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38-years seismic observations and the estimation of seismic b-values along Myanmar-Andaman-Sumatra-Java subduction margin: a caution for future hazard management

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The Mw $\geq$ 9.0 1952 Kamchatka, 1957 Aleutians, 1960 Chile, 1964 Alaska, 2004 Sumatra, and 2011 Japan earthquakes triggered destructive tsunami rupturing hundreds of kilometers along few specific segments of the subduction margins globally in a while. Such infrequent mega-events had shown their far-reaching effects and perplexed the world community. The 2004 mega-event in association with few other great earthquakes in the central and southern parts of the Sumatra margin (e.g., 1797 M $\sim$ 8.4, 1833 M $\sim$ 9.0, 1861 M $\sim$ 8.5, 1905 Mw $\sim$ 8.4, 2005 Mw 8.7, 2007 Mw 8.5) provided unprecedented opportunity for a critical reappraisal of hazard for the adjoining areas. We explore here the characteristics of seismic energy released along the Myanmar-Andaman-Sumatra-Java subduction margin, based on USGS catalogue for the period between 1976 and 2013. We consider the earthquakes with body wave magnitude 4.0 and above. We find the earthquake activities are mainly concentrated in four tectonic domains: first one covers the entire Myanmar margin (Segment I), second one includes Andaman-Nicobar-Northwest Sumatra margin (Segment II), third one is located in the Southeast Sumatra-West Indonesia (Segment III), and the fourth domain lies in the East Indonesia (Segment IV).

The tectonics parameters, geological locations, great earthquake occurrences, seismic energy release, and the Wadati-Benioff zone geometry in these four segments also display distinct features. We find the aftershock activities of 2004 mega-event has been shifted from deeper to shallower level of the lithosphere in Segment II. The shifting of aftershocks of the 2005 Mw 8.7 Nias earthquake from deeper to shallower part of the subducting oceanic lithosphere was also noticed. Such shifting of seismicity towards the trench-axis after the 2004 MW > 9.0 earthquake was apparently caused by migration of the stress-field from deeper to shallower part of the Indian lithosphere. Similar shifting of aftershocks were also observed along the Kuril trench after the incidence of 15th November 2006 Mw 8.3 earthquake, and interpreted to be caused by stress transfer through the subducting lithosphere. Further, the energy bursts happened near the Northwest Sumatra and Car Nicobar areas are likely located in the zone of seismic quiescence during 2004 event. We find spikes in the plot of seismic energy distribution, which apparently indicates the stress energy transferring happened from east to west, towards the zone of occurrence of 2004 Mw>9.0 earthquake during the quiescence period.

The b-values show a constant decrease in Segments II, III, and IV, whereas the Zone I does not show any such pattern prior to the 2004 mega-event. These typical observations account for dominant stress accumulation near the Sumatra area. We thus believe that the occurrence of 2004 mega-event was apparently concealed behind the long-term seismic quiescence existing near the Sumatra and Nicobar margin. A systematic study of the patterns of seismic energy release and b-values, and the long-term observation of collective behavior of the margin tectonics, might had given clues for the forecasting of the 2004 mega-event, and thus contribute to improve seismic hazard estimates.