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Seismic reprocessing of 2D marine seismic reflection data from the Baltic Sea

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Large quantities of seismic reflection data acquired in the Baltic Sea before 1990 exist. Several decades later, it is common that these datasets are considered to be obsolete. However re-processing these data using modern technology can provide significant uplift in the quality of the final product. As highlighted by this study, opportunities to extract additional subsurface information from these historical data at a relatively low cost are significant.

In this study, several historical 2D seismic reflection lines from different vintages acquired between 1970 and 1990 in the Baltic Sea have been re-processed from raw shot gathers using current techniques and computer hardware. A significant uplift has been achieved in pre-stack gathers and the final stacked images when compared to the original processing. As a result a more confident interpretation of the shallow crustal sedimentary sequence is obtained, which differs notably from the interpretation of the original data. The potential benefits of seismic data re-processing are wide ranging. However, in this case the reprocessed lines form a small part of a large publicly available historical dataset of 2D seismic reflection data acquired in the Baltic Sea. Reprocessing this dataset could therefore provide valuable information which would be of interest for a number of research areas. These could include the evaluation of the CO_2 storage potential in Scandinavia and the Baltic states, improving the understanding of Baltic Sea geology and evaluating remaining hydrocarbon potential.

The data presented consists of lines from 3 different 2D marine surveys acquired using a single towed streamer. The offset range across all 3 acquisitions is 65m to 1397m, both airgun and water gun sources were used. Receiver spacing across the 3 surveys varied from 6.25 to 50m. The study profiles are located in the Southern Baltic Sea, with two intersecting profiles lying approximately 50km south of Öland and one profile lying 10km to the south east of Gotland. A revised processing flow for these Baltic Sea data has been developed and implemented. This provides general improvements to the processing flow as well as specifically targeting two significant data issues which exist in the original stacked sections. The first is the presence of high angle linear noise which is identified as diffracted multiple energy. This noise is thought to be generated as a result of undulating structure at the top of a layer with a sharp impedance increase located in the shallow subsurface. In this study this noise is successfully attenuated by filtering out negative dips by means of an FK mute applied to shot and receiver gathers. The second issue is multiple energy. In this case, the same sharp impedance increase located in the near subsurface acts together with the seabed to generate significant multiple noise. Deconvolution applied in the Tau P domain is found to be the most effective method for attenuating multiples in this dataset.

This study therefore highlights the uplift in final stacked image and tangible differences in interpretation which can be achieved when re-processing historical seismic data with modern day technology.