Multidimensional Analysis and Interpretation for the delineation of complex geologic structures through Seismic Multi-attribute Realistic Co-visualizations (MRC) techniques.

Ignacio Rovira  Staff Geophysicist
Pan American Energy
DISCLAIMER 2019

The contents of this presentation are for informational purposes only. Halliburton** makes no representation or warranty about the accuracy or suitability of the information provided in this presentation and any related materials. Nothing in this presentation constitutes professional advice or consulting services. No contractual relationship with Halliburton is established by attending or viewing this presentation. No rights to intellectual property of Halliburton are granted through this presentation. The opinions expressed in this presentation are those of the author and do not necessarily represent the views of Halliburton. **Halliburton means Halliburton Energy Services, Inc., Landmark Graphics Corporation, and their affiliates.
Challenges & Objectives

- Identification of **structural styles**, recognition of **main geological structures**, delineation of **faults** resulting from **complex tectonic processes**.

- Introduce a **workflow** based in the combination of geometric seismic attributes and automatic faults recognition tools.
What is MRC?

- Multiple Realistic Covisualizations

The **constructive co-visualization** of two or more seismic attributes that, together, enhance certain geologic features which, otherwise are very hard to identify and interpret.
This interpretation couldn’t be considered wrong.

But, is it complete? How accurate is it?
What is AVT?

The step from the bi-dimensional vision to the feeling of a **realistic seismic section**.

- **Amplitude Trace**
  - RMS Amplitude with a specific window.
  - Hilbert’s Transform

- **AVT Attribute Trace**
  - **Meta-Attributes**
    - Coherence
    - Cosine of Phase
    - Curvature
    - Instantaneous Phase
    - Likelihood

AVT Attribute Seismic Section
Using AVT as input, **Fault Likelihood** volumes were calculated.

We also computed the **Cosine of Phase from the SofS4** volume.

And combined it with **Tracking volume** to generate the MRC.

The MRC Section shows **more detail** for this intensely faulted area.
» The increment in visible detail gives the interpreter the possibility of re order the fault swarm and offer an alternative interpretation.

» This could also give more insight in the mechanisms of development of the observed structure.

» Therefore, give new clues about the petroleum system in that area.
- Discontinuity (AVT) attribute shows a heavily faulted area produced by this large faults indicated with black polygons.

- As seen in the picture, this attribute by it self is **not capable of giving a very detailed response** to this structural style.
Calculating Fault Likelihood attributes and running an Automatic Fault Recognition process gave the first clues. So, a two direction fault system was proposed.
Aided by this type of MRC, we were able to easier interpret faults.
- The identification of the structural style improved the interpretation and mapping process.
- Faults and surfaces were identified and mapped with great detail using Framework.
- A great insight in the evolution of the structure was gained.
Argument:

» Faults don’t cut Vaca Muerta Formation.
After calculating attributes and generating the MRC, it becomes very clear that faults cut Vaca Muerta Fm.

This could have great impact in the generation of sweet spots with drilling potential.

Is it possible to go beyond?
Vaca Muerta Base Horizon Slice Fault Tracking (AVT 12-24 degrees Angle Stack)

Vaca Muerta Base Horizon Slice Fault Tracking (AVT Full Stack)
- Principal trends of faulting can be spotted on Full Stack volumes, but...

- On partial angle stacks, we could get a clearer image on what could be happening between main faults.

- This should be matched with microseismic and geomechanical data.
Conclusions

- MRC techniques proved to be a very helpful tool to interpret heavily faulted areas.

- The combination of attributes and meta-attributes impacts positively in gaining new geological insight.

- This improvement in visualization resulted in maximizes the added value of seismic data and the interpreter’s work.
Summary

» Structural style identification.
» Recognition of main geological structures.
» Delineation of faults resulting from complex tectonic processes.

» Calculate attributes and meta-attributes.
» Use Oriented filters and Automatic Fault Recognition Tools (Likelihood).
» Generate MRC (Multiple Realistic Covisualizations).

» Improvements in visualization, recognition and interpretation.
» Increment of the added value of seismic interpretation.

- Challenge
- Solutions
- Results
Thank You
Your feedback is very important to us. Please open the LIFE2019 app to answer a few short questions on this presentation.