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Poisson's ratio model derived from P- and S-wave reflection seismic data at the CO2CRC Otway Project pilot site, Australia

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Compressional wave (P-wave) reflection seismic field measurements are a standard tool for subsurface exploration. 2-D seismic measurements are often used for overview measurements, but also as near-surface supplement to fill gaps that often exist in 3-D seismic data sets. Such supplementing 2-D measurements are typically simple with respect to field layout. This is an opportunity for the use of shear waves (S-waves).
Within the last years, S-waves have become more and more important. One reason is that P- and S-waves are differently sensitive to fluids and pore fill so that the additional S-wave information can be used to enhance lithological studies. Another reason is that S-waves have the advantage of higher spatial resolution. Within the same signal bandwidth they typically have about half the wavelength of P-waves. In near-surface unconsolidated sediments they can even enhance the structural resolution by one order of magnitude.
We make use of these capabilities within the PROTECT project. In addition to already existing 2-D P-wave data, we carried out a near surface 2-D S-wave field survey at the CO2CRC Otway Project pilot site, close to Warrnambool, Australia in November 2013. The combined analysis of P-wave and S-wave data is used to construct a Poisson's Ratio 2-D model down to roughly 600 m depth. The Poisson's ratio values along a 1 km long profile at the site are surprisingly high, ranging from 0.47 in the carbonate-dominated near surface to 0.4 at depth. In the literature, average lab measurements of 0.22 for unfissured carbonates and 0.37 for fissured examples have been reported. The high values that we found may indicate areas of rather unconsolidated or fractured material, or enhanced fluid contents, and will be subject of further studies.
This work is integrated in a larger workflow towards prediction of CO_2 leakage and monitoring strategies for subsurface storage in general.

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