

Enigmatic phase lead of pore pressure: 11+ years of ACORK monitoring at the frontal decollement of Nankai Trough

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For more than 11 years we have been conducting a continuous monitoring of downhole pore pressures at multiple sub-bottom intervals in ODP Holes 808I and 1173B situated landward and seaward of the deformation front in the Nankai Trough off Cape Muroto. We found that the pressure response to the semi-diurnal ocean tide (M2), both amplitude and phase, gradually change during the observed period. The M2 amplitudes at most depths in Hole 808I decay as their phase delay (up to 45 degrees), ONLY IF the amplitude is larger than ~ 0.2 of that for the seafloor. On the other hand, we observe an anomalous phase LEAD (up to -40 degrees) if the relative amplitude is less than ~ 0.2 . We hypothesize that the recorded pore pressure is a combination of two components; one with larger amplitudes and phase-delay and the other with small amplitude and phase-lead. The former can be interpreted as the decrease in formation compliance relative to that of the system, or as the decrease in hydraulic diffusivity around the sensors. The mechanism of the latter variation remain still enigmatic. Existence of gas-rich layer next to the sensor, as suggested by wang and Davis (1996), is difficult to generate such a large phase lead. The predicted earth tide at this site does not coincide with the observed phase. Thermal expansion/contraction caused by the flow within the casing, induced by tidal loading, may cause this phase shift, but a simple thermal/hydrological diffusion cannot explain both the amplitude and phase simultaneously. A complex process including some unknown mechanism may be in operating at Hole 808I.

Keywords: Nankai Trough, ACORK, ODP