

## Later phase observations and seismic velocity structure in the subducting crust of the Pacific slab beneath Hokkaido

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The subducting crust at the uppermost part of the oceanic lithosphere is considered to play important roles for generation of intraslab earthquakes (e.g., Kirby et al., 1996) and arc-magmatism in the mantle wedge (e.g., Nakajima et al., 2013), because the crust involves a large amount of water in form of hydrous minerals and these hydrous minerals affect seismic velocities in the crust (e.g., Hacker et al., 2003). Therefore, to understand water circulation in the subduction zones and genesis of intermediate-depth earthquakes, it is important to reveal where dehydration reaction of hydrous minerals occurs in the crust. However, it is generally difficult to obtain the detailed velocity variation in the crust because the thickness of the crust is ~7 km.

Later phases, such as mode-converted wave and guided wave, are sensitive to heterogeneous structure in the crust because of their longer propagation paths in the crust, and hence they are very useful to resolve small-scale seismic velocity structure in the crust (e.g., Matsuzawa et al., 1986; Abers, 2005).

At the Hidaka mountain range, middle of Hokkaido, northern Japan, some later phases are reported from earthquakes that occurred in the Pacific slab (e.g., Shimizu and Maeda, 1980). A later phase (Xp phase) recorded in this region has some characteristics: 1) amplitudes of Xp phase are similar to or larger than those of the P wave, 2) Xp-P time lies in a range of 2-10 s and increases with epicentral distances. Shiina et al. (2013, SSJ) discussed the origin of the Xp phase with numerical modeling and interpreted the Xp phase as guided P-wave that propagated in the crust. Moreover, we identified a later phase (Xs phase) that arrives several second after the theoretical initial S waves, and such a phase usually appears in seismograms with guided P-wave. We interpreted the Xs phase as guided S-wave by comparison characteristics of guided P-wave and results of numerical modeling.

In this study, based on these interpretations for later phases that observed in the western part of Hidaka mountain range, we estimated P- and S-wave velocity distributions in the subducting crust beneath the eastern part of Hokkaido. The number of arrival times of guided P- and S-waves picked in this study is 117 records and 56 records, respectively. Then, we obtained Vp of 6.8-7.7 km/s and Vs of 3.5-4.0 km/s at depths of 50-100 km in the crust. The obtained Vp in the crust is similar to that observed beneath Tohoku (Shiina et al., 2013) and lower than that expected for fully-hydrated MORB materials (e.g., Hacker et al., 2003). This result suggests that aqueous fluids may co-exist with hydrous minerals in the crust beneath the eastern part of Hokkaido.

Keywords: subducting crust, later phase, guided wave, the Pacific slab

## Pore fluid geochemistry and carbonates in cores and cuttings from the Nankai accretionary prism

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The recent IODP Exp 348 at Site C0002 has successfully deepened Hole C0002F (Exp 338) down to 3058.5 mbsf, deep into the accretionary prism of the Nankai Trough. During Exp 348, cuttings were collected and analysed from drilled interval of Holes C0002N (875 mbsf- 2325 mbsf) and C0002P (1965 mbsf- 3059 bsf) and limited coring was performed from 2163 to 2218 mbsf in Hole C0002P. The major-element composition of the solid cuttings and the geochemistry of interstitial water in cores was determined. Results provide insights into exchange of elements between minerals and pore water phases, and into geochemical signatures related to lithological changes within the prism. This study reports the main geochemical results from IODP Exp 348.

Interstitial waters were collected using the GRIND method (Wheat et al., 1994), in which core sediments were ground in an agate mill with ultra-pure water. The interstitial water percentage was determined by drying sediments at 60 °C and 105 °C, the former to minimize loss of clay-bound water, and the latter to follow the GRIND procedure used in previous expeditions. Concentrations were interpreted with data corrected for dilution at 60 °C, 105 °C and normalised to chlorinity values. Profiles of carbonates (as CaCO<sub>3</sub>), organic carbon and total nitrogen were determined from cuttings of 1-4 mm and >4 mm sizes and are compared with the observed lithological boundaries. Carbonate veins were observed in a core sample exhibiting a fault zone at ~2205 mbsf, but no increase was observed at the same depth in the carbonates profile.

The GRIND method has limitations in recovering absolute values of dissolved ions in interstitial waters, and yielded very high dissolved-ion concentrations in some samples. But comparison of ions normalized to chlorinity yielded results comparable to what was observed in pore waters at shallower depths of Site C0002. Some of the trend variations in the cuttings profiles of carbonates, organic carbon and nitrogen match the unit boundaries determined by observation of lithological changes in the cuttings. Therefore, it can be suggested to integrate these data when defining geological units.

*Wheat, Boulegue and Mottl (1994) Proc. ODP, Sci. Results, 139: College Station, TX (Ocean Drilling Program), 429-437*

Keywords: Accretionary prism, GRIND method, IODP Expedition 348, Nankai Trough, Pore water

## Solution mechanism of water in depolymerized silicate melts

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It is known that the effect of dissolved water on the viscosity of silicate melts is larger for polymerized melts than for depolymerized melts [e.g., 1, 2]. Direct spectroscopic measurements of melt structure and water speciation at high temperature provide information about the mechanism of water dissolution and its influence on the physical properties of the melts. While *in situ* measurements of water speciation were widely conducted for rhyolitic melts and their analogues [e.g., 3, 4, 5], only limited data are available for depolymerized silicate melts.

We performed high-temperature near-infrared and Raman spectroscopic measurements of hydrous  $\text{Na}_2\text{Si}_2\text{O}_5$  melts (2.3-8.1wt%  $\text{H}_2\text{O}$ ) using externally heated diamond anvil cell (HDAC).  $\text{Na}_2\text{Si}_2\text{O}_5$  composition was chosen as a structural analogue of basaltic melt (anhydrous NBO/T = 1). Experimental pressure was monitored with the pressure- and temperature-dependent Raman shift of  $^{13}\text{C}$  diamond [6]. Near-infrared spectra of the homogeneous liquid phase, observed above 820 degree C, 1.7GPa in the  $\text{Na}_2\text{Si}_2\text{O}_5+2.3\text{wt}\%\text{H}_2\text{O}$  system and above 700 degree C, 1.6GPa in the  $\text{Na}_2\text{Si}_2\text{O}_5+8.1\text{wt}\%\text{H}_2\text{O}$  system, contain absorption peaks corresponding to molecular  $\text{H}_2\text{O}$  (at  $\sim 5200\text{ cm}^{-1}$ ) and structurally bound OH groups (at  $\sim 4500\text{ cm}^{-1}$ ). At 900 degree C and 1.6-1.9GPa the ratio of these peaks height remains approximately constant (2.6-2.2), implying a constant (structurally bound OH)/(molecular  $\text{H}_2\text{O}$ ) ratio for this range of water contents. This observation differs from the regularities reported for more polymerized melts (rapid decrease of OH/ $\text{H}_2\text{O}$  with total water content) [e.g., 4, 7]. At the same time no pressure effect on the ratio of  $4500\text{ cm}^{-1}$  peak height to  $5200\text{ cm}^{-1}$  peak was observed below 2.4 GPa.

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