

# **Bypassed Pays and Bypassed Plays: The Importance of Integrating Well Data of All Types: Logs, Shows, DST's**

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## **Abstract**

By-passed pays and plays are more common than most geoscientist might think. Plays can be missed for two reasons: 1) Pay was missed in a well that would have been economic at the time (typical for conventional reservoirs); 2) New technology has made previously tight reservoir economic (typical for unconventional reservoirs). Pay in a well, Type 1 plays, can be missed for myriad reasons: lack of data integration, shaley sands, dual porosity in carbonates, no DSTs or RFTs taken over show intervals, incorrect  $R_w$  - to name a few causes. Type 2 plays, unconventional reservoirs (e.g., tight sands, shale gas, shale oil) are their own class of by-passed play. They are made economic by new technology (e.g., multi-stage fracs, horizontal drilling, etc.) and multi-discipline teamwork.

Case studies for both types are provided below. Hopefully, these case studies will help explorationists by showing that that while oil is first found in the mind, its physical discovery can be elusive.

### **James Lime Play: Eastern GOM**

The James Lime Play of the Eastern GOM is a classic example of a bypassed play created by missing a test. In 1987, a major oil company drilled a 20,000 ft test in Mobile Bay, targeting the Jurassic Norphlet sand. The Lower Cretaceous James Lime Formation had unexpected shows. There was a three-fold increase in drill rate and a four-fold increase in mud gas. The primary objective, the Norphlet, was noncommercial. The well was plugged and abandoned. The James Limestone was not tested or logged.

In 1994, Chevron offset this 1987 “dry hole” by less than 1,900 feet to the east, specifically targeting the James Lime. The Chevron Mobil Bay 991 tested the James Lime for 10 MMCFD. To date, eight James Lime fields have been found, and the play has produced 1/3<sup>rd</sup> TCFG. Total play reserves might be one TCFG.

### **Muddy Formation Play: Powder River Basin**

In 1964, a major oil company drilled eight wildcat wells in the Powder River Basin in Campbell County, Wyoming, targeting the Minnelusa Formation. One wildcat well was plugged after two DSTs in the Minnelusa recovered just water. This well was interpreted to condemn several townships. However, the shallower Muddy Formation in the well was not tested because it only had 5 feet of pay sand – apparently dismissed out-of-hand as “uneconomic.”

Anderson Oil re-entered this in 1969 and completed the Muddy for 230 BOPD. A well drilled immediately to the west flowed 7,000 BOPD. Many of the wells immediately around the “dry hole” flowed over 1,000 BOPD. Hilight Field (83 MMBOE EUR) was missed for lack of one DST.

### **Mission Canyon Play: North Dakota**

The Mississippian “Mission Canyon” play (cum: 352 BCFG, 259 MMBO) of the Williston Basin provides classic examples of both missed pays and a missed play. In the late 1950s and early ‘60s, Shell Oil Company drilled a dozen dry holes specifically targeting stratigraphic traps of the now-prolific Mission Canyon formation. Many of the now-known Mission Canyon fields have Shell wells offsetting them, or Shell “dry holes” drilled in them. Shell’s stratigraphic model of prograding sabkha deposits and oil being trapped by lateral facies change was decades ahead of the rest of industry. Shell’s seismic data defined the Billings Nose, a now-prolific structure. Unfortunately, Shell underestimated the play’s risk, and drilled too few wells to test adequately their exploration model.

Shell drilled a well in Elkhorn Ranch field in 1961, but failed to recognize the Mission Canyon pay. A former Shell geologist at CENEX discovered the Mission Canyon accumulation in 1974, after reviewing the cores and DSTs in the Shell well. CENEX offset the Shell well by less than ½ mile, and completed the well for 281 bopd from a 4-foot zone in the Mission Canyon. When the greater Mission Canyon play was discovered in the 1970's, operators still failed to recognize the enormous size of the fields. Operators did not lease sufficient acreage to control the fields. Many of the fields were “re-discovered” by exploration wells that ultimately were recognized to be extensions of the existing fields.

### **Austin Chalk: East Texas**

In the mid 1990s, Marathon geoscientists in Tyler, Texas pushed the Austin Chalk play into the dry gas window in Grime County, Texas. At the time of the play initiation, the few scattered vertical wells drilled in the “down-dip Austin Chalk” had encountered water-free gas production and very high pressure (15# mud). Production from the Austin Chalk was no more than a show (~ 110 mmcf/g EUR/ well). The target zone was a 40' limestone of the Austin Chalk Formation, deposited in a deep-water setting, with black shale above and below.

This play was an early and very successful horizontal “tight gas” reservoir. Marathon’s Austin Chalk wells were completed in 1996 to 1999 for about 24 mmcf/gpd, and had an average EUR of about 10 bcf/g/well. Pilot holes were drilled to 15,000 feet, and had horizontal legs up to 5,000 feet. Total reserves for the play were about 100 bcf/g. At the time, the play was thought to have reached its limit. Log and production analysis showed that more gas was produced than could be accounted for from only the thin, tight, fractured Austin Chalk reservoir: the excess gas was coming from the black shales. Geologists at EOG keyed off the meaning of the field’s production, leading to EOG’s Eagle Ford play.