



Imaging the Deep Galicia margin using three-dimensional full waveform inversion

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Imaging of hyperextended zone and exhumed continental mantle rocks can improve our understanding of the tectonics of the final stages of rifting. In the Deep Galicia margin, the upper and lower crust are coupled allowing the normal faults to cut through the brittle crust and penetrate to the mantle leading to serpentinization of the mantle. Localized extensional forces caused extreme thinning and elongation of crystalline continental crust causing the continental blocks to slip over a lithospheric-scale detachment fault called the S-reflector.

A high-resolution velocity model obtained using seismic full waveform inversion gives us deeper insights into the rifting process. In this study, we present results from three dimensional acoustic full waveform inversion performed using wide-angle seismic data acquired in the deep water environments of the Deep Galicia margin using ocean bottom seismometers. We performed full waveform inversion in the time domain, starting with a velocity model obtained using travel-time tomography, of dimensions 78.5 km x 22.1 km and depth 12 km. The high-resolution modelling shows short-wavelength variations in the velocity, adding details to the travel-time model. We superimposed our final model, converted to two-way time, on pre-stack time-migrated three-dimensional reflection data from the same survey. Compared to the starting model, our model shows improved alignment of the velocity variations along the steeply dipping normal faults and a sharp velocity contrast across the S-reflector. We validated our result using checkerboard tests, by tracking changes in phases of the first arrivals during the inversion and by comparing the observed and the synthetic waveforms. We observe a clear evidence for preferential serpentinization (45 %) of the mantle with lower velocities in the mantle correlating with the fault intersections with the S-reflector.