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Seismic event and source fault with weak features on the earth's surface, and evolution of strain release system

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The longer an active fault is, the higher its activity is. This tendency can be derived from the length distribution of active faults in Japan on the assumption that the power law distribution holds for the length of seismic source faults. The tendency is consistent with an idea that faults effective for strain release are connected and become longer and more active with time (Stirling et al., 199 6).
Some recent damaging earthquakes in Japan are associated with active faults with extremely short length; i.e., the estimated length of the 2008 Iwate-Miyagi earthquake source fault is 30km or longer while the length of active fault found after the event on areal photograph taken prior to the earthquake is only 3 to 4km (Suzuki et al., 2008). Similar situation is found for the M7.3 Western Tottori earthquake of 2000. Thus the length of active fault does not necessarily represent the length of source fault. The length distribution of active faults in Japan shows the power law distribution with a bend at JMA magnitude 7.5. The bend can be interpreted as follows. At this threshold magnitude and above, the length of active fault represents the length of source fault. However, below this level, some active faults are shorter than its corresponding source fault. Thus we can expect an M7.4 earthquake at most on a short active fault. The true length of underground source fault can be estimated by using gravity anomaly and geological fault data. The power law distribution of the length of active fault also shows a bend around M7.1 to 7.2. This probably corresponds to the threshold of magnitude at and above which at least a part of source fault or its elongation reaches the surface of the earth. Thus we can expect an M7.0 to 7.1 earthquake at most where no trace of active fault is found. Those unidentifiable sources are less active than identifiable sources.

Keywords: shallow crustal earthquake, active fault, strain release system