Estimating Fault Parameters of the Fukaya Fault System, An 80-km-long Active Blind Fault in Greater Metropolitan Tokyo, Japan

Yuichi Sugiyama[1], Haruko Sekiguchi[1], Tatsuya Ishiyama[1], Kiyohide Mizuno[1], Toshihiko Sugai[2], Eric C. Cannon[3]

[1] Active Fault Research Center, GSJ/AIST, [2] Active Fault Lab., Geological Survey of JPN, [3] Dept. Geol. Sci., Colorado Univ.

Active faults in depositional basins usually appear as flexures or monoclines at the surface. In the Kanto basin where greater metropolitan Tokyo is located, the Fukaya fault system is typical of these blind faults. We summarize its fault parameters and discuss future investigations to more tightly constrain the parameters.

A 12-km-long, west-side-up flexure scarp called the Fukaya fault traverses Pleistocene terraces in an NW direction along the northwestern margin of the Kanto Plain. Seismic reflection surveys (Yamaguchi et al., 1996; Saitama Pref., 1999) have revealed that the flexure is located at the hinge of an asymmetrical syncline composed of east-dipping west and nearly horizontal east limbs.

Fault length. Seismic reflection surveys in the areas about 20 and 35 km northwest of Fukaya imaged a concealed asymmetrical syncline similar to that beneath the Fukaya flexure (Sugiyama et al., 2000). Seismic profiling also tracked this concealed asymmetrical syncline southeastwards to Fukiage Town about 20 km southeast of Fukaya (Yamaguchi et al., 1999). These results indicate that the Fukaya fault is an asymmetrical syncline hinge that extends for about 65 km. Taking into account the Ayasegawa fault 2 to 3 km to the southeast, the total length of the Fukaya fault system reaches about 80 km.

Distribution pattern of fault lines (syncline-hinge traces). The 80-km-long Fukaya fault system probably comprise at least four left-stepping syncline-hinge traces: Haruna (8 km), Takasaki (18 km), Fukaya (38 km) and Ayasegawa (16 km). Whether these respective fold-hinge traces are equivalent to behavioral segments is a problem that needs further paleoseismological studies.

Subsidiary structures. East-side-up flexures such as the Kushibiki fault are located several to 10 km southwest of the Haruna-Fukaya traces, together forming a pop-up structure (Yamaguchi et al., 1999). A broad anticline develops to the southwest of the Ayasegawa trace.

Strike-slip component. Long-term crustal strain and focal mechanism for the 1931 Saitama earthquake (Abe, 1974) suggest a left-lateral strike-slip component for the Fukaya fault system. However, no geomorphic and geologic evidence for lateral slip has been obtained.

Vertical offset rate of flexures. A consistent 6 m vertical offset was measured across the 20-ka, 5-km-wide terrace in Fukaya, resulting in a 0.3 m/ky vertical offset rate. Borehole data combined with seismic profiles also identified uplift rates ranging from 0.3 to 0.4 m/ky for the Fukaya trace (Saitama Pref., 2000). Vertical offset rates of larger than 0.2 m/ky and around 0.25 m/ky were obtained for the Takasaki trace on the basis of vertical offsets of 400-ka and 50-ka tephras (Mizuno et al., 2001; Sugai et al., 2000). These data imply that the Fukaya and Takasaki traces have nearly the same vertical offset rate, or the former has a slightly larger vertical offset rate. The southernmost Ayasegawa trace has a much lower vertical offset rate of less than 0.1 m/ky when compared to the Fukaya and Takasaki traces. Vertical offset per event on each fault trace still remains to be solved.

Dip angle of blind faults. Yamaguchi et al. (1999, 2000) interpret a 1.5-km-deep, 20-degree-west-dipping reflector, which is imaged on two profiles across the Fukaya trace, as a main blind thrust. However, seismic profiles across the Ayasegawa trace and the southernmost part of the Fukaya trace (Kasahara, 1995, 1996) suggest a deep fault plane with a 45-degree or steeper dip angle. To determine geometry and slip rate of the main blind fault, quantitative analysis based on fault modeling is necessary. We will present preliminary results of the analysis.