
Subsalt Imaging: beyond depth migration and model building

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Large hydrocarbon reservoirs are located below salt bodies in several areas of the world, such as the Gulf of Mexico, the Persian Gulf, and offshore West Africa. In these areas, economical recovery of the hydrocarbons depends on our ability to image the reservoir with seismic data. Seismic imaging below salt bodies is a challenging task that pushes the limits of current imaging methods. The difficulties are associated with the complexity of the wave-propagation phenomena that occur when the seismic wavefield interacts with the salt body (e.g. multi-pathing, scattering, mode conversion) and with the structural complexity of the salt bodies and the target reservoirs.

The routine use of 3-D prestack depth migration, and in particular of wave-equation migration, had a positive impact on many exploration projects. However, simple migration has difficulties to produce artifact-free images where the salt geometry prevents an even illumination of the subsalt reflectors from surface data.

A promising research direction is to go beyond simple wave-equation migration and instead iteratively invert 3-D wave-equation operators. I will illustrate this idea by describing two research projects. The first project aims at improving the image of poorly illuminated areas by inverting a 3-D one-way wavefield operator. The second project developed a robust Migration Velocity Analysis (MVA) method based on wave-equation operator, that can be used where conventional ray-based tomography fails. This method bypasses the difficulties involved in tracing high-frequency rays through a complex salt body and accurately models finite-frequency wave propagation.
