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Stress states at site C0002, Nankai accretionary wedge, down to 2000 m below seafloor

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The boreholes drilled at site C0002 under the Nankai Trough Seismogenic Zone Experiment project, southwest Japan were used to estimate in situ stress states that prevail in the plate interface region between Philippine Sea plate and the Eurasian plate. The depth covered in this study is from seafloor down to ∼2000 meter below seafloor (mbsf), somewhat shallow compared to the depths of the megasplay fault (∼5000 mbsf) and the plate interface (∼6800 mbsf). However, the shallow stress may reflect some tectonic processes prevailing in this region and may give some insight into tectonic settings. Multiple techniques of borehole observations and borehole tests were used to estimate the magnitudes and the orientations of the stresses. The borehole breakouts in the vertical boreholes indicate a consistent orientation (margin-parallel) of the maximum horizontal principal stress (SHmax) throughout the depths. The analysis on the geometry (or azimuthal span) of borehole breakouts and rock strengths (from log-based estimations) suggests that the stress states in the upper forearc basin sediments above the unconformity (∼980 mbsf) are constrained to be in favor of normal faulting (vertical stress (Sv) > SHmax > least horizontal stress (Shmin)). The stress states in the old accretionary prism below the unconformity down to ∼1400 mbsf are possibly varying with depth between normal, strike-slip and reverse faulting favored stress regimes. At depths below 1400 mbsf, occurrences of borehole stress indicators (breakouts and drilling-induced tensile fractures (DITFs)) are limited due to optimally controlled mud pressures. Two sets of breakouts (1616 and 1862 mbsf) and DITFs (1648 and 1884 mbsf) were jointly used to constrain stress states there, which yielded that Shmin is 79-85% of Sv and SHmax is nearly equal to Sv, suggesting a mixed stress regime for normal and strike-slip faulting (Sv ∼ SHmax > Shmin). The range of constrained Shmin is consistent with the results from leak-off tests. Overall, the estimated stress results suggest that the margin-normal stress component (subparallel to subduction direction of the Philippine Sea plate) might reflect the present-day stress condition having released and settled after the large earthquakes in 1944 and 1946. However, since the stress states at other near sites (e.g., C0009, C0001, and C0006) in the Nankai forearc show that the margin-normal stress components are predominantly the largest horizontal stress, the margin-normal Shmin at C0002 appears to be a local phenomenon. It is speculated that the margin-normal stress component at deeper depths may increase rapidly with depth toward the megasplay fault, resulting in a reversed horizontal stress orientation.