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Vertical crustal movement around the northern Itoigawa-Shizuoka Tectonic Line Fault Zone revealed by continuous GPS

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The Itoigawa-Shizuoka Tectonic Line (ISTL) delineates the western margin of northern Fossa Magna, and has experienced active deformation since the opening of Japan Sea. At present, ISTL is one of the most active faults in Japan. However, there has been no historical large earthquake along ISTL and fault models for future earthquakes along ISTL have large uncertainties. We established 11 continuous GPS sites during 1999-2000 in order to resolve detailed crustal deformation around ISTL, but only horizontal movements have been discussed so far because of the limitation in measurement accuracy. Here we processed the ten-year long GPS data and obtained precise vertical signals.

Characteristics of vertical crustal movements around northern ISTL can be summarized as follows. 1) The Hida Mountains are uplifting at a rate of 4-5 mm/yr. The uplift zone extends to the boundary between the Hida Mountains and the Matsumoto Basin. 2) The Matsumoto Basin is tilted eastward and the eastern end of the basin has a subsidence of 1-2 mm/year. 3) Vertical movement of the Ohmine belt located between the Eastern Matsumoto Basin Fault and the Otari-Nakayama Fault is negligible. 4) Folding area east of the Otari-Nakayama Fault is uplifting at a rate of 1-2 mm/year. 5) No significant vertical motion in the Central Uplift Zone.

These features are consistent with geological/geomorphological features, implying that current crustal movement reflects tectonic motion in a much longer term. Noticeable contrast in the vertical movement across the East Matsumoto Basin Fault, together with the concentrated shortening, implies that inelastic processes such as deep fault creep contribute to the regional WNW-ESE contraction. In addition, we should take other factors such consolidation of the sedimentary basin, secondary faults, and active faulting into account in modeling crustal deformation.

Keywords: Itoigawa-Shizuoka Tectonic Line, GPS, crustal deformation, East Matsumoto Basin Fault, Fossa Magna, uplift