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The reproductive experiments of stratum deformation on the trench for the Kushibiki fault using numerical experiments

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Introduction

The Quaternary regional stress field in eastern-central Japan tend to be east and west compaction force. Therefore, a number of thrust faults develop in this area. These faults sometimes indicate complex features, such as back thrusts or branches above 3 km depth.

It is considered that seismic waves are generated by fault activity below 3 km depth. Therefore, indirect earthquake surface faults which branch off from a earthquake source fault not generate seismic waves. Additionally, earthquake surface faults which directly connect to a earthquake source fault specify crustal movements around these faults. Therefore, we must distinguish between indirect earthquake surface faults and faults which directly connect to a earthquake source fault.

According to the approach of foam rubber models and dynamic lattice model simulations, it is known that a fault slip velocity accelerates toward a ground surface (e.g., Oglesby *et al.*, 2000; Ma and Hirakawa, 2013). According to numerical calculations which base on dynamic models, peak slip velocities of thrust faults with dip angles of 30-45 degree are 2.5-4.0 m/s (e.g., Oglesby *et al.*, 2000; Ma and Hirakawa, 2013). On the other hand, according to the numerical calculation, the peak slip velocity of the back thrust which was the indirect earthquake surface fault from the 2008 Iwate-Miyagi Nairiku earthquake in Japan was 0.05 m/s (Ando and Yamazaki, 2013). Therefore, we may be able to distinguish between indirect earthquake surface faults and faults which directly connect to a earthquake source fault, from peak slip velocities. Thus I estimated the peak slip velocity of the Kushibiki fault which is considered as indirect back thrust of the Fukaya fault, from numerical experiments.

Relation between the Kushibiki fault and the Fukaya fault

Sugiyama *et al.* (2009) described that the Kanto-heiya-hokuseien fault zone is active fault zone which intervenes between the Kanto mountain terrain and the Kanto plain with NW-SE strike. The Kanto-heiya-hokuseien fault zone which is SW dipping thrust consists chiefly of fault groups along the Fukaya fault and the Fukaya fault.

The Hirai-Kushibiki fault zone which is considered as back thrust of Fukaya fault except the Hirai fault, consists of the Hirai fault, the Kushibiki fault and Kamikawa fault. In addition, the Kushibiki fault is bedding fault of Neogene sediments which have a dip angle of about 20 degree (Sugiyama *et al.*, 2009b; Shintani *et al.*,2009).

Methods

In this study, I performed numerical experiments about stratum deformation by faulting of the Kushibiki fault, and these experiments were executed by SDSSC (Strata Deformation Simulation System using CIP method) Ver 4.09. The model which feeds into SDSSC is modeled by the stratigraphy, the dip angle and the unit displacements from drilling surveys (Sugiyama *et al.*, 2009b) and trenching study (Shintani *et al.*, 2009).

Numerical experiments were performed with taking into account the erosional vacuity and the sedimentation for stratum by the faulting at the trenching area, and the peak slip velocity was estimated by comparison between experimental results and trenching results.

I adopted CWFS (cohesion weakening and frictional strengthening) model (Hajiabdolmajid *et al.* 2002) as the deformation characteristic about the stratum.

Result and Discussion

I estimated the peak slip velocity of the the Kushibiki fault at 1-1.5 m/s. Therefore, this conclusion leads to the suggestion that the peak slip velocity of the indirect back thrust is slower than the thrust faults.

Achnowlegement

For this study, I have used the computer systems of the Earthquake and Volcano Information Center of the Earthquake Research Institute,the University of Tokyo.

Keywords: Kushibiki fault, earthquake surface faults, back thrust, fault slip velocity, numerical experiment, CIP method