Seismic activities in and around the large asperity areas off the eastern coast of Aomori prefecture, NE Japan

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From recent waveform analyses for both the large subduction earthquakes and small repeating earthquakes in the plate boundary zone of NE Japan, it has become clear that asperities on plate boundary play key role to the occurrence of these events. However the information about spatial distribution and nature of intermediate-scale asperities are still lacking, because of the difficulty of waveform analyses for earthquakes with intermediate magnitudes. Thus, to get information about unknown asperities with intermediate-scale, we have investigated seismic activities in and around the large known asperity areas off the eastern coast of Aomori prefecture.

We selected the earthquakes that occurred near the plate boundary between the Pacific and overriding plates in the NE Japan, from the earthquake catalog of JMA during the period from 1961 to 2003. The basic data for the present analysis are the annual values of seismic moment release for blocks with a size of 0.25 degrees both in latitude and longitude direction.

The average values of annual moment release tend to decrease toward the land area, which reflects the weakening of plate coupling with distance from the trench. The western boundary of strong coupling coincides roughly with the eastern extent of a region with a large number of small repeating earthquakes. We found that the moment release is extremely low in some blocks around the large asperities. On the other hand the moment release within the large asperities is not low compared with the surrounding areas. We interpret these observations in terms of strength distribution of plate coupling; there are preferentially small and weak asperities in the areas of low moment release whereas there is a wide variation of coupling strength in the areas of large asperity. Quasi-static slip that occurs in the former areas causes stress buildup in the adjacent areas. As the stress is increased the asperities with intermediate-strength break down but the asperities with larger strength still remain contact. Finally the strong asperities slip together with the previously slipped weaker asperities, resulted in a large area of coseismic slip. Thus there is a kind of hierarchical structure of seismic coupling in the large asperity areas.