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Application of stacking techniques to 3-D wide-angle reflection and refraction data from Southern Norway

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In 2007, seismic wide-angle reflection and refraction data were acquired along three profiles in Southern Norway in the project “Magnus Rex”. Seismic waves were recorded both inline and crossline which makes 3-D interpretation feasible as supplement to 2-D interpretation. Due to the variable coverage, we chose a modeling approach which has been successfully applied to sparse 3-D wide angle data from the Eastern Alps.
It is difficult to assign the correct seismic phases to the observed arrivals on cross-line profiles. Therefore, signal detection and stacking routines are applied to the traces in order to enhance Pg and PmP phases, and to simplify the wave field. Signal processing includes trace equalization, bandpass filtering and short term average to long term average event detection in case of the Pg phases. Furthermore we exclude traces without significant signal by quality control prior to stacking. The traces are sorted to CMP gathers assigned to cells specified on a regular grid. Static corrections and an offset dependant time correction, which accounts for an average velocity-depth function obtained from previous 2-D investigations, are applied to the CMP gathers. By this approach the Pg phase is horizontally aligned and is further stacked in offset bins, which allows for derivation of a 1-D travel time curve for each cell. The travel time curves are inverted for local velocity-depth functions and are finally interpolated to a 3-D velocity model.
PmP phases are analyzed to obtain information on Moho depth. The traces are again CMP sorted to cells. The influence of the varying velocity distribution in the upper crust is overcome by advanced static corrections which also consider the change of ray geometry. Normal moveout velocities are calculated from the 3-D velocity model, and the PmP phases are stacked. Two way travel times are picked from the PmP stacks, and are converted to depth. We present first results from the 3-D approach, and discuss their significance and new insights in relation to the results from prior 2-D interpretation.