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Abstract

Objective/Scope: De-primary reverse time migration (dpRTM) aims at removing false structures in RTM images due to complexities/inaccuracies of the migration velocity model. However, an interesting side effect of this new technology is the missing of steep-dip flanks in its images. We propose a novel flank-preservation de-primary reverse time migration (FPdpRTM) technology that allows to remove the false structures in the final image and preserves the steep-dips.

Methods, Procedures, Process: We first analyse the mechanisms used by reverse time migration to image a flat reflector and a steep-dip reflector, and then point out the root cause of the missing flanks in dpRTM. We further propose a modified imaging condition in FPdpRTM as its remedy, which is to adopt one more partial upgoing source wavefield in the imaging condition compared to that of dpRTM. We use a realistic velocity model which has a salt diapir to compare the image quality of dpRTM to that of FPdpRTM in order to demonstrate uplift gained by FPdpRTM.

Results, Observations, Conclusions: We first use a stair step model to illustrate the correctness of our newly proposed imaging condition in FPdpRTM. The vertical flanks, missing in dpRTM, are nicely recovered. We next carry out a comprehensive case study of FPdpRTM using a realistic complex velocity model, and both the true velocity and a much smoothed velocity model are used as the migration velocity models for dpRTM and FPdpRTM. Results from this case study convincingly demonstrate that FPdpRTM not only maintains the capability of dpRTM to remove false structures in the RTM image, but also preserves the steep-dip flanks of the subsurface structures which are missing in the dpRTM image. Furthermore, we also analyse how to deal with the low-frequency image noise in the result of FPdpRTM, how its computational efficiency compares to that of dpRTM, and how to calculate a suitable partial upgoing source wavefield in FPdpRTM. We believe flank-preservation de-primary reverse time migration is a solid contribution to the seismic imaging toolbox.

Novel/Additive Information: False structures are a big challenge in RTM, and their proper removal is of high value to seismic interpretation. Although de-primary RTM removes false structures successfully, it also removes all steep-dip flanks of the subsurface structures. We propose a modified imaging condition which accommodates a partial upgoing wavefield to fix this side effect. This new algorithm, FPdpRTM, maintains the de-primary effect and preserves steep-dip flanks of subsurface structures.