Comments from historiographical seismology to off-fault paleoseismology

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Off-fault paleoseismology based not on displacements of active faults but on geological, geomorphological and archaeological investigations of field records of old earthquakes such as surface fractures, landslides, liquefaction features, uplifted marine terraces, subsided marshes, damaged archaeological remains, tsunami deposits, turbidites and dendrochronological materials are very important for elucidating pre-instrumental seismic activity. In off-fault paleoseismology in Japan it should be noted that in the Japanese islands rather many deep-focus slab earthquakes of M7~8 class take place as well as large or great shallow-focus inland and interplate earthquakes. We tend to assume implicitly that earthquakes responsible for field records were shallow-focus, which may sometime lead us to wrong conclusions. In recent historical seismology, if many high-quality historical records are available for a certain event, the type of that earthquake (shallow inland event, interplate event, or slab event) can be inferred, as well as its epicentral area, occurrence date and time, and magnitude, by analyzing information of characteristics of strong ground motion (predominant period and duration time), aftershock activity, tsunami, and coseismic crustal deformation described in historical documents. The study of the 1819 Bunsei-Ohmi earthquake, a presumable slab event (Ishibashi, 1999), is a good example. In paleoseismology, when a large offshore earthquake is investigated mainly by tsunami deposits, we should not forget the 1933-type intraplate event within the shallow part of an oceanic plate.

A big problem in off-fault paleoseismology is that the location and size of past earthquakes can hardly be estimated, as well as the difficulty of the occurrence time estimation, because time resolution of each field record is not so good and identification of records due to the same earthquake is difficult. We should note that, except for the records of coseismic crustal movements, field records of earthquakes are just records of strong ground motion or tsunami attack and do not include information of source location. Although the result of archaeoseismology on the recurrence history of great Tokai and Nankai earthquakes (e.g., Sangawa, 1992) is often referred to, evidences of past liquefactions cannot tell where causative earthquakes took place, neither exactly when. It is a good lesson that the 1233 Tenpuku Nankai earthquake suggested by archaeoseismology was proved to be a ficticious (fake) earthquake by historical seismology (Ishibashi, 1998, 2004).

Historical seismology, which investigates old earthquakes based on written historical records, is very useful for studying pre-instrumental earthquakes. However, historical seismology has limitation in the study of paleo-earthquakes at the same time. First of all, the time coverage is very short; even for the area around ancient capitals Asuka, Nara and Kyoto in Japan, the study can go back only to the late 6th century. Second, even in historical times the density of historical documents is temporally and spatially very inhomogeneous and existing catalogues of historical earthquakes are very incomplete. Therefore, we should be careful in identifying historical events suggested by paleoseismology or archaeoseismoloty.