Modeling Multiples at Well Locations and Attenuating Them from 3D Seismic Data Using Adaptive Subtraction, A Case Study From Lower Indus Basin

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Abstract

Reflection seismic data contains a portion of energy referred to as multiples. This energy has bounced multiple times back and forth between boundaries of acoustic impendence contrast. There can be surface related multiples or interbed multiples.

Contamination of seismic data by multiples has traditionally been a constraint for mapping and delineating subsurface features with confidence. The interbed multiples, in particular, pose a serious problem in land seismic datasets. The various algorithms have been introduced to discriminate these multiples from primary reflections and to subsequently remove them from seismic data. Thus, various discriminatory attributes have been utilized for this differentiation; for example, the difference in move-out has been capitalized in many algorithms, such as those often-used algorithms based on radon de-multiple technique. However, such discrimination is not always achievable due to the comparable velocities of multiple and primary reflection events; this is even a more pronounced issue in areas with more or less flat geology.

In this paper, we present a case study based on a deterministic approach that involves ray trace modeling using 1D-Elastic Model at well locations, to obtain information on velocities for primaries and multiples and to identify the main multiple generators. This information is used in seismic data processing for multiple identification and attenuation using adaptive subtraction.

Huge computational effort is required in the 3D implementation of this workflow, involving each trace for each multiple generator, as each source receiver trace pair is convolved and then correlated with every trace in the gather. This reflects in a relatively heavier price tag than conventional processes, which in the overall scope of exploration budgets is an insignificant cost, whatsoever.

However, as is the case with many other advance seismic data processing techniques, the value addition it can bring to the seismic data has so far not been fully appreciated; as such, the utilization of this technique has so far been non-existent on any dataset from Pakistan. In this study, a workflow for the above mentioned multiple attenuation technique is tested and its benefits are highlighted, particularly in reference to the great untapped oil and gas potential of the Lower and Middle Indus Basin of Pakistan.