

Mechanical weakness of the Nankai accretionary prism: Insights from a correlation between Vp and strength of cuttings

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The elastic wave velocity (Vp) and unconfined compressive strength (C0) of sedimentary rocks are key parameters needed to address the stress state at depth in subduction zones. However, a correlation between Vp and C0, particularly for active accretionary prism sediments, is unknown because samples from active offshore prisms have been limited to depths shallower than 1 km. We thus measure Vp on intact cuttings collected from 980 meters below seafloor (mbsf) to 3040 mbsf, the Nankai accretionary prism at Site C0002, Integrated Ocean Drilling Program (IODP) Expedition 348. Vp at room temperature and pressure gradually increases with depth from 2.2 - 2.5 km/s at 980 - 1180 mbsf to 2.5 - 3.2 km/s at 2910 - 3040 mbsf. Previous studies investigated that Vp for the Nankai accretionary prism sediments increases with increasing effective pressure, and provided the values of pressure correction of 0.02 - 0.04 km/s per MPa (e.g., Raimbourg et al., 2010; Hashimoto et al., 2010; 2011). We thus use the value of pressure correction of 0.02 km/s per MPa to estimate the in-situ Vp. The in-situ Vp increases from 2.4 - 2.6 km/s at 980 - 1180 mbsf to 3.2 - 3.8 km/s at 2910 - 3040 mbsf. Our estimated in-situ Vp are consistent with Vp measured on cores under in-situ pressure conditions by laboratory experiments (Raimbourg et al., 2010; Hashimoto et al., 2011) and Vp for logging while drilling (LWD) (Expedition 315 Scientists, 2009; Strasser et al., 2014; Tobin et al., 2015). Finally, we compare the relationship between our estimated Vp and C0 (reported by Kitamura et al., 2019) at the Nankai accretionary prism with the global empirical Vp-C0 relationships (e.g., Chang et al., 2006). The global empirical relationships are based on the data on onshore sedimentary rock samples all over the world. Our provided Vp-C0 relationship suggested that the Nankai accretionary prism sediments are weaker in strength (C0) than those of global trend at any given Vp.

Keywords: Nankai Trough, IODP Expedition 348, Elastic wave velocity, Drill cuttings