Long-term rates of gravitational slope deformations on a low-angle fault that forms a dip slope in the Shimanto Belt, in the Kanto Mountains

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Deep-seated gravitational slope deformation (DGSD) proceeds very slowly and sometimes transforms into catastrophic failure, but its rates are not well addressed. The rates of DGSD must be strongly controlled by geological structures and landforms so they need to be examined from this view point. We performed geological investigation and dating of DGSD, which was found to be due to the sliding along a low-angle fault, in the Shimanto Belt in the Kanto Mountains. The Shimanto Belt is a typical accretionary complex with well-developed thrust faults, which have been recently found to control DGSD in wide areas in the Kii Mountains in Japan.

We found linear depressions that are aligned along an E-W-trending ridge top as long as 5 km. Geological investigation strongly suggests that these linear depressions are due to the sliding of the hanging wall of a low-angle fault nearly parallel to the slope surfaces. The linear depressions are up to 30 m deep and up to 1.3 km long. We made drill holes at 4 locations in the linear depressions and took filling sediments, which were 4.5 to 7 m thick. We analyzed the volcanic glass in the sediments and identified two horizons of tephra, AT (30 ka) and K-Tz (95 ka) and/or On-Pm 1 (98 ka). These ages suggest the bottoms of the sediments are of approximately 80 to 100 ka. On the other hand, the eastern linear depression is known to have tephra layers of AT, On-Om1 and Yt-Kw (171 ka), which suggest that the age of the bottom of the filling sediments is at least 210 ka. The ages of the sediment bottoms are interpreted as the starting ages of the DGSD. The age of the eastern DGSD is thus much older than the central and westernmost linear depressions, which may be attributed to that knickpoints migrated from the east to the west and that the low-angle fault is nearly exposed to the river side in the eastern DGSD. The displacement rates of DGSD were calculated using the displacements of the ridge tops and the initiation ages, which provided 0.2 to 0.5 mm/y for all the linear depressions.

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