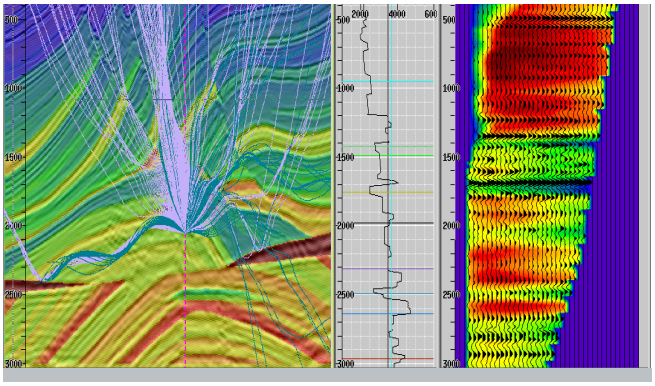
Prospecting for Direct Hydrocarbon Indicators in the Local Angle Domain

An Emerson E&P Software Geoscience Service

Seismic amplitudes and the attributes resulting from measured changes in amplitude across the offset or angle dimension of prestack common image point gathers are used every day as Direct Hydrocarbon Indicators (DHI). As the science of amplitude versus offset (AVO) and angle (AVA) inversion has evolved, so has the use of seismic amplitudes and their success as Direct Hydrocarbon Indicators.

Seismic imaging applications also have a direct influence on the use of amplitudes as Direct Hydrocarbon Indicators, as their ability to preserve and organize amplitudes in migrated prestack data can produce genuine DHI's or false ones. While traditional imaging applications like Kirchhoff migration and Reverse Time Migration are used with amplitude inversions to produce DHI attributes, limitations in amplitude preservation and organization can reduce their usefulness and success.

To provide more reliable DHI's from the seismic method, Emerson E&P Software has developed the Common Reflection Angle Migration (CRAM), a depth imaging solution that simultaneously uses the full recorded wavefield within a controlled aperture to generate amplitude preserved, subsurface angle domain image gathers. The procedure is based on a specially designed point diffracted operator that ensures maximum illumination of the image points from both all subsurface directions and all surface source-receiver locations, where all arrivals are taken into account and amplitudes and phases are preserved. The amplitude preservation qualities of CRAM, combined with the organization of amplitudes in the angle domain, make it ideal for seismic characterization procedures and DHI prospecting.



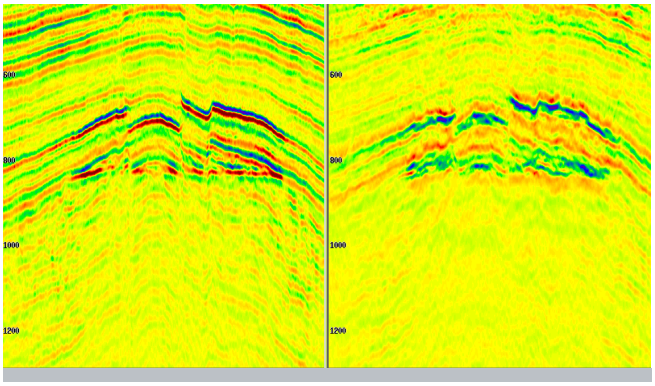
▲ Common reflection angle gather from CRAM. All arrivals are included and all phases preserved. Illumination is included with the gather (background color) as a diagnostic.

Emerson AVA and Local Angle Domain Imaging Solutions

- A seismic imaging and inversion procedure carried out in the local angle domain for high resolution imaging and for AVA operations in search of optimal Direct Hydrocarbon Indicators
- CRAM makes use of a model-based migration aperture which only uses data points in the vicinity of specular rays, for more reliable AVA and DHI attributes.
- CRAM preserves amplitudes and phases even in in complex areas that cause ray triplications and caustics.
- CRAM angle gathers can be simultaneously viewed with poststack data in the Emerson E&P Software interpretation canvas. AVA inversions can be run in real time to evaluate DHI attributes and qualify them with forward modeling.
- The rich Emerson E&P Software library of two and three term AVA inversion solutions and advanced fluid substitution modeling options facilitate the qualification of DHI attributes.

Emerson AVA and Local Angle Domain Imaging Advantages

The Emerson E&P Software Geoscience Services team combines Common Reflection Angle Imaging with AVA inversion and modeling to generate and qualify high-resolution DHI attributes, free from many of the limitations of traditional imaging methods. Emerson interpretation solutions allow customers to work collaboratively with our geoscientists in evaluating AVA inversion parameters and qualifying prospective DHI's, with advanced fluid substitution modeling.



▲ AVA inversion fluid factor as a DHI. Left: CRAM fluid factor; right: Kirchhoff fluid factor.

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