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Late quaternary slip rates and vectors on the Median Tectonic Line active fault zone in eastern Shikoku, southwest Japan

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ABSTRACT

The Median Tectonic Line active fault zone (MTLAFZ) extends for about 190 km through Shikoku, southwest Japan. Though the MTLAFZ is the most significant onshore active tectonic feature in southwest Japan, its late Quaternary slip rate has been estimated at only a few locations with reasonable references and ages. Better information on this feature's recent slip rates is critical to understanding the ongoing tectonic processes in the region and evaluating the seismic risk of this fault zone. In this paper, new estimates of the late Quaternary slip rate are reported from the Ikeda and Chichio faults in the central portion of the MTLAFZ. The author mapped late Pleistocene fluvial terrace surfaces and used tephrochronology and radiocarbon dating to constrain the age, and measured offset of terrace risers. The slip vectors of both faults are similar, as derived from piercing points on the bottoms of the terrace risers. The vertical component of displacement is 2–6% of the horizontal component. Long-term slip rates during the late Quaternary were calculated at 7.8–9.1 mm/yr, which is more precise than those in the previous studies and represents the highest slip rate in the MTLAFZ. This rate is also much faster than previously reported shorter-term slip rates of geodetic study. The long-term seismic risk of large earthquakes (>M8) along the Ikeda and Chichio faults in the next 30 years are evaluated to be more than 0.4–1.9% and 0.1–3%, respectively, much higher than a previous estimate of 0–0.3%.

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1. Introduction

The Median Tectonic Line (MTL) is the most prominent geological boundary in southwest Japan (Fig. 1A). The Median Tectonic Line active fault zone (MTLAFZ) extends along the MTL for about 190 km through Shikoku (Research Group for Active Faults of Japan, 1991, Fig. 1). The MTLAFZ is an arc-parallel, right-lateral strike-slip fault related to the oblique subduction of the Philippine Sea plate beneath the Eurasian plate along the Nankai trough (Fitch, 1972), suggesting that the MTLAFZ is the most significant onshore active tectonic feature in southwest Japan. Though late Quaternary slip rate has been estimated at a few locations, these studies were conducted in 1960–90s based on the amount of offset measured on topographic map with a contour interval of 5–10 m. Improved constraints on the slip rate of this feature are critical to assessing the seismic hazard along this fault zone and to understanding the ongoing tectonic processes in the region.

In this paper, new late Quaternary slip rate estimates are

reported for the Ikeda and Chichio faults along the central portion of the MTLAFZ in Shikoku, Japan. Towards this end, the author mapped fault traces and measured offsets within late Pleistocene fluvial terraces and dated terrace deposits using tephrochronology reported in the prior study and radiocarbon ages. Slip vectors and offset were measured from topographic profiles and maps derived from digital elevation models (DEM) developed from processing of aerial imagery taken in the 1975, before the construction of an expressway near the active fault traces.

2. Regional setting

The MTL separates the low-pressure, high-temperature Ryoke metamorphic belt to the north and the high-pressure, low-temperature Sambagawa metamorphic belt to the south, along a line running from Shikoku to Kanto (Fig. 1A) (Hashimoto and Kanmera, 1991; Takahashi, 2006). The MTL is offset along the Itoigawa-Shizuoka Tectonic line (ISTL) in Chubu, suggesting that the MTL is older than the ISTL. The Upper Cretaceous Izumi group, composed of interbedded sandstone and mudstone, was deposited in the narrow half-graben to the north of the MTL, related to left-lateral

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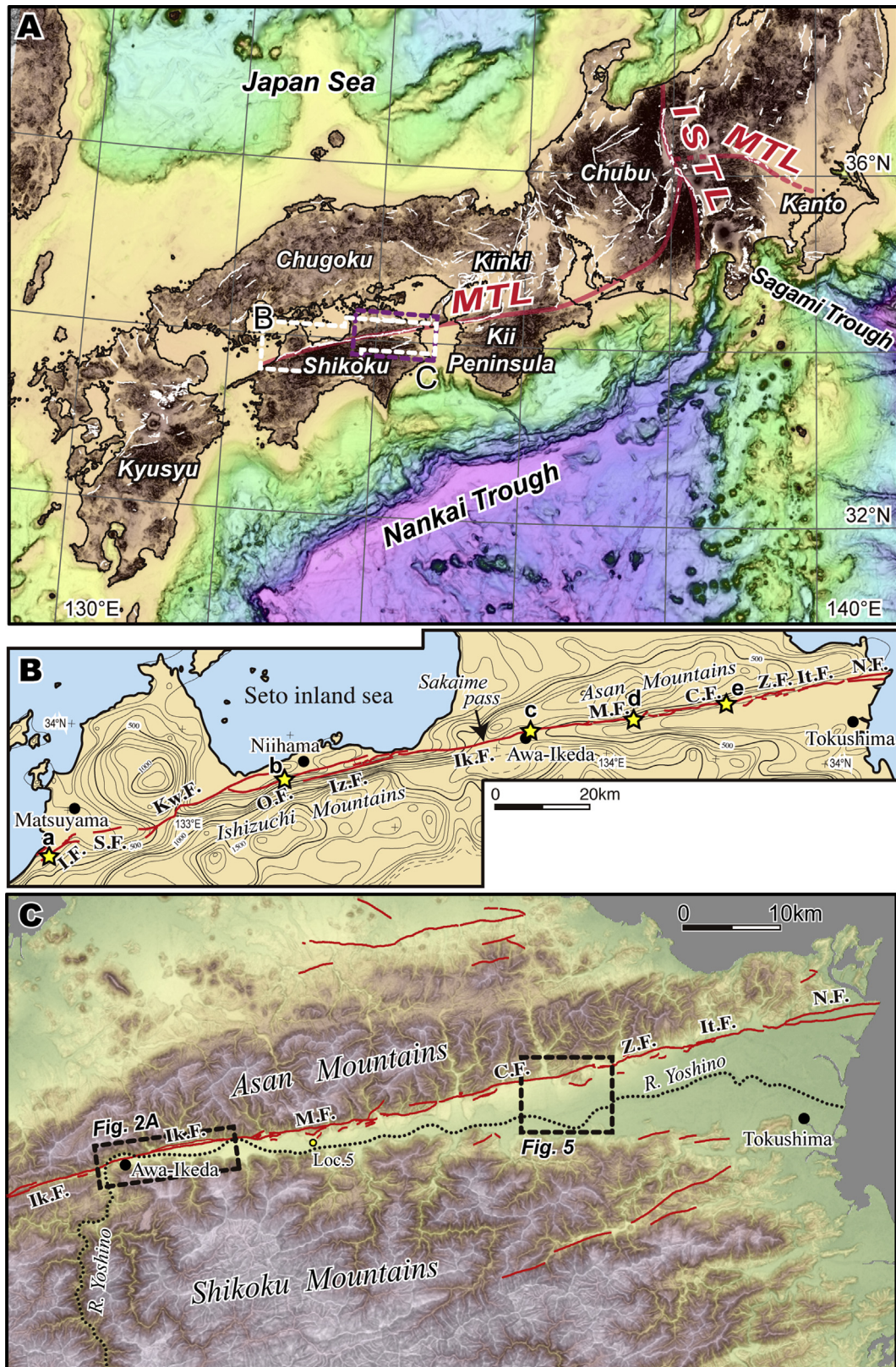


Fig. 1. A: Distribution of active faults and major tectonic lines in central Japan. The shaded relief map uses a 1-km grid DEM from SRTMplus Data provided by the USGS. White and red lines indicate active fault lines and tectonic lines, respectively, after Nakata and Imaizumi (2002) and Hashimoto and Kanmera (1991). The rectangle of dashed white line and purple line indicate location of Fig. 1B and C, respectively. Abbreviations are as follows: MTL, Median Tectonic Line; ISTL, Itoigawa-Shizuoka Tectonic Line. B: Active faults (red lines) along the MTL within the Shikoku region. Topographic map is after Okayama (1988). The stars with abbreviation indicates where the prior studies evaluated the long-term slip rates. Abbreviations show the site where the studies are conducted as follows: a: Goto (1996); b: Tsutsumi et al. (1991); c: Okada (1968); d: Okada (1970); e: Tsutsumi and Okada (1996). Abbreviations of the faults are as follows: I.F., Iyo fault; S.F., Shigenobu fault; Kw.F., Kawakami fault; O.F., Okamura fault; Iz.F., Ishizuchi fault; Ik.F., Ikeda fault; M.F., Mino fault; C.F., Chichio fault; Z.F., Zunden fault; It.F., Itano fault; N.F., Naruto fault. B: Enlarged geomorphological map of area C in Fig. 1A. The shaded relief map uses a 90-m grid DEM from SRTM Data provided by the USGS. Red lines indicate active fault lines, after Nakata and Imaizumi (2002). Abbreviations of the faults are same as Fig. 1B.

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