EAGE

SS04

Keynote Presentation - Towards a comprehensive response to pressing E&P challenges: Removing multiples and depth imaging primaries without subsurface information

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SUMMARY

Abstract
The US Dept. of the Interior, Mineral Management Service, reported the drill success rate in 2007, in subsalt plays, as 8% in the deep water GOM. The success rate dropped from 20% to 8% from 2000 to 2007. At 150 million dollars per exploration drill, that comes to over 1 billion dollars per success. And that is not sustainable.

Seismic E&P challenges derive from the violation of assumptions or prerequisites behind seismic processing methods.

We can classify three types of assumptions: (1) the required data, e.g., aperture, azimuth, sampling, completeness/fidelity and type of data collected and/or extrapolated/interpolated, (2) adequate compute capability and resources, and (3) innate algorithmic assumptions or limitations.

Innate algorithmic limitations are not addressable by improved acquisition, azimuth or compute power. A comprehensive and effective response to seismic E&P challenges must begin with a frank and forthright understanding and recognition of all three very different types of assumptions behind seismic processing breakdown, and dry hole drilling. To address each of these three distinct factors behind seismic breakdown requires a very different type of response.

There is a serious danger of defining the problem only in terms of the issues that we know how to address, and hence typically confined to issues concerning data acquisition and compute power. That can be a useful strategy, but on its own does not represent a comprehensive and fully effective response or solution. A comprehensive approach must address all three significant factors behind failure. We recommend starting with the problem that needs to be solved, rather than the problem that we know how to solve.

Among innate algorithmic challenges in seismic imaging (frequently occurring beneath a complex overburden, e.g., subsalt, sub-basalt, sub-karsted sediments and/or at or beneath a complex boundary) is the inability to provide either an adequate velocity model above the target, and/or to be able to adequately back-propagate waves and image through a perfectly known velocity model, e.g., a velocity model with both rapid lateral variation and a wide range of dip angles.

In response, we can choose one of two approaches: (1) to improve the prerequisite satisfaction required of current seismic methods or (2) to develop fundamentally new imaging methods that avoid the assumptions that are behind current seismic capability. Both approaches are reasonable, and we recommend and we assume one or the other of these two attitudes: (1) better satisfy the requirements, or (2) completely avoid the need for the requirements, as our response for different assumptions and issues, and under different circumstances and links in the processing chain. Two examples: (1) We need to seek to satisfy (and cannot avoid) data collection and data extrapolation/interpolation demands of all wave theoretic processing, while (2) the need for subsurface information to achieve multiple removal and depth imaging are, in principle, avoidable.

The inverse scattering series (ISS) has the unique ability to achieve all processing goals, directly, and in precisely the same manner that free surface multiples are removed, i.e., without subsurface information. The ISS is the only methodology that communicates that message. Among processing goals are: (1) free surface multiple removal, (2) internal multiple removal, (3) Q compensation without Q, (4) depth imaging without a velocity model, and (5) direct non-linear AVO. In this presentation, we will briefly review the logic that communicates that ISS potential, and then we will exemplify where we are in the campaign to mine and apply that potential for addressing seismic E&P challenges. Open issues and plans will also be discussed.