

RECENT TRENDS IN OFFSHORE EXPLORATION: MORE DATA, LESS MODEL**Guillaume Cambois & Maz Farouki**

Petroleum Geo-Services; maz.farouki@pgs.com

New marine acquisition techniques – such as wide- and multi-azimuth, over-under and dual-sensor – provide additional data that complement conventional narrow-azimuth towed streamer data. These new data help reduce uncertainties in velocity model building and ultimately lead to a more accurate image of the subsurface.

It is a well-known aspect of the general inverse theory that ill-posed problems need additional constraints to be resolved. These constraints often take the form of an a priori model from which the solution is required not to differ too much. This model represents an initial guess that must obviously be close to the exact solution if we want the correct answer. An alternative approach is to collect more independent data to reduce the under-determination of the system.

Imaging in complex geology where pre-stack depth migration is required to correctly reveal the subsurface structure is such an ill-posed problem. Common exploration targets include sub-salt, sub-basalt, and beneath gas plumes. The complex structures and the high velocity contrasts in these regimes combine to diffract seismic waves in all directions. The little energy that gets recorded by the relatively small

streamer spread does not contain enough information to fully reconstruct the complex structures. In addition, noises (such as multiple reflections) further distort the already weak signals. Consequently, imaging in these complex geology regimes leaves a lot to interpretation.

To reduce under-determination more independent data must be collected. The industry started to gradually increase the streamer spread, reaching typically 9km in length and up to 1.3km in width. This comparatively small width was first addressed by acquiring surveys in multiple directions. Later techniques extended the width using additional source vessels. An alternative approach is to acquire ocean-bottom seismic, which provides wide-azimuth as well as potentially multi-component data, but at a significantly higher cost.

Recent developments, such as dual-sensor streamer and 3D over-under gather more independent data and offer a no-compromise bandwidth extension on the receiver side. On the source side, over-under and multi-level arrays also increase low-frequencies without loss of high-frequencies.

The methods listed above will be further developed and illustrated with various examples from around the world.