

## Fault outcrops and tombstone fall-down rates of the 2007 Noto-hanto Earthquake, central Japan

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The 2007 Noto-hanto (Noto Peninsula) Earthquake occurred at 9:42 (JST, GMT+9h) in the morning of Sunday, March 25. Wajima City, Anamizu Town, Shika Town, Nanao City and the nearby areas counted 1 death, 26 heavy injuries, 283 minor injuries, 537 totally collapsed houses and 820 partly collapsed houses in total (at April 10, by Ishikawa Prefecture Government). We found fault outcrops on March 27 at Nakanoya and Andaihara in the Monzen area, Wajima City. The fault cuts a N-S stretching paved road in N60°E direction at Nakanoya, and causes 8 cm right-lateral displacement. En echelon cracks are formed in its western extension on a dried rice paddy, and a concrete dyke of the river aside the paddy is also crashed. Analogous 5 cm right-lateral displacement of a paved road is seen at Andaihara 1 km to the southwest of Nakanoya with en echelon cracks in the nearby paddies. At Kaiso, 5 km to the southwest of Andaihara, a breakwater dyke on the Japan Sea shore suffers 4 cm right-lateral displacement, and compressional destruction is seen on the stone pavement of a small river at Toge, 1 km to the east of Kaiso. These four points are aligned on a line in N60°E direction, and closely follow the outcrop line of the fault plane estimated from the crustal deformation by the Geographical Survey Institute.

The intensity of earthquake was 6+ degree (in the scale of Japan Meteorological Agency) in Wajima City, Anamizu Town and Nanao City, 6- degree in surrounding Shika Town, Nakanoto Town and Noto Town, 5+ degree in Suzu City to the northeast, and 5- degree in Hakui City and Kahoku City to the south as well as in the northern half of the neighboring Toyama Prefecture to the southeast. On March 27, 28 and April 1, we counted tombstone fall-down rates in the 35 cemeteries (public or temple-owned) in the Noto Peninsula. The area with the fall-down rate higher than 50% is restricted in the western coast from Togi (Shika Town) to Minazuki (Wajima City), including the cemeteries of the Monzen area, where houses were most badly damaged, with more than 90% fall-down rates as well as a cemetery in Sasanami (Shika Town), the closest to the epicenter, marking 100% rate. Although considerable injuries and house damages were reported from downtowns of Wajima, Anamizu and Nanao, where the intensity was 6+, the tombstone fall-down rate was less than 20% in these urban areas. This means that the strong high-frequency seismic waves to destroy tombs were restricted to the area very near to the fault, while low-frequency waves to damage houses and large constructions were propagated or generated farther outward. The width of the area with the tombstone fall-down rate higher than 50% measures 20 km, which is narrower than the case of the 2004 Chuetsu Earthquake (30 km), equivalent to that of the 2000 Western Tottori Prefecture Earthquake (20 km), and wider than that of the 1995 Kobe Earthquake (6 km). Movements of several faults are suggested for the Chuetsu Earthquake by the plural major shocks and widely scattered distribution of aftershocks, but a nearly vertical fault indicated by the planar distribution of aftershocks and the propagation effect of seismic waves due to a belt of thick alluvial deposits have caused a narrow, deadly high intensity zone in Kobe. The distribution of aftershocks shows a fault plane dipping 50 degrees to the southeast for the Noto-hanto Earthquake, and this is the main reason to cause relatively wide, high fall-down rate area that is displaced to the south in reference to the fault outcrop line. Our observation from a helicopter revealed that the large-scale collapses of steep cliffs on the Japan Sea shore occurred along the western coast from Togi to Fukami and along the northern coast near Wajima downtown, but were not visible in the northwestern coast in between, where tombstone fall-down rate was also low. This suggests that the ground motion was relatively weak to the north of the fault line (footwall area).