Detailed Seismic Characterization of a Heavily Karsted Zone*

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Abstract

Producing hydrocarbons in karsted and fractured zones is a very risky procedure. This is the case of the source and reservoir Barnett Shale Formation that is overlying the highly karsted and fractured limestone of the Ellenburger Group in the Fort Worth Basin. Typically, karsted and fractured zones had been avoided because of the potential of the faults to connect with the water in the Ellenburger Group. We propose to generate a geological and geophysical model to delineate and characterize these karsted and fracture features on the production from the Barnett Shale Formation.

Traditional exploratory approach to this area of study may not be the same as the well developed Newark East Field. It is vital to understand the geological setting and petrophysical settings involved in the evolution of this part of the basin to improve exploratory analysis results in this highly prospective zone.

References Cited


Abstract

Producing hydrocarbons in karsted and fractured zones is a very risky procedure. This is the case of the source and reservoir Barnett Shale Formation that is overlying the highly karsted and fractured formations of the Ellenburger Group in the Fort Worth Basin. Typically, karsted and fractured zones have been avoided because of the potential of the faults to connect with the water in the Ellenburger Group. A proposal to generate a geological and geophysical model to delineate and characterize these karsted and fractured features on the production from the Barnett Shale Formation.

Geology

Geologically the study area falls in the Bend Arch–Fort Worth basin situated in North-central Texas and southwestern Oklahoma. The eastern and southern boundaries of the basin are bounded by the Guadalupe structural front and Louis uplift (Ball and Perry, 1996). The northern boundary follows Paducah dome and the Muñster Arch (Thompson, 1982). The western boundary follows the Concho platform that separates the study area from the adjacent to the Permian Basin (Thompson, 1982; Ball and Perry, 1996). The study area is located on the west from the Newark East Field in the Wise County, Texas. The main difference between the Newark East Field and the study area is that the Viola limestone and Simpson Group are absent, and the Fort Worth Group, that separates the upper and lower Barnett, is thinner (Pollastro et al., 2003). These formations are known as barriers that keep hydrocarbons included into the karsted formation and keep the original formation pressures when its artificially stimulated (Bowker, 2003; Shirley, 2002; Pollastro et al., 2007). To understand the geological setting and petrophysical settings involved in the evolution of this part of the basin to improve exploratory analyses results in this highly prospected area.

Conclusions

Carbone deposits are all but continuous and isotopic. Environmental conditions such as oxygen, water depth, and type and distribution of "microbial" animals will be vital in the understanding of the limestone, characteristics and rock quality. In this case, the shape, orientation and location of the collapsed features may be controlled by the collapse mechanisms. The pore structure and porosity are affected by the underlying sediments, as explained by Loucks (2001) at his analysis of the Lower Ordovician Ellenburger Group of the Permian Basin. These processes work across the lower Barnett shales, reaching sometimes the Marble Falls limestone. This could be explained by the absence of the natural fracture barriers such as Viola/Simpson interbed and Fort Worth Group in the area.

Exploratory approach to this particular area should be different to the one apply previously to other productive fields.

Future Works

• Microseismic data should be included to better understand the extension, distribution and intensity of the fractures in the target zone of the Barnett shale. This will allow to verify the effect of the proximity to the karsted zones associated with the Ellenburger Group and how it affects stress and strain fields in the area.
• Using the well log data available inside the study area, we will generate Fracture Tougnesses and Fracture Quadrant models using the interpreted horizon as references surface. This will give an idea of how fracture prone are the different formations and how this fractures will propagate through them.
• Take into account the stress and strain regimes in the area. These mechanical properties will be different to that in the near Newark East Field due to the presence of the Marble Wells block and the more prominent karst features.
• Process the raw 3D prestack seismic data in a way to improve the seismic image of the target zone. The vintage poststack time migrated amplitude volume have migration artifacts in the interval of interest that will be corrected by doing a more careful velocity analysis. New techniques will be applied, such as seismic attribute calculation and poststack Structural Oriented Filtering.
• These results will be compared with the production performance of the wells inside the area. This will allow us to determine new and better perspective zones in a more quantitatively manner.

There is important productive potential associated with the 2003 Assessment Unit 1, the Ellenburger Subcrop Fractional Barnett Shale Gas for the USGS National Oil and Gas Assessment of the Barnett shale Gas Petroleum System in the Bend Arch–Fort Worth Basin Province.

An important observation is that it seems that the exploration of the area of study was done following the same approaches and procedures than in Newark East Field. But this are not necessarily effective in this area since the stratigraphic, structural, and petrophysical settings seems to be particular of this location.

References and Acknowledgements

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Figure 1. The central Texas and southwestern Oklahoma are areas of great interest in the petroleum sector. The study area is located on the west from the Newark East Field (Wise County, Texas) and it is characterized by a highly karsted and fractured formations of the Ellenburger Group. The chemical composition of the Devonian carbonates deposits to be consider in further analysis.