Effects of active fault types on earthquake-induced deep-seated landslides

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We collected documents on historical earthquake-induced deep-seated landslides (DSLs) published by the Japan Landslide Society and active faults from the digital active fault map of Japan, the Headquarters for Earthquake Research Promotion, and the National Institute of Advanced Industrial Science and Technology. Comparing and analyzing the distribution of DSLs with corresponding active faults, we found following results. (1) DSLs induced by reverse fault earthquakes were distributed equally on a wide range of about 20 km from the active faults. On the other hand, more than 80% of DSLs induced by strike-slip fault earthquakes were concentrated within a narrow range of about 5 km to the active faults. (2) Most of the DSLs (24 out of 25 cases) induced by reverse fault earthquakes were distributed on the hanging wall side of the reverse faults. (3) As is shown in the cases of reverse faults, many DSLs in the cases of strike-slip faults earthquakes occurred in the hanging wall if the location of an epicenter is considered to be in the hanging wall.
As is known in the earthquake engineering field (e.g., Sato and Hirata, 2000, KAGAKU, vol. 70, No.1, 58-65, in Japanese), the damage caused by a strike-slip fault earthquake is more concentrated in a narrower range around the fault compared with the case by a reverse fault. A similar phenomenon was also confirmed for DSLs in this study. Many recent cases demonstrate that many DSLs occur in the hanging wall because the hanging wall suffers larger seismic motion than the foot wall by reverse fault earthquakes (e.g., Has Baator et al., 2010, JSECE annual meeting abstract, No. 57, 48-49, in Japanese). A similar result was also observed for the historical events. The discussion above suggests that, in addition to the distance to the nearest active fault of a potential landslide, we should take account of types of the active fault (reverse/strike-slip/normal) and whether the landslide is located in hanging or foot wall to assess the occurrence of earthquake-induced DSLs. The popular attenuation model (Si and Midorikawa, 1999, Journal of Struct. Construct. Eng., No. 523, 63-70, in Japanese) of peak ground velocity (PGV) that is commonly used for the building assessment is also required for similar considerations when used for the landslide assessment.

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