

Paleoseismic history revealed by two trench investigations across surface ruptures appeared associated with the 2016 Kumamoto Earthquake

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Associated with the 2016 Kumamoto earthquake, surface ruptures were produced along the Futagawa Fault Zone and the Takano-Shirahata segment in the northern part of the Hinagu Fault Zone. Their traces extended to the northwestern part of the Aso caldera. After the earthquake, Geological Survey of Japan (GSJ) conducted boring and trench investigations at two sites on the surface ruptures to obtain detailed paleoseismic histories of the Futagawa and Hinagu Fault Zones.

Around the end of 2016, the first trench referred to Yamaide site was excavated at the southernmost part of the surface rupture on the Takano-Shirahata segment, Hinagu Fault Zone. After the boring survey, the trench, which is 14 m long, 10 m wide, and 4 m deep, was excavated. Some reverse faults and deformed layers possibly deposited by fluvial processes since late Pleistocene were obvious on the trench's walls (Fig. 1). Two strands of reverse faults on the northern wall which was facing the south and four strands on the southern wall steeply dipped to the east. The vertical displacements along some of the faults increase to older (lower) layers. Sediments for ^{14}C dating were systematically and densely collected even from low carbon content layers along with some vertical sections on the trench walls. These results demonstrated continuous deposition and the oldest humic silt layer in the trench deposited about 15 ka. Sedimentary structures and deformation of some layers along the faults suggest that at least 6 events occurred before the 2016 Kumamoto earthquake at the Yamaide site.

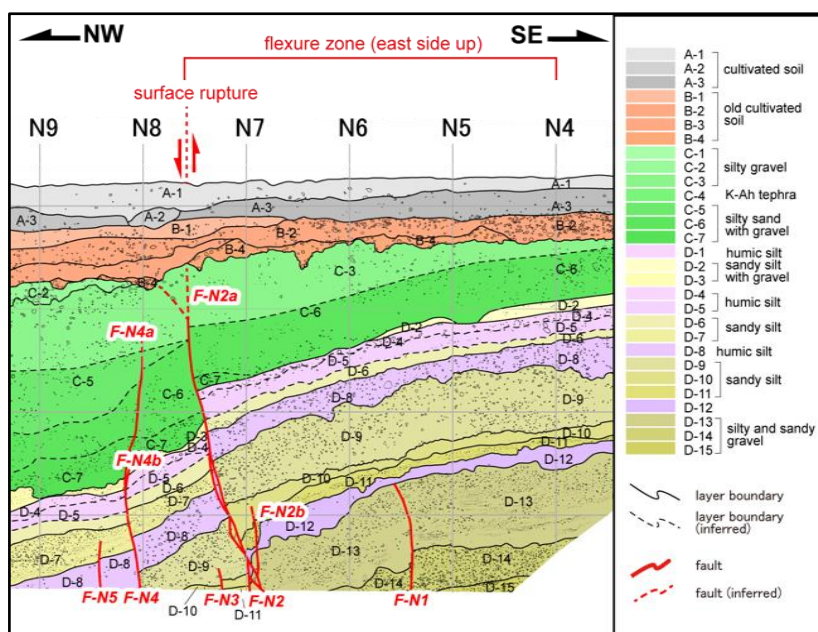


Fig. 1

A part of the log of the north wall of the trench at the Yamaide site. The trench was excavated on the Takano-Shirahata segment, Hinagu Fault zone.

Around the end of 2017, the second trench referred to Sawazuno site was excavated across the surface ruptures appeared at the western part of the Aso caldera. In this area, an EW-trending branch, about 2.5 km long, separated from the main trace with NE-SW trend at Tateno appeared along the south side of Nigorikawa River, where previous researches had not confirmed any active fault traces. GSJ conducted a trench investigation on the surface rupture along the branch in order to confirm that the ruptures are produced by active faulting as well as to obtain a paleoseismic history in an EW-trending graben around the Sawazuno district, Minamiaso village. During the earthquake, two traces of surface ruptures appeared almost along the foot of northern and southern scarps of the graben. The trench, which is 34 m long, 7 m wide and 4 m deep, was excavated across two rupture traces in the graben. On the east and west walls, two strands of normal faults and deformed layers were dipping towards the center of the graben (Fig. 2). The sediment was mainly composed of volcanic sediments that originally came from Aso Volcano. On some trench walls, a few widespread tephra, such as Kikai-Akahoya tephra (K-Ah), Aira Tn tephra (AT) and Kusasenrigahama pumice (Kpfa), as well as some pieces of clay pot of the Yayoi period were recognized. Most of the results of ^{14}C dating are consistent with them. Vertical displacements along some faults and deformation of older (lower) layers were accumulated larger and more than younger (upper) layers. This cumulative displacement clearly shows that the normal faults consisting of the graben are active faults. Sedimentary structures, deformation of some layers along the faults, and a few event deposits suggest that at least 5 events occurred before the 2016 Kumamoto earthquake since ~ 15 ka at the Sawazuno site.

Those results of both trenches provided that recurrence intervals of the Futagawa and Hinagu fault zones are about 1000~3000 yr. Those shorter intervals indicate that those fault zones are more active than estimations before the earthquake.

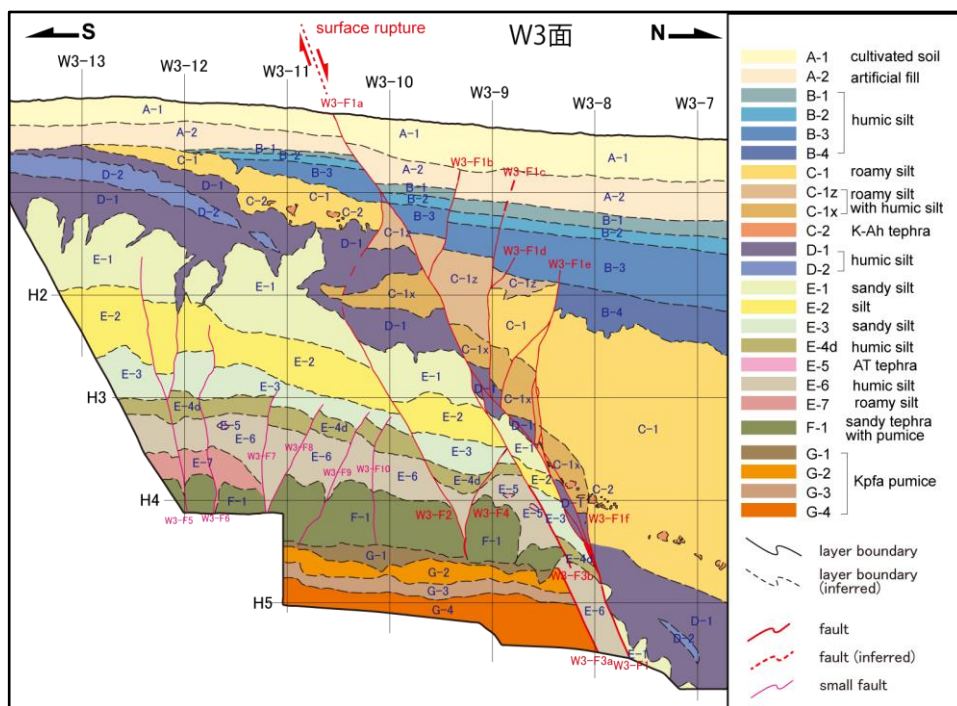


Fig. 2

A part of the log of the west wall of the trench at the Sawazuno site. The trench was excavated across the surface ruptures appeared in the western part of the Aso caldera.