The Quest from the Marsh out onto the Shelf and Beyond: How the Offshore Exploration Journey in the Gulf of Mexico Evolved and Led to a Global Revolution

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Abstract

The late 1930s saw the world's first oil exploration foray out into open ocean away from shore-based piers on Louisiana's Gulf of Mexico shallow shelf. Industry visionaries stepped out from prolific discoveries onshore and in bordering marshes using trendology, rudimentary seismology employing bottom-laid geophones and dynamite with analog recording, followed with wooden post-pile platforms supporting what were essentially land rigs. The initial discovery was the 1938 Pure-Superior Creole Field a little over a mile offshore in about 15 ft water depth.

After an interruption by World War II industry got serious in the late 1940s, enabled by a booming U.S. post-war economy and a wealth of former military ocean engineering know-how. This money and talent fostered a rapid succession of innovations in just a few years that enabled a number of discoveries on the shallow shelf from West Cameron to Main Pass. The initial major breakthrough used Navy surplus hulls as tenders even though the wells were still drilled from post-pile platforms. The first production using this technology was the famous Kerr-McGee Rig 16 Field, in about 20 ft water depth about 10 mi offshore, out of sight of the low Louisiana coast.

A surge in exploration and production innovations then rapidly progressed in the early 1950s. Tired of having to construct disposable post-pile platforms for every exploratory well, innovators developed the wholly contained, mobile submersible rig concept, workable out to 40 ft water depth. This enabled much more rapid exploratory drilling along the entire Louisiana shallow shelf. In five short years by 1949, over 10 offshore fields were under production or being developed from barge-tendered post-pile platforms. Also tired of the laborious process of placing geophones on the bottom and handling cumbersome, dangerous dynamite, seismic explorers developed the hydrophone cable and eventually the airgun source, enabling orders of magnitude more shelf being surveyed and mapped.

As the 1950s progressed, two refinements were matured that set the foundation for a proliferation of shelf exploration across the globe: The jack -up rig and the steel jacket to support a steel deck for all drilling and tendering needs, although some steel platforms continued to be supported by barge tenders depending on the economics.

Also in the mid–1950s, the same Gulf of Mexico innovation shops in companies including Shell, Esso and Chevron saw different challenges in offshore California. There, a much narrower shallow shelf and sloping ocean bottom fostered the need for the development of the dynamically-positioned drillship, where only anchors and the blowout prevention stack were tied to the ocean bottom. At first, converted Navy surplus barges were employed, similar to those used as tenders in the Gulf of Mexico. The technology was also scaled down for core hole drilling from converted supply vessels, useful in California's convergent margin foldbelts with submarine outcrops. This California cradle of dynamic-

positioning technology enabled the development of purpose-designed drillships and eventually semisubmersibles that could drill beyond the capability of the largest jack-ups where the shelf deepened in the Gulf of Mexico and elsewhere.

Initial forays beyond the U.S. Gulf of Mexico shelf and independently developed California exploration in the mid to late 1950s were logically south to Mexico's nearby Tampico and Salina basin shelfs, across the Caribbean to Trinidad's Gulf of Paria and shelf portion of the Columbus Basin. Meanwhile, the construction of more capable jack-ups incrementally extended exploration out into hundreds of feet of water depth on the Gulf of Mexico shelf, followed by setting of increasingly taller steel production platforms.

Then the early 1960s brought the digital revolution of seismic surveying, enabling the rapid reconnaissance large multiclient 2D surveying of virtually all the world's shelves not under ice. Drafting of offshore legislation by countries holding continental shelfs outboard of producing areas in the southern North Sea, Niger Delta, Australia's Bass Strait, and in Southeast Asia soon led to global leasing and exploratory success through the 1960s.

From the late 1960s until the 1990s, exploration forays beyond the shelf edge into deepwater were actually hindered more by production technology, economics, and geologic paradigms about reservoir and source occurrence than drillship and semi-submersible capabilities. Through the 1990s and into the early 2000s, however, production technology rapidly caught up to drilling capabilities with innovations such as the floating tensionlegged platform and eventually subsea completions. Geologic paradigms also evolved with advances in understanding plate tectonics and petroleum systems. Since then incremental improvements have enabled the entry into the deepwater realm from productive shelves with huge success across the globe, and even making large discoveries outboard of barren shelves.

While most analysts agree that the potential for giant oil discoveries on the world's shelves outside of polar regions is low, significant interpolation exploration such as in Mexico's Salina Basin remains, plus deep gas and unconventional potential if supported by economics. Also, shelves outboard of major industrial regions such as the Gulf of Mexico and North Sea are a present focus for huge projects for carbon sequestration into deep saline reservoirs.