

Discovery of Original Material of Nakamura Nakazo's Account on the 1855 Ansei Edo Earthquake

*Ryoichi Nakamura¹, Motoko Ishise¹, Reiko Sugimori^{2,3}, Kenji Satake^{1,3}

1. Earthquake Research Institute, The University of Tokyo, 2. Historiographical Institute, The University of Tokyo, 3. Collaborative Research Organization for Historical Materials on Earthquakes and Volcanoes

1. Introduction

Estimated depth of the 1855 Ansei Edo Earthquake varies from deep in/on the Philippine Sea Plate (PHS) to very shallow in the crust. These estimates base on the seismic intensity distribution and/or the S-P time estimated from historical materials.

A famous kabuki actor, Nakamura Nakazo, left the following description that included P and S-wave arrivals. "The strong upward movement came from the ground. Almost all the women were surprised and screamed. I said, 'calm down, it's a big earthquake.' Omitu said to me 'you should stand up rather than sitting.' I stood up and walked. Then the strong shaking started, and I could not walk normally." Three studies investigated the hypocentral depth based the above description. Hagiwara(1990) estimated the S-P time as approximately 10 s and the hypocentral depth as ~100 km. Nakamura et al. (2003) estimated the S-P time as 5–10 s based on the above description and other documents, concluding that it was an intra-slab earthquake within the PHS. Usami (1983) estimated the S-P time as 3–5 s based on the above description, for which case the depth would be shallower.

Above description was based on the contents in "Japan Earthquake Historical Materials" (Musha,1951), called "the Musha book" hereafter. On the other hand, we discovered the original of Nakazo's own two handwriting books in the National Diet Library, hereafter called "the 9th Diet book" and "the 10th Diet book" .

2. Comparison between Nakamura Nakazo's articles

There are four versions on Nakamura Nakazo's description: "the Musha book", "Kabuki Shimpo", "the 9th of the Diet book" and "the 10th of the Diet book".

The decoding of "the Diet books" has been performed by one of the authors, Sugimori. Table 1 shows the description of S-P time parts on "the 9th Diet book" and "the Musha book". The bold characters show the difference. At the first part, it can be seen that "movement" where the ground lifts is depicted in "the Musha book", whereas "rumble" is depicted in "the 9th Diet Book" . There are many historical materials reported rumble in the Ansei Edo Earthquake.

Descriptions for the first part in "The Musha book", "the 10th Diet Book" and "the Kabuki Shimpo" are almost the same, but that in "the 9th Diet Book" is different. The article of "the Kabuki Shinpo" was written by Kyogen writer Kubota Hikosaku, based on the record of Nakazo's handwritings, as a prosthesis and was abbreviated.

Our analysis of indicates that “the 9th Diet Book” was written earlier than the other three historical materials, and is considered as a contemporary document. It is desirable to use it for future studies of this earthquake.

3. Effect on S-P time estimation

The first difference between the "the Musha Book" and “the 9th Diet Book” is sound (rumble) or movement (Table 1). However, it does not significantly affect the estimation of the arrival time of the P-wave if the ground motion of the P-wave is transmitted to the air. Regarding the S-wave main motion, the "the Musha Book" states that it began to sway after walking, while it began to sway when he stood up (before walking) in "the 9th Diet Book", indicating S-P time is slightly shorter. It is known for large earthquakes that a large rupture at the so-called strong ground motion generation area (SMGA) is delayed from the initial rupture at the epicenter. In this case, the amplitude of the initial S-wave is small and large shaking occur later. Therefore, the actual S-P time can become shorter.

4. Possible depth from S-P time

Using the JMA2001 travel time table, an S-P time of 5 seconds indicates the epicenter depth of 40 km for the epicentral distance of 20 km. However, in the Kanto region covered with thick sedimentary layers, the depth can be shallower. Fig. 2 shows the waveform, indicating S-P time of 5 seconds, from the 2015/12/26 earthquake (M3.4, depth=23 km) at the K-NET Sarue (TKY021) station (epicentral distance=20 km). This depth can be possible for the 1855 earthquake.

Keywords: the 1855 Ansei Edo Earthquake, Historical Material, S-P time

表1 中村仲蔵記事の地震動の部分の記事

Table 1 Article on the seismic motion part of Nakamura Nakazo.

「日本地震史料」 The Musha Book	「国会本」第9冊（翻刻：杉森による） The 9th Diet Book
地よりドゥゥと持ち上る。皆々女の事ゆゑキヤツといつて立騒ぐ。我れ之を鎮め騒ぐことはない、是は地震の大きいのだといふ時に、小みつは親方座つて居ずとマアお立ちでないかといはれ、成程座つて居るにも及ばぬと思つて立て歩行き出すと揺れ出し、足を取られて歩行自由ならず	其内大地轟キ出ス、女子供ハハツトいつて立騒ぐ、我夫ヲ押へ、騒ぐニ及ばず、此ハ地震の大キイのだ、静まり候へと言ふ、坂東小三津と言ふ師匠、親方すわつて居づ共、マア御立ナサイといふ、本ニそふだと立上るとゆれ初メ、ヒヨロヒヨロして歩行れず
The strong upward movement came from the ground. Almost all the women were surprised and screamed. I said, 'calm down, it's a big earthquake.' Omitu said to me 'you should stand up rather than sitting.' I stood up and walked. Then the strong shaking started, and I could not walk normally.	The strong rumble occurred. The women and children were surprised and screamed. I said, 'calm down, it's a big earthquake.' Omitu Bando said to me 'you should stand up rather than sitting.' I stood up. Then the strong shaking started, and I could not walk normally.

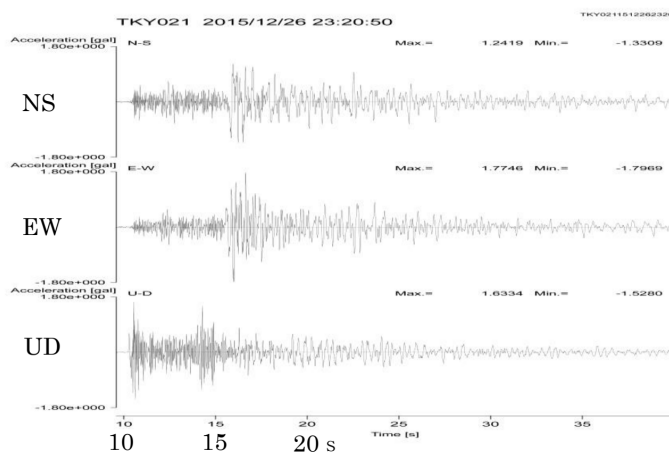


図1 2015/12/26 23:20の地震(M3.4, 深さ23 km) K-NET 猿江(TKY0021)での加速度記録.
震央距離 20km SMDAにより描画・加筆.

Fig. 2 Acceleration wave form of the 2015/12/26 earthquake (M3.4, depth=23 km) at the K-NET Sarue (TKY021) station (epicentral distance=20 km).