Wednesday, February 26, 2003

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by *Michael C. Forrest*
Consultant, Houston, TX

Gulf of Mexico "Bright Spots"—Early Shell Discoveries 1967 to 1973

The author observed a strong seismic reflection, with attenuation below the event, at a depth of approximately 2500 feet on the crest of a low-relief structure in Main Pass area, offshore Louisiana during 1967. The most likely interpretation was that a calcareous zone, a "hard streak," caused the strong reflection. Later, two exploration wells penetrated the shallow reflection and found a 25-foot gas pay with very low sonic log velocity, a "soft" reflection.

In late 1968, a strong seismic event that conformed to fault closure was observed on the south flank of Bay Marchand Field. The strong event was considered a positive factor in estimating the reserve potential of the prospect. After leasing the block, drilling found the amplitude anomaly corresponded with a 100+ foot oil sand with approximately 100 MMBO. This was the first qualitative application of Bright Spots.

During 1968 and early 1969, strong seismic reflections were observed at depths of 5000 to 10,000 feet on exploration prospects in the offshore Texas and Louisiana Pleistocene trend. Digital acquisition and processing preserved the relative amplitudes of seismic data in contrast to automatic gain control. Because the Pleistocene trend was essentially an unexplored province at the time, well data were not available to help determine the cause of the strong reflections.

The term Bright Spot was coined during informal discussions. Seismic was primarily used to map structure at that time, and most geoscientists doubted the relationship of Bright Spots to gas/oil pays.

In mid-1969, several oil and gas fields in the offshore Louisiana Pliocene/Miocene trend were studied and Bright Spots were correlated with gas sands with low velocities on the sonic logs. Shell senior management acted quickly and an operations/research team was formed to study seismic amplitude changes that may be related to gas and oil pays.

Prospect Posy (EI 330 Field) – "J" sand map

Figure 1. Structure map, Prospect Posy (EI 330 Field) contoured on the "J" sand. A good Bright Spot conforms to structural closure with downdip extent at approximately 6750 feet.

Prospect Posy, Eugene Island 330 Field

The first significant quantitative application of Bright Spot technology was in 1970 when Shell technical mapped two pays and predicted the thickness of a gas sand on Eugene Island (EI) Block 331 (150 MMBOE). Ultimate recovery of the entire EI 330 Field, in the Plio-Pleistocene trend, is 750 MMBOE.

At the "J" sand map level at 6500 feet, a good Bright Spot conformed to structural closure (Figures 1 and 2). Amplitude/Background (A/B) and thickness measurements at "J" sand level were made, using the program Payzo written by Shell Geophysicist Aubrey Bassett (Figures 2 and 3). ➢

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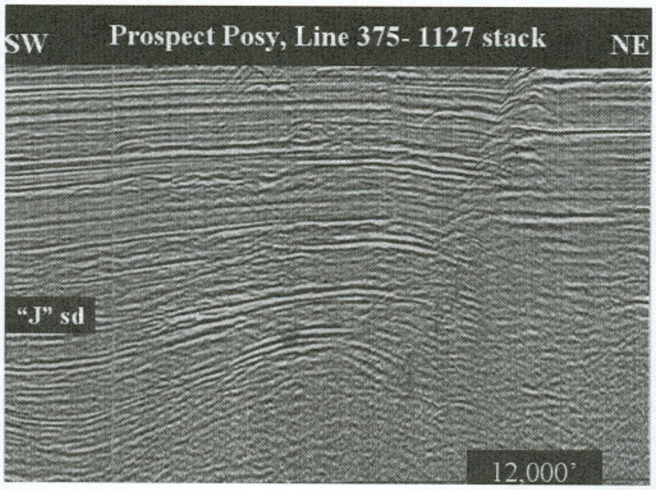

Figure 2. Northeast-southwest seismic line (375-1127) showing “J” sand Bright Spot. Other amplitude anomalies above and below the “J” sands are gas and oil pays.

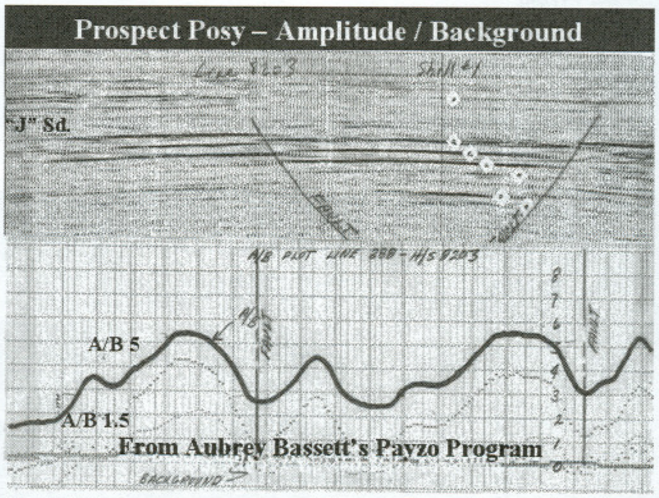

Figure 3. Seismic line over crest of Prospect Posy with amplitude/ background (A/B) measurements at “J” sand level. Line is approximately through location of Shell #1 well.

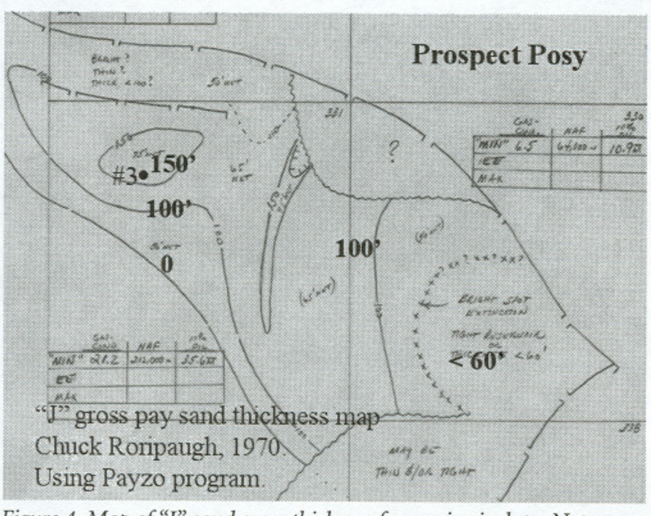

Figure 4. Map of “J” sand gross thickness from seismic data. Note gross thickness is 150 feet in northwest portion of Block 331 (near Shell #3) and thins to less than 60 feet near crest of structure in Block 330.

There is a good match between seismic amplitude interpretation and well data (Figures 5 and 6). All of the oil and gas pays correlate with amplitude anomalies of varying quality. In hindsight, the “L” sand, a few hundred feet deeper than the “J” sand, was the first oil sand recognized as a Bright Spot.

Crossplots called “trend curves” show reflection coefficient vs. depth for gas, oil, and wet sands and were derived from petrophysical data in different geologic provinces in offshore Louisiana. “Trend curves” were used to help interpret amplitude anomalies for the 1972 Federal lease sale.

Prospect Pine, South Marsh Island 130 Field

The first detail application of Runsum (integration of the seismic trace) seismic processing was made at Prospect Pine (250 MMBOE ultimate reserve in SMI 130 Field) in 1972. Seismic amplitudes were calibrated to petrophysical trend curves. Bright Spots were used successfully to predict oil pays; this was very important at the time as oil was a much more valuable resource than gas.

The West Pine amplitude anomaly located on the west side of Block 131 has the same measured amplitude as an oil pay across the syncline at Pine. Shell tested low quantities of gas, and the sonic log showed cycle skipping, suggesting that the sand had about 10% gas saturation.

Summary

Shell discoveries using Bright Spots on the shelf of the Gulf of Mexico (GOM) are estimated to have found 1.5 to 2 BBOE. In the GOM deep water, the estimate of recoverable hydrocarbons is approximately 4 BBOE. The present of Bright Spots was a key factor in entering GOM Deep Water during 1983 to 1986.

Lessons from Shell initial Bright Spot studies and Prospect Posy and Pine successes

- Good ideas come from operations people; these need to be followed up with a research team.
- New ideas require persistence. “Beware of the skeptics.”
- In hindsight, good ideas are very often simple and easy to understand.
- If technical staff and management agree on the application of new technology, “go for it.” ■

ACKNOWLEDGMENT: *Thanks to Shell Offshore in New Orleans for allowing the author to review old files so that data “from the time” could be included in this paper.*

Biographical Sketch

MIKE FORREST is a Petroleum Exploration Consultant after a career with Shell Oil Company and Maxus Energy Corporation. ➢

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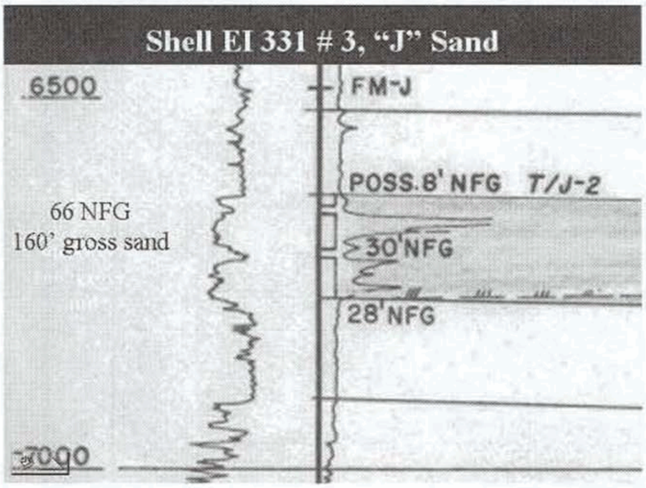

Figure 5. "J" sand log in Shell #3 well that has 166 feet gross sand and 66 net feet gas. This closely matches seismic interpretation.

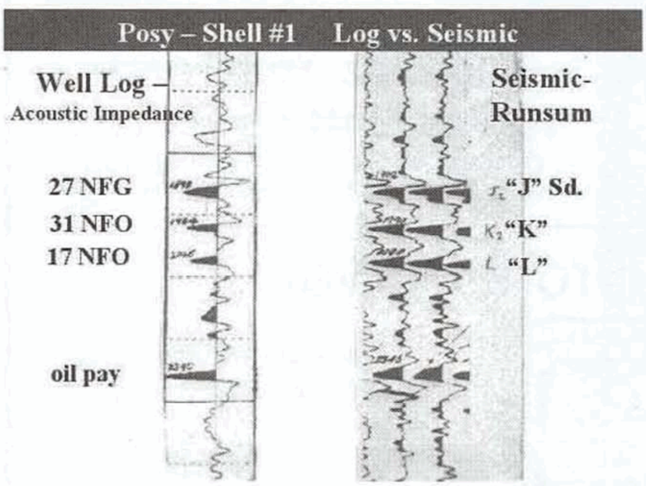

Figure 6. Seismic acoustic impedance compared to well log impedance from Shell #1 test.

Forrest retired from Maxus in 1997 as Senior Vice President of Business Development and Technology. He joined Maxus in 1992 as Vice Chairman/Chief Operating Officer and continued working for the company after the YPF purchase of Maxus in 1995.

Mike worked with Shell Oil Company for 37 years and retired in 1992 as President of Pecten International Company, a Shell U.S.A. subsidiary. During his Shell career, he had extensive experience in Gulf of Mexico exploration plus Alaska, onshore Gulf Coast and the Mid-Continent. He is a graduate of St. Louis University with a BS degree in Geophysical Engineering.

Forrest serves on the Board of Trustees for the Institute for the Study of Earth and Man at Southern Methodist University and is a Trustee Associate with the Society of Exploration Geophysicists. He is a director of Matador Petroleum, a private oil company, and Corporate Advisor of Alliant Geophysical, a seismic data processing company.

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