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Prestack depth migration for 3D offshore methane hydrates data

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One of the indicators for the existence of methane hydrates on seismic data is BSR (bottom simulated reflector), which shows the base of the gas hydrate stability zone. It shows a reversed phase polarity compared to that of the water bottom reflections and high amplitude reflections. It is well known acoustic velocity decrease at the contact between gas hydrates and free-gas-bearing sediments. Prestack reverse time migration (RTM) is a method for imaging the subsurface in depth domain using inner product of source wavefield extrapolation in forward and receiver wavefield extrapolation in backward. It is widely used for imaging the complex subsurface structures with keeping amplitude. We applied RTM to 3D offshore seismic data for methane hydrates exploration. The study area is 12 x 25 km with 120 survey lines offshore. The shot gathers were acquired with 2 streamers and each one has 240 channels. Shot and receiver spacing is 25 m and 12.5 m. The line spacing is 100 m. Near offset is 150 m and maximum far offset is 3137.5 m. The record length is 7 second with a sampling rate of 1 ms. Shot gathers after resampled with 4 ms were processed to enhance signal to noise ratio using conventional basic processing such as amplitude recovery, deconvolution, and band-pass filtering. Interval velocities which were calculated from conventional stack velocities were used for velocity model for RTM. The basic-processed shot gathers and a velocity model were used for input data to obtain 3D image using RTM. For RTM, 20 Hz Ricker wavelet were used and grid size of x, y and z direction is 20x20x20 m. The total number of shot gathers is 176,387 and every 10th shot gather was chosen for reducing computer times and storage. The result is 3D image with inline, cross-line and depth slice image. High amplitude events are shown around (6 km, 4 km, 2.3 km) of in-line image. Each depth slice shows amplitude variation according to different depth steps. Especially channel structure variation are shown at (13 km, 20 km, 4km) of depth slice. If we get more correct velocity model and use high frequency source wavelet, we could get more clear 3D image in the depth domain.