

## 北海道で観測されるスラブ内地震の後続波と海洋性地殻の構造 (その2) Later phase observations and seismic velocity structure in the subducting crust of the Pacific slab beneath Hokkaido

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海洋プレートの沈み込みに伴い地球内部に供給された水は、沈み込み帯における地震活動や島弧マグマ活動と密接に関係していると考えられている (e.g., Kirby et al., 1996; Nakajima et al., 2013). 特にスラブ最上部に存在し、地震波速度の遅い海洋性地殻は含水鉱物として多量の水を保持しており、これらの鉱物の脱水反応や相転移の進行が海洋性地殻の地震波速度やスラブ内の水の分布に影響していると考えられている (e.g., Hacker et al., 2003). したがって、海洋性地殻の詳細な構造を明らかにすることは、沈み込み帯における水循環やスラブ内地震の発生メカニズムを理解する上で非常に重要である。

しかしながら、海洋性地殻の厚さは 7 km 程度であり、初動走時解析などの従来の手法では、地殻の構造不均質を詳細に推定することは困難である。一方で、スラブ内地震で観測される後続波 (PS 変換波や guided wave など) は海洋性地殻やスラブマントルを長い距離伝播するため、スラブの構造不均質により敏感であることが知られている (e.g., Matsuzawa et al., 1986; Abers, 2005)。

本研究では、北海道の日高山脈西部で観測される後続波 (e.g., 清水・前田, 1980) を解析し、北海道東部下に沈み込む海洋性地殻の地震波速度を推定することを試みる。本研究で注目する後続波は、P 波初動の 2-10 秒後に P 波初動よりも大きな振幅を持つ波群として観測される。椎名・他 (2013, 地震学会) ではフォワードモデリングにより後続波の伝播過程を検討し、海洋性地殻内を伝播する guided P-wave であると再解釈した。本解析では彼らの解釈に基づき、guided P-wave の同定と走時の読み取りを行い、海洋性地殻の P 波速度を推定した。加えて、guided P-wave が観測される観測点とイベントのペアに対して、初動 S 波の理論走時より数秒遅れて S 波的な振動を持つ振幅の大きな波群が到着することが確認された。この波群 (Xs phase) に対してもフォワードモデリングにより伝播過程を検討し、観測される走時などを guided P-wave と比較した結果、Xs phase は海洋性地殻内を S 波として伝播した波群、すなわち guided S-wave として解釈できることがわかった。

P 波と S 波、それぞれに対応する guided wave は、地震波速度の遅い海洋性地殻内部を伝播し、海洋性地殻と日高山脈下でスラブ直上まで分布する低速度域 (大陸地殻物質; Kita et al., 2010, 2012) の接触により地表へ放出されると考えられる。このため、同一観測点で観測された guided wave の走時差をとることで、イベント間の海洋性地殻の地震波速度を見積もることができる。本研究では北海道日高山脈西部で観測された太平洋スラブ内地震の観測波形記録から guided wave の読み取りを行い、それぞれ guided P-wave で 117 個、guided S-wave で 56 個の走時から海洋性地殻の地震波速度を推定した。その結果、北海道東部下に沈み込む海洋性地殻に対して、深さ 50-100 km 程度の範囲で、P 波で 6.8-7.7 km/s、S 波で 3.5-4.0 km/s の速度が得られた。深さ 100 km 以浅で得られた P 波速度は東北地方下で推定された海洋性地殻の P 波速度 (Shiina et al., 2013) と同様に、MORB などの含水鉱物から期待される P 波速度 (約 7.2 km/s) よりも小さい。このことは北海道東部下でも海洋性地殻内で流体の水と含水鉱物が共存して存在している可能性を示している。一方で、海洋性地殻の S 波速度に関しては、読み取った走時のデータ数も十分でなく、読み取りの精度も P 波に比べて低いという問題がある。このため、今後、guided wave の読み取りを増やすなどして、S 波速度の推定精度向上させる必要がある。

キーワード: 海洋性地殻, 後続波, guided wave, 太平洋スラブ

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

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

### 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*

キーワード: Accretionary prism, GRIND method, IODP Expedition 348, Nankai Trough, Pore water

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## Solution mechanism of water in depolymerized silicate melts 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 Na<sub>2</sub>Si<sub>2</sub>O<sub>5</sub> melts (2.3-8.1wt% H<sub>2</sub>O) using externally heated diamond anvil cell (HDAC). Na<sub>2</sub>Si<sub>2</sub>O<sub>5</sub> 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 <sup>13</sup>C diamond [6]. Near-infrared spectra of the homogeneous liquid phase, observed above 820 degree C, 1.7GPa in the Na<sub>2</sub>Si<sub>2</sub>O<sub>5</sub>+2.3wt%H<sub>2</sub>O system and above 700 degree C, 1.6GPa in the Na<sub>2</sub>Si<sub>2</sub>O<sub>5</sub>+8.1wt%H<sub>2</sub>O system, contain absorption peaks corresponding to molecular H<sub>2</sub>O (at ~5200 cm<sup>-1</sup>) and structurally bound OH groups (at ~4500 cm<sup>-1</sup>). 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 H<sub>2</sub>O) ratio for this range of water contents. This observation differs from the regularities reported for more polymerized melts (rapid decrease of OH/H<sub>2</sub>O with total water content) [e.g., 4, 7]. At the same time no pressure effect on the ratio of 4500 cm<sup>-1</sup> peak height to 5200 cm<sup>-1</sup> peak was observed below 2.4 GPa.

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