New view on the recurrence pattern of interplate earthquakes along the northern Japan to southern Kurile trenches

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The subduction boundary along the northern Japan to southern Kurile trenches has been regarded as a typical region of great interplate earthquake recurrence with rather beautiful spatial and temporal regularities. The source regions have been divided into 6 segments, A to F. We, however, have pointed out several questions on the so-far believed regularities by examining relocated mainshock-aftershock distributions of large/great interplate and slab earthquakes in this region (Harada and Ishibashi, 1999, 2000, 2001, 2002). In this paper we summarize our results and propose a new view on the recurrence pattern of interplate earthquakes in this region.

The points are as follow: (1) There exist a few asperities in each segment, A to F. (2) Although almost all asperities in every segment ruptured simultaneously and, therefore, great earthquakes occurred one after another in A to F during the last active period from 1952 to 1978, recent occurrence of M7-class events strongly suggests that great earthquakes do not necessarily recur. (3) Since the coupling rate of each asperity is inferred to be nearly 100% (Nagai et al., 2001), it is natural that recurrence interval of the rupture of each asperity is not very long, around 30 years. (4) Judging from historical events, simultaneous rupture of a few to several asperities over two or more segments may be possible. (5) Recent occurrence of large interplate earthquakes suggests initiation of a new active period of interplate events in this region, and large or great interplate earthquake may be imminent in the northern half of A region and in B region. (6) In addition to interplate events, not a few great/large slab earthquakes have taken place along the Kurile trench.

Thus the segmentation, A to F, of the region along the Japan-Kurile trench is more or less meaningless. However, the features of earthquake occurrence in each region are as follow. A is the source region of the 1968 Tokachi-oki earthquake (Mw8.2). Large events recurred in 1989 (Mw7.4), 1992 (Mw6.9), and 1994 (Mw7.7) in this region, and their aftershock areas occupied southern half of the 1968 source region. Since the coupling rate of each asperity is estimated at almost 100% (Nagai et al., 2001), it is probable that the northern asperity in this region may rupture in the near future. B is the source region of the 1952 Tokachi-oki earthquake (Mw8.2). Since 1952 no large interplate event has occurred and ISC hypocenter data show remarkably low siesmicity in this region. Therefore, here also a large/great interplate earthquake is anticipated to recur in the near future. C is the source region of the 1973 Nemuro-Hanto-oki earthquake (Mw7.8). The largest aftershock of this event occurred around the boundary of C and D regions, and its aftershock area overlapped on a part of those of 1973 and 1969 events. D is the source region of the 1969 Hokkaido-Toho-oki earthquake (Mw8.2). Many large interplate events have occurred in the 1969 source region. Partially, large interplate earthquakes recurred in the southern part of the 1969 source region in 1964, 1968, and 1968. E was believed to be the interplate source region of the 1958 Etorofu earthquake (Mw 8.3). However, as Harada and Ishibashi (2000) showed, this event is regarded as a great slab earthquake. Instead, large interplate events occurred in 1976 and 1978 in this region. F is the source region of the 1963 Etorofu earthquake (Mw8.5). Two large interplate earthquakes recurred in the eastern and western part of this region in 1991 and 1995, respectively.