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Direct evidence of high pore pressure at the toe of the Nankai accretionary prism

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The Nankai Trough is a locus of slow slip, low frequency earthquakes and M_w>8 classical earthquakes. It is assumed that high pore pressure contributes substantially to earthquake dynamics. Hence, a full understanding of the hydraulic regime of the Nankai accretionary prism is needed to understand this diversity of behaviors. We contribute to this understanding by innovatively integrating the drilling and logging data of the NanTroSEIZE project. We focus on the toe of the accretionary prism by studying data from Hole C0024A drilled and intersected the décollement at 813 mbsf about 3km away from the trench.

Down Hole Annular Pressure was monitored during drilling. We perform a careful quantitative reanalysis of its variation and show localized fluid exchange between the formation and the borehole (excess of 0.05m^3/s), especially in the damage zones at the footwall of the décollement.

Pore pressure was estimated using Eaton's method on both drilling and sonic velocity data. The formation fluids are getting significantly over-pressurized only a few hundred meters from the toe of the accretionary prism near the décollement with excess pore-pressure (P*≈0.04–4.79MPa) and lithostatic load (λ≈88-0.96 & λ*≈0.1-0.62) contributing to maximum 62% of the overburden stress.

The hydraulic profile suggests that the plate boundary acts as a barrier inhibiting upward fluid convection, as well as a lateral channel along the damage zone, favouring high pore pressure at the footwall. Such high pressure at the toe of the subsection zone makes high pressure probable further down in the locus of tremors and slow slip events.