Investigation of tidal-induced poroelastic responses at IODP Sites C0010 and C0002 along the Kumano Transect - SE Japan

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The Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) is a multi-expedition Integrated Ocean Drilling Program (IODP) project along the Nankai Trough subduction zone with the purpose of better understanding subduction-zone earthquakes and seismogenic processes. Long-term pressure and temperature monitoring along the Kumano transect produced valuable data records, which constrain potential fluid flow paths and help to identify regions of strain accumulation/release. Simultaneous pressure and temperature records are available for IODP Site C0002 and IODP Site C0010.

The recent IODP Exp. 365 in April 2016 recovered an autonomous borehole observatory named “GeniusPlug”. The GeniusPlug was recovered from Site C0010, were it was installed within the megasplay fault zone at 407 mbsf. The GeniusPlug observatory was equipped with temperature loggers and two pressure sensors. One pressure sensor is used as hydrostatic reference, while the other measures formation pressure. The GeniusPlug recording has a sampling period of 30 sec from November 2010 –April 2016. Complementary formation pressure data at various depths (PPI 940 mbsf, PPII 920 mbsf, PPIII 770 mbsf) and a hydrostatic reference are available via the C0002 long-term borehole monitoring system (LTBMS) installed in November 2010. Hence, formation pressures can be compared via monitoring at the megasplay fault zone and the inner accretionary prism/deep Kumano Basin.

Amplitude and phase of formation pressure variation have been determined relative to tidal pressure variations at the hydrostatic reference. Mean formation pressure amplitudes are reduced to 62 - 74 % and not shifted in phase. Theory of porous media response to periodic loading allows the calculation of frame bulk modulus, specific storage, hydraulic diffusivity and strain sensitivity. This approach allows investigation of formation-scale hydraulic and mechanical properties for the fractured mega splay fault sediments in C0010, and the inner accreted sediments of Unit IV at C0002 and the Kumano Basin sediments of Unit II at C0002.

Keywords: Poroelastic properties, Borehole observatory, Fluid pressure, NanTroSEIZE

