Enhancing Seismic Data Resolution by Integrating Seismic Spectral Blueing and Reconvolution of Thin Bed Reflectivity Techniques: A New Approach to Resolve Thin Beds Pay Zones

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Abstract

There has always been a controversial issue around revealing sub-seismic geological features using seismic data. In fact enhancing seismic data resolution through broadening the frequency bandwidth of seismic data is desired by geoscientists at all times. Obtaining a broader seismic bandwidth is not limited to acquisition and processing steps such as High Resolution seismic, 3D VSP in acquisition or deconvolution and spectral shaping in processing. Instead, broadening as well as other techniques which help improving the seismic interference issue are tried in imaging and interpretation steps. Spectral blueing using well data, Geostatistical inversion, spectral decomposition methods by wavelet transformation, tuning cube calculation and color blended display are among the most predominant techniques utilized for this purpose. However, some of these techniques are case dependent and others should be used with care as they have tendency to boost high frequency noises and introduce some false geology.

To reduce uncertainties the algorithm is preferable which results in optimizing the vertical resolution without boosting noise. Integrating different techniques and their advantages could help in achieving this goal. In this study an integration of spectral blueing and reconvolution of thin bed reflectivity techniques is proposed and applied to delineate thin bed pay zones of oil bearing sand patches. The results shows that the Blueing-Reconvolution Integration (BRI) approach is more capable to enhance the seismic resolution and map the thin bed pay zones than each technique separately. Cross validation with well information proof the results. The reservoir in the studied oil field includes thin oil and water bearing sand patches where the continuity prediction of the oil bearing sand patches is a crucial stratigraphic aspect of the static modeling. Seismic data is the only laterally extended data which can be used to map the distribution of the patches, however there are resolution (both vertical and horizontal) as well as data quality limitations. To overcome the issue, a new advanced technique using both spectral blueing and thin bed reflectivity (Blueing-Reconvolution Integration technique (BRI)) were utilized for detection of thin bed pay zones. The technique is based on a careful broadening of the seismic frequency bandwidth together with minimizing the effect of wavelet interference during reflectivity Reconvolution which enhances the vertical resolution below the tuning thickness.