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using rock physics to reduce uncertainty

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Shear wave velocity – using rock physics to reduce uncertainty

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By stacking recorded wave trains in a graphical strain-time-amplitude domain, we demonstrate that an early shear wave feature marks a converted shear to compressional to shear wave and not the transmitted shear wave. Elastic wave velocities of compressional and shear waves propagating through sedimentary rocks are often coupled with bulk density to derive the rock stiffness. Acquiring the transit time of compressional and shear waves often involves manual picking of wave arrival times from wave trains recorded in the laboratory or by well-logging tools. Picking of the compressional wave arrival time is commonly accepted as straightforward. Oppositely, detecting the shear wave arrival and picking its arrival time is often troublesome because the transmitted shear wave partly converts to compressional waves and back to a secondary shear waves, concealing the transmitted shear wave arrival in the wave train. We illustrate the difficulty of shear wave detection in wave trains recorded on highly porous chalk plug samples from the Danish North Sea Basin in laboratory settings. Wave trains were recorded on plugs dry, Tap-water, or Isopar-L saturated during uniaxial strain compaction. The recorded shear wave trains showed two distinct features, which could be interpreted as the transmitted shear wave first arrival, we denoted them as early and late arrivals. However, as only one feature can mark the arrival of the transmitted shear wave, we propose a disclosure strategy combining a graphical representation of stacked wave trains (Figure 1) with rock physical modelling.

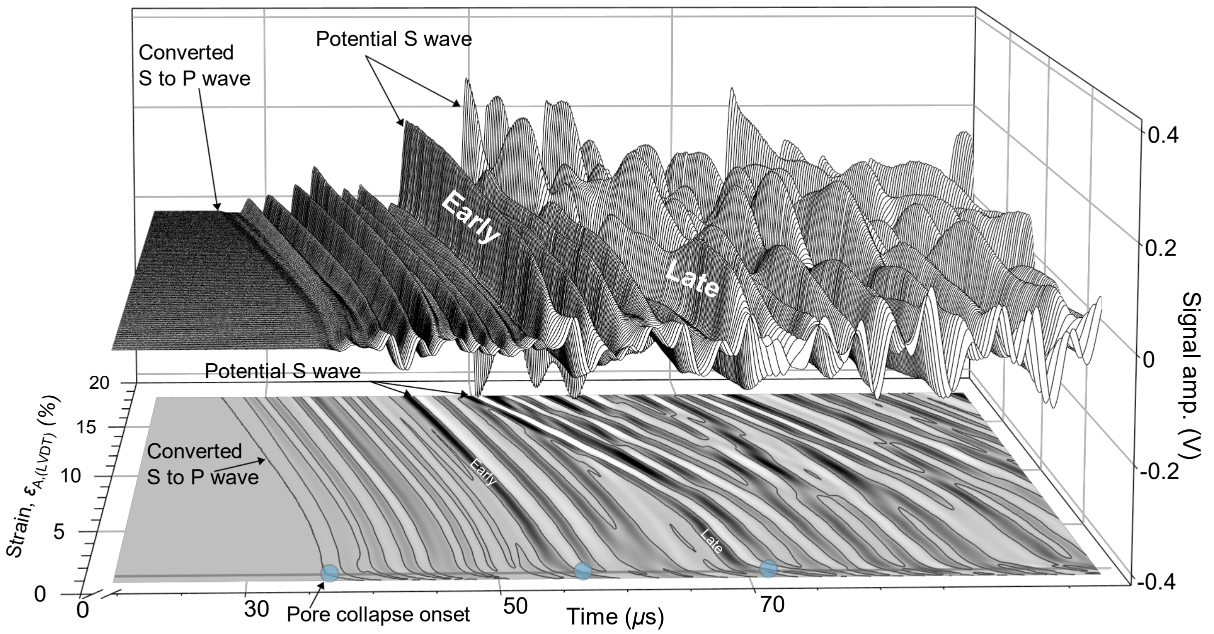

Figure 1 Example of stacked shear wave trains in the strain-time-amplitude domain from an oil-saturated chalk plug tested under uniaxial strain compaction. At the bottom, zero amplitude contour lines are projected.