the race against depletion offshore, see Tyler Priest, *The Offshore Imperative: Shell Oil's Search for Petroleum in Postwar America* (College Station, Texas, 2007).

3. Quoted in Curtis Rist, ''Why We'll Never Run Out of Oil,'' *Discover* 20 (June 1999): 82. The historian of technology Nathan Rosenberg also argues for the importance of technological change in defining or valuing natural resources. See Rosenberg, *Technology and American Economic Growth* (New York, 1972), 18–24.

4. Rist, ''Why We'll Never Run Out of Oil,'' 82; Alex Taylor III, ''Oil Forever,'' *Fortune* (22 Nov. 1999): 193–94; and Jonathan Rauch, ''The New Old Economy: Oil, Computers, and the Reinvention of the Earth,'' *Atlantic Monthly* (Jan. 2001): 35–49.

5. For an argument that it was, see Douglas R. Bohi, ''Technological Improvement in Petroleum Exploration and Development,'' in *Productivity in*

physical characteristics of Gulf hydrocarbons shaped innovation in important but unacknowledged ways. Industry experts' enthusiasm about technological advances mystifies the complex history of business, government, technology, and the environment offshore, and obscures the continuity between previous eras of development and the current one.

Historians have not seriously tried to analyze the development of the Gulf's offshore industry, which helps explain the prevalence of simple, celebratory narratives. The few historical accounts we have of the rise of offshore oil in the Gulf, largely produced in collaboration with the industry, emphasize oilmen's heroic conquest of nature.[6] In their more critical analyses of related topics, historians of business, technology, and the environment often share the industry's tendency to privilege stories about humans acting on their physical surroundings. As Christine Meisner Rosen and Christopher Sellers have pointed out, business and environmental historians should talk more about how extractive enterprises adapted and molded themselves to the physical environment in addition to how they imagined or altered it.[7] Environmental historians examine business's role in despoiling the environment, but they often neglect the impact of the natural environment on business.[8] Their concerns also are weighted toward cultural perceptions of nature and the social construction of the environment. Recent work on the history of ''upstream'' petroleum (exploration and production) addresses either the industry's alteration of landscapes or changing political and cultural perceptions of oil development.[9] Scholars have

Natural Resource Industries: Improvement through Innovation, ed. R. David Simpson (Washington, D.C., 1999): 73–108.

6. See, for example, Joseph A. Pratt, Tyler Priest, and Christopher J. Castaneda, *Offshore Pioneers: Brown & Root and the History of Offshore Oil and Gas* (Houston, 1997); Hans E. Veldman and George H.G. Lagers, *50 Years Offshore* (Tulsa, Okla., 1997); and Clyde W. Burleson, *Deep Challenge! The True Epic Story of Our Quest for Energy Beneath the Sea* (Houston, 1999).

7. Christine Meisner Rosen and Christopher C. Sellers, ''The Nature of the Firm: Towards an Ecocultural History of Business,'' *Business History Review* 73 (Winter 1999): 577. Also see Christine Meisner Rosen, ''The Business-Environment Connection,'' *Environmental History* 10 (Jan. 2005): 77–79.

8. A notable exception is William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York, 1991). Still, Cronon is more interested in explaining how business has transformed nature. It has done so to such extent, he argues, that we can even speak of a ''second nature'' arising in place of ''first nature.''

9. See, for example, Paul Sabin, ''Searching for Middle Ground: Native Communities and Oil Extraction in the Northern and Central Ecuadoran Amazon, 1967–1993,'' *Environmental History* 3 (April 1998): 144–68; Myrna Santiago, ''Rejecting Progress in Paradise: Huastecas, the Environment, and the Oil Industry in Veracruz, Mexico, 1900–1935,'' *Environmental History* 3 (April 1998): 169–88;

been much more interested in the legal conflicts and ''contested visions'' of offshore oil in California than in actual development in the Gulf of Mexico.[10] There is an unexpected affinity between tales of technological marvels offshore and social constructionist approaches to environmental history (whose practitioners rarely intend to applaud market forces). Both industry boosters and scholars influenced by post-structuralism view natural resources as social products, thereby deemphasizing their intrinsic value.[11]

Even Gavin Wright's essay on the importance of mineral resources to U.S. industrial success claims that ''resource abundance was historically rather than geologically determined.''[12] Wright offers a refreshing analysis of the material foundations of American

Nancy Quam-Wickham, '''Cities Sacrificed on the Alter of Oil:' Popular Opposition to Oil Development in 1920s Los Angeles,'' *Environmental History* 3 (April 1998): 189–209; Brian Black, ''Oil Creek as Industrial Apparatus: Re-creating the Industrial Process Through the Landscape of Pennsylvania's Oil Boom,'' *Environmental History* 3 (April 1998): 210–29; Roger M. Olien and Diana Davids Olien, *Oil and Ideology: The Cultural Creation of the American Petroleum Industry* (Chapel Hill, N.C., 2000); and Paul Sabin, *Crude Politics: The California Oil Market, 1900–1940* (Berkeley, Calif., 2005). In general, environmental historians have largely ignored the world's oceans. A recent exception, and possibly the sign of a new trend, is Helen M. Rozwadowski's *Fathoming the Ocean: The Discovery and Exploration of the Deep Sea* (Cambridge, Mass, 2005).

10. Several works on the political controversies over offshore drilling have focused on national policy or offshore California, but not on the Gulf of Mexico. See Robert E. Kallman and Eugene D. Wheeler, *Coastal Crude: In A Sea of Conflict* (San Luis Obispo, Calif., 1984); R. Scott Farrow, *Managing the Outer Continental Shelf Lands: Oceans of Controversy* (New York, 1990); Charles Frederick Lester, ''The Search for Dialogue in the Administrative State: The Politics, Policy, and Law of Offshore Development'' (Ph.D. diss., University of California at Berkeley, 1992); William R. Freudenburg and Robert Gramling, *Oil in Troubled Waters: Perceptions, Politics, and the Battle over Offshore Drilling* (Albany, N.Y., 1994); Robert Gramling, *Oil on the Edge: Offshore Development, Conflict, and Gridlock* (Albany, N.Y., 1996); and Sarah S. Elkind, ''Public Oil, Private Oil: The Tidelands Oil Controversy, World War II, and Control of the Environment,'' in *The Way We Really Were: The Golden State in the Second World War*, ed. Roger W. Lotchin (Urbana, Ill., 2000), 120–42. The best studies on the battle between coastal states and the federal government concerning jurisdiction over submerged lands are Ernest R. Bartley, *The Tidelands Oil Controversy: A Legal and Historical Analysis* (Austin, Texas 1953); and Ann L. Hollick, *U.S. Foreign Policy and the Law of the Sea* (Princeton, N.J., 1981).

11. This point is the focus of a heated debate among environmental historians. See the exchange over social/cultural versus materialist approaches to environmental history in Donald Worster, ''Transformations of the Earth: Toward an Agroecological Perspective in History,'' *Journal of American History* 76 (March 1990): 1087–1106, who takes the materialist position, and the comments on his essay in the same volume by William Cronon, Carolyn Merchant, and Richard White, who argue for the social construction of nature.

12. Gavin Wright, ''The Origins of American Industrial Success, 1879–1940,'' *American Economic Review* 80 (Sept. 1990): 664.

industrial development, finding that capital and natural resources were complementary factors of production and that American technology had a material-using bias. Yet he concludes that ''mineral supplies were more a matter of 'development' than 'endowment,'" implying that minerals themselves had little to do with the way they were exploited.[13] As Wright suggests, firms, markets, law, and culture define physical reality and assign values to resources. But accounting for material change and development over time also requires a better understanding of how the physical environment has constrained market-based extraction. History and geology are not alternative variables in the exploitation of resources. Technology, access, and business organization have often been a function of the particular characteristics of resources, not merely a shaper of them.[14]

The unique geology and geography of the Gulf created opportunities as well as challenges for the extraction of petroleum. The particular characteristics of Gulf hydrocarbons allowed for developments not possible in other marine environments. Still, major projects in open water, which required capital-intensive infrastructure at risk from extreme weather, often entailed costs too large for private firms to handle on their own. Government support or mediation assisted the industry in dealing with these enormous costs and challenges. It is true that managers, geoscientists, and engineers responsible for offshore operations trained themselves to rethink the notion of an exploitable resource and to question the idea of environmental limits much more rigorously than oil operators did on land. However, government aid, protection, and corruption, in addition to entrepreneurial engineering and risk-taking, were required to make business profitable in this high-cost and uncertain natural environment. Discovering oil and gas with greater precision required increasingly advanced exploration technology.[15] But it also required favorable access resulting from

13. Ibid., 652.

14. Sociologist Stephen Bunker's substantial work on extractive economies most clearly elaborates this insight. See Stephen G. Bunker, *Underdeveloping the Amazon: Extraction, Unequal Exchange, and the Failure of the Modern State* (Urbana, Ill., 1985); Stephen G. Bunker, ''Staples, Links, and Poles in the Construction of Regional Development Theories,'' *Sociological Forum* 4, no. 4 (1989): 589–610; Stephen G. Bunker and Paul S. Ciccantell, *Globalization and the Race for Resources* (Baltimore, Md., 2005); and Paul S. Ciccantell, David A. Smith, and Gay Seidman, eds., *Nature, Raw Materials, and Political Economy* (Oxford, U.K., 2005), a volume of essays in honor of Stephen Bunker, which includes Tyler Priest, ''A Perpetual Extractive Frontier? The History of Offshore Petroleum in the Gulf of Mexico,'' 209–29.

15. Studies of offshore oil have not directly addressed the forces that pushed the race against depletion further offshore. Studies of the drilling and construction

the politically negotiated leasing of offshore public lands. Unusual geologic luck, moreover, was a key factor at critical moments. Frequently, technology did not lead to major discoveries offshore; rather, big discoveries, using basic technology, stimulated the spending on new technology to develop those fields and find others. Each new cycle of development in deeper water created greater economies of scale, which replicated and expanded the material and spatial problems of previous cycles. As the industry adapted to the specific character of the Gulf, with crucial government protection, the coastal ecosystem and communities proved far less adaptable. The accumulating damage from oil activity and changes to the south Louisiana wetlands undermined the local foundations of the industry and increased its vulnerability to devastating hurricanes.[16]

The following narrative diverges from both celebratory narratives of offshore development and interpretations that emphasize the social construction of the environment. It highlights the importance of access, and how both access and technology were shaped by the geology and geography of the Gulf. These points are made through an analysis of four eras that represent different phases in the evolution of the industry. In the first era, lasting from the birth of the industry in the Louisiana bays and wetlands in the 1930s through the first wave of ''open-water'' developments in the 1950s, the industry's success owed as much to insider politics, state support, and good fortune as to technology. The second era, from the mid-1950s through the late 1960s, witnessed reforms in leasing and significant advances in exploratory drilling but, on balance, did not reward the industry with greater returns. The price spike of the early 1970s, combined with important site-specific innovations in geophysical technology, revived the Gulf and carried the industry through a third era that lasted into the early 1980s, when rising costs again dimmed prospects for expansion. The reform of the federal leasing system in the early

industries highlight offshore production, to the neglect of exploration, which is where oil companies achieved competitive advantage. See, for example, Pratt, Priest, and Castaneda, *Offshore Pioneers*; Veldman and Lagers, *50 Years Offshore*; Burleson, *Deep Challenge!*; and Tai Deckner Kreidler, ''The Offshore Petroleum Industry: The Formative Years, 1945–1962'' (Ph.D. diss., Texas Tech University, 1997).

16. Environmental studies analyzing the tragic loss of wetlands in South Louisiana recognize offshore oil development as an important contributing factor. See Christopher Hallowell, *People of the Bayou: Cajun Life in Lost America* (Gretna, La., 2003); Hallowell, *Holding Back the Sea: The Struggle for America's Natural Legacy on the Gulf Coast* (New York, 2001); and Mike Tidwell, *Bayou Farewell: The Rich Life and Tragic Death of Louisiana's Cajun Coast* (New York, 2003).

1980s and the subsequent discoveries of new, highly productive oil-producing reservoirs in ''deepwater'' initiated the fourth era, the end of which may be coming into view.

In each of these eras, the technological and organizational development of the industry depended on some combination of government assistance, relaxed terms of access, and unique environmental conditions. The importance of these factors calls into question the storyline of market-driven technology and its miraculous ability to expand and create petroleum abundance in the Gulf. Since the early 1970s, petroleum extraction in the Gulf of Mexico has not produced abundance; it has merely postponed rapid depletion. The recent trajectory of decline in the Gulf supports the arguments of geoscientists who warn of an impending peak in world oil production, and not those of economists who claim that the magic of the market will create new supplies.[17] It reveals that the Gulf environment has left its imprint on the oil industry and coastal support communities, and indeed on our larger oil-dependent society, as much as the enterprise of oil has shaped the region and transformed its resources. The devastating impacts of Hurricanes Ivan, Katrina, and Rita, striking the Louisiana and Texas Gulf Coast in 2004 and 2005, punished the region for its history of ecological mismanagement, and affirmed that the Gulf's most important industry is still shaped by the natural forces it has sought to subdue.

The First Era: Environmental Opportunities and Challenges

Favorable geology, fortuitous environmental conditions, and special political support combined to stimulate the formation and early growth of the offshore petroleum industry. The prospect of moving into the wetlands of south Louisiana and then into the open Gulf was at first daunting. Exploration, drilling, and production techniques had to be adapted to marine conditions. In designing and building offshore structures, something first tried in the late 1930s, engineers encountered novel conditions arising from wave forces, unstable foundations, and storms and hurricanes. Infrastructure built for this

17. See Colin J. Campbell, *The Coming Oil Crisis* (Brentwood, U.K., 1997); Kenneth S. Deffeyes, *Hubbert's Peak: The Impending World Oil Shortage* (Princeton, N.J., 2001); and Bob Williams, ''Debate Over Peak-Oil Issue Boiling Over, With Major Implications for Industry, Society,'' *Oil & Gas Journal* (14 July 2003): 18–29.

environment—platforms, pipelines, drilling and support vessels, port facilities—therefore had to be highly specialized. Their development required high fixed costs and long lead times. As oil was discovered and produced, marshes had to be cut and dredged all along the Gulf Coast to allow entry for the thousands of miles of pipelines from the ocean. The mobilization and adaptation of entire communities (shipyards, fabrication yards, depots, labor camps, and administrative centers) were needed to support this monumental undertaking.

The physical environment of the Gulf created opportunities as well as challenges for the oil industry. First, the region had widely varying deposits of hydrocarbons. Unlike most petroleum provinces in which discoveries have been concentrated in a short span of one to three decades, substantial discoveries have been made in the Gulf basin for the past *nine* decades. In contrast to the major provinces of the world where hydrocarbons are concentrated in a small number of world-class ''giant'' fields (fields with a known recovery of more than 500 million barrels of oil equivalent [boe]), the Gulf basin has yielded thousands of smaller fields of less than 50 million boe, as well as ''large'' fields of 50 to 500 million boe and giant fields.[18] This unique geology created opportunities for a wide range of companies and oil hunters and for an even greater number of subsidiary businesses. The Gulf's gradually sloping, deltaic plain permitted experimentation with building free-standing structures in the open water. The sedimentary layers of the Gulf's ocean bed are relatively soft, making them easier to drill than hard-rock layers in other regions, onshore or offshore. The water is shallow for many miles and the conditions are mild, except for hurricanes. In the 1950s, the main areas of activity in the Gulf were largely hurricane-free, with the devastating exception of Hurricane Audrey in 1957.[19]

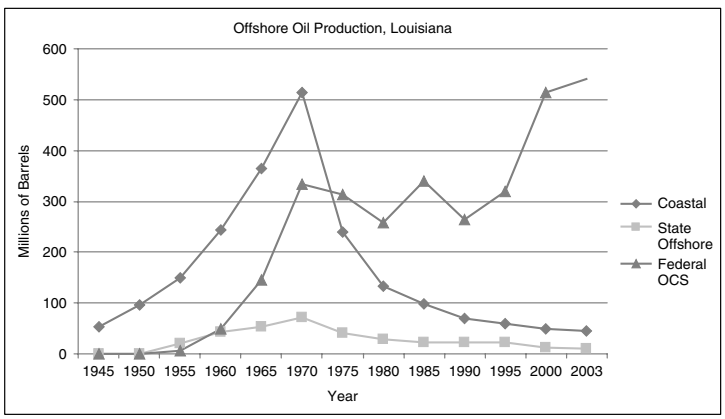
Offshore, there are relatively few barriers to gathering seismic and geological information. Companies did not have to contend with individual property holders or imposing topography, as they did onshore. The achievement of mobility on the water, first in geophysical prospecting and then in drilling with the successive development of submersible, jack-up, and semi-submersible vessels,

18. Richard Nehring, ''Oil and Gas Resources,'' in *The Gulf of Mexico Basin*, ed. Amos Salvador (Boulder, Colo., 1991), 445–94.

19. The frequency of hurricanes in the Gulf depends on a 60–70 year cycle, called the Atlantic Multdecadal Oscillation (AMO), which alters the strength of ocean currents that distribute heat around the world. During the offshore industry's formative years in the 1950s, the AMO was in a down cycle, with sea-surface temperatures, and thus hurricane frequencies, well below normal. See Chris Carroll, ''In Hot Water,'' *National Geographic* (Aug. 2005): 72–85.

made offshore oil viable by eliminating the need to build platforms for exploratory drilling, which, in the event of a dry hole, involved huge, stranded costs. Offshore fields were close enough to established refining centers along the Gulf Coast that early output could be barged to supply depots, and the laying of the first underwater pipelines was not prohibitively expensive or technically challenging.[20]

Before the industry developed in open water in the 1950s, early drilling success along the coast of the Gulf of Mexico was due mostly to geological good fortune and corrupt deals with Louisiana officials, in addition to the afore-mentioned relative absence of hurricanes. Salt-dome discoveries, first in the marshes, bays, and swamps of south Louisiana in the 1920s and 1930s, and then in the shallow waters offshore in the 1940s and 1950s, were numerous and significant by U.S. standards. However, seismic technology often did not yield workable results for refining the location of oil prospects in the soft, unconsolidated sands of the Gulf Coast. Consequently, oil companies desired large and cheap leases to allow for wider-ranging drilling programs—a spatial fix to compensate for imperfect seismic technology and the relatively high costs of operating in the wetlands environment.[21]



Louisiana officials were happy to oblige. In the late 1920s and early 1930s, the state and local levee districts leased millions of

20. Pratt, Priest, and Castaneda, *Offshore Pioneers*; and Gramling, *Oil on the Edge*.

21. Edgar Wesley Owen, *Trek of the Oil Finders: A History of Exploration for Petroleum* (Tulsa, Okla., 1975), 454–57, 759–69.

acres to oil interests through corrupt schemes involving Huey Long, his machine cronies, and other local political bosses such as the notorious Plaquemines Parish district attorney, Leander Perez. Long's famous Win or Lose Oil Company earned a reputation for never losing, as did the many front companies controlled by Perez through friends and families. These companies obtained leases on public lands very cheaply and then subleased them to oil companies, keeping a right to overriding royalties and, it was strongly presumed, collecting political contributions or under-the-table payments.[22] Some *single* leases, many of which ended up being held by Texaco (Gulf Refining, Humble Oil, and Shell Oil were the other major players), covered hundreds of thousands of acres.[23]

Corrupt though they were, leasing practices in Louisiana stimulated oil development in marine locations onshore and in the open sea. Hugely profitable oil and gas fields in south Louisiana generated interest in the adjacent offshore domain and financed a new wave of exploration and drilling by the established firms. Texaco had the largest lease position on the coastal plain and a lucrative portfolio of oil fields.[24] The company could afford to experiment with new-fangled exploration techniques, pioneering the use of a ''submergible barge'' in 1933–1934 to drill in soft-bottomed wetlands. After World War II, the submergible barge concept was applied successfully in shallow open water. Here, established oil firms, as well as those who lacked the political connections and had missed out on the action in south Louisiana, began to cast their sights. In 1938, Pure Oil and Superior Oil installed the first free-standing structure that produced oil in the Gulf, in the Creole field, a mile and a half from the city of Cameron. The next landmark achievement was Kerr-McGee's Ship Shoal Block 32 platform, installed in 1947 in eighteen feet of water, ten and one-half miles from the Louisiana shore. This is typically recognized as the first offshore platform ''out-of-sight-of-land.''[25]

22. Glen Jeansonne, *Leander Perez: Boss of the Delta* (Baton Rouge, La., 1977); Brady Michael Banta, ''The Regulation and Conservation of Petroleum Resources in Louisiana, 1901–1940'' (Ph.D. diss., Louisiana State University, 1981); and William J. Dodd, *Peapatch Politics: The Earl Long Era in Louisiana Politics* (Baton Rouge, La., 1991).

23. State Mineral Board of Louisiana, *Biennial Report, 1946* (Baton Rouge, La., 1946); ''Disputed Louisiana Lease Looks Hot,'' *Oil & Gas Journal* (5 May 1958): 72–73.

24. In addition to its state lands, Texaco, in a famous 1928 contract, also subleased hundreds of thousands of acres of private land held by the Louisiana Land & Exploration Company.

25. G.I. McBride, ''Drilling Barges,'' in *Drilling and Production Practice*, American Petroleum Institute (New York, 1935), 40–46; ''First Well in Gulf of

In the local lore of offshore Gulf of Mexico, these early pioneers took supreme risks and overcame frightful challenges to open up the offshore frontier. That is true, but the risks of venturing offshore were offset by the tremendous opportunities afforded by the Gulf of Mexico's location, topography, and geology, which produced politics and policies encouraging oil extraction. Moreover, if companies wanted to remain competitive or survive, they had no choice but to take risks. Although the oil industry had made some major discoveries in the 1930s, U.S. reserves were at a near-record low. The United States was the oldest producing region in the world. Oilfields came out of the Second World War worked over and depleted. Exploration for new fields had been largely postponed during the conflict, and the stupendous potential of the Middle East had not yet been fully recognized.

The opportunism of oilmen was rewarded. The success rate for wildcat, exploratory wells offshore was exceptionally high, much higher than onshore. During 1949–1956, the increase to U.S. domestic reserves from offshore development was nine times the average for onshore wells. Innovations in marine drilling (jack-ups and drillships, in addition to submersible barges) and marine design and construction were important, but companies also were able to cherry pick the most easy-to-identify salt-dome prospects in shallow water (30 feet or less), such as Shell Oil's South Pass 24 and 27 fields, the California Company's (Chevron) Bay Marchand and Main Pass 69 fields, and Humble Oil's (Exxon) Grand Isle 18 field. Shell Oil drilled its 1950 discovery well at South Pass 24, the largest field ever discovered in Louisiana (onshore and state waters), from a subsurface structure map based on very poor seismic data. But the first seventeen wells hit oil. Not bad for leases that cost a mere $4/acre. In the early history of the offshore industry, technology did not lead to big oil finds. Just the opposite, big oil finds led to the technology to develop those finds, and production from these finds enabled the companies to finance the search for new fields in deeper water.[26]

Mexico was Drilled Just 25 Years Ago,'' *Offshore* (Oct. 1963): 17–19; ''Pioneers Mark Anniversary of First Commercial Offshore Well,'' *Ocean Industry* (Dec. 1977): 43, 45.

26. U.S. Department of Interior, ''Petroleum and Sulfur on the U.S. Continental Shelf,'' internal study, Aug. 1969, box 134, Central Classified Files, 1969–72, Record Group 48, Records of the Secretary of the Interior, National Archives and Records Administration, II [hereinafter, NARA], Washington, D.C.; B.B. Hughson (seismologist who drew the South Pass 24 map), interview with author, 24 June 2002; ''Island on Stilts,'' *Shell News* (Feb. 1952): 11–13; ''No. 1 Gulf Field Growing Fast,'' *Oil & Gas Journal* (18 June 1956): 139.

Even with the revenue generated by these fields, in a truly open market the costs and risks of developing reserves in increasing water depths might have outweighed the returns. Government support for the offshore industry, both direct and indirect, was crucial to its ongoing viability. The governance arrangements in the U.S. oil industry allowed for the shifting of differential oil rents from lower-cost producing areas overseas, which were radically changing the world oil market in the 1950s, to higher-cost U.S. prospects, such as those offshore. These arrangements included the percentage depletion allowance, fixed in 1926, which allowed the industry to write off 27.5 percent of revenue from federal taxation.[27] Congress also passed tax incentives that reduced the costs of research, prompting many companies to build their first exploration and production research laboratories. These labs generated new technological capabilities aiding the search for more difficult-to-find hydrocarbons such as nonsalt dome deposits in soft-rock, sedimentary basins like the Gulf of Mexico.[28] In 1959, just after the major offshore discoveries of the early- to mid-1950s came on-stream, the Eisenhower administration restricted the flood of cheap imported oil into the United States by imposing mandatory quotas, or limits, on oil that could sold in the United States from abroad. This brought new salvation to higher-cost U.S. producers like those offshore, who might otherwise have had to abandon their operations. By 1960, the United States was one of the most protected oil markets in the world.[29]

27. Vern Baxter, ''The Effects of Industry Governance on Offshore Oil Development in the Gulf of Mexico,'' *International Journal of Urban and Regional Research* 21, no. 2 (1997): 238–58. The government also ruled that ''intangible'' drilling costs, such as dry holes, could be expensed against current income, rather than capitalized for recovery through depreciation. In the 1930s, to stabilize markets, conserve oil resources, and prevent excess production, oil-producing states and the federal government worked out an administrative ''prorationing'' system that restricted oil production among all producers in proportion to their rated capacities. Although critics charged that prorationing inflated both prices (by restricting production to demand) and costs (by reducing output of the more efficient low-cost wells and keeping in operation inefficient, high-cost wells), it nevertheless enabled the industry to expand. For the classic critique of U.S. domestic oil policies, see John M. Blair, *The Control of Oil* (New York, 1978), especially chapter seven on the ''domestic control mechanism,'' 152–86.

28. James M. Parks, ''Unintended Consequences of Oil Company Research Laboratories,'' *Oil Industry History* 4, no. 1 (2003): 32–41.

29. On the imposition of import quotas, see William J. Barber, ''The Eisenhower Energy Policy: Reluctant Intervention,'' in *Energy Policy in Perspective: Today's Problems, Yesterday's Solutions*, ed. Craufurd D. Goodwin (Washington, D.C., 1981), 205–86.

In addition to tax incentives and import protection, the federal government also aided the industry in other ways. Sonar and radio-positioning systems developed by the Navy for warfare at sea proved essential for oil exploration offshore. The Navy Experimental Diving Unit trained schools of divers in underwater salvage operations and developed mixed-gas and saturation diving techniques, jump-starting the postwar commercial diving business that became a vital adjunct to the offshore industry. Gulf Coast construction companies such as Brown & Root and J. Ray McDermott acquired war-surplus landing craft for pennies on the dollar and converted them to drilling tenders, supply and crew boats, and construction and pipelaying vessels.[30] Under the interstate prorationing system, generous production ''allowables'' for offshore wells set by the state of Louisiana and the federal government compensated for higher fixed costs compared to those onshore.[31] The initial absence of safety and environmental regulations also minimized operating costs—but not pollution and worker injuries and fatalities—and encouraged trial-and-error engineering and construction.[32]

Sustained by productive shallow-water discoveries and federal support, offshore operations developed new functional complexity and spawned a diverse array of companies. Oil companies tapped into a preexisting Gulf Coast oil-service sector, but they also cultivated new ones in drilling and supply, thereby transferring some of the risk to others and protecting themselves against the high infrastructure costs and irregular pace of exploration and development. The seeds of the larger offshore industry were planted during this period with the rapid growth of specialized geophysical contractors (i.e. Geophysical Services Incorporated, Western Geophysical, Petty-Ray Geophysical), engineering and construction firms (Brown & Root, J. Ray McDermott), supply and transport firms (Tidewater, Petroleum Helicopters), naval architects (Friede-Goldman), and various shipyards along the Gulf Coast turning out new-fangled

30. On both diving and the acquisition of war-surplus vessels, see Pratt, Priest, and Castaneda, *Offshore Pioneers*, 15–52, 137–57.

31. In the mid-1950s, the production allowable for a 10,000- foot deep well offshore (242 barrels/day) was nearly double the allowable for a comparable well onshore. Encouraging a greater spacing of development wells (up to 40 acres offshore compared to 30 acres onshore), the higher allowable lowered field development costs to compensate for higher individual well costs. Allowables in federal waters usually followed those set by Louisiana. Dean A. McGee, ''Economics of Offshore Drilling in the Gulf of Mexico,'' *Offshore Drilling* (Feb.1955): 16.

32. National Research Council, Marine Board, Assembly of Engineering, Committee on Assessment of Safety in OCS Activities, *Safety and Offshore Oil* (Washington, D.C., 1981).

drilling vessels. New drilling companies, such as the Offshore Drilling and Exploration Company (ODECO), Zapata, Global Marine, and The Offshore Company, captured imaginations with their development of a variety of submersible and jack-up drilling vessels. By 1960, the Gulf environment had yielded a new extractive industry vital to its regional economy.

The Second Era: Confronting Physical and Economic Limits

The second era of offshore development in the Gulf was a remarkably innovative period. In the early 1960s, most notably, path-breaking advances in mobile drilling launched the emerging industry into water depths previously unimaginable, confounding predictions about terminal physical and economic limitations on its expansion. Still, the offshore industry's ability to confront and overcome these limitations relied to a significant extent on supportive government policies. In particular, strengthened import protection and the acceleration of federal leasing buoyed the offshore enterprise through the 1960s.

By the late 1950s, the prospects for further success offshore had dimmed, due to political controversies and economic constraints that had environmental dimensions. Ambiguities over the definition of property offshore, stemming in part from the difficulties of physically defining the location of the irregular Louisiana coastline, suspended federal offshore leasing in the mid-1950s. U.S. Supreme Court decisions in 1948 and 1950 had awarded the federal government ''paramount rights'' over submerged lands beyond the low-tide mark. After a lengthy political battle over the ''tidelands,'' in which federal vs. state offshore jurisdiction became an important issue in the 1952 presidential election, President Dwight Eisenhower signed legislation that ''quitclaimed'' submerged lands out to three miles from coast back to the states and authorized the federal government to lease land beyond three miles. The federal government held three Gulf of Mexico lease auctions in 1954 and 1955 before the State of Louisiana obtained an injunction against further sales. Louisiana demanded a more precise definition of the ''coastline'' and an explicit determination of the state-federal boundary offshore, as well as a determination of rights of ''ownership,'' as distinct from ''paramount rights,'' over submerged lands.[33]

33. Bartley, *Tidelands Oil Controversy*; Gregory Blaine Miller, ''Louisiana's Tidelands Controversy: *The United States of America V. State of Louisiana*

In 1956, Louisiana and the federal government worked out a complicated interim agreement dividing the Gulf into zones of overlapping jurisdiction.[34] However, economic constraints in the form of a national recession, an oversupply of crude oil, and declining oil finds in deeper waters soon forced a slowdown in offshore exploration. Dry holes and capital costs increased for water depths beyond sixty feet. Underwater pipelines offered solutions to problems of storing and barging oil from wells with high levels of production in deeper waters, but pipelines were expensive and tricky to lay further from shore. The industry also had to drill to deeper formation depths to find oil, but high pore-fluid or formation pressures—''geopressures''—in those deeper wells created problems that could lead to disastrous blowouts. Fixed platforms, even smaller ones supported by drilling tenders, were economically unfeasible for exploration. Submersible drilling vessels were impractical and unstable in deeper water, and early jack-up rigs designed for greater depths were prone to capsizing. Consequently, insurance premiums for mobile drilling vessels soared.[35]

Many people believed offshore development had reached its limits. Top management in Shell Oil Company, one of the Gulf's leaders, seriously debated whether or not to expand exploration there. The vice president of the company's New Orleans office argued that the technology required for going deeper than sixty feet might be impossible to develop, and even if it were, the costs would be prohibitive. Better to be happy with what Shell had and stick to

Maritime Boundary Cases,'' *Louisiana History* 38 (Spring 1997): 203–21. Most of the crude oil and natural gas offshore in the Gulf was found off Louisiana; natural gas fields were later found and developed off of Texas beginning in the 1960s, but Louisiana remained the center of interest and activity.

34. In May 1960, the Supreme Court ruled that Louisiana, as well as Mississippi and Alabama, could claim jurisdiction only over submerged lands out to three geographical miles from the coastline. The Court also validated the three-league boundary claimed by Texas when it entered the Union, as well as the extension of Florida's Gulf Coast boundary to three leagues by virtue of Congressional approval of a boundary asserted in Florida's constitution upon its readmission to the Union after the Civil War. These decisions, however, did not determine the location of the coastline along these states, and the outer zones offshore Louisiana continued to be administered under the Interim Agreement. Although final determination of Louisiana's coastline would consume many more years of litigation, the state was forced to drop its liberal territorial claims, placing the federal leasing program on firmer legal footing. *United States v. Louisiana et al.* 363 U.S. 1 (1960).

35. Joe Zeppa, ''What is the Outlook for Drilling in the Gulf of Mexico?'' *Drilling* (Dec. 1959): 59.

production. His pessimism about the future of marine operations for oil companies was not uncommon in the industry.[36]

Others were more optimistic. The top exploration and production officials in Shell Oil overrode the objections of its New Orleans manager and funded research on new marine drilling technologies that would ultimately break the industry's tether to shallow-depth submerged lands. In January 1962, Shell successfully tested a new kind of ''floating drilling platform.'' This converted submersible vessel, the *Blue Water 1*, was equipped to operate in 600 feet of water without resting on the bottom. It was a space-framed structure consisting of three large columns on each side and a submerged hull—the first ''semi-submersible.'' To complement the new floating platform, Shell also tested the first successful subsea wellhead completion, all by remote control because the practical limit of diving at the time was only 150 feet. Overnight, Shell's *Blue Water 1* and subsea completion system changed the mindset of the entire industry. In early 1963, Shell shared its revolutionary technology with other oil and drilling companies. The company did this in order to bring its suppliers and contractors up to speed on the latest drilling and production innovations and to ensure that it would have at least some competition from other oil companies. Without such competition, Shell would not be able to obtain ''deepwater'' (300 feet or deeper) federal leases. The diffusion of technology led to shipyards all along the Gulf turning out purpose-built semi-submersibles. ''We're looking now at geology first, then water depths,'' said one Shell official at the time. In this way, the semi-submersible drilling vessel redefined the marine geography of commercially exploitable hydrocarbons.[37]

Other innovations also helped revive the offshore enterprise in the Gulf. Dynamically positioned drillships further increased the industry's ability to drill in deepwater. New drilling and well-logging techniques resolved many deep-drilling problems and reduced individual well costs. Magnetic recording and playback of seismic signals (commercially developed in 1958) led to

36. Bouwe Dykstra, ''Costs, Allowable Rate Hinders Offshore Work,'' *Drilling* (Aug. 1959): 65, 114; Zeppa, ''What is the Outlook for Drilling,'' 59.

37. ''Offshore Drilling Gets Better Sea Legs,'' *Business Week* (18 Aug. 1962): 101. The changing definition of ''deepwater'' over time testifies to the way in which the industry has reevaluated and revalued marine petroleum. In the late 1940s, deepwater was 60 feet. Over time, it has been revised repeatedly. The only constant definition has been ''the depth of the water just past the deepest platform.'' The modern concept of deepwater, in use since about the early 1980s, refers to depths deeper than 1,000 to 1,500 feet, the maximum depth for a conventional six-leg platform. Every company, however, has had their own definition.

the technique of ''common-depth-point'' stacking (licensed by the most technologically advanced oil companies between 1960 and 1962), which greatly enhanced seismic signal-to-noise ratios and revolutionized the collection of geophysical data offshore.[38] The increasingly sophisticated scientific means of collecting and processing seismic data was accompanied by new methods of analyzing prospects and developing bidding strategies for offshore lease sales. These methods employed rigorous, quantitative studies of reserve estimates, risk discounting, net-present-value rates of return, and bidding tendencies of competitors.[39]

As much as new exploration and drilling technology, federal government policies aided the revival of offshore oil in the Gulf. Mandatory import quotas went into effect in 1959, and the Kennedy Administration tightened them in 1962. This carved out a larger market for higher-cost offshore oil. Furthermore, in 1960 and 1962, the federal government opened large swaths of offshore territory in the Gulf of Mexico to industry. In the historic March 1962 offshore lease sale, the federal government leased nearly two million acres, more than all previous offshore sales combined. This had the effect of driving down the price of cash bonuses. A cash bonus was simply a price paid by oil companies to obtain an individual lease in a sealed-bid auction. An individual lease could be no larger than a 5,670-acre square (nine square miles) tract, and lease maps consisted of a grid of these tracts grouped into regionally defined areas (Main Pass, South Pass, Eugene Island, etc.).[40] In a typical federal lease sale, companies would nominate tracts they felt were good prospects, as well as ones they did not like, in order to hide their true interests and misdirect competitors. The Department of Interior's (DOI) Bureau of

38. W. Harry Mayne, *50 Years of Geophysical Ideas* (Tulsa, Okla.,1989).

39. Jerry O'Brien, interview with author, 5 June 2002; Gene Bankston, interview with author, 3 Dec. 1999; and Joe Foster, interview with author and Joseph A. Pratt, 22 April 2002.

40. To accommodate prior state leases and reduce confusion from transferring leases from state to federal jurisdiction after resolution of the Tidelands conflict, the first OCS leasing maps were extensions of the leasing maps of Texas and Louisiana as authorized by the Outer Continental Shelf Lands Act (OCSLA). These states had adopted the Lambert Grid Coordinate System, developed in France during the late eighteenth century for artillery firing. A regular block offshore Louisiana consisted of 5,000 acres and those offshore Texas were sized at 5,760 acres, the maximum allowed by OCSLA. Director, Geological Survey, to Assistant Secretary Lewis and Assistant Secretary Wormser, memo, 24 May 1954, box 513, CCF, 1954–1959, RG 48, Records of the Secretary of the Interior, NARA; ''First Offering of Continental Shelf Leases Brings High Bonuses,'' *World Petroleum* (Nov. 1954): 86; and Harry J. Donohue, special assistant to Lewis, 16 Aug. 1954, box 513, CCF, 1954–1958, RG 48, NARA.

Land Management (BLM) would then pick and choose from the set of nominated tracts to offer at the sale. In the March 1962 sale, however, the BLM offered every tract that had been nominated.

So again, technology was not driving development so much as policies that provided greater access were encouraging drilling and technological innovation. The landmark 1962 sale opened the Gulf of Mexico to a broader range of players and turned the Gulf into the major focus of oil and gas exploration in the United States.[41] The sale also opened up larger areas in the western part of the central Gulf (the Eugene Island, South Marsh Island, Ship Shoal areas). This inventory of leases would keep the industry busy drilling for the next five years. Many of the two million acres in new leases were in unprecedented water depths.[42] Advances in steel-jacket platform design techniques, aided by new installation equipment and the digital computer, which enabled three-dimensional modeling of structures, moved production operations into 350-foot water depths by the end of the decade.[43]

Although the success rate of exploratory drilling offshore Louisiana in the immediate years after 1962 could not match the extraordinary record of the 1950s, the 1962 sale nevertheless enhanced the attractiveness of the Gulf of Mexico as an exploration frontier.[44] Another impact of the March 1962 sale was that it awakened the federal government to the importance of offshore leasing as a

41. During 1951–1960, major oil companies drilled over 90 percent of the exploratory wells in federal waters (beyond three miles) and over 75 percent of the wells in state waters. The majors also accounted for nearly 100 percent of the discoveries in federal waters and over 80 percent in state waters. By the late 1960s, however, nonmajors were drilling nearly 30 percent of wildcat wells in federal waters with a corresponding rise in their share of discoveries. E.D. Attanasi and L.J. Drew, ''Offshore Exploration Performance and Industry Change,'' *Journal of Petroleum Technology* (March 1984): 440.

42. The average water depth of leases in the 1962 sale was 125 feet, compared to 67 feet in 1954–1955 and 89 feet in 1960.

43. F.P. Dunn, ''Deepwater Production: 1950–2000,'' OTC 7627. Paper presented at the 26th Annual Offshore Technology Conference, Houston, Texas, May 2–5, 1994.

44. Overall drilling success in the Gulf during the 1960s approached the U.S. average of 60 percent, and drilling success on federal leases issued in 1962 compared favorably to earlier federal sales. Total state and federal offshore crude oil production from the Gulf of Mexico rose from 127.6 million barrels in 1962 (4.8 percent of total U.S. production) to 334.6 million barrels in 1968 (8.6 percent of the U.S. total). Even more impressive was the rapid rise of natural gas production offshore, which went from 606 billion cubic feet in 1962 (4.4 percent of total U.S. production) to 1.98 trillion cubic feet in 1968 (10.3 percent of the U.S. total). Most of this crude oil and natural gas production came from federal areas, and most of it from acreage leased in 1960 and 1962. U.S. Department of Interior, ''Petroleum and Sulfur on the U.S. Continental Shelf.''

source of public revenue. DOI officials discovered that this program, administered by a small number of people in the BLM and U.S. Geological Survey (USGS), could take in more money in a single sale ($445 million in the March 1962 sale) than all the timber sales in Oregon and California and onshore mineral leasing for the year *combined*. The next general sale was not held until five years later in 1967, and in the intervening years, the DOI developed a new system referred to as ''tract selection,'' which imposed stringent acreage limitations on sales to increase cash bonuses. As the costs of the Vietnam War escalated, Johnson Administration officials pressured the BLM to increase its take from bonuses and search for a more scientific estimation of ''fair market value'' for the public lands being offered. After the 1962 sale, the BLM became much more selective about the tracts it offered. In 1967, the agency implemented its first systematic plan to reduce the size of sales. The result was a notable increase in cash bonuses, to the pleasure of government officials.[45] In this way, the federal government redefined the public value of offshore petroleum resources, as much as or more so than market-driven technology.

The Third Era: Adapting Exploration Technology

The late 1960s through the 1970s was another fertile period for innovation in offshore technology. Gulf Coast diving companies continually set new depth records in assisting platform and pipeline installation. Three major hurricanes in the 1960s helped bring about a convergence of improved ideas and practices on platform design and construction. Major platform disasters led to improvements in facilities engineering, safety equipment, and procedures. The founding of the annual Offshore Technology Conference in 1969 provided a new forum for the standardization and diffusion of advanced technology. Despite all these developments on the production side, the industry might not have met the challenges of deepwater operations in the Gulf without a crucial breakthrough in seismic exploration technology, which was made possible only by an adaptation to the particular geology of the Gulf of Mexico.

45. Ibid.; John Rankin, former Director of BLM/MMS Gulf of Mexico Region, ''History of Federal OCS Leasing,'' unpublished manuscript in author's possession, 1986.

A boom in the drilling and service industries in the mid-1960s, as oil companies drilled their large inventory of leases, disguised impending troubles for offshore operators. Although enough important discoveries were made to hold the industry's interest, many of the leases proved to be unproductive, and the cost of bringing in the productive ones began to outrun the price of oil, which in the United States had remained in the $2–3 per barrel range since the end of the Second World War. U.S. prices were higher than world prices, but U.S. oil was still considered a buyer's market during the 1960s.[46] With the large, easy-to-identify structures already drilled and picked over, some companies were fooled by geology and literally in over their heads in the Gulf. At a federal offshore Texas lease sale in 1968, an Exxon-Texaco partnership dished out a whopping $350 million for leases that yielded nothing. On the production side, three monster hurricanes in 1964, 1965, and 1969 (Hilda, Betsy, and Camille) damaged many producing platforms and inflicted carnage on the complex network of marine pipelines. Then, catastrophic blowouts at a Union Oil platform in California's Santa Barbara channel in 1969 and on three Gulf platforms (owned by Shell, Chevron, and Amoco) in 1970–71 forced a radical reevaluation of environmental and safety practices within the offshore industry.[47]

As for overall profitability, the industry did not perform well in the 1960s. A 1975 study showed that since the beginning of federal leasing in 1954, the industry as whole had spent $18 billion in cash bonuses offshore but had earned only $17.8 billion in revenues from offshore production. The statistics in the study did not reflect valuable leases bought in the early 1970s that had yet to pay out. The point remains that performance in the offshore industry was highly variable. Notable successes included Tenneco, Gulf Oil, Chevron, and Forrest Oil. Most striking was Shell Oil, whose geoscience and engineering capabilities surpassed all. Conspicuous failures were Texaco, Amoco, and Sun. ExxonMobil Chairman and CEO Lee Raymond commented in 2002 that ''the best thing ExxonMobil could have done after it drilled its first well in the Gulf was to never drill another again.''[48] On balance, oil companies had not seen favorable returns during the 1960s from

46. Howard M. Wilson, ''Drillers Face Offshore Deadline with 40 Leases to Test.'' *Oil & Gas Journal* (11 April 1966): 48–51.

47. M.D. Reifel, ''Offshore Blowouts and Fires,'' in *The Technology of Offshore Drilling, Completion and Production*, compiled by ETA Offshore Seminars, Inc. (Tulsa, Okla., 1976), 239–57; and Dunn, ''Deepwater Production.''

48. ''Oil Majors Wonder,'' *Financial Times*, 25 April 2002, p.29.

federal waters (beyond three miles off Louisiana and 10.4 miles off Texas) in the Gulf.[49]

According to operators, the tract selection leasing system in the Gulf impeded continued development. The main problem was that the grid pattern of the leasing maps, in which the offshore public domain was divided into 5,670-acre square tracts and subdivided blocks (see footnote 40), did not correspond to the configuration of oil and gas deposits and often frustrated or complicated the interpretation of the geology. This hindered more efficient exploration strategies involving basin-wide assessments, the pursuit of structural trends or ''plays'' (a group of geologically related prospects), or control over single structures that transcended tract boundaries.[50] Inner core tracts of hydrocarbon-bearing structures were more likely to receive nominations than less desirable outer tracts, with the result being the outer tracts were not offered for lease. For all tracts, nominations and bonus bids could vary greatly among bidders, whose staffs used increasingly sophisticated digital capabilities in seismic exploration and geological analyses. These data typically were unavailable to the BLM and the USGS, which were charged with the impossible task of estimating the market value for leases. The government often ended up offering tracts not desired by the leading oil companies, and the BLM and USGS frequently could not even agree on the proper ones to offer. Concerned with protecting their own proprietary data, companies would not share their specific interests with the government in the nomination process, submitting many decoy tracts as a diversion. This secrecy obscured an oil company's specific objectives not only from its competitors but also from leasing officials, who often did not fully understand what the companies' desires were until after the sale. The system brought in substantial revenue for the government, and many unproductive tracts were leased. This kept demand for offshore leases high, which was reflected in rising bonus prices. But it also frustrated the efforts of offshore operators to find larger reservoirs with greater production in progressively deeper waters.[51]

49. Elmer L. Dougherty, Lawrence A. Bruckner, and John Lohrenz, ''Cumulative Bonus and Production Profiles with Time for Different Competitive Bidders: Federal Offshore Oil and Gas Leases,'' Society of Petroleum Engineers (SPE) Preprint 7134, 1978.

50. Charles Frederick Lester, ''The Search for Dialogue in the Administrative State: The Politics, Policy, and Law of Offshore Oil Development'' (Ph.D. diss., University of California, Berkeley, 1992), 91–93.

51. Rankin, ''History of Federal OCS Leasing;'' and Lester, ''The Search for Dialogue,'' 91–93.

In the early 1970s, fortunes changed for the offshore industry in the Gulf. Most obviously, the price spike caused by the OPEC oil embargo in 1973 made offshore exploration much more attractive. Companies could afford a higher ratio of dry holes and unproductive leases to discoveries. Consequently, the price of lease bonuses began to soar. However, a close look at the data reveals that lease bonuses began rising sharply before 1973, so this trend cannot be attributed solely to rising oil prices, or to the rationing of leases under federal tract selection. An unappreciated factor in the upward price trend for bonuses was the discovery and adoption during the 1968–1972 period of a revolutionary method of interpreting seismic data.

Advanced digital recording and processing of seismic data, which had made quantum leaps in the mid-1960s, made possible this new method of interpretation by allowing geophysicists to measure the ''relative wave amplitudes'' between seismic traces for the first time. Up to that point, seismic techniques only helped map subsurface structures and identify possible oil traps. Operators still had to take the risk of drilling to find oil and gas. But the new digital seismic data offered the enticing possibility of directly detecting hydrocarbons as so-called ''amplitude anomalies'' or ''bright spots'' on the seismic record.[52] Pioneered separately by Shell Oil and Mobil Oil starting in 1967–1968, bright spots greatly diminished the dry hole factor in the risk equation. For example, if a bright spot scan reduced the probability for drilling a dry hole from 50 percent to 10 percent, then on a risk-weighted basis, an oil company could put a lot more money into its lease bids and more than make up for it in decreased drilling costs. Once the technology was embraced, it had a giant impact on offshore exploration in the Gulf. Shell and Mobil were first to put money behind the technology in lease sales held in late 1970, but it did not take long for other companies to catch on. During the 1970s, companies pressed on to discover and develop fields in water depths extending out to 1,000 feet. Decreased overall exploration costs afforded by bright spot technology also allowed companies to spend more on innovative production technologies, building ever larger, steel-jacket fixed platforms in deeper water.[53]

52. ''Direct detection'' was based on the principle that the acoustic impedance of a loosely cemented rock filled with hydrocarbons was different from that of a similar water-filled rock, and with advanced digital methods, this difference could often be detected.

53. Mike Forrest, ''Bright Idea Still Needed Persistence,'' *AAPG Explorer On Line* (May 2000), available at http://www.aapg.org/explorer/wildcat/2000/wildcat05.cfm; Mike Forrest, '' 'Toast Was on the Breakfast Menu,' '' *AAPG Explorer*

An important qualifying point about direct detection, or bright spots, is that it works only for select kinds of geology. The porous, clastic, deltaic rocks of the Gulf Coast are highly amenable to this technique. Hard-rock areas of the United States and around the world are not. Regions outside the United States where bright spot technology has worked include the Campos Basin off Brazil and the delta regions in the Gulf of Guinea off West Africa, two offshore areas with geology similar to the Gulf of Mexico, which have been the most active in recent years. But these areas are geologically exceptional. Bright spots and the digital seismic revolution provided the technological innovations needed to overcome water depth/cost limits in the earlier phase of offshore development in the Gulf, through a process of adapting to the particular characteristics of the region's environment.

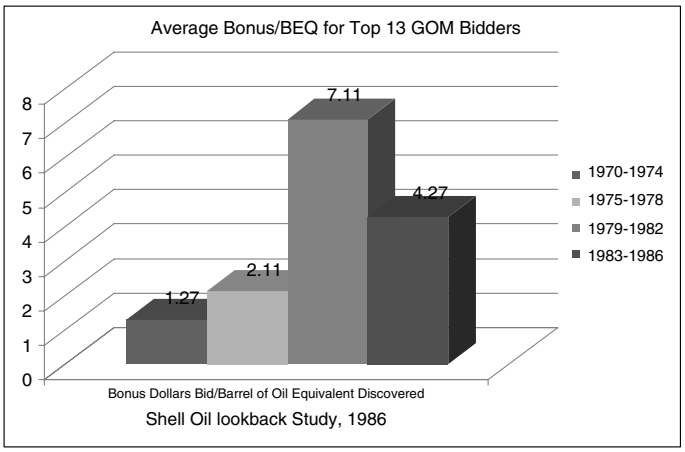
Like the development of the semi-submersible drilling vessel, the breakthrough in seismic exploration during the 1960s largely resulted from the increasing technological sophistication of oil companies. This breakthrough did not depend on government support as did many other innovations in the earlier phase of offshore development. However, as with most technological innovations offshore, it was still conditioned by the environment. Although bright spot interpretation was an important technological development arising from the persistent application of digital technology to seismic exploration begun in the late 1950s, only a unique kind of resource endowment made it possible.

The Fourth Era: Deepwater Gushers

The impressive growth in oil production from ''deepwater'' Gulf of Mexico since the mid-1990s has attracted widespread commentary about the technological miracles conjured up by the modern petroleum industry. What oil companies and their contractors have accomplished in thousands of feet of water is indeed extraordinary. But typical accounts about the mechanical and digital mastering of the

On Line (June 2000), available at http://www.aapg.org/explorer/wildcat/2000/wildcat06.cfm; Mike Forrest, interview with author, 29 June 1999. A geophysicist for Shell Oil in New Orleans, Forrest first discovered and advocated direct detection within his company in 1968–1969, and he popularized the term ''bright spots.'' Geophysicists with Mobil Oil discovered the method about the same time. Robert Hirsch, interview with author, 26 Nov. 2003. For more on the bright spot story, see Priest, *Offshore Imperative*.

ocean are insufficient and misleading. As in earlier eras, deepwater developments in the Gulf are as much a product of changing terms of access and unique geology as of technological innovation.



By the early 1980s, developments and adaptations in the Gulf had appeared to give the industry only a short lease on life there. Once again the forecast was grim, and the periodic debate over the viability of the Gulf resumed. The price of lease bonuses had risen to astronomical levels. Companies were desperate for new oil sources after the nationalization of foreign holdings in the 1970s and the shrinking of virgin exploration frontiers in North America. Offshore Gulf of Mexico remained one of the few promising areas, leading the industry to spend more than $1 billion, and sometimes more than $2 billion, at each Gulf of Mexico sale. Even the largest firms could not afford to bid alone and brought in partners to offload some of the capital risk. Despite the price spike of the ''second oil shock'' prompted by the Iranian Revolution in 1979, and despite the application of new technologies, offshore leases were becoming prohibitively expensive. Over the course of the 1970s, the ratio of bonus paid per boe discovered among the top companies increased by a factor of four or five, once again pushing the economic limits of offshore exploration.[54]

54. ''Oil Firms Spend Record Amount for Gulf Leases,'' *Wall Street Journal*, 1 Oct. 1980, pp. 4, 15; and D.A. Holmes, ''1970–1986 Lookback of Offshore Lease Sales Gulf of Mexico Cenozoic,'' Interoffice Memorandum, Shell Offshore Inc. (24 Aug. 1987). Copy provided to author by Mr. Holmes.

The costs of development also rose as the deepwater frontier migrated out to the edge of the continental shelf in 1,000-feet-plus water depths. Throughout the 1970s, continuing improvements in the design and installation of steel-jacket templates for deepwater platforms, as a result of lessons learned from the hurricanes of the 1960s, helped production technology keep up with exploration. This technology, however, increasingly depended on favorable economic conditions. In 1981, oil prices peaked and began to plunge. Falling oil prices placed pressure on companies to reduce the costs not only of production, but exploration as well. Industry leaders again complained that the tract selection system of leasing was creating a shortage of exploration opportunities in the declining oil province of the United States, especially as environmental concerns blocked leasing off the Atlantic and Pacific coasts. They lobbied for a reform that would allow companies access to larger acreage, both to reduce competition and bring down the price of cash bonuses. This would enable them to implement more creative exploration strategies and acquire a greater number of contiguous blocks around a given prospect. Gaining control over a greater share of production would help offset the soaring fixed costs of deepwater development.[55]

The companies got their wish with the controversial appointment of James Watt, an antagonist of the environmental movement, as secretary of the interior under President Ronald Reagan. In short order, Watt instituted a new ''area-wide leasing'' (AWL) system offshore, which put into play entire planning areas (e.g., the central Gulf of Mexico) up to 50 million acres, as opposed to tracts specifically nominated and offered under the tract selection system. In other words, companies could bid on any tract they wanted in the planning area rather than have to choose from a limited number of carefully selected ones, and they would be more likely to acquire them in bunches, giving them greater control over large prospects. Beginning in 1983, major oil firms leased large offshore acreage in the Gulf of Mexico planning areas at sharply reduced bonus prices. Under tract selection, top bids could be rejected if they did not meet fair market value criteria, but procedures under the new system led to the acceptance of practically every top bid, no matter how low.[56]

55. R. Scott Farrow, *Managing the Outer Continental Shelf Lands: Oceans of Controversy* (New York, 1990), 137–38; and ''At Issue: Land Access,'' *Shell News* 5 (1980): 18–19.

56. Juan Carlos Boué, with Gerardo Luyando, *U.S. Gulf Offshore Oil: Petroleum Leasing and Taxation and Their Impact on Industry Structure, Competition, Production, and Fiscal Revenues* (Oxford, U.K., 2002).

A 2002 study by the Oxford Energy Institute (OEI) argues that the AWL system was an unnecessary reform that had unfair effects. Echoing criticism made at the time, the OEI study claims that AWL is a giveaway to the major oil companies, who have been permitted to pick up vast acreage for low-ball bids. Total Outer Continental Shelf (OCS) leasing revenues for the federal government, as a consequence, have declined significantly since the early 1980s. The study also points out that AWL sharply reduced competition between oil companies for offshore acreage, or at least for control of deepwater development. Their superior capital and technological capabilities for plying deepwater gave the majors and larger independents a substantial edge under this system. The OEI study argues that AWL was unnecessary to technological innovation and bad policy that squandered public resources and favored Big Oil. The link between AWL and the deepwater boom of recent years, according to the OEI, is ''*sequential* and not *consequential*, because the real driving force behind the renaissance in Gulf of Mexico production has been technological progress, rather than ease of access to prospective acreage'' (emphasis in original). This implies that the technology for developing deepwater reserves would have materialized with or without AWL.[57]

AWL indeed was a policy that favored big oil companies. Yet, these companies would not have invested in deepwater technology without it. The history of this industry shows that government support and expanded access to offshore acreage have been vital at critical stages in its technological development. AWL is only the most recent example. Certainly, technological innovation—especially bright spot seismic, but also the new generation of 3-D seismic surveys, tension-leg and compliant tower platforms, directional drilling, and subsea wells—have brought Gulf deepwater fields into play. Not until companies possessed cheap and extensive acreage, however, did they have the incentive to develop and refine these technologies. Of course, federal revenues from cash bonuses declined under AWL, but the statutory mission of the leasing program was never to maximize revenues (although certain administrations have viewed it that way). Rather, it was to promote the ''expeditious development'' of oil and gas resources on the OCS. Interviews with industry and government officials confirm the importance of AWL in encouraging

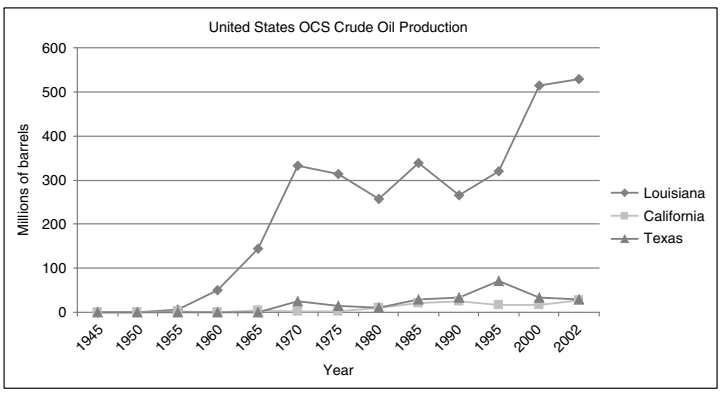
57. Ibid., 57.

such development.[58] The costs and risks of deepwater operations dictated policy changes in leasing if the industry were to expand further. Shell Oil acquired a vast majority of the early deepwater leases under AWL and pioneered many of the technologies needed to operate on them. Without this large inventory of leases, Shell Oil's top management and board of directors would not have approved the large capital outlays needed to test new concepts for deepwater drilling and production. Again, the reform of the leasing system and subsequent deepwater boom demonstrates that technological change has not been strictly market driven, but also a product of government policies.

Improved access to offshore tracts alone, however, did not bring about the deepwater boom of the 1990s and 2000s. Just as importantly, the particular characteristics of deepwater reservoirs allowed for a whole new approach to offshore operations. Initially, deepwater was too expensive, risky, and dangerous for small or undercapitalized companies. Many in the industry thought that major companies as well would not be able to afford it, even under area-wide leasing. But Shell Oil's 1994 ''Auger'' discovery in 2,860 feet of water revealed that deepwater reservoirs were much more productive than most people in the industry had anticipated. This revelation radically changed the economic picture of the deepwater play. The reservoirs beyond the continental shelf occur in unique geological conditions: in turbidite sandstones that are capable of producing as much as 40,000 barrels/day from a *single well*, compared to 1,000–2,000 b/d from a good well on the shelf. Although the fields do not compare in size to the Middle East, they generate Middle Eastern rates of production. An operator could drastically reduce the number of expensive wells on a given platform and still produce at a rate greater than original estimates required for making the field profitable. In 1995, as word spread about the new potential of deepwater, Congress added further incentive to deepwater exploration by passing the Royalty Relief initiative, which suspended royalties on portions of production from deepwater fields. These events brought numerous companies, large and small, into the game in force. By 2002, at least forty different operators had drilled deepwater wells in the Gulf, and the industry had discovered 192 fields. Thirty-eight of these fields contain more than 100 million boe, including five giant fields with more than 400

58. Chris Oynes, interview with author, 8 July 2003; J. Robinson West, interview with author, 18 Nov. 2002; Mike Forrest interview.

million boe.[59] All the wonderful technology developed to produce deepwater hydrocarbons, however, would not have been economical had it not been for the productivity of those reservoirs. The deepwater boom in the Gulf owes its success not simply to technology, but most of all, to the particular characteristics of the resource and the favorable terms of access to it.[60]



The Past, Present, and Future of Offshore Gulf of Mexico

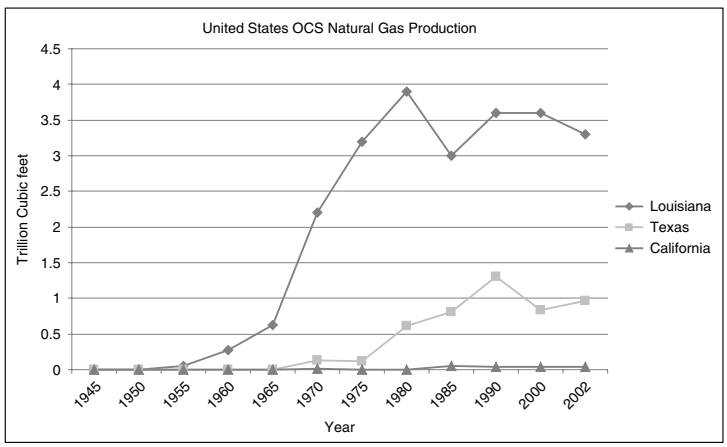
As important as deepwater Gulf of Mexico has been to the offshore industry in recent years, it would be a mistake to view this development as a sign of new plenitude for American petroleum. Deepwater is the latest, and perhaps last, step in the half-century struggle to fight the decline of American oil production. The characteristics of deepwater petroleum are different from those on the continental shelf; the adaptations that companies have made to

59. Michael L. Godec, Vello A. Kuuskraa, and Brian T. Kuck, ''How U.S. Gulf of Mexico Development, Finding, Cost Trends Have Evolved,'' *Oil & Gas Journal* (6 May 2002): 52–60.

60. Jeff Ryser, ''Hot Play in the Gulf.'' *Texas Business* (Aug. 1995): 33; Helen Thorpe, ''Oil and Water,'' *Texas Monthly* (Feb. 1996): 90–93, 139–145; Shell Oil Company, ''Shell in the U.S.: 1999 Annual Review,'' (Houston, 1999); and Priest, *Offshore Imperative*. Offshore West Africa and Brazil have similar geology and similar deepwater well production rates, but these areas and the Gulf of Mexico are special cases and should not serve as models of extractive development that can be applied to most offshore environments.

operate in deepwater are different from the kinds they had made in earlier cycles of development; and many of the variables that enabled the offshore industry to overcome material and economic constraints no longer apply.

The incredible productivity of deepwater wells only postponed the day of reckoning for the Gulf Coast economy, which is highly dependent on, yet in crucial ways increasingly ambivalent about, offshore oil and gas. Deepwater fields are likely to have relatively short life-cycles, as high rates of production drain them faster than production from equal-size fields on the continental shelf. While more oil reserves were added than produced during the 1990s in the Gulf, the industry will have to continue finding major oil fields each year in order to sustain this performance and to keep infrastructure employed. Furthermore, the deepwater Gulf has turned out to be mainly an oil province. It has not greatly slowed the steep decline in U.S. natural gas reserves, arguably a more immediate threat to U.S. energy security.[61]



The legacy of earlier development weighs heavily on the industry. Existing shallow-water assets have declined sharply in value, and the decommissioning and disposing of old platforms is expensive.[62] As major companies high-graded their portfolios in deepwater, they sold

61. Godec, Kuuskraa, and Kuck, ''How U.S. Gulf of Mexico Development, Finding, Cost Trends Have Evolved.''

62. Mark J. Kaiser and Allan G. Pulsipher, ''Various Factors Affect Severance Selection,'' *Oil & Gas Journal* (27 Sept. 2004): 41–52.

off shallow-water reserves to smaller companies, which has increased activity there and created some very profitable opportunities. But it also has sped depletion of these reserves. Ultimately, deepwater has kept the industry running to stand still, staving off steep decline but not reversing it. Recently, even drilling in deepwater has dropped off sharply, despite rising oil prices. Only 6.5 percent of leases acquired since the mid-1990s, which will expire soon, have been drilled to date.[63] One recent study estimates that deepwater discoveries in the Gulf of Mexico and in the world's other deepwater provinces already have peaked, with a production peak to follow in ten years.[64]

Earlier phases of offshore development in the Gulf of Mexico benefited from a heavily protected domestic oil market. That protection is long gone, dissolved in the early 1970s when OPEC wrested control over global pricing and production. The incentives provided by AWL and Royalty Relief, although important, may not be enough to sustain the industry in the way earlier forms of government support did, or to make the Gulf of Mexico competitive with other oil-producing regions for oil company investments. After the 1990s wave of industry consolidation, large oil companies now organize their operations and allocate their budgets functionally on a global scale, rather than geographically on a national scale as in earlier years. Many large companies scaled back their overall exploration budgets in recent years, despite rising oil prices, preferring to increase their oil reserves through acquisitions rather than through new discoveries, which are increasingly hard to come by.[65] In this global market, the Gulf of Mexico no longer enjoys the privileged position in oil company exploration strategies that it once did.

In other words, the recent offshore boom in the Gulf is not like past booms; it involves relatively little natural gas, U.S. government support is not as salient, and the industry structure has changed. Furthermore, regional economic gains may not be as substantial. Many field developments are tied into existing infrastructure, and more of the infrastructure that is added is built overseas, usually in East Asian shipyards, and transported to the Gulf. Coastal communities

63. Nelson Antosh, ''Foreign Drilling Stealing Gulf's Thunder,'' *Houston Chronicle*, 6 May 2004, p. B1; ''Oil Rigs Stage Exodus from Gulf of Mexico,'' *The Wall Street Journal*, 5 July 2006, p. C-1.

64. Ivan Sandrea, ''Deepwater Oil Discovery Rate May Have Peaked; Production Peak May Follow in 10 Years,'' *Oil & Gas Journal* (26 July 2004): 18–23.

65. ''Oil Explorers Searching Ever More Remote Areas,'' *New York Times*, 9 Sept. 2004, pp. 1-B, 4-B.

thus derive less economic benefit.[66] Although smaller oil companies have drilled wells in deepwater, they still do not have the capital to participate to the extent that larger ones do, and fewer large companies engaged in various offshore activities are local. Established basin masters, such as Shell and other deep-pocketed super majors such as British Petroleum, continue to maintain an advantage through their control of platform and pipeline infrastructure, which now serve as hubs to take other companies' surrounding production at a premium. Furthermore, the offshore drilling industry is forced to assume greater risk and liability, as evidenced by the growing use of ''turnkey'' as opposed to ''day-rate'' drilling contracts. Under a turnkey contract, the drilling company covers the costs of delays and overruns. So the driller is more likely to sacrifice health, safety, and environmental performance to complete the project.[67]

As activity gets pulled further offshore, technology becomes more specialized and regional employment rates become more volatile. During the late 1990s consolidation, many companies closed regional offices in New Orleans and moved staff to Houston. Although Louisiana still is more closely linked to offshore developments than any other place, deepwater does not promise to restore the state's fiscal health, which, after decades of relying almost entirely on oil severance taxes, royalties, and leases, has never fully recovered from the bust of the 1980s.[68] With yearly production in permanent decline, Louisiana now derives less than 30 percent of its revenues from oil and gas. In 2006, coastal states for the first time succeeded in getting Congress to approve federal-state revenue sharing for leasing in federal waters, which will help compensate for the environmental and socioeconomic risks of offshore petroleum activities assumed by states like Louisiana. Still, this may come as too little and too late. [69]

66. ''Na Kika Topsides on the Move in the Gulf of Mexico,'' *Go Gulf Magazine* (May/June 2003): 24–25.

67. Kenneth S. Corts, ''The Offshore Drilling Industry,'' HBS Case Services, 387-020, Harvard Business School (Cambridge, Mass., 1999). In a turnkey contract, the drilling company agrees to complete a drilling project for a fixed price, as opposed to a day-rate contract in which an oil company hires the services of a drilling company by the day. Anders Toft, ''Design of Drilling Contracts - Economic Incentives and Contractor's Focus on HSE,'' Society of Petroleum Engineers International Conference on Health, Safety, & Environment, Calgary, Alberta, March 29–31, 2004.

68. Michael L. Kurtz and Morgan D. Peoples, *Earl K. Long: The Saga of Uncle Earl and Louisiana Politics* (Baton Rouge, La., 1990).

69. ''State Takes Long Road to Share in Oil Revenue,'' *The Times-Picayune*, 6 Dec. 2006, p. 1.

A manifestation of both the spreading risk of offshore operations and the physical constraints imposed by the environment is the gathering damage to the Louisiana coastal wetlands caused by offshore petroleum development. In the United States and Gulf of Mexico, the oil industry's record on oil spills and pollution generated from offshore activities has been quite good since 1970, when the Santa Barbara blowout and the three other major blowouts and platform fires in the Gulf alerted everyone to the potential hazards, strengthening federal regulatory oversight and improving company practices. However, the thousands of miles of canals dredged and laid with pipelines in a spaghetti-like maze through the marshes and swamps of south Louisiana have contributed to another sort of environmental calamity. The canals break up natural barriers and provide easy conduits for salt-water intrusion and tidal scouring, leading to massive erosion and drowning of the marshes. Each year, Louisiana loses twenty-five to thirty-five square miles of coast, a land area larger than Manhattan. This land loss endangers wetlands petroleum operations and pipelines not designed for open waters. It also destroys the ecosystem that supports the nation's largest commercial fishing industry. Indeed, the receding coast threatens whole communities as well as the survival of Cajun culture.[70] The greatest factor in this tragedy is the containment of the Mississippi River by levees, which prevents soil replenishment by periodic flooding and the spreading of estuaries. But scientists believe that canals are responsible for no less than one-third of the total coastal-zone degradation.[71] Furthermore, some geologists are convinced that the industry's removal of billions of barrels of oil and saline formation water, along with trillions of cubic feet of natural gas, has caused serious subsidence in the wetlands and offshore, and thus is also responsible for the receding coastline and the heightened vulnerability of the region to hurricane devastation, which was put on shocking display during Hurricanes Katrina and Rita in September 2005.[72]

The offshore industry is ever more constrained by the Gulf of Mexico environment. The destruction of the wetlands and the coastal communities increases the risks of offshore operations by exposing

70. Hallowell, *Holding Back the Sea*; Tidwell, *Bayou Farewell*; and Don Davis, ''From the Marshes to Deepwater, Louisiana's Hydrocarbon Infrastructure is At Risk,'' available at http://www.epa.gov/oilspill/pdfs/d_davis_04.pdf.

71. Tidwell, *Bayou Farewell*, 117.

72. Joel K. Bourne, Jr., ''Gone with the Water,'' *National Geographic* (Oct. 2004): 88–105.

offshore support centers to environmental hazards. At the same time, despite declining reserves and environmental crisis, many oil companies and ancillary businesses find themselves inextricably bound to the Gulf due to their massive technological commitment, high fixed-cost infrastructure, and specialized operations. New investments may be more globally than regionally oriented, but there are still enormous sunk investments on the coast and offshore. The technological and economic imperative to keep expanding offshore deepens society's dependence on hydrocarbons, postponing the inevitable transition to alternative energy and making the eventual day of reckoning more painful.

During the past fifty years, the Gulf of Mexico has yielded great wealth and significant but uneven economic development for the Gulf Coast region. The new oil and gas reserves discovered and developed in deepwater reestablished this province in the late 1990s as one of the world's most attractive investment opportunities for large oil companies and a proving ground for the next generation of innovations in offshore technology. The offshore industry has produced eye-opening technologies and extended the frontier of oil exploration and development beyond what anyone could have imagined sixty years ago. But rather than merely celebrating this story, we must contextualize it. The fascination with technological achievement and entrepreneurial engineering should not obscure other material factors in the offshore industry's longevity, uneven dynamism, and future. The Gulf of Mexico petroleum province has presented singular challenges and opportunities. Interactions between technology, capital, geology, and the political structure of access in the Gulf has generated a functionally and regionally complex extractive industry with a history of defying critics who periodically predicted its boom-and-bust demise. Nevertheless, the industry has expanded into deeper waters only by more profoundly adapting to the environment, not by transcending its limits. And while the industry has adapted, the drowning coastal communities have not.

This crisis should alert scholars to the environmental dimensions of offshore industry's evolution, and give them pause when making subjective interpretations about how the Gulf of Mexico and its resources have been valued and exploited. The historical development of the Gulf should be characterized as an adaptation to decline, not a breakthrough to growth. As the Gulf of Mexico offshore industry matures, the limits on its potential become more apparent, even with the revival of activity in deepwater. The fact that the industry must keep searching in ever deeper, more remote waters, with increasingly expensive and sophisticated technology implies growing scarcity, not

abundance. Upon close scrutiny, Chevron's media-hyped ''Jack-2'' discovery in 7,000 feet of water in September 2006 appeared to be a sign a desperation, rather than assurance, about new oil potential in the Gulf.[73] It may be premature to suggest that rising costs and risks offshore cannot be reversed, but as concerns about petroleum supply deepen, we must accept that the offshore industry's business is extracting a finite resource, not creating it. The Gulf of Mexico's longevity as a hydrocarbon province has been surprising, but so may be the brevity of the deepwater era.

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73. Dave Cohen, ''Jack-2 and the Lower Tertiary of the Gulf of Mexico,'' *The Oil Drum*, 11 Sept. 2006, available at http://www.theoildrum.com/story/2006/9/8/11274/83638.

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