Seismic trenching on offshore part of the Hinagu Fault Zone, Kyushu, Japan −3D structure and paleo-seismicity of offshore dextral strike-slip fault

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As a part of "Comprehensive research project for the major active faults related to the 2016 Kumamoto earthquake" of MEXT, we conducted offshore-fault surveys at the offshore part of the Hinagu-Fault-Zone, Kyushu, Japan. We have obtained ultra-high-resolution 3D-seismic data and two offshore drilling cores, and integrated them to clarify detailed geological structure and paleo-seismicity of the fault zone since the Last glacial maximum (LGM).

We chose coastal area of the Yatsushiro Sea, off the Tsunagi town, Kumamoto Prefecture, as study area. The sedimentary body of the postglacial period is formed thicker than 10 m at the area. Inside a rectangle area of 1 km by 2 km, we obtained ultra-high-resolution 3D-seismic data using the boomer source. Two drilling cores are obtained at both sides of the target fault.

3D geological structure and shape of the fault are figured out based on the 3D-seismic data. We distinguished extensional duplex structure at right-stepover section along the fault, which strongly suggest dextral strike-slip faulting. The structural depression associated with the extensional duplex would emphasize vertical faulting, which would provide clues to clarify the paleo-seismic events based on sedimentary analysis.

Two drilling cores penetrates the sedimentary body of the postglacial period, and are classified into Facies B, A4, A3, A2 and A1, in ascending order. Our interpretion of them are followings. Facies B: Sediment before LGM. Facies A4: Terrestrial sediment after LGM. Facies A3: Muddy bay sediment of transgressive stage. Facies A2: Sandy sediment overlapping ravinement surface. Facies A1: Sandy and muddy bay sediment of highstand. Based on 3D-seismic data, we classified strata of facies A4, A3, A2 and A1 into 7 seismic units (U7-U1, in ascending order) . The seismic units of U7-U3 are composed of facies A4 and A3. The seismic unit of U2 and U1 correspond with facies A2 and A1, respectively. The basement of seismic unit of U7 corresponds to the boundary of facies B/A4, and is interpreted as an erosional surface during lowstand of LGM around 18 ka.
Thickness of the seismic unit of U7, U5, U3, U2 and U1 changes abruptly at the fault, which should have result of 5 faulting events of E5-E1, in ascending order. Based on age-depth curve at drilling site on the downthrown side of the fault, faulting events of E5-E3 could be estimated as followings. E5: 18 ka-12.01 cal kBP, E4: 9.96-9.50 cal kBP, E3: 8.86-8.62 cal kBP. E2 should occurred during formation of seismic unit U2, which corresponds to the sediment of facies A2 (8.31-1.65 cal kBP). E1 displaces top of seismic unit U2, and we don’ t recognize displacement inside U1 and sea floor. Therefore, E1 should have occurred just before U1 deposition. Facies A1 corresponds to U1 and its deposition started after 1.59 cal kBP. Therefore, E1 should have occurred just before 1.59 cal kBP.
This study successfully demonstrated "3D-seismic trenching", which comprises ultra-high-resolution 3D seismic survey and offshore drilling surveys, can figure out detailed geological structure and paleo-seismicity of strike-slip fault.

Keywords: offshore active fault survey, Holocene, paleo-seismicity, offshore drilling survey, 3D-seismic survey

