Use of Mud Gas Compositional Analysis to Determine Fracture Quality of Natural Fractures in the Austin Chalk*

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Search and Discovery Article #40778 (2011)
Posted July 26, 2011

*Adapted from e-poster presentation at AAPG Annual Convention and Exhibition, Houston, Texas, USA, April 10-13, 2011

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Abstract

The Austin Chalk has proven to be a prolific carbonate reservoir over the past 30 years, it is thought, mainly through natural fractures which act both as a storage and as a delivery system for hydrocarbons. Throughout the exploration and development of this formation, characterizing the quality of fractures encountered has been somewhat problematic. This is largely due to difficulties in standardizing shows because of the numerous factors that can control the apparent quality of the show while drilling, such as choke and mud weight. In order to gain a greater insight into the quality of fractures near the well bore, mud gas samples were collected during the drilling of the up dip and down dip portions of two horizontal Austin Chalk wells from the Texas county of Jasper. The hydrocarbon composition of these samples was determined by GC analysis from Isotubes© collected during the drilling and the results were related to well production.

As seen in previous studies, the composition of mud gas captured in Isotubes© did not reflect the composition of the well when it was brought onto production. However, the variation seemed to be systematic in relationship to the quality of the well, and by inference, the quality of the fractures encountered. The Jasper-1 well had consistently higher concentrations of C2 through C5 hydrocarbons (average of 23%) correlating with better overall shows and a higher EUR (987 MMBOE, 74 BOE/FT vertical section), while the Jasper-2 well with a lower concentration of heavier gas phase hydrocarbons (average of 8%) had a markedly lower EUR (61 MBOE, 13 BOE/FT vertical section). Both of the wells, when brought on production had the same concentration of methane (90%) and this has remained relatively constant throughout the production life of these wells thus far. The described method of correlating mud gas composition to production from fractures may prove to be useful in determining the relative ability of natural fractures to contribute to production not only in carbonates, but may also provide insight into the importance of natural fractures in horizontal wells drilled in other formations such as shale.

Anadarko Petroleum Corporation

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Background

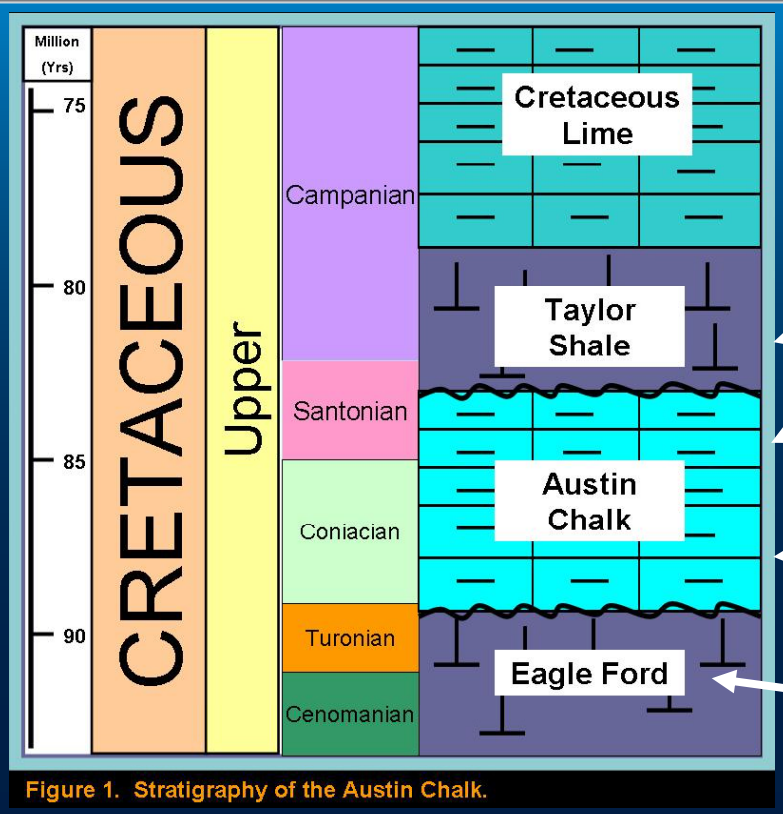


Figure 1. Stratigraphy of the Austin Chalk.

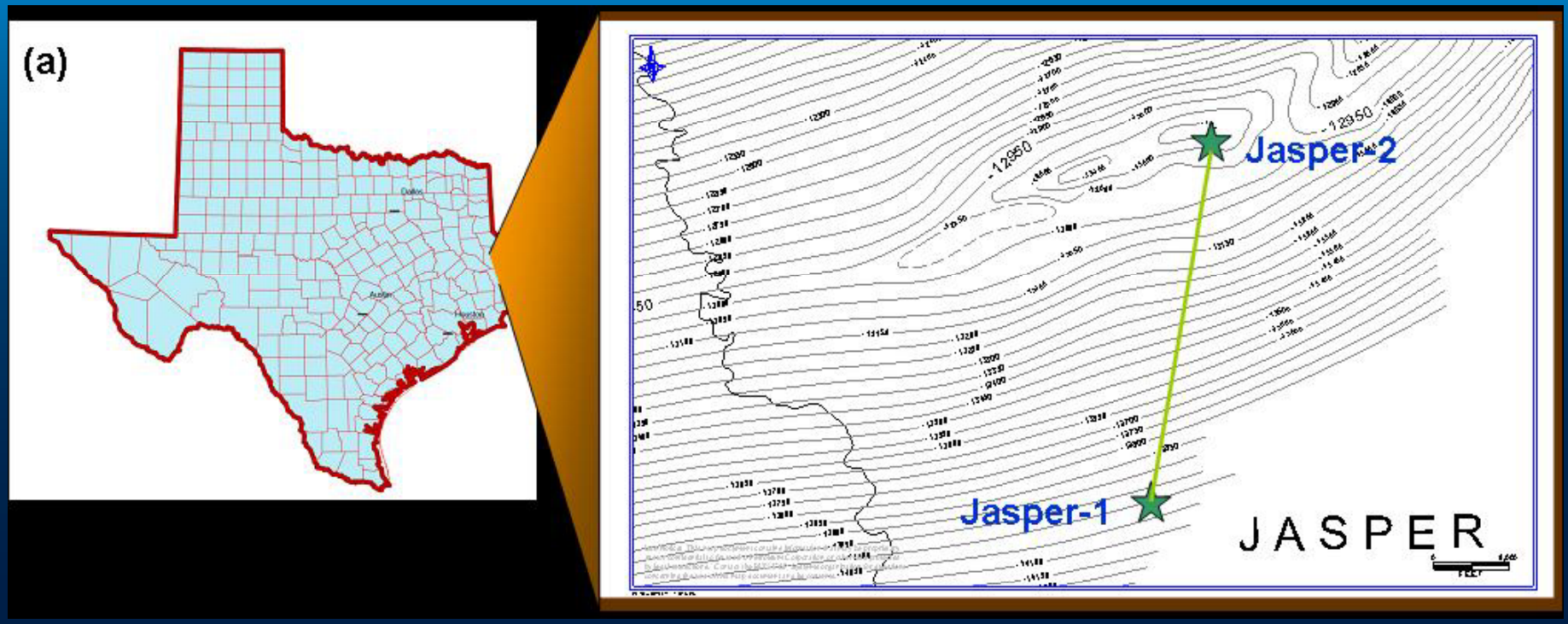
Seal

Reservoir, Source ?

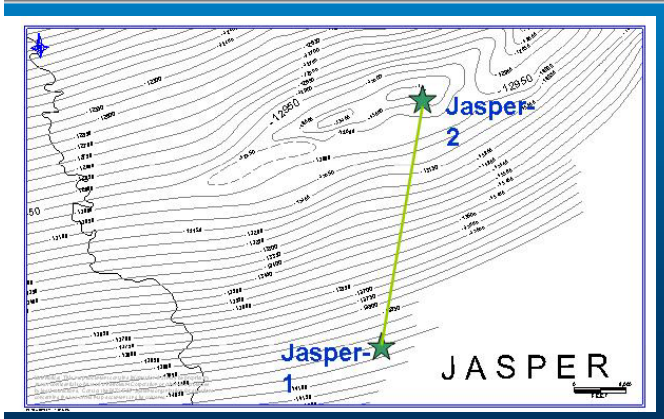
Source

- The Austin Chalk is a naturally fractured carbonate which has been a producer for many years

Location



Target Selection



- Target zone selected based on resistivity

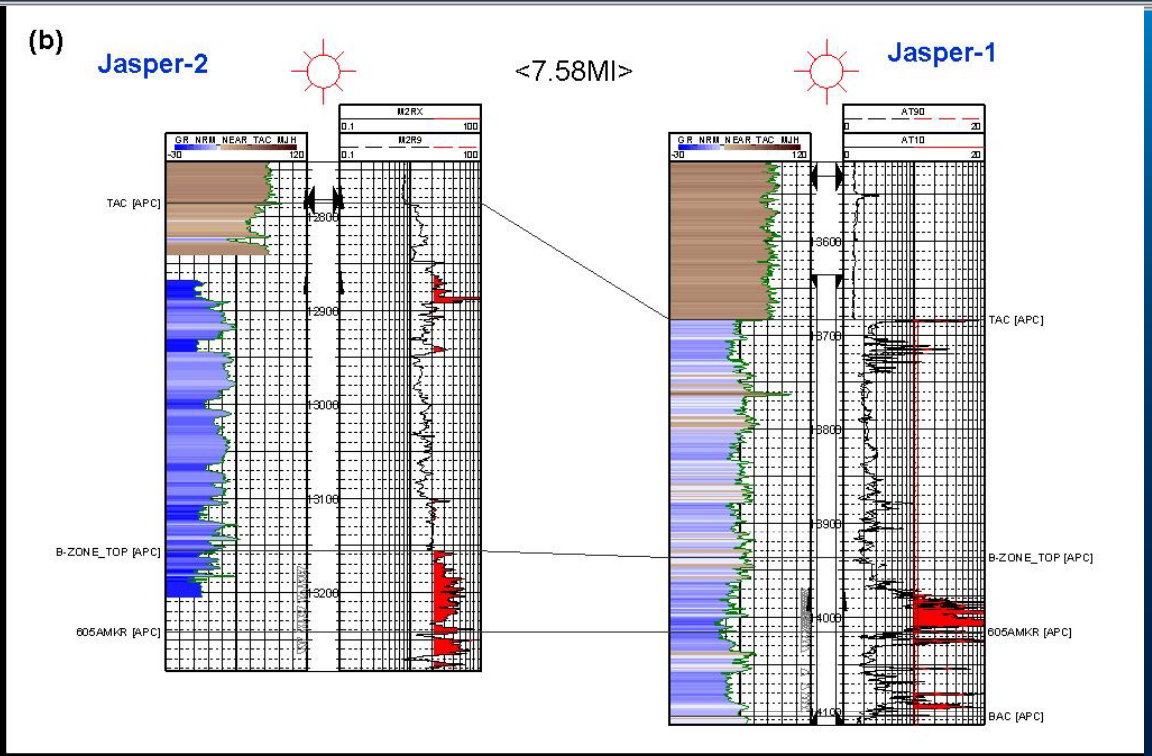
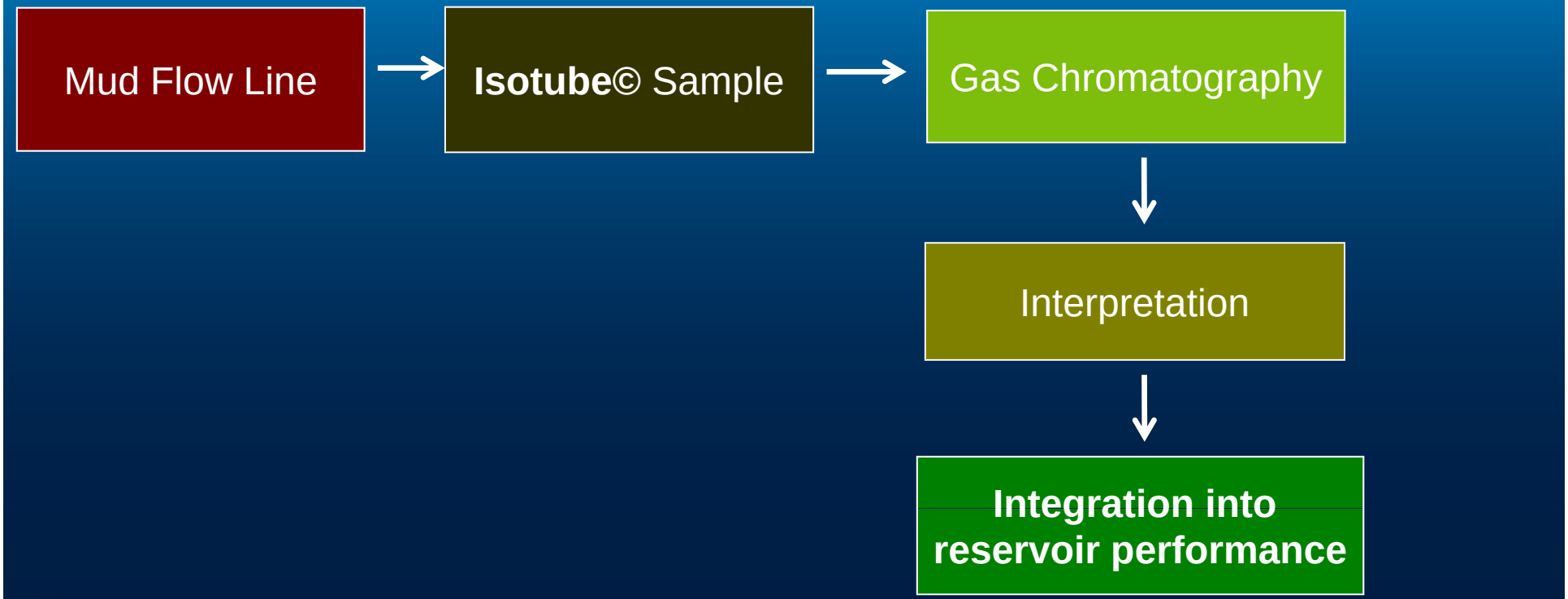
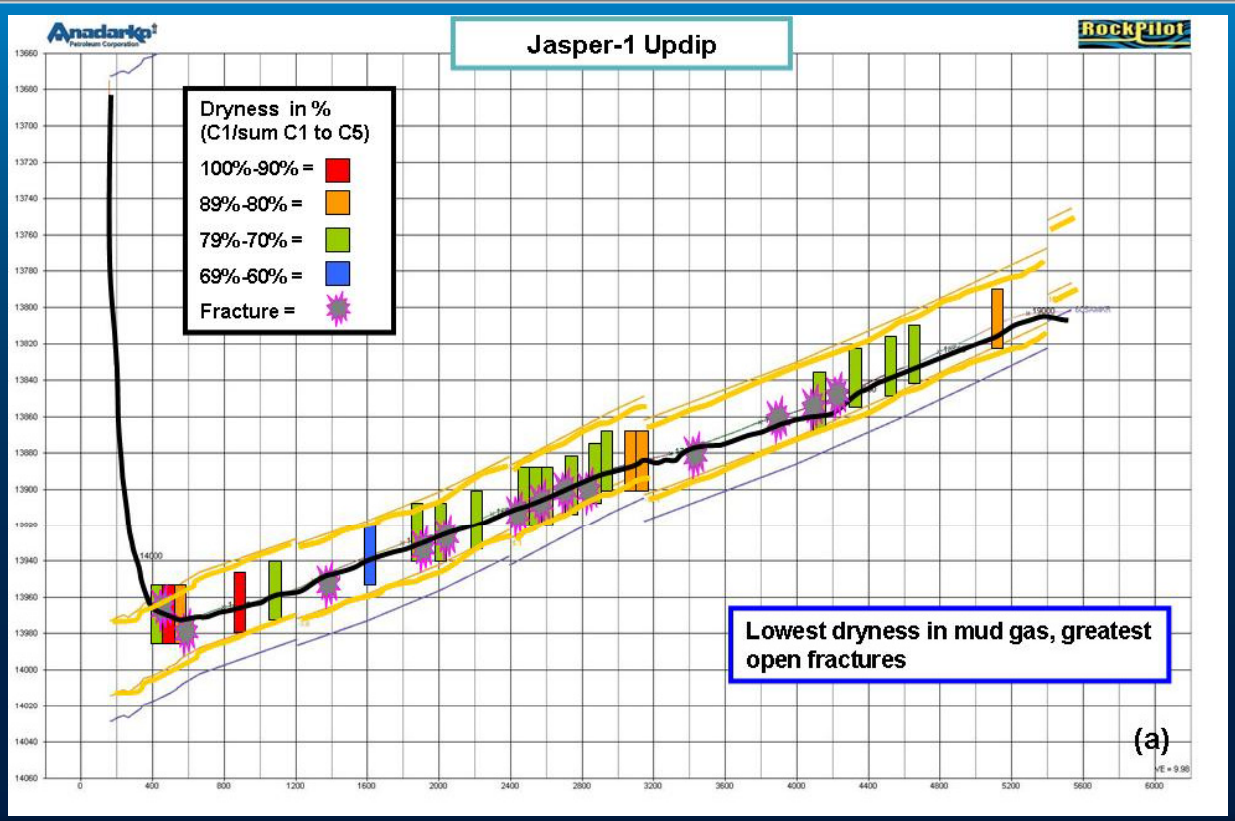


Figure 2. (a) location of the wells used in this study. (b) logs taken from pilot holes drilled for both Jasper-1 and Jasper-2.

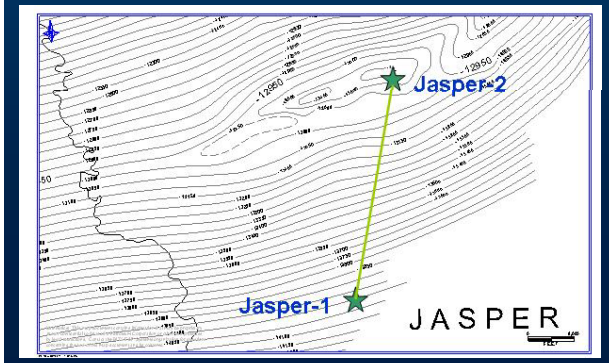
Method


Mud Flow Line
Isotube© Sample
Gas Chromatography
Interpretation
Integration into reservoir performance

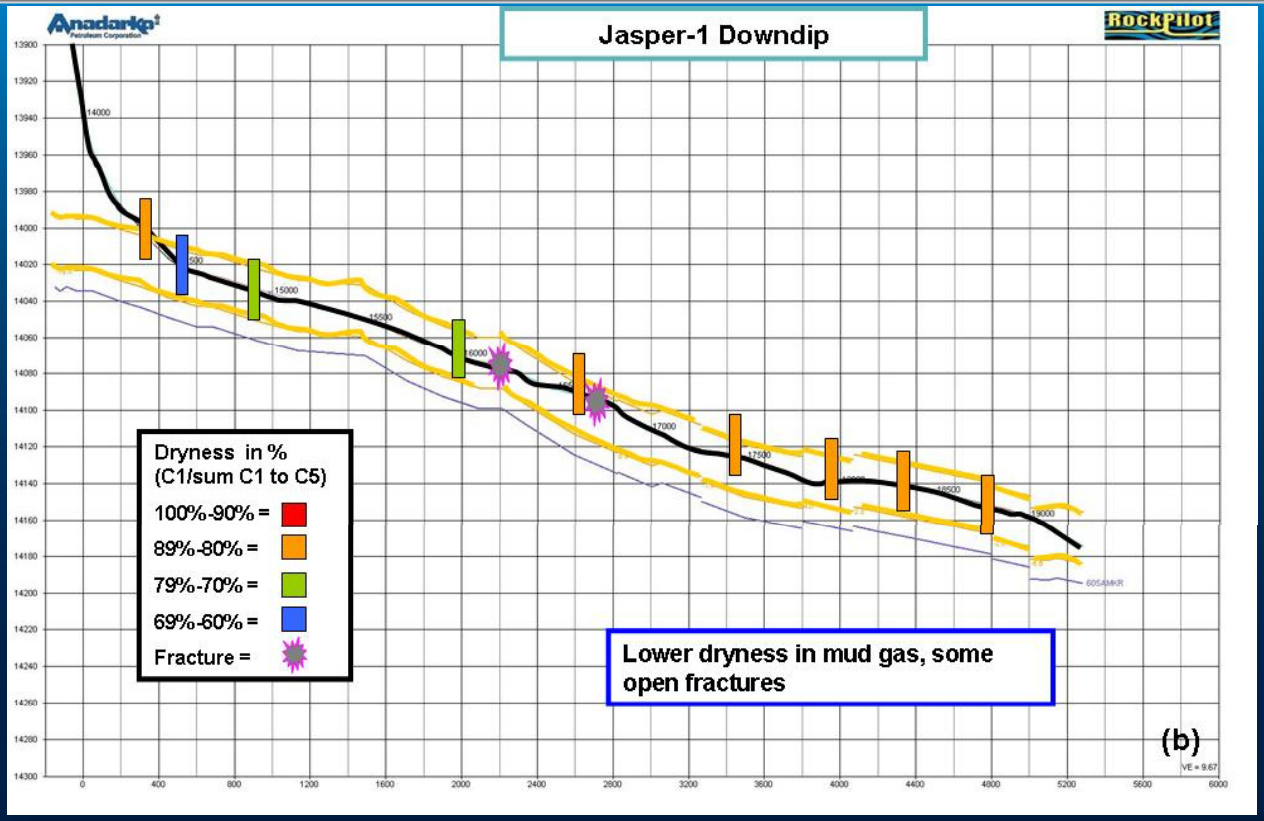
Jasper-1 Updip



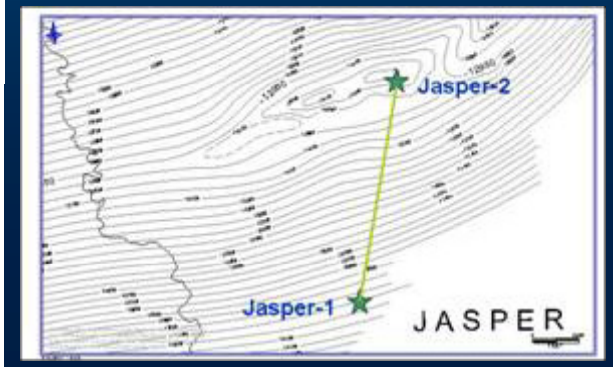
- Ro ~1.6 %
- Average gas dryness while drilling = 75%
- Average gas dryness during production = 90%



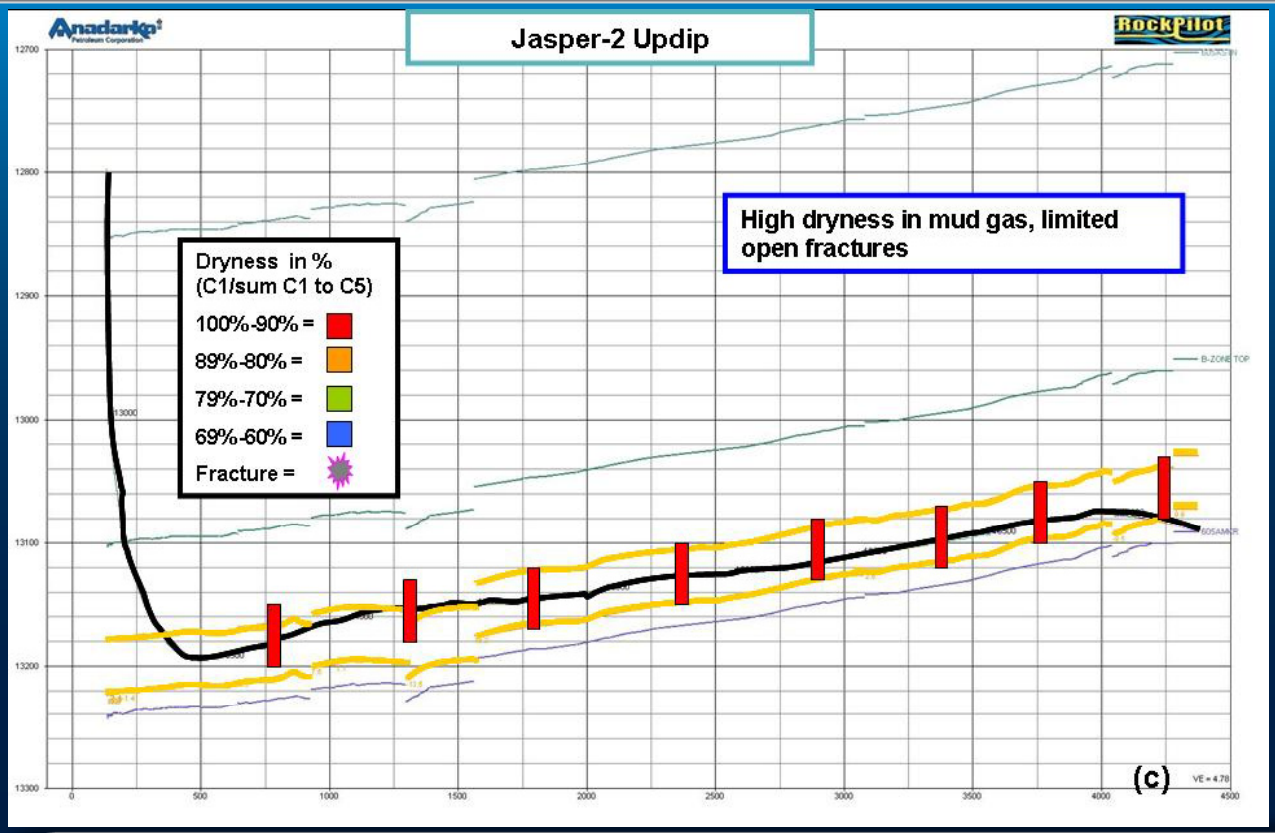
Jasper-1 Downdip



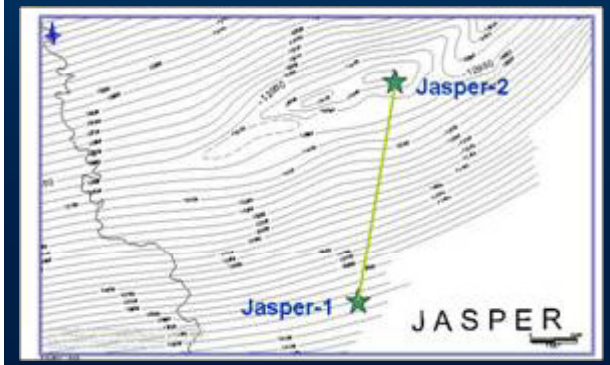
- Ro ~1.6 %
- Average gas dryness while drilling = 81%
- Average gas dryness during production = 90%



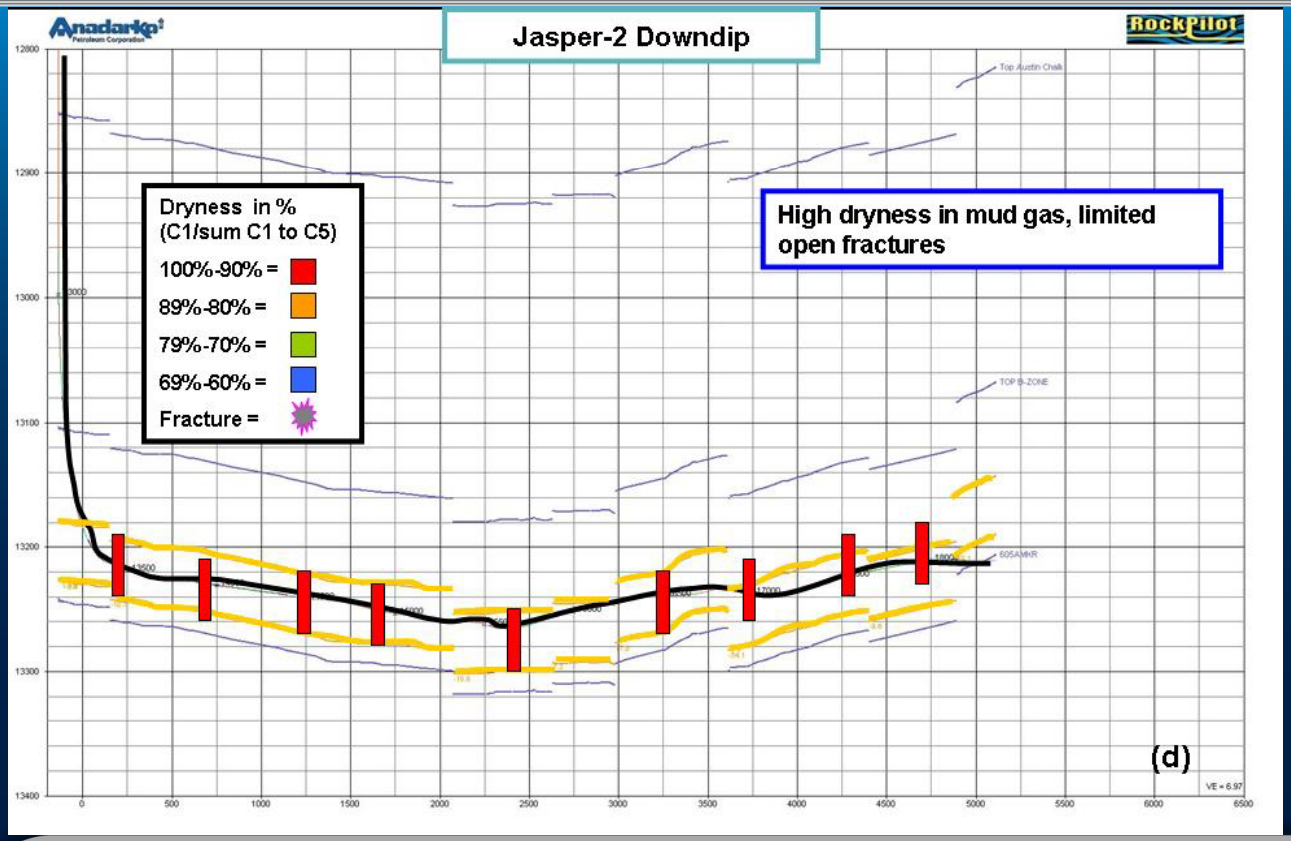
Jasper-2 Updip



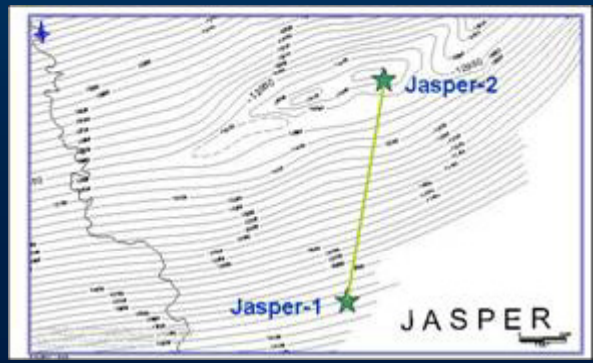
- Ro ~1.6 %
- Average gas dryness while drilling = 93%
- Average gas dryness during production = 90%



Jasper-2 Downdip



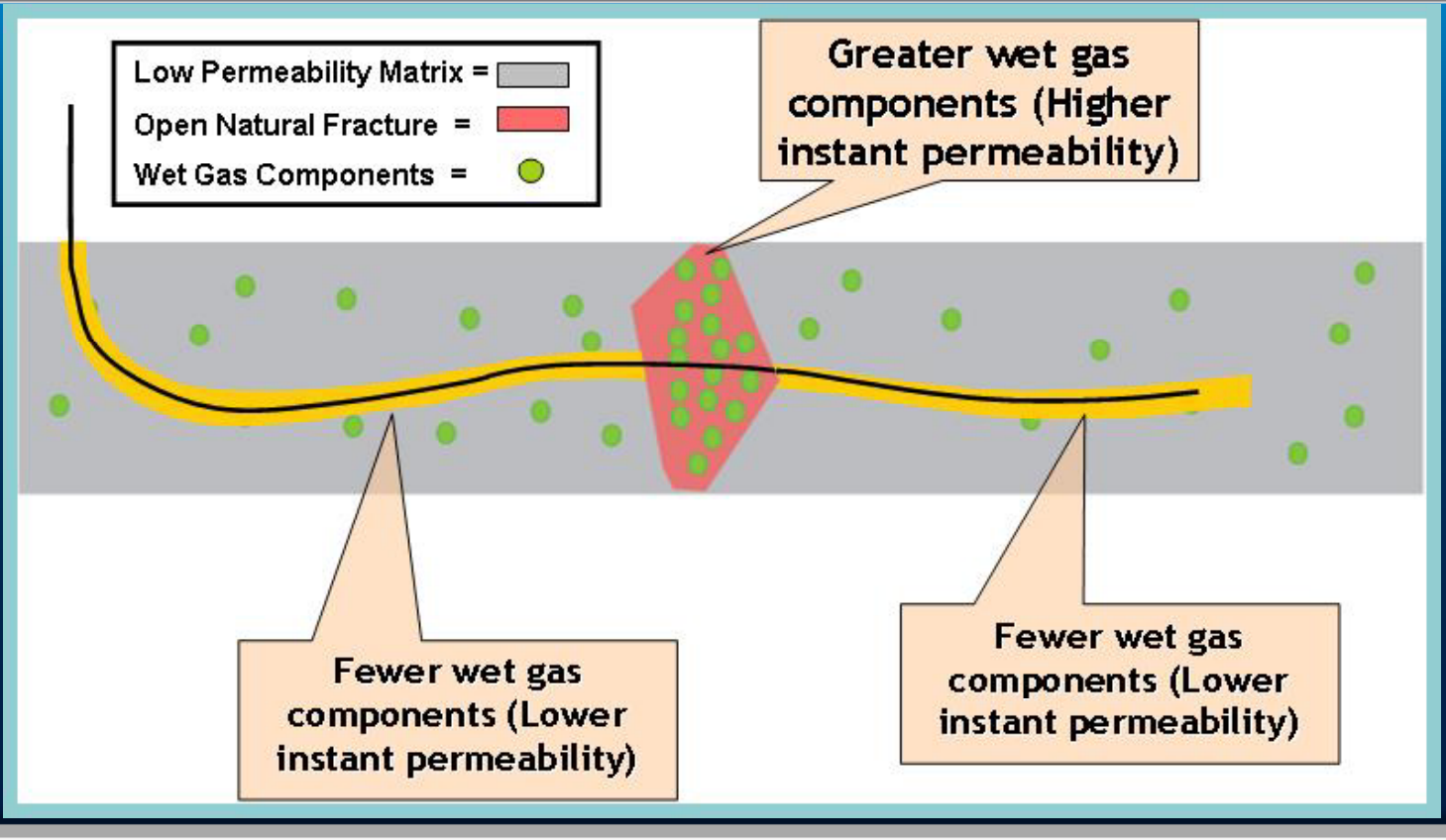
- Ro ~1.6 %
- Average gas dryness while drilling = 92%
- Average gas dryness during production = 90%



Results Summary

- **Jasper-1**
  - Updip several open natural fractures, average dryness 75%
  - Downdip fewer open natural fractures, average dryness 81%
  - EUR ~980 MBOE
- **Jasper-2**
  - Updip limited open natural fractures, average dryness 93%
  - Downdip limited open natural fractures, average dryness 92%
  - EUR ~60 MBOE

Mechanism of Action



Conclusions

- Gas sampled while drilling does not always match the composition of produced gas
- An increase in gas components larger than methane is associated with open natural fractures which are charged with hydrocarbons
- This phenomenon may be due to the radical difference between the very low permeability of the matrix and the very high permeability of open fractures