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High-resolution seismic imaging for CO2 storage site assessment

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3D seismic imaging is considered as one of the key investigation and monitoring techniques in the frame of CO2 underground storage. The knowledge about the geometry and the structure of the reservoir including its fault inventory is a prerequisite for a reliable assessment of storage capacity and safety. The recent development of advanced seismic imaging and inversion techniques directly suggests their exploitation in order to achieve these aims.

We present one of these developments, 3D Fresnel-Volume-Migration (FVM). This technique is an extension of Kirchhoff-Prestack-Depth-Migration (KPSDM) and restricts the smearing of the wavefield along two-way-traveltime isochrons to the actual reflection/diffraction point using the concept of Fresnel volumes. The necessary information to perform this restriction is the emergence angle at the receiver, which is obtained from local slowness estimates using slant-stack or cross-correlation techniques.

The method has been applied to the 3D SEG/EAGE salt model data set as well as a real 3D seismic data set from a potential CO2 storage site. The results show that FVM yields images of superior quality compared to KPSDM, both in terms of resolution as well as the suppression of artefacts. Therefore the quality of the resulting FVM images provide an excellent basis for further studies with respect to reservoir assessment and monitoring.