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Fine structure of hypocenter distribution within subducting slab under NE Japan and its relation with possible volatile release

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The generation process of intraslab earthquakes is one of important problems to be solved in seismology. One of the hypotheses on the generation of intraslab earthquake is the dehydration embrittlement and the CO2-bearing devolatization embrittlement. In order to discuss the detailed hypocenter distribution within the slab and its relation with the dehydration embrittlement hypothesis, we relocated microearthquakes within the subducting Pacific plate slab beneath Tohoku and Hokkaido, Japan by applying the double-difference relocation method (Waldhauser and Ellsworth, 2000) to the dense seismic network data (Japanese universites, JMA and Hi-net).

The characteristics on the relocated hypocenter distribution of the intraslab seismicity are as follows : 1) Many anomalous interplane earthquakes are distributed inhomogeneously between the upper and lower planes of the double seismic zone. This anomalous interplane earthquake might be explained by the dehydration and/or CO2-bearing devolatization of the minerals in the mantle portion of the subducting slab (Kirby, 1995; Omori et al., 2002). The lower and upper-plane seismicity is also active where this anomalous interplane earthquakes frequently occurred. Areas with high intraslab (upper, lower and interplane) seismicity seem to be located along the deep extension of seamounts alignment on the Pacific plate. This fact shows that the abundant hydrated minerals and carbonated minerals, which are generated by the plume and magmatic intrusion, may dehydrate and/or CO2-bearing devolatize and activate intraslab seismicity (e.g. Kirby et al., 1996, 2004; Seno and Yamanaka, 1996). 2) We can see some earthquake alignments in the slab. The direction of these alignments almost corresponds with the strike of the fracture zones on the Pacific plate before the subduction. This fact shows that hydrated minerals may be distributed along these fracture zones. 3) The upper plane seismicity is very active at depth from 70 to 90 km. They form a seismic belt along the NE Japan arc and the Kuril arc. This observation can be explained by the dehydration of the crustal minerals in this depth range (e.g. Hacker et al., 2003). This observation also suggests that the hydrated minerals would be distributed more uniformly in upper part of the oceanic crust than in lower part of oceanic crust. Note that this seismic belt of the upper plane seismicity is located east from the volcanic front. 4) High activity of lower plane seismicity occurred beneath the area where the back-slip and the after-slip occurred following the 2003 M8.1 Tokachi-oki earthquake extend along the deeper (than 60km depth) portion of the plate boundary.