Full-Fidelity Real-Time INTERPRETATION

Rapid advances in computing power and increases in storage capacity are fueling a surge of interest in pre-stack seismic interpretation. Oil and gas companies increasingly demand access to full-fold 3D gathers to assess amplitude response in complex reservoirs, instead of relying on a few partial angle stacks. Sharp Reflections has embraced this sea change, commercializing a rich set of "big data" software tools to quickly QC data quality, boost signal, and quantify amplitudes on pre-stack seismic. Now the company is harnessing in-memory compute power to accelerate interpretation and validate amplitude anomalies on new datasets, with powerful post-stack and pre-stack horizon tools.

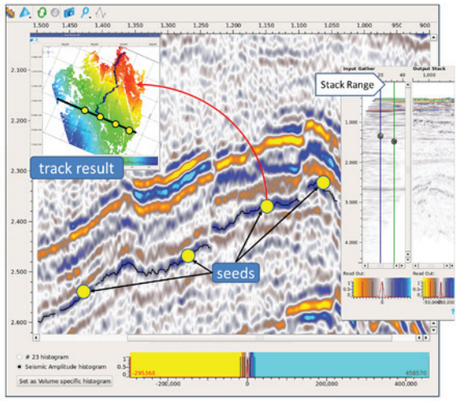

Figure 1. Tracking result from four seed points placed along a single inline, and tracked on "live" mid-angle stack generated in memory from angle gathers. Initial tracking result in shown on map inset, and accurately delineates major inter-reservoir faults. Tracking can be updated instantly after making changes to the stack mute, without first saving stack volume to disk.

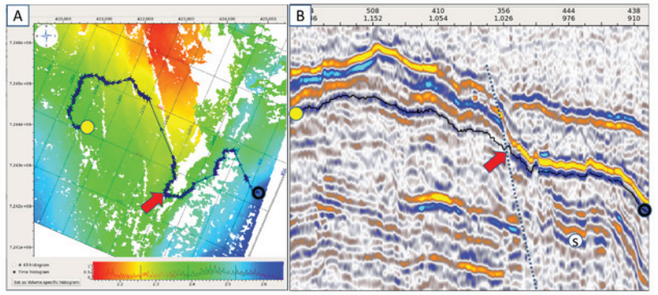

Figure 2. Track-back path from seed (yellow) to tracked point (black ring) on map (A) and section (B), which displays path as arbitrary line. The red arrow identifies the exact location where autotracker bled across a large fault and mispicked a younger event. By setting a new seed (S) on the correct event, tracking errors can be eliminated on the next tracking run.

Fast-track interpretation is a natural extension of Pre-Stack Pro's processing and AVO screening capabilities. Interpreters can quickly pick tops and bases of all potential reservoirs, and examine detailed AVO behavior in 3D. Interpretation spreads from one or more seed points, which can be tracked on any stacked volume (Figure 1). The search algorithm is executed with the entire dataset in memory, and is blazingly fast. Users adjust any parameter and see results in seconds, even on very large volumes. Seeds are logged in an editable table, so any picking error that results from seeding the wrong event can be quickly addressed by deactivating the bad seed.

"The idea to build a new autotracker evolved from really positive customer reaction to our interactive stack tool", explains Sharp Reflections' CEO Bill Shea. Interpreters change inner and outer stack mutes, and watch specific reflections instantly come into focus. "Lundin Norway, one of our R&D sponsors, encouraged us to develop a tool that could track events on these "virtual volumes", and treat the mute as another parameter. " They provided a development grant, helped define the technical specification, and evaluated early prototypes on their own data. The new horizon toolkit was launched at the 2014 EAGE convention in Amsterdam, and is included in the latest Pre-Stack Pro 4.0 Release.

Advanced QC and editing tools simplify error identification and correction. A unique track-back feature allows users to view tracking paths as arbitrary lines, which are created automatically by pointing to any tracked point on a map. This helps identify the root cause for mispicks, which usually occur in specific 3D locations (Figure 2).

The toolkit also contains automated and manual editing, spike filtering, and gridding tools, to prepare the stacked horizons for more detailed pre-stack work.

With the 4.0 Pre-Stack Pro release, Sharp has added a 4-dimensional “pre-stack” horizon object to the data structure. Stacked horizons can be snapped or tracked on gathers, filtered, and stored in the project (Figure 3). For complex AVO events that show polarity reversals, two different post-stack horizons (e.g. near and far) may be used as guiding seed. All amplitude maps and AVA attributes can be quickly extracted from a single set of angle gathers, and displayed as a series of map layers.

The pre-stack amplitude extraction tools are tightly linked to cross-plots (Figure 4). Sub-regions defined by polygons in either map or cross-plot space can be broadcast to the other viewer to identify the location of hydrocarbon fluids or distinct lithology classes. Cross-plot displays can be used to generate custom attributes which optimize the definition of DHIs.

The new tools are already reducing interpretation cycle time in significant ways, and Sharp has added fast-track interpretation to its data analysis workshop service. Interpreters can pick several events on raw stacks, in just a few hours. Following pre-stack data conditioning, the same seeds can be used to retrack on new volumes, and assess the impact of noise removal on tracking accuracy. Final seed point sets and post-stack horizon results can be output to most interpretation packages for refinement and subsequent surface modeling, to preserve workflow continuity.

Sharp Reflections’ parallel, in-memory software solutions are creating new value from big seismic data, and herald the arrival of real-time, high-fidelity interpretation. Companies that embrace them can confidently seize new exploration opportunities, and optimize their exploration portfolios by drilling more prospects with clear an convincing hydrocarbon indicators.

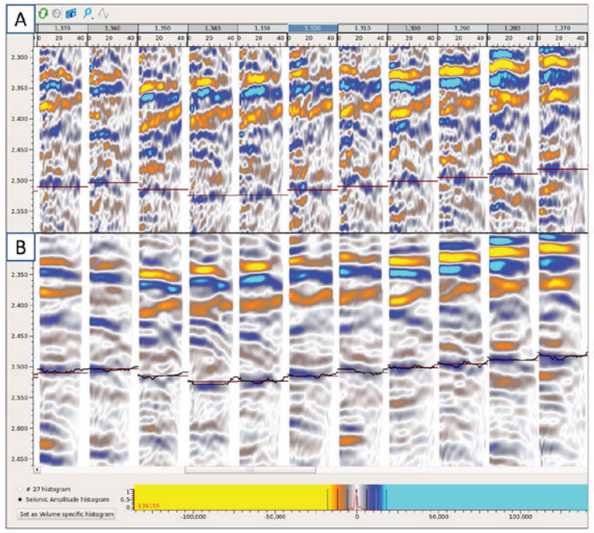

Figure 3. A) Autotracked horizon (red horizontal lines) displayed on raw (A) angle gathers. B) “Extend to pre-sack horizon” result, showing new pre-stack horizon fitted to the same reflection on the conditioned angle gathers. The event has been snapped to the nearest peak, despiked, and median filtered, before amplitude extractions are carried out in 3D.

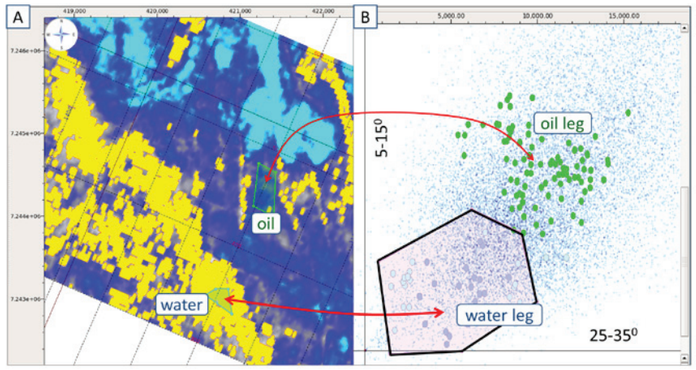

Figure 4. Far-angle (25-350) amplitude map (A) and crossplot (B) from an interpreted pre-stack horizon. Cross-plot compares the near (5-150) and far (25-350) angle amplitudes extracted from map polygons drawn in the oil and water zones of this reservoir interval. A cross-plot polygon drawn around the water-bearing point cloud is used to create a mask (displayed in yellow on A) which highlights all points with a similar amplitude range. Similar displays can be constructed for any pre-stack attribute.