

Seismic slipping events recorded in a fault gouge zone: evidence from the Nojima Fault drill holes, SW Japan

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It is well known that large intra-continental earthquakes occur repeatedly along mature active faults and that the seismic slip may be recorded by cataclastic rocks, including fault gouge zones, that form at shallow depths in the upper crust (e.g., Lin, 2008). A fault gouge zone, bounded by a principal fault plane, is considered to represent the seismic slip zone that accommodates most of the accumulated fault displacement in the seismogenic regime. Therefore, studies of fault gouge zones along mature active faults would provide important information for reconstructing the long-term seismic faulting behavior of such faults, as well as providing new insights into the individual seismic slipping processes of active faults and their paleoseismic histories.

In the present study, we focused on the structural features of the fault gouge zone observed in drill cores acquired from nine holes that were drilled through the Nojima Fault (NF) at different depths from ~260 to 900 m at the Ogura site (Lin and Nishiwaki, 2019). Drilling investigations and structural analyses of drill cores reveal that a ~60 m wide fault damage zone containing a 10–30 cm thick fault gouge zone developed along the Nojima Fault (NF), on which the 1995 M_w 6.9 Kobe (Japan) earthquake occurred. The fault gouge zone was observed at depths of ~260 to 900 m in nine drill holes that intersected the NF. Our findings show that i) the fault gouge zone observed at different depths in the nine drill cores is the principal fault slip zone of the NF, ii) the fault gouge zone can be divided into 11–20 thin layers of different color, and iii) the individually colored layers contain different color breccias of fault gouge that are offset and/or cut by cracks and crack-filled calcite and quartz veinlets. Our results reveal that the fault gouge zone probably records more than 11–20 paleoseismic faulting events along the NF during the late Pleistocene-Holocene.

References:

- 1) Lin, A., 2008. Fossil Earthquakes: The Formation and Preservation of Pseudotachylytes. Springer, Berlin, 348p (ISBN 978-3-540-74235-7).
- 2) Lin, A., Nishiwaki, T., 2019. Repeated seismic slipping events recorded in a fault gouge zone: evidence from the Nojima Fault drill holes, SW Japan. *Geophys. Res. Lett.*, doi: 10.1029/2019GL081927.

Keywords: Fault gouge zone, Nojima Fault, Seismic slipping event