Role of mega-splay fault and associated regional stress distribution in the Nankai seismogenic zone

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In 2007-2008, the first series of IODP expeditions on Nankai Trough Seismogenic Zone Experiments were completed using the deep-sea drilling vessel 'Chikyu' of JAMSTEC. 8 sites were explored, from the accretionary toe, shallow portion of mega-splay thrust to the Kumano forearc basin of the Nankai Trough off Kii Peninsula. Through borehole breakout images acquired during Exp.314 LWD operation, we found that the direction of maximum horizontal principal stress is parallel or ˜10 deg oblique to the direction of plate convergence in the accretionary prism (Sites C0001/C0004/C0006), whereas that in the Kumano forearc basin (Site C0002) is perpendicular to it. 3D seismic record shows clear thrusts and compressive features in the accretionary prism and extentional character in the forearc basin. Fractures identified either in the resistivity image and in the core samples indicate stress condition similar to estimate from borehole breakouts. These are indicative that the horizontal maximum stress regime sharply changes its orientation between Sites C0001/C0004 and Site C0002, each ˜10 km apart, and that it has been caused by the movement of mega-splay fault that branches further landward of Site C0002 at ˜10 km below sea floor, and reaches the seafloor seaward of site C0004. We are not sure whether the extentional feature at site C0002 and around is caused by gravitational instability or by elastic rebound due to uplift of the hanging wall. In order to assess potential stress and fracturing regime around the mega-splay system, we estimated elastic strain and stress caused by deformation accumulated during the interseismic period, superimposed by the rupture along the mega-splay. For simplicity we set the fault straight and assumed a homogeneous elastic media The extension caused by the downdip tip of mega-splay can reproduce sigma1 that is vertical and sigma3 that is parallel to the strike in the forearc basin region.

By applying Coulomb criteria of rock failure, the condition of the normal faulting in the Kumano basin can be tested using the above estimates and the frictional coefficient estimated from the dip angle of normal faults. Overburden is calculated from the measured bulk density data; we ignored the effect of pore pressure in this study.