

## **“Developing Conventional Resource Unconventionally”**

This presentation was given at the monthly luncheon meeting of RMAG on September 2 by Louis Mazzullo, the head of Petroleum Geological Advisory Services, Morrison, Colorado. Mr. Mazzullo’s education includes a BS in Geology from Brooklyn College (CUNY); an MS in Earth and Space Sciences from State University, NY in 1975; and an MS in Geophysical Sciences from the University of Chicago in 1976. He has had an extensive career in both the uranium and oil and gas industries and is the author of many papers and presentations on carbonate and clastic petroleum regimes.

According to Mr. Mazzullo, the recent price drop for oil field services and leasing presents an opportunity for small operators. The technology that has been developed in the last eight to ten years for resource plays can now be applied to conventional fields. Resource plays are often based on statistical repeatability that may not be borne out by the geology. Also, it may not be clear where the production is originating. Mr. Mazzullo has observed a situation where twenty two zones had been completed but most of the production was from only two zones due to differences in both permeability and pressure gradients that could not be predicted.

In contrast, the architecture of conventional reservoirs is well understood and there are conventional plays that have been bypassed and underdeveloped. Conventional reservoirs require fewer completion stages and are thus less expensive to produce. Also, horizontal completions expose more of the formation to the well bore and reduce water coning by spreading the pressure drop and allowing the reservoir to be developed more efficiently. They also reduce the number of wells needed to drain a reservoir. An example of this technique applied successfully to an established oil field is in the San Andres Formation of the Permian Basin.

But also in the Permian Basin, a well in the Cline Shale was discussed as an example of the downside of resource plays. It showed a high initial IP and was forecast to produce 450,000 bbl. However, after examination of the decline curve, the total production could not be projected to more than 201,000 bbl, with 135,000 bbl more likely. This well was in the sweet spot and cost \$7.5 million to drill. Analysis of several Niobrara wells on the western side of the DJ Basin (not the sweet spot) showed their total production would not be expected at greater than 31,000 bbl each. The economics of these wells is poor, given the cost of completing and fracking. There are very profitable Niobrara wells, but the play is very sweet-spot driven and difficult to model.

In contrast, there are conventional reservoirs where resource play techniques work extremely well. The Madison Formation of the Williston Basin is one of the oldest producing horizons in the Williston Basin and has accounted for over 60% of the production prior to the exploitation of the Bakken-Three Forks. It is comparable to the San Andres of the Permian Basin. The Madison is a low permeability play and is shallower and more pervasive than the Bakken. Horizontal wells have been drilled in the

formation from the 1990s to the early 2000s, but none since the advent of the shale boom. The older vertical Madison wells are very long-lived, with up to 30-40 years of exponential decline and total production of up to 1 million bbl, but usually closer to 150-350,000 bbl. Newer horizontal wells have 2-4 times the IP of the vertical wells. The decline is hyperbolic but however they can pay-out within 1-4 years, much more quickly than the 10-15 years required for vertical wells. The Madison formation can be compartmentalized--one horizontal well drilled among existing vertical wells had an EOR of 450,000 bbl, but an average horizontal well in this field produces 186,000 bbl. The Bakken Play makes it prohibitively expensive to drill in the center of the Williston Basin, but there are areas of Madison on the eastern fringes at 4,800 to 6,500 ft. in depth that have never been fully developed.

These techniques of infield and extension drilling can also be applied to the Pennsylvanian Morrow Formation of the Midcontinent and the Permian Basin. These fields were often drilled using standardized spacing but there is now the opportunity to optimize production by a reexamination of the geology. Mr. Mazzullo discussed additional specific opportunities in southeastern Colorado and in the New Mexico portion of the Permian Basin.

Mr. Mazzullo also mentioned the Cisco Canyon Sequence of the Permian Basin, which experienced limited horizontal drilling in the 1990s. Select shelf margin horizontal wells drilled in Knox County have produced 250,000 bbl. There are examples where the field geometry is such that the formation could be much more easily drained with horizontal wells. There are obvious problems of water flooding a field that is compartmentalized, such as the San Andreas, but if the geology is understood, these poorly developed fields can now be efficiently produced using horizontal drilling techniques.

For companies that can survive this downturn, utilizing geologic analysis in combination with new technology is the key. In the boom times, science may be ignored in favor of the rush to extract the resource. But the current economic conditions may show that there is opportunity to use the drilling and completion techniques that have been developed in the last ten years on conventional fields.

A member of the audience asked about land costs. He replied that they were beginning to decline as owners were becoming hungrier. He had previously mentioned that seismic costs were not dropping.

Mr. Mazzullo's website can be located at <http://www.lmazzullo.com/>