Found an amplitude anomaly on the seismic! Great, now what?

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Abstract

For a sandy reservoir level filled with gas, it is usually good news when we extract an amplitude anomaly and see that it conforms quite nicely with the structural map. But what additional work can we do to gain more confidence when relating the anomaly to fluid content and discard other possible explanations? We present a case study from a tight aeolian sand in Bolivia with a detailed analysis to understand the link between the seismic amplitude anomaly we found and the expected fluid in the reservoir.

We began by modeling the seismic response in the wells with fluid substitution. This showed a higher amplitude response for the gas-filled sands than the brine case, which was very encouraging.

Next, the amplitudes were extracted in the same horizon-guided window at different seismic volumes: PSTM raw, PSTM with a conservative trace balance and PSTM with regular “gain (AGC) & filter”. It was important to see that the anomaly was present in all three extractions, regardless of the post-processing applied.

Another possible cause of structure-conforming (non fluid-related) amplitude anomalies are illumination artifacts. To discard this effect, we extracted amplitude maps at non-reservoir levels below the target and checked that those did not show a similar seismic anomaly. This is a very easy verification step, recommended when analyzing seismic in thrust belt areas to avoid false DHIs.

Since the gas absorbs the higher frequencies in the seismic, we then analyzed frequency-related attributes: a Sweetness extraction through the target level again showed an anomaly with good conformance with structure (this attribute is computed by dividing Amplitude with the square root of frequency).

Finally, we performed Spectral Decomposition at the reservoir interval and found that a seismic anomaly was present in the lower frequencies but not in the higher ones. This was also consistent with our hypothesis: seismic response of gas bearing sands should be attenuated for higher frequencies, whereas stratigraphy related anomalies are not frequency dependent. Similar results were presented for the El Dorado field in Bolivia, with successful drilling outcomes, by A. Arias (*2013. Atributos sísmicos y el desarrollo del campo Dorado. Memorias de XIX Congreso Geológico Boliviano. P99-102*).

Our conclusion was that the anomaly seen in all the amplitude extractions and Spectral Decomposition maps was very likely related to gas bearing sands. Since the seismic quality in this area is poor it was not appropriate to perform a more quantitative approach, nonetheless, the outline of the anomaly was used qualitatively as the field extension for development planning.