WAZ and WEM velocity model building

Guest editors Christian Hanitzsch, Wim Mulder and Rob Wervelman, introduce this thematic set.

New wide-azimuth (WAZ) seismic data acquisition techniques have recently opened up opportunities for exploration, allowing improved imaging below complex overburdens. Most surveys so far have been acquired in the Gulf of Mexico, but multi-azimuth techniques are also of high interest for the North Sea and other regions. As the large data volumes pose a challenge for traditional migration and model building workflows, they provide an incentive for the development and application of new geophysical concepts, mostly based upon the wave equation. The dedicated session on Wave Equation Migration (WEM) and Wide-Azimuth Velocity Model Building at the 71st EAGE Conference & Exhibition in Amsterdam aimed at bringing data and methods together, and drew a record attendance. The five papers included in this set provide a summary of progress in the area.

Houbiers and Thompson present the results of a modelling exercise and a field trial at Heidrun, an oil and gas field offshore Norway in a complex geological environment. Synthetic data obtained by one-way and two-way wave-equation modelling supported a survey design with an increased crossline offset range and larger fold. A coil shooting field trial confirmed the expected improvement and provided images that suffered less from noise and multiple energy than conventional streamer data. Audebert et al. discuss one-way WEM and velocity analysis based on such a propagator. Gathers obtained by WEM can be treated by classical means, similar to ray-based or beam-based approaches. Focusing at zero subsurface offset is an alternative that does away with picking, but requires primaries-only data. Higginbotham et al. employ a time shift instead of a lateral subsurface shift to define focusing of the WEM image. The velocity model is correct if focusing is best at zero time shift.

Full waveform inversion (FWI) using low-frequency WAZ data allows for a dramatic improvement of the velocity model in the shallow subsurface. Sirgue et al. describe the application of the method to OBS data acquired over the Valhall Field. The resulting velocity model not only captures far more geological details, but at the same time significantly improves the wave-equation migration image. Plessix and Perkins reach a similar conclusion after applying FWI to an OBS dataset from the Gulf of Mexico.

