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Advanced Microseismic Interpretation Reduces Uncertainties in an Unconventional Exploratory Well, Northern Mexico

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Summary

Micro-seismic interpretation is not a straightforward process. It generally presents different challenges and particularities, such us abnormal behaviors that should be addressed with different interpretation tools. During this stage, the effort is focused on conciliating the theory behind the generation and detection of micro-seismic events and the theory of hydraulic fracturing for conventional and unconventional reservoirs, and explains any deviation from this conciliation. Finally, the integration of all the information available (well logs, surface seismic, structural model, geology, petrophysics, geomechanics, etc.) is a crucial step toward the final interpretation of the micro-seismic event patterns.

Introduction

Micro-seismic interpretation is not a straightforward process. It generally presents different challenges and particularities, such us abnormal behaviors that should be addressed with different interpretation tools[1]. During this stage, the effort is focused on conciliating the theory behind the generation and detection of micro-seismic events and the theory of hydraulic fracturing for conventional and unconventional reservoirs, and explains any deviation from this conciliation[2]. Finally, the integration of all the information available (well logs, surface seismic, structural model, geology, petrophysics, geomechanics, etc.) is a crucial step toward the final interpretation of the micro-seismic event patterns.

The present study focuses on challenges and particularities found during the analysis, interpretation and evaluation of the micro-seismic mapping recorded on a horizontal exploratory well in northern Mexico (Figure 1).

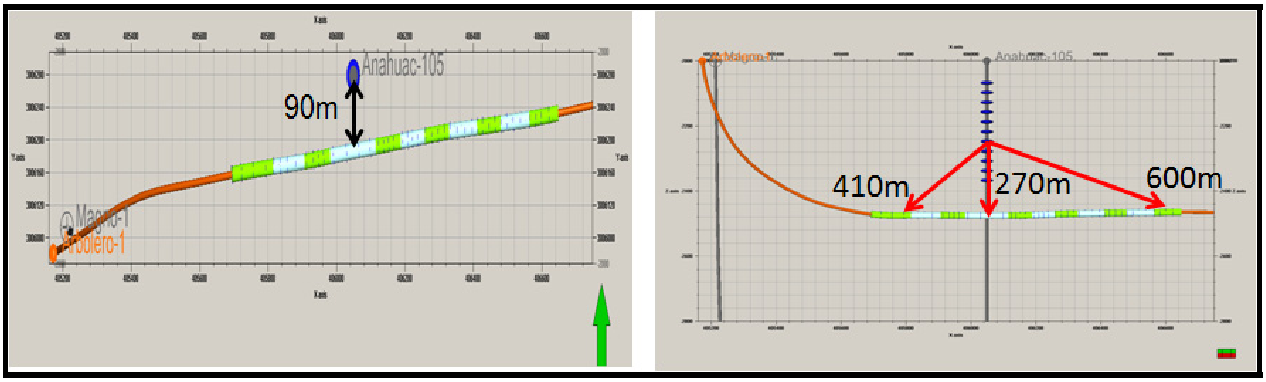

Figure 1 *A-1 and A-105 wells.*

Method and Theory

This microseismic mapping showed excellent results, with more than 22,400 events detected during the pumping of 11 stages along the horizontal section. Many abnormal behaviors were observed, and hard work was made to calibrate velocity model and reduce uncertainties of micro-seismic event location.

Analysis of the final processing results determined that 98% of these events are related to the activation of pre-existing planes of weakness within an upper formation (outside the target formation).Integrated data showed the faulting was due to a fold structure (**Error! Reference source not found.**, structural model shows an anticline).

The application of different interpretation tools and filters permitted the remaining 2% of microseismic events directly related to the hydraulic fractures to be selected. At last, these microseismic event patterns were interpreted using unconventional fracture models, allowing the characterization of fracture network geometries and volumes. The final evaluation results were compared with the initial fracture network designs, enabling accurate calibration of models for future jobs (Figure 1).

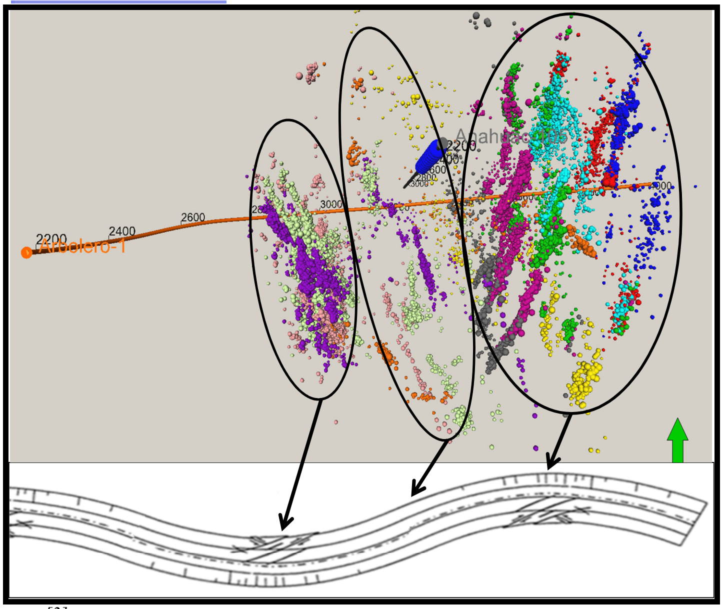

Figure 2 *Fold Structure[3] Interpretation.*

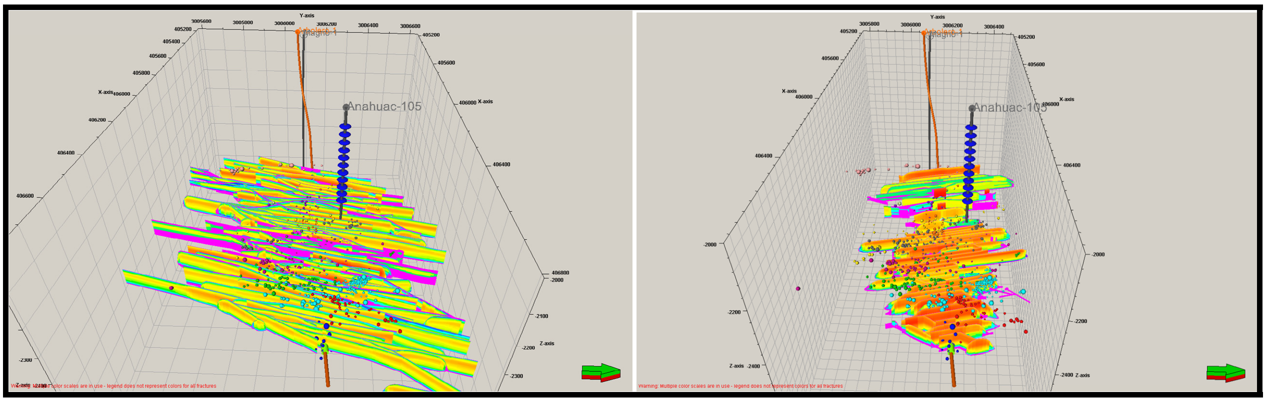

Figure 1 *Fracture networks, initial design vs. final calibration results. A-1 well.*

Conclusions

Conclusion and lessons learn obtained during this process are associated to microseismic monitoring condition and limitation for this job (structure influences, formation texture and properties, etc), characterization of the fracture network (geometries, coverage), efficiency of the multi-stage fracturing job and recommendation for future works.

References

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