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Petrophysical properties of eclogite facies shear zones and their relationship to receiver function signals

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The visualization of subducting lithosphere is dependent on geophysical methods such as receiver functions. With this the shallow part of the slab can be imaged clearly while the deeper part often eludes detection due to its insufficient seismic velocity contrast compared to the earth's mantle. Inbetween these two sections a blurry zone can be observed, which is often interpreted as the zone of progressive partial eclogitization of the subducting material. To investigate this blurry zone we chose the island of Holsnøy in the Bergen Arcs of western Norway as a natural analogue. This area is comprised of lower crustal granulite facies rocks, which were partly eclogitized during Caledonian subduction. Partial eclogitization is induced by fluids and can be observed in distinct shear zones as well as statically overprinted finger-like areas. In order to incorporate the structural geometry and relationships of this area into seismic models, the area was mapped and samples for petrophysical analysis were collected. To constrain the petrophysical properties of the rocks at depth seismic velocities were calculated using thermodynamic modelling (Perple_x) as well as Voigt-Reuss-Hill averaging. Both methods yield consistent results for p-wave and s-wave velocities and are compared to ultrasonic pulse measurements of the same samples. These results show clearly that the eclogite facies shear zones observed in the field constitute seismic boundaries with contrasting velocities at depth within subducting lithosphere. Using these results as an input for seismic modelling of different simple case studies, we can reproduce the signals obtained from real receiver function studies and help to interpret the structures at depth.