Joint pre-stack depth migration and travel-time tomography applied to a deep seismic profile across the northern Barents Sea igneous province

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The mainly Permo-Triassic North Barents Sea Basin is considered as a superdeep intracratonic basin containing over 20 km of sedimentary material. This basin was strongly affected by magmatism attributed to the formation of the Early Cretaceous High Arctic Large Igneous Province. Dolerite dikes, sills, and lava flows are observed in the northern Barents Sea and on the islands of Svalbard and Franz Josef Land. Some dike swarms can be traced over hundreds of kilometers using high-resolution airborne magnetic data. In the North Barents Sea Basin, the dikes fed giant sill complex emplaced into organic-rich Triassic siliciclastic rocks. The sill complex creates a major challenge for seismic imaging masking the underlying strata.

In this contribution, we first perform refraction and reflection travel-time tomography using wide-angle ocean-bottom seismometer data (with receivers deployed every 10 km) along the 4-AR profile (Sakulina et al. 2007, Ivanova et al. 2011). The resulting tomographic model is then used to construct a background velocity model for the pre-stack depth migration. We show that the use of a combined velocity model for the time and depth imaging based on travel-time tomography and RMS velocities constitutes a substantial improvement with respect to a standard processing workflow providing a more coherent seismic structure of this volcanic province. The interpretation of multichannel seismic and high-resolution magnetic data together with P-wave velocity and density anomalies allow to create a model for the system of magmatic feeders in the crystalline basement of the northern Barents Sea region.

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