



UR17

Integrated 3D Seismic Attributes with Microseismic to Estimate Shale Plays

W. Liu* (BGP Inc., CNPC), ZYS. Zhang (BGP Inc., CNPC), Y.G. YU (BGP Inc., CNPC), C.F.Cheng (BGP Inc., CNPC), L.T. Li (BGP Inc., CNPC)

Summary

Hydraulically induced micro seismic fractures can be used to increase reservoir permeability, which is an important process in the shale gas exploration & development. Micro seismic monitor can be used to estimate induced fracture's orientation and fracture's size, guiding completion design. However, micro seismic events are affected by many factors. How to understand micro seismic events characteristic is very important for the reservoir construction. In this paper, we try to understand, (1) why are the micro seismic events different for the adjacent well. (2) Why there are a lot of big energy events above the target layer? (3) For the micro seismic events, the more, the better? We introduced the 3D seismic attributes to evaluate micro seismic events and summarized a set of methods to solve some engineering problems.

Introduction

Microseismic monitor can be used to estimate induced fracture's orientation and fracture's size, guiding completion design. However, microseismic events are affected by many factors. How to understand micro seismic events characteristic is very important for the reservoir construction. We introduced the 3D seismic attributes to evaluate micro seismic events, integrated seismic fracture attributes(e.g., coherence, curvature attributes) with the reservoir characteristic (e.g., brittleness, Poisson's ratio) to analyze microseismic events distribution characteristic, which will explain anomalous events and increase interpretation credibility.

Method and/or Theory

Microseismic events is related to reservoir characteristic, the events preferably occur in high brittleness index zones and natural fracture developed area. Integrated these information will help us to understand further microseismic events spatial location, increasing the interpretation credibility as well. Seismic reservoir characteristic can be obtained by AVO inversion from different angle stacks. According to Rickman's mechanical rock properties study, the brittleness index can be expressed as by Rickman

Examples (Optional)

During fracturing monitor, appearing some large magnitude anomalous events at the bottom of H1 and H3-3(see figure 1(a) red circles). There are exist a lots large magnitude events under the target layer(about 300m,see figure1(b) black broken Circle, which are responding to the black circle in figure 1(a)).What's more important, when fracturing H3-1,H3-2,the H3-3 is still exist large magnitude during the microseismic monitor.That's is confused.

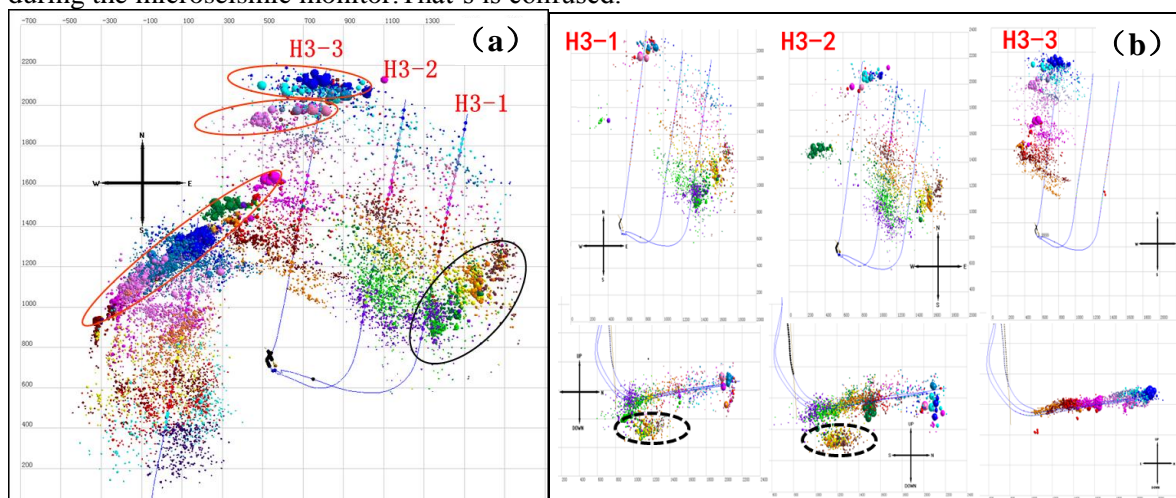


Figure 1 microseismic monitor different view for H1 & H3.

We extracted fracture attribute across the H1 (line2,see Fig.2), we find, at the bottom of H1, the fracture attribute changed greatly (see the red arrow indication). In these changed greatly area, the lithology & mineral components are changed, natural fracture most likely to be activated in these area. Maybe is a reason why there are big events at the bottom of H1.Similarly,we got another location fracture attribute(line 1). The big events cluster is responding to the fracture attribute changed greatly(see the rectangle indication)

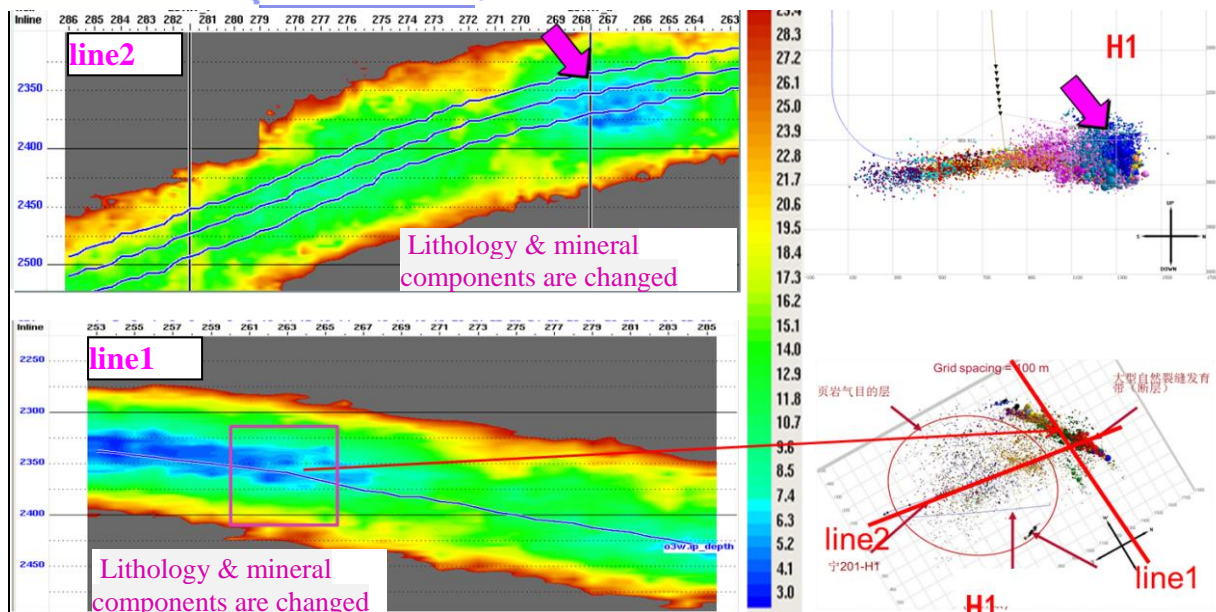


Figure 2 Microseismic events and fracture attributed analysis. left figure are the fracture attribute.

Based on these results, to understand why there exist a lots large magnitude events under the target layer. Fig.3 is the fracture attribute section crossed the H3-1, H3-2, H3-3, the red color means fracture developed, the blue is undeveloped. We find, under the H3-1, at the end of H3-1 horizon well path under 300m, the fracture is very strong. Compared with H3-2, the fractures is weakened gradually. The figure 3(b) is the fracture attribute section across H3-3, the fracture very weak, nearly disappeared. Maybe the fracture is the reason why both the H3-1 and H3-2 exist a lots large magnitude events under the target layer.

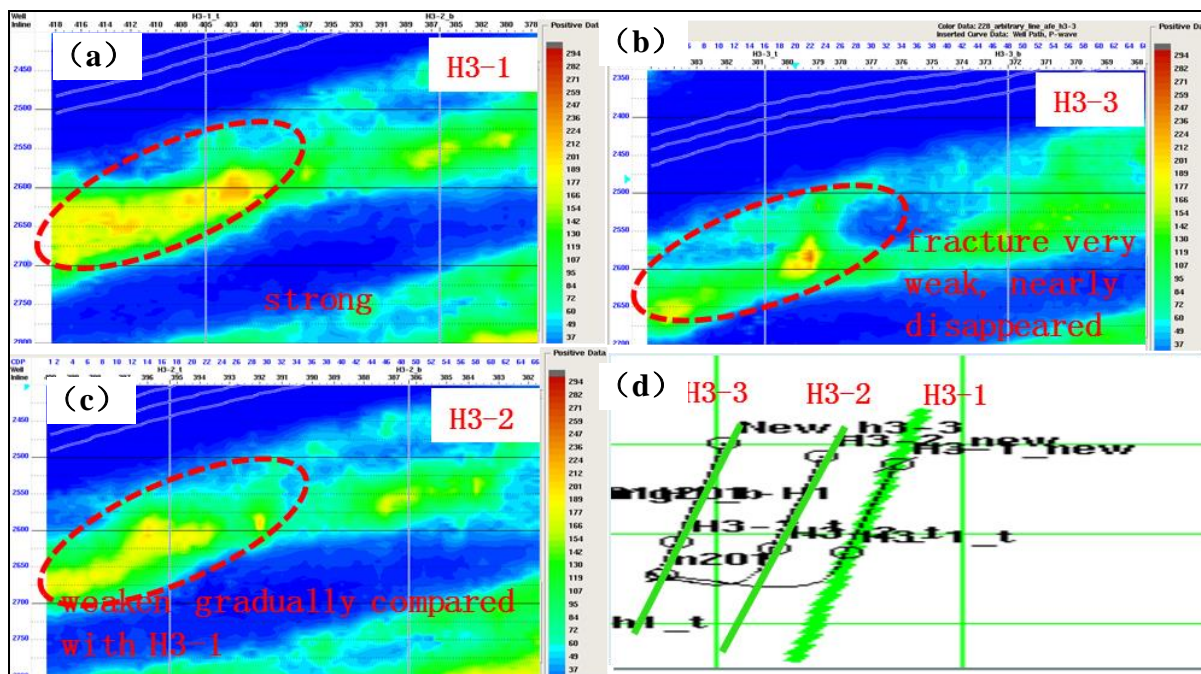


Figure 3 Three horizon well fractures attribute section.



Conclusions

We should integrated seismic fracture attributes with the reservoir characteristic (e.g., brittleness, Poisson's ratio) to analyze microseismic events distribution characteristic, to guide shale gas completion design as well.

References

Rick Rickman, Mike Mullen, Erik Petre et al. A practical use of shale petro physics for stimulation design optimization: all shale plays are not clones of the Barnett shale, SPE, 115258, 2008.