

Clarification of Large or Great Historical Earthquakes in Tokyo Metropolitan Area

SATAKE, Kenji^{1*}, SHIMAZAKI, Kunihiko¹, TSUJI, Yoshinobu¹, KIM, Haeng Yoong¹, MUROTANI, Satoko¹, ISHIBE, Takeo¹

¹Earthquake Research Institute, the University of Tokyo

The Tokyo Metropolitan area is located in a tectonically complex region associated with the subduction of the Philippine Sea (PHS) and Pacific (PAC) Plates, and various types of large or great earthquakes have occurred. We have studied past large or great earthquakes in order to estimate their recurrence intervals and to evaluate the future probability of occurrence by using geological and geomorphological data such as tsunami deposits and marine terraces, historical documents, and seismological data.

The great Kanto earthquakes ($M \sim 8$) occurred in 1703 and 1923 between the continental plate and PHS. However, the occurrence time of the antepenultimate Kanto earthquake have not been revealed although some candidates are proposed based on geological or geomorphological surveys and/or historical documents (e.g., Ishibashi, 1991, 1994; Shishikura, 2003). We have studied tsunami deposits obtained from geoslicer survey at Koajiro Bay, Miura Peninsula, Kanagawa Prefecture and revealed that the antepenultimate Kanto earthquake occurred between 1060 and 1400 (Shimazaki et al., 2011). This may correspond to the 1293 earthquake which caused extensive damage at Kamakura, the capital in those days. We have also conducted geoslicer survey at Ena Bay, southern tip of the Miura Peninsula and obtained tsunami deposits during the past 4000 years (Chiba et al., 2011). Furthermore, detailed distribution of uplifts due to the 1923 Kanto earthquake was revealed by the LIDAR data, air photos and topography maps (Kim et al., 2011).

There are historical documents describing detailed damage due to the historical earthquakes since 1600, hence we obtained a detailed distribution map of seismic intensity using historical documents for the large earthquake which occurred at Kanagawa post town, in Yokohama city on 7th December, 1812 (Tsuji, 2009). The seismic intensity in the main area of Yokohama city was estimated to be 6 in Japan Meteorological Agency (JMA) scale, and the magnitude was estimated to be 6.4 based on the area of seismic intensity 5. We have also revealed the detailed distribution of damage in residential area, at temples, and old samurai residences due to the 1855 Ansei Edo earthquake. Furthermore, we established a database which compiles historical documents for these damaging earthquakes.

The occurrence probability of $M \sim 7$ earthquakes during the next 30 years was estimated to be about 70 % by the Earthquake Research Committee in 2004, based on five damaging earthquakes since 1885 (i.e., 1894 Meiji Tokyo, 1895 and 1921 Ibaraki-Ken Nambu, 1922 Uraga Channel, and 1987 Chiba-Ken Toho-Oki earthquakes). We reviewed previous studies on these five earthquakes, collected seismic waveform records and pick data (Ishibe et al., 2009a, 2009b; Murotani et al., 2011), and classified these earthquakes into intraplate or interplate earthquakes by analyzing collected data and comparing with seismic velocity model (Nakagawa et al., 2011) obtained from the newly developed seismic observation network (MeSO-net; Kasahara et al., 2009). The 1894 Meiji Tokyo Earthquake was a slab earthquake within PHS or an interslab earthquake between PHS and PAC. The 1895 Ibaraki-Ken Nambu Earthquake was a slab earthquake within PAC. The 1921 Ibaraki-Ken Nambu, 1922 Uraga Channel and 1987 Chiba-Ken Toho-Oki Earthquakes were slab earthquakes within PHS with strike-slip fault mechanisms.

Keywords: Kanto earthquake, Historical earthquake, $M7$ -class earthquake, Tsunami deposit, Classification