SS25

Keynote Presentation: Subsalt Imaging by Image-Domain Target-Orientated Wavefield Inversion

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SUMMARY

The past few years have seen dramatic improvements in our capabilities to image targets below complex salt bodies. The routine acquisition of wide-azimuth data both on land and marine (either by multi-vessel streamer acquisition or by ocean-bottom seismometers) has substantially improved target illumination and reduced multiples-related noise. The capability to perform large-scale reverse-time migration (RTM) is enabling the industry to take full advantage of wide-azimuth data. However, two main obstacles are still hampering subsalt imaging: 1) poor and uneven illumination and 2) velocity estimation, particularly in the subsalt regions and in above-salt minibasins.

These two problems are tightly interrelated and should be addressed together by an integrated wavefield-inversion approach that fully uses all the information present in the recorded wavefield (i.e. phase and amplitude) and our knowledge of the actual data-acquisition geometry. This integration is easier when both the illumination-compensation and the velocity-estimation problems are solved in the image domain. Furthermore, image-domain methods lend themselves to target-oriented solutions that are practical now, notwithstanding the huge computational cost of wavefield-inversion methods. I discuss two examples of target-oriented wavefield inversion applied to velocity estimation and illumination compensation.

The velocity-estimation method that I present is well suited for subsalt imaging because it enables the performance of target-oriented wave-equation migration velocity analysis under a complex, but possibly known, overburden. Starting from a poorly focused image we model a new data set that is drastically reduced in size compared with the original data set, but preserve all the velocity information in the original data. The data-size reduction makes possible the application of accurate, but computationally expensive, wave-equation migration velocity analysis to update migration velocity in the target area.

The application of linearized waveform inversion compensates for poor illumination of subsalt reflectors and reduces migration artifacts caused by uneven illumination. Linearized waveform inversion can be applied either in the data domain (by data fitting through iterate modeling and migration) or in the model domain (by inverting a pre-computed approximation of the Hessian). I show how model-domain inversion is effective for subsalt imaging in areas of poor illumination and for reservoir monitoring by time-lapse seismic when new production facilities (e.g. platforms) hamper the survey-geometry repeatability.