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Seismic velocity structure with respect to the inland giant earthquakes in and around the high strain rate zone

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1. Introduction
The high strain rate zones are located at the eastern margin of Japan Sea from western Hokkaido to Niigata (Okamura et al., 2007) and the Niigata-Kobe Tectonic Zone is located from Niigata to Kobe in the central Japan (Sagiya et al., 2000). Inland giant earthquakes occurred in these regions. We present the characteristic seismic velocity structure in the lower crust and uppermost mantle at the inland giant earthquakes in the high strain rate zone based on the three-dimensional seismic velocity structure beneath whole Japan Islands (Matsubara et al., 2008).

2. Northeastern Japan arc
The high strain rate zones are estimated at the eastern margin of Japan Sea in the north-south direction and the Tohoku backbone region from Tsugaru peninsula to Sendai by studies of geology and seismicity. The other one is also estimated at the eastern part of the Tohoku region from Iwate to Miyagi by geodetic study.
Low-velocity and high-Vp/Vs regions are located in the lower crust around the volcanic front and low-Vp/Vs zone is distributed broadly in the uppermost mantle. However, there are high-Vp/Vs zones are also located in the uppermost mantle on the backarc side such as beneath the central Aomori prefecture, Oga peninsula, and northern part of Niigata prefecture (Matsubara et al., 200 8). Low-Vp zone with the length of 400 km in the uppermost mantle, 250-km low-Vs and 400-km high-Vp/Vs zone in the lower crust are located along the high strain rate zone in the backbone region. Low-Vs and high-Vp/Vs zone in the lower crust and low-Vp and low-Vp/Vs zone in the uppermost mantle with the lengths of around 500 km is located along the high strain rate zone at the eastern Tohoku region.
The epicenters of the inland giant earthquakes are located the edge of the high-Vp/Vs zone in the uppermost mantle, such as Tsugaru earthquake in 1766, Rikuu in 1896, Sempoku in 1914, Kisakata in 1804, Shonai in 1894, Chuetsu-oki in 2007, Sanjo in 1828, Chuetsu in 2004. The lower crust beneath these events is also edge of a little high-Vp/Vs zone. Former studies pointed out that the inland giant earthquakes are related with the fluid in the lower crust. The fluid may be derived from the uppermost mantle.
There is no high-Vp/Vs zone at the uppermost mantle beneath the forearc region. The Iwate-Miyagi Inland earthquake in 2008, northern Miyagi in 1900 and 2003 occurred in the forearc region. The low-V and high-Vp/Vs zones exist in the lower crust beneath these events similar to those in the backarc region.

3. Southwestern Japan arc on the western side of the Itoigawa-Shizuoka Tectonic Line along the Niigata-Kobe Tectonic Zone
The Niigata-Kobe Tectonic Zone is pointed out as the high strain rate zone by the GPS observation. The low-V and low-Vp/Vs region exists in the lower crust and the aqueous fluid is expected (Nakajima and Hasegawa, 2007, Matsubara et al., 2008). This low-V zone with width of 100 km is located with the length of 300 km. There are some high-V and high-Vp/Vs regions with

width of 25-60 km and length of 40-120 km in the uppermost mantle. The epicenters of the inland giant earthquakes are located at the edge of these high-Vp/Vs zone in the uppermost mantle such as 1858 Hietsu earthqueks, Tensho in 1586, north-Mino in 1961, Eno (Anekawa) in 1909, western side of the Lake Biwa in 1862, Kyoto in 1185 and 1317, Keicho-Fushimi in 1596, Hyogoken-Nanbu in 1995.

4. Conclusion

The epicenters of the inland giant earthquakes within the high strain rate zone in the southwestern Japan arc and the backarc side of the northeastern Japan arc is located at the edge of the high-Vp/Vs zone in the uppermost mantle. The lower crust has high-Vp/Vs beneath the northeastern Japan arc, however, it has low-Vp/Vs beneath the southwestern Japan arc. The fluid in the lower crust as the cause of the inland giant earthquakes may be derived from the uppermost mantle.

Keywords: high strain rate zone, low-velocity region, uppermost mantle, high-Vp/Vs region, seismic tomography