Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SCG66-10 会場:201A 時間:5 月 24 日 11:30-11:45

北海道下の３次元地震波減衰構造：島弧ー島弧衝突と M7 クラス内陸大地震（その２）

Seismic attenuation structures beneath the Hokkaido corner: Arc-arc collision and its relation to M˜7 inland earthquakes

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1. Introdution

In the Hokkaido corner, the Kuril forearc sliver collides with the northeastern Japan arc. Using data from the nationwide Kiban-network and a temporary seismic network, Kita et al. [2012, JGR] determined high resolution 3D seismic velocity structure beneath this area for deeper understanding the collision process between the Kuril and NE Japan forearcs. The results show that a broad low-V zone (crust material) with a total volume of 80 x 100 x 50 km^3 anomalously descends into the mantle wedge area at depths of 30-90 km west of the Hidaka main thrust. On the other hand, several high-velocity zones having velocity of mantle materials are distributed at depths of 10-35 km, being in contact with the eastern edge of this low-V zone. Two of boundaries of the high-V zones with the broad low-V zone correspond to the fault planes of the 1970 Mj 6.7 Hidaka and the 1982 Mj 7.1 Urakawa-oki earthquakes, respectively. Inland micro-earthquakes also occur in the low-V zone at depths of -80 km. Kita et al. [2012, AGU fall meeting] estimated 3D seismic attenuation structure beneath the Hokkaido corner, but data used in that study are only from the Kiban-network. In this study, we estimated a detailed seismic attenuation structure by integrating data from the Kiban-network and those from the temporary seismic network operated by Katsumata et al. [2002], and compared it with the seismic velocity image previously obtained by Kita et al. [2012, JGR].

2. Data and method

We applied the method of Hada et al. [2011] to waveform data obtained from the Kiban network and the dense temporary seismic network. We estimated corner frequency for each earthquake by applying the spectral ratio method to the coda wave part [e.g. Somei, 2010; Wada, 2010; Mayeda et al., 2007]. We simultaneously determined values of $t*$ of earthquakes and amplitude level for the calculated spectra after determining a value of corner frequency. Then, seismic attenuation structure (Q structure) was imaged using $t*$ values and tomographic code of Zhao et al. [1992]. Ray paths were calculated by adopting the detailed 3-D seismic velocity structure by Kita et al. [2012]. In the calculation, we also used the geometry of the Pacific plate precisely estimated by Kita et al. [2010, EPSL]. The study region is 41-45N, 140.5-146E, and a depth range of 0-200 km. We obtained 57,132 P-wave and 41,251 S-wave spectra from 4,952 events (M>2.5) that occurred in the period from Oct. 2006 to Dec. 2011 (JMA catalog) and Aug. 1999 to Apr. 2001 (Katsumata et al., 2002). The number of stations is 353. Horizontal and vertical grid nodes were set with a spacing of 0.10-0.3 degree and 10-30 km, respectively.

3. Result

Estimated corner frequencies for earthquakes roughly obey cube-root scaling with seismic moment, stress drop being 0.1-10 MPa. In the Hokkaido corner, obtained image of seismic attenuation structure generally has the same anomalous structure as the detailed seismic velocity structure by Kita et al. [2012]; A broad low-Qp zone are located at depths of 0-60 km beneath the western area of the Hidaka main thrust, whereas the eastern area of it (Kuril forearc) has very high-Qp values. The low-Q zone almost coincides to the low-V zone in the collision zone found by Kita et al. [2012]. The fault planes of the 1970 M7.1and the 1982 M6.7 earthquakes are respectively located at the eastern edge of the low-Qp zone. Those tendencies in the image of Qp are also confirmed in the image of Qs. Western portion of the low-Qp zone has relatively lower Qp values, where inland type deep micro-seismicity is active. These results suggest that the occurrence of anomalous deep inland earthquakes in this region is related with spatial distribution of hydrous minerals or fluids.

キーワード: 地震波減衰構造, 北海道島弧会合部, 1970 年 M7.1 日高山脈南部地震, 1982 年 M6.7 浦河沖地震
Keywords: Seismic attenuation structure, Arc-arc junction, the 1970 M7.1 Hidaka earthquake, the 1982 M6.7 Urakawa-oki earthquake