Chasing the Holy Grail: Taking Stock of True Amplitude Imaging in an Era of Rapid Seismic Technology Improvement

Bill Shea, Stephane Perrier, Andreas Rasmussen, Peter Harris[1], Cyrille Reiser[2]. [1]Sharp Reflections, Stavanger, NO, [2]PGS Weybridge, UK.

The past decade has seen dramatic advances in marine seismic acquisition and depth imaging, with new technologies improving image quality, at reduced cost and with faster turnaround. Newer multi-sensor towed streamer and seabed seismic acquisition methods yield higher channel counts and enable full wavefield separation, increasingly with full-azimuth illumination. New broadband processing flows utilize this full wavefield to generate volumes with richer high and low frequencies and better resolution.

At the same time, the industry has rapidly moved towards a multi-client business model. Relatively large surveys are acquired for several companies, often with different objectives. “Amplitude-preserved” processing techniques are generally applied to these large new seismic datasets. Nonetheless, the AVO/AVA characteristics of final migrated gathers can be challenged to match those of synthetic gathers from wells. In this context, is newer always better?

The Norwegian Continental Shelf offers a rich library of overlapping 3D marine multi-client seismic surveys of different vintages, with different acquisition and processing parameters. These surveys are the primary source of seismic amplitude data for APA licensing rounds. We use migrated gathers from several vintages of PGS multi-client data with both conventional (MegaSurvey+) and acquired broadband (GeoStreamer) acquisition to track the evolution of amplitude quality with time, and assess AVA reliability.

The study was carried out in the North Sea Central Graben, near the UK/Norway border. In an effort to achieve an objective comparison, we apply similar post-migration data conditioning workflows to all surveys, with an aim toward generating AVO-compliant gathers. For each dataset we assess amplitude quality by comparing pre-stack amplitudes to synthetic gathers at key wells. We also compare quantitative AVA attribute response and “one-step” pre-stack seismic inversion for lithology-fluid for the different surveys, to understand the impact of amplitude integrity on geophysical end-products used for prospect assessment. Results suggest that careful, post-migration gather processing is still required to “harvest” the improved amplitude signal on newer data.