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Paleoseismological Evidence for Non-Characteristic Behavior of the Surface Rupture Associated with the 2004 Mid-Niigata Prefecture Earthquake, Central Japan

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The 2004 Mid-Niigata Prefecture earthquake sequence(mainshock magnitude: MJMA 6.8), which occurred on active fold-and-thrust belt in northern central Japan, generated a small thrust surface faulting(<20 cm of vertical offset) at eastern margin of the epicentral region. To better understand the past seismic behavior of this fault, we conducted a 15-m-long, 4-m-deep paleoseismic trenching across the 10-cm-high west-side-up surface rupture that generated on the foot of pre-existing 1.8-m-high east-facing scarp. A well-defined thrust fault zone, which displaces the Pliocene-Pleistocene strata and unconformably overlying Holocene strata, was exposed. This thrust fault zone is connected directly with 2004 surface rupture. Based on deformational characteristics of the strata and radiocarbon dating, it is inferred that two paleoseismic events occurred in the past 8, 000 years prior to the 2004 event. These two pre-2004 events have nearly identical slip amounts(at minimum 1.5 m), which are >15 times larger than that of the 2004 event. This paleoseismic data coupled with geological and geomorphological features suggests that the 2004 event was non-characteristic behavior on the fault having a potential for generating more destructive earthquake accompanying with meter-scale surface displacement.