[PS]Searching for Shallow Gas - A Geohazards Workflow in Kingdom*

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Abstract

Within the Norwegian Continental Shelf (NCS), there is a constant pressure on subsea operations, as oil and gas discoveries are attempted and achieved. A geohazards study is necessary prior to any subsea operations, especially the ones involving a platform onset or drilling operations. Shallow gas is a major problem in the NCS and therefore it remains the focus of a geohazards study within this area. IHS Kingdom® software provides several tools to analyse shallow gas from seismic 2D and 3D data.

Workflow

To characterize shallow gas we need a detailed study of amplitude anomalies in terms of magnitude, geometry and distribution. We would like to show two different approaches to do this:

(1) A quantitative approach, where we can extract amplitude anomalies from a given interval with the Volume Attribute Calculator.
(2) A qualitative approach, which is important if we want to have a regional view and to understand the big picture. We will use the combination of our 3D module (VuPAK) and Rock Solid Attributes to visualize the amplitude anomalies in different ways, in the aim of better understanding their geological meaning.

(1) A Quantitative Approach, Extracting Amplitude Anomalies from a Given Interval

The objective is to scan a seismic dataset for high amplitude anomalies that may represent accumulations of shallow gas. First we need to define an interval with high amplitude anomalies.Then we can pick the brightest reflector as a reference to define the interval. It is advised to use 3D Seeker+ (the Kingdom autopicker based on the Illuminator[TM] technology) to optimise the quality of the picks. Then we proceed to the anomalies extraction-

Amplitude Anomalies Extraction

The function vatABS from Kingdom Volumen Attribute Calculator will scan the amplitudes and retain the largest positive or negative amplitude within the given interval. The Kingdom Extended Math Calculator provides numerous functions that can be applied to horizons and grids. In this case the Abs function is chosen on the vatABS horizon (Abs(x); x=vatABS horizon). The output is a chart showing the Absolute amplitude anomalies within a given interval (Figure 1).

(2) A Qualitative Approach, Understanding the Big Picture

The objective is to better visualize and understand the amplitude anomalies through 3D view and seismic attributes. Seismic attributes will extract more information out of the seismic data and therefore help us to perform a better seismic interpretation.

Kingdom Rock Solid Attributes computes and outputs numerous physical and geometric attributes from seismic data. As many as 54 attributes can be generated, including similarity and spectral decomposition.
To study shallow gas we have chosen 2 main attributes: Dip of Maximum Similarity and Trace Envelope.

Dip of Maximum Similarity
Calculates Similarity and Corresponding Dips as Lateral Continuity Attributes. Higher values of Similarity are indicative of high degree of lateral similarity of depositional environment, therefore Dip of Maximum Similarity is often used to map structural discontinuities.

Trace Envelope
Trace Envelope represents the total instantaneous energy of the complex trace independent of the phase. The envelope relates directly to the acoustic impedance contrasts, hence reflectivity. It may represent the individual interface contrast or, more likely, the combined response of several interfaces, depending on the seismic bandwidth. It is often used to map gas accumulation and bright spots, but also sequence boundaries or major changes of depositional environments, thin-bed tuning effects, unconformities, major changes of lithology, local changes indicating faulting, and spatial correlation to porosity and other lithologic variations.

Rock Solid Attributes in 3D (Vupak)

The combination of VuPAK and Rock Solid Attributes provides many possibilities to visualize amplitude anomalies, adding valuable information and insight to the interpretation. VuPAK will allow us to visualize the amplitude anomalies in their spatial context. Rock Solid Attributes will allow us to understand their rock nature context, in this case we are able to compare the gas amplitude response of an event (Trace Envelope) with its geological structure (Dip of Maximum Similarity).

Finally, the ability to co-blend these two attributes in VuPak will allow us to see the amplitude anomalies location merged together with a structue map (Figure 1), most of the anomalies appearing confined within discontinuities. We can conclude that calculating and co-blending these two attribute helps to understand the origin of these anomalies and also their potential danger.
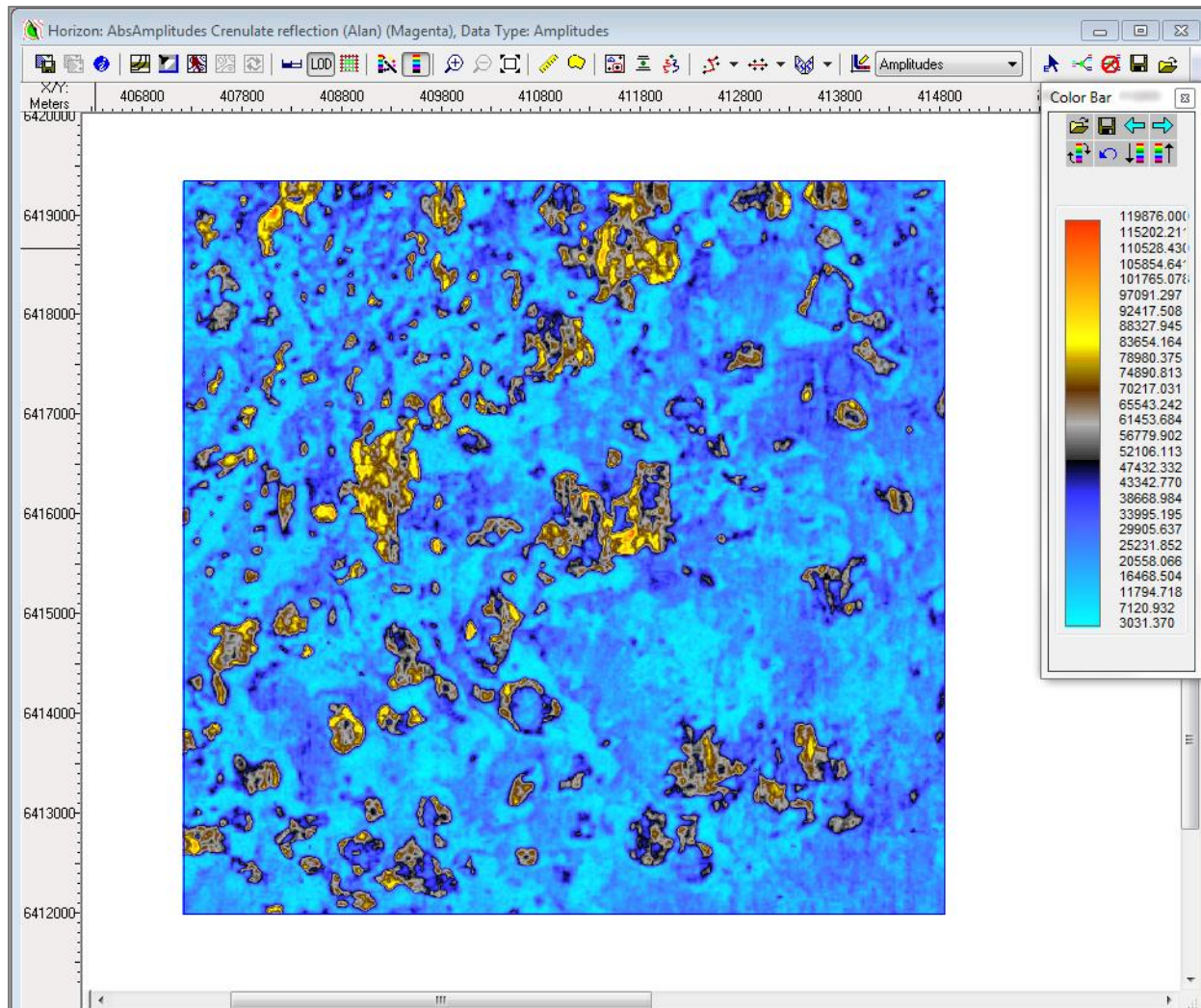
Acknowledgements

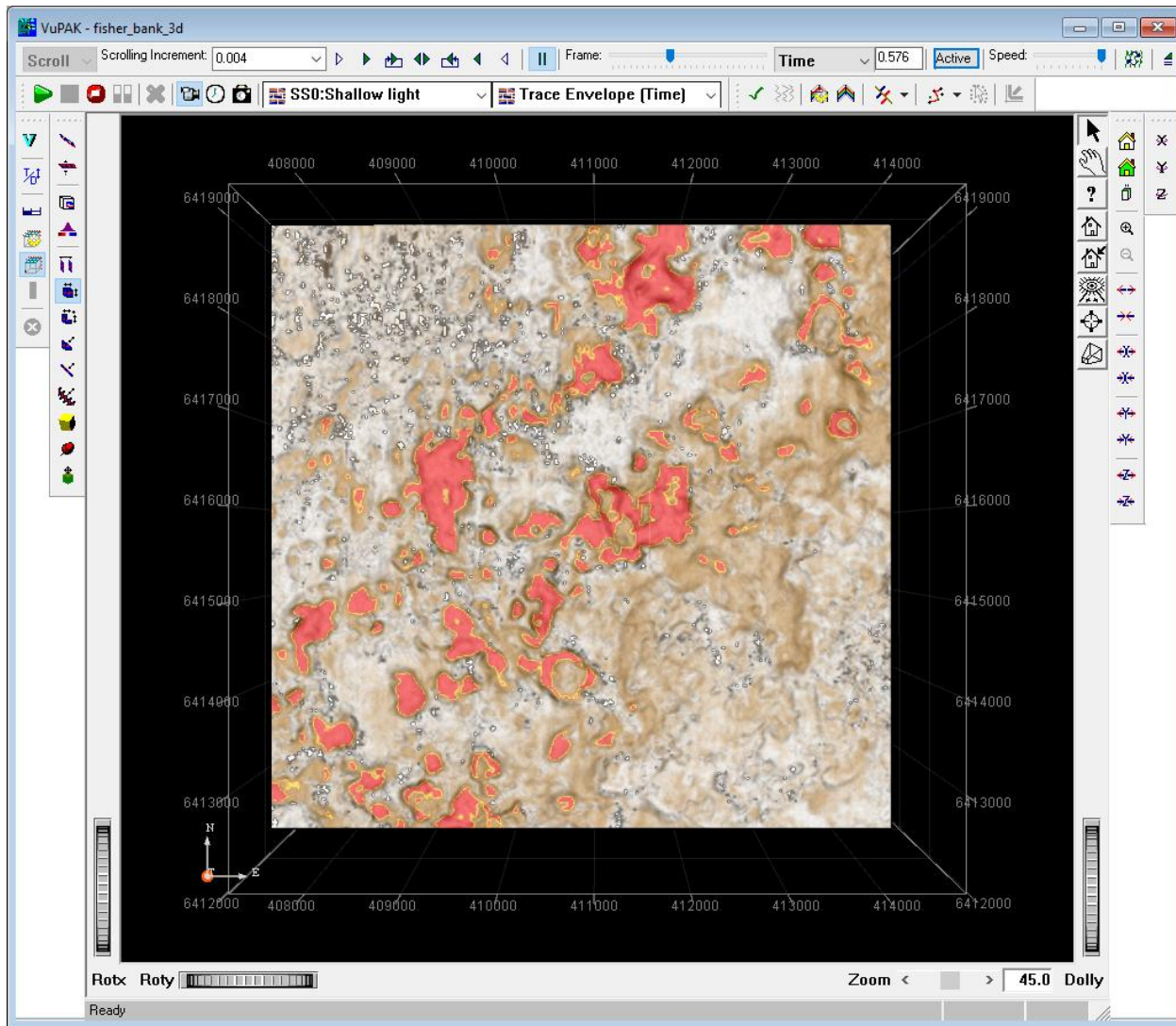Figure 1. Calculating the absolute amplitude value within a given interval.

Figure 2. Co-blending two attributes: Dip of Maximum Similarity and Trace Envelope