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S-wave velocity structure in the accretionary prism beneath the Kumano Basin, Nankai Trough, Japan, revealed by vertical

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The Kumano Basin is a forearc basin located on the landward slope of the Nankai Trough. It lies directly above the large co-seismic slip area of the 1944 Tonankai earthquake (M 8.1) and directly above the megasplay fault. Although a number of surface seismic surveys have been acquired in this area to reveal seismic signatures characterizing an asperity of megathrust earthquakes, S-wave velocity structure remains almost unknown. In 2009, we conducted a walk away vertical seismic profiling (VSP) experiment using a large, 7,800 cu. in. airgun array as a sound source and an array of 16 three-component downhole seismometers as receivers, during the IODP Exp. 319. P-to-S converted waves were successfully observed on the horizontal component of the downhole seismic records. Refracted S waves that were converted at the seafloor from P waves have arrival times that are explained by assuming Vp/Vs values of 1.73 in the old accretional sedimentary layer overlain by the unconsolidated basin sediment with Vp/Vs > 2.0. The obtained Vp/Vs ratio, or equivalent Poisson's ratio, is somewhat smaller than the value estimated in the Ashizuri region, southwestern end of the Nankai subduction system, although the observed Vp values are almost the same in the two regions. The lower Poisson's ratio in the old accreted sediment suggests that the layer is highly cemented and therefore impermeable. The existence of the impermeable layer in the hanging wall side of the mega-splay fault could increase pore pressure along the fault zone where VLF earthquakes are observed frequently.

Keywords: IODP, VSP