# Objective Seismic Insight

*Gregory A. Partyka*
*OpenGeoSolutions Inc.*

## Introduction

There is a wealth of geological insight embedded within seismic data. With its continuous (albeit remote sensing) 3-D coverage, seismic imaging makes for a near-ideal virtual backdrop for subsurface integration and modeling. Careful seismic processing can reveal structure, stratigraphy, rock mass characteristics, and associated morphology and heterogeneity. A key principle of such characterization is to impart as little as possible subjective guidance (i.e. to objectively reveal the geological content without biasing the solutions via preconceived notions). Targeted processing readies the solution space, but it does not facilitate navigation through the dimensionality of information. Effective exploration of the solution space requires something else. It requires comprehensive, intuitive, easy-to-use, real-time visualization that avoids problems associated with data access and data management.

## Targeted Processing

"Targeted processing" refers to the imaging of geologic content that is available within seismic data. It is the generation of seismic imaging products that maximizes resolution and detection of rock mass characteristics, discontinuities, and flexures. It requires (A) inversion to bandlimited realizations of target properties (leveraging AVO content to target and predict relevant rock and fluid properties), and (B) decomposition of each realization into comprehensive sets of descriptive attributes/dimensions that respond to distinct characteristics. The combined attribute sets should ensure that no available geologic content gets missed.

## Data Growth

Such comprehensive attribute characterization leads to tremendous data growth, which if managed traditionally, often leads to a sense of data-overload. Traditional seismic interpretation systems are not geared to deal with such data growth. Databases become unwieldy, due to the sheer volume of computed attributes, problems with data access, and difficulties with data visualization. Functional issues become as demanding as the actual interpretation questions. This leads to a shift in focus for the interpreter - from exploration and discovery to coping and managing. Corners are cut, and subsurface investigations become more subjective, more rigid, and follow paths of investigation that are more hard-wired. The data space becomes overwhelming, anomalies go unnoticed, and decisions are made based on an incomplete exploration of the solution space.

## Comprehensive, Intuitive, Easy-to-Use, Real-Time Visualization

Traditional interpretation/visualization solutions are geared towards detailed (surgical) subsurface work. They require expert knowledge not only related to the subsurface science, but also related to preparing the data, loading the data, scaling the data, rendering the data,

displaying the data, and the tedious mechanics associated with using the interpretation/visualization software itself. Hardly ever, will everyone on the multi-disciplinary team, be an expert in all aspects of this. Prominent seismic interpretation software providers have continued with incremental improvements, but many bottlenecks remain and get in the way of instant access to data exploration and investigation. There will always be a need for individuals to dig into the intricacies of full-fidelity datasets within traditional interpretation software, but that very discipline-specific expert-effort does not address the critical, front-end-loaded multi-disciplinary exploration and discovery.

The solution proposed here, is to pre-render a comprehensive, "ready-to-display", web-based, cloud-ready, library of subsurface images that capture the complete set of seismic inversion and attribute products in a navigable fine-grained manner. This approach makes the seismic characterization instantly and intuitively available (via a web browser so there is no new software to learn). There is no need for the time-consuming prep that is traditionally required when visualizing seismic data via today's seismic interpretation and visualization software. This "image-library" approach bridges the gap between processing and interpretation by providing a comprehensive pre-rendered backdrop for subsurface investigations. It allows the team to fly through their virtual subsurface within minutes of getting access to the image library. It makes it possible to explore and investigate a pre-rendered virtual subsurface (in its full dimensionality, captured at one pixel per bin), in near real-time, without the bottlenecks and delays associated with reading, parameterizing, processing, and rasterizing of seismic data. It allows you to jump right into the data, and objectively visualize, explore, and geo-reference geological components, in a way that requires no additional prep time and ensures nothing important is missed.

## Summary

Data growth associated with seismic inversion and characterization can easily overwhelm end users. Painless data access, presentation, and visualization are just as important to the act of interpretation, as the content itself. To maximize interpretational insight that seismic can provide, requires: (1) targeted processing (i.e. careful and comprehensive inversion and attribute decomposition), and (2) comprehensive real-time visualization that avoids problems associated with data access and navigation through the solution space. Both aspects are equally important. The targeted processing, reveals the breadth of geological details that are embedded within the seismic signal. The comprehensive real-time visualization makes it easy to explore the attributes that make up the solution space. The ability to quickly investigate and extract the embedded geological content in a non-overwhelming way, is just as important as the processing products themselves.

**References**

Partyka, G., 2017, Seismic processing and analysis in service of interpretation. SEG technical Program Expanded Abstracts 2017: pp. 5261-5266. https://do.org/10.1190/segam2017-17675881.1
Partyka, G., 2019, Bridging to a Big Data World, SEG New Advances in Seismic interpretation Workshop Abstract.