

Crustal deformation around the Kamishiro fault and its implications for the 2014 Northern Nagano earthquake

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The Itoigawa-Shizuoka Tectonic Line (ISTL) is a major geologic boundary intersecting the Japanese mainland into the north-eastern and the southwestern parts. It is also an active fault system that is supposed to have a high seismic potential. We have conducted dense GPS observation and identified a highly localized E-W contraction

around the Kamishiro fault at the northern ISTL. Kinematic modeling of this deformation pattern suggests that the fault is dipping to the east and accommodating the E-W contraction by aseismic faulting below the depth of 2-4 km.

On November 22, 2014, a Mw 6.3 earthquake occurred at the Kamishiro fault. The hypocenter is located at a depth of 5 km and surface rupture appeared for about 9 km along the fault trace. Considering the pre-seismic deformation pattern and aseismic fault slip at depth, this earthquake is considered to rupture the remaining shallow locked part. Thus no further large earthquake is not anticipated in this area in the near future although much larger event is expected to occur along the whole ISTL.

This earthquake caused a heavy damage on a small neighborhood called Horinouchi. It should be noted that the same neighborhood had experienced a severe damage by another earthquake in 1714. Considering that the locked portion is limited to the shallowest 5 km and strain rate around this area is very large, it is possible that the same fault segment was reactivated in 300 years, which is an unusually short recurrence interval as an intra-plate active fault. This example demonstrates an importance of dense as well as precise geodetic observation for seismic hazard evaluation and understanding the crustal seismogenesis.

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