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Evidence for varying pore-pressure at the décollement offshore Costa Rica

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The convergent margin offshore Costa Rica is the focus of the investigations within the SFB 574. The main objectives of subproject A2 are the coupling and the mass transfer between overlying and downgoing plate.
We present a detailed seismic study of the near trench plate boundary, just 3 km landward of the Middle American Trench, located between the Quepos Plateau and the Cocos Ridge.
In this area, previously recorded dip-profiles showed a very bright decollement reflection of negative polarity within the first five kilometres landward of the trench. Along strike, the zero-offset reflection strength of the décollement shows a high lateral variability. To further investigate these lateral variations, we deployed ten ocean bottom stations on a profile of 1.5 km length. Due to the shallow depth of the décollement (around 700 m below seafloor), we were able to observe reflected waves at angles up to 55 degrees.
We extracted the amplitude for each reflection and converted it to a real reflection coefficient. Additionally, we calculated the angle of reflection. For each point of the décollement, we obtained reflection coefficients for at least five different angles. By using the Zoeppritz equations, we modelled seismic velocities above and below the boundary. The resulting P-wave velocity of the subducting sediment varied between 1800 and 1950 m/s, while the S-wave velocity varied between 350 and 650 m/s. These large variations can only be explained by differences in the fluid pressure. A comparison with laboratory measurements of unconsolidated sediments showed that the pore pressure must vary between near hydrostatic and 90% of the lithostatic pressure along this profile.