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Quantitative analysis of tectonic landforms along the Nagamachi-Rifu fault segment by using LiDAR-based 2-m-grided DEM

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The location and slip-distribution of the Nagamachi-Rifu fault segment is quantitatively analyzed using 2-m-grided DEM that detected by airborne LiDAR. 0.5-2 m interval contour maps and 150 topographic cross sections generated from DEM permit identification and measurement of 13 river terraces and a 5-km-wide flexure and fault zone in and around the urbanized Sendai city.

The narrowly-defined Nagamachi-Rifu Line fault is a 22-34 km-long and 2.5-km-wide active flexure and fault zone, which consists of the right-stepping Miyagino and Nigatake flexures, and the Dainenji-yama back thrust. Each of flexures and fault displace the terrace surfaces and recent alluvial plain cumulatively. The Dainohara terrace of 100 ka or older has received a maximum 70 m vertical by the movement of the Miyagino and Nigatake flexures. The total deformation of the flexures consist of 70 % of uplifting relative to the alluvial plain. 30-50 % of uplifting of the flexures attribute the deformation by the Dainenji-yama back thrust.

The Yagiyama flexure is an active structure longer than 10km, which developed on the upthrown side of the Nagamachi-Rifu Line fault. A 1-1.5 km-wide asymmetric anticline of the terrace surfaces are newly recognized in the downtown of the city. A 2-km-long scarplet on the river terraces continues northward from 3-km-north of the Yagiyama flexure. The active Tsubonuma-Enda fault is located on the SW of the flexure.

The displacements of river terraces, normalized by the number of faulting event, depict the pattern of slip-distribution along the active fault and flexure with high clarity. The normalized displacements along the Nagamachi-Rifu Line fault are constantly large along the 15-km-long central part of the fault and gradually decrease toward the both ends. On the other hand, the displacement along the Yagiyama flexure increase in the southwestern part of the flexure seems continue to the Tsubonuma-Enda fault. When the 4.5 m of uplifting of lowest terrace has experienced 2 faulting events caused by the Nagamachi-Rif Line fault, the recurrence interval of the fault is estimated to be 5-6 ky or longer based on the age and cumulative displacement of the Dainohara terrace. This estimation is consistent with the paleoseismicity in Holocene revealed at the NE part of the fault.

Keywords: Nagamachi-Rifu Line fault, airborne LiDAR, DEM, tectonic landform, active fault, slip distribution