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Holocene surface faulting on the western segment of the Tonami-heiya fault zone, Toyama Prefecture

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Constraining the timing and characterizing the deformation style of individual past surface-rupturing earthquake events, particularly those of the recent events are important for better evaluating future probability of large earthquakes generated from inland active fault zone and for assessing seismic hazard. The western segment of the Tonami-heiya fault zone (active fault zone along the western margin of the Tonami Plain), which composed of two NNE-SSW-trending west-dipping reverse faults; the Horinji fault on the south and Isurugi fault on the north, is one of the major active fault zones in Hokuriku region. Late Quaternary faulting is delineated by tectonic geomorphic expression and Plio-Pleistocene stratal deformation, but its Holocene faulting behavior is poorly known. In order to clarify the Holocene activity we have conducted detailed geologic and tectonic geomorphic investigations at selected sites, including trenching and arrayed drilling helped by archeologists for age determination of pottery shards incorporated into strata. On the trench walls across the Horinji fault at Horinji site, Nanto City, distinct west dipping main thrust faults with a series of east-dipping back thrusts displacing late Pleistocene to Holocene strata were exposed. Principal deformation in the trench walls is incremental rotation and/or warping of strata on the hanging wall side of the main thrust associated with horizontal shortening. Multiple paleoseismic events were identified based on stratigraphic and structural evidence of paleoearthquake events such as angular unconformity and cross cutting relations of strata and faults. Cross cutting relations of two sets of oppositely dipping faults and radiocarbon dates from faulted strata suggest that the at least two paleoearthquakes occurred after ca 5.7 ky ago, which raises the possibility that this fault was responsible for the enigmatic 1586 Tensho earthquake. Detailed examination of back thrusts exposed in the trench walls at Kamimukuta site, Takaoka City, reveals first direct evidence of the late Holocene faulting on the Isurugi fault. One of three subparallel strands of back thrust displaces channel-fill sediments containing abundant pottery fragments and covered by black soil layer. Archeological examination and radiocarbon dating indicate that the latest faulting on this strand occurred between ca 4 ka and ca 2 ka. These new findings would contribute to refine evaluation of future probability of earthquakes generated from this fault zone. This research was conducted as an entrusted project from Ministry of Education, Culture, Sports, Science and Technology.

Keywords: paleoseismology, active fault, Holocene, Horinji fault, Isurugi fault, Toyama Prefecture