

Is mortality an indicator for the location of epicenter of inland great historical earthquakes? –a case study of the Hyogo-ken Nanbu Earthquake in 1995-

*Taku Komatsubara¹

1. Institute of Geology and Geoinformation, Advanced Industrial Science and Technology

1 Introduction Some historical earthquake researchers propose that mortality is a source for estimation the locality of inland earthquake epicenter (e.g. Tsuji, 2010). This methodology based on the following two assumptions. 1. Human beings attempt to escape from collapsing residential houses immediately after perception the preliminary tremors. 2. Thus, there should be a close relationship between duration of preliminary tremors (i.e. epicentral distance) and survival rate. Former studies (e.g. Komatsubara, 2016) applied this presupposition to rural nighttime earthquakes which are acceptable such assumptions, and concluded the mortality is better indicator than the fallen house ratio. In the dense populated cities, however, above mentioned assumptions are nonsensical, because even if persons could escape from residential houses, vacant area would be blocked by fallen buildings, survival rate would consequently be reduced than rural areas. Therefore, it is worthy to test whether relationship between the duration of preliminary tremors and survival rate does occur or not. The presenter examines a case of the Hyogo-ken nanbu Earthquake in 1995, as a rudimentary test for applicability on this method to urban earthquake such as the Ansei Edo Earthquake in 1855.

2 Outline of the 1995 Hyogo-ken Nanbu Earthquake The hyogo-ken Nanbu Earthquake (Mj=7.3) occurred at AM 5:46, its' epicenter was at the Akashi strait. The hypocenteral processes were well analyzed by Sekiguchi et al, (2000). They made clear the processes as follows. 1. The first rupture initiated under the Akashi strait, west of Kobe City, and rupture expanded forward both sides. 2. The next break occurred just under Kobe City at five seconds after the initiation of the first rupture. 3. The third rupture occurred at the east end of the second rupture at nine seconds after the initiation of the first rupture. The presenter estimates mortality based on the address of victims (Mainichi Newspapers Co. Ltd., 1995). and basic residents' registers of local governments. The distribution of mortality is closely similar to the fallen buildings rate (Building Research Institute, 1996), and has less relationship with distance from epicenter.

3 Discussion and next theses This result shows there is a little relationship between mortality and epicentral distance in overpopulated areas. The presenter think of following three factors would be important on the severe mortality in distant place from epicenter. 1. Many two-storied low resistant buildings collapsed, and many residents could not run off fallen houses although they tried. 2. Many persons died by collapsing buildings which blocked vacant ground. 3. Almost all people have studied "Crawl under desk or bed while shaking". This education is not effective at the case of house falling. The second factor is common situation with the early modern cities. Thus, it must be cautious to make use of the survival rate to be an indicator of epicentral distance for historical earthquakes in urban areas. The presenter wants to continue studying on the mortality in rural Awaji Island by this earthquake. And statistical studies on relationships among mortality, rate of fallen buildings and epicentral distance in urban earthquake disaster are needed.

References

Mainichi Newspaper Co. Ltd. (1995) Documents Hanshin great earthquake disaster. 242p.

Building Research Institute (1996) Final report on the damages by the Hyogo-ken Nanbu Earthquake in 1995. 303p.

Komatsubara, T. (2016) Estimation on the location of epicenter of an inland earthquake inferred by the

distribution of the ratio of killed and/or injured persons to total population - A case study of the Ansei Etsu Earthquake of April 9 in 1858, Gifu and Toyama prefectures, central Japan-. *Historical Earthquakes*, **31**, 1-7.

Sekiguchi, H., Irikura, K. and Iwata, T. (2000) Fault geometry at the rupture termination of the 1995 Hyogo-ken Nanbu Earthquake. *BSSA*, **90**, 117-133.

Tsuji, Y. (2010) Distribution of numbers of casualties in villages of the Echigo Sanjo Earthquake of December 20, 1828. *Chishitsu News*, 676, 16-20.

Keywords: historical earthquake, mortality, epicenter, Hyogo-ken Nanbu Earthquake, urban earthquake disaster