# GEORADAR IMAGERY OF A WIDE FRACTURE ZONE OF THE MEDIAN TECTONIC LINE IN SOUTHWEST JAPAN


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## Introduction

The Median Tectonic Line (MTL) in western Kii Peninsula, Southwest Japan, is an active fault system. We applied georadar technique to a wide fracture zone survey of the MTL in order to get a high-resolution image of its shallow subsurface structures. It is important to get information on a location and deformation width of an active fault for mitigation of the earthquake disaster.

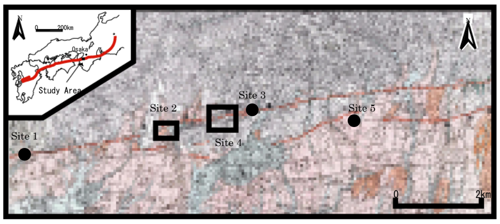


Fig. 1. Location map of GPR survey lines (Geographical Survey Institute, 1996)
This area is located to the west of Kii Peninsula. The fault system runs from about west to east. We surveyed 5 sites across the fault system. . Black dots show the site investigated before. Black rectangular is a location of survey this time.

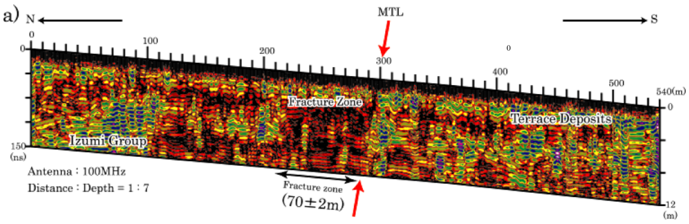


Fig. 3 Ground-penetrating radar profile at the site 1.
Frequency antenna; 100MHz, Travel times; 150ns, Distance; 540 m, Depth; 12 m, Distance: width= 1:7, Red arrows; Median Tectonic Line (MTL). The weak reflected intensity part between 230 m to 300 m corresponds to the fracture zone. The MTL dips northward at about 50 degrees.

Photo A: Outcrop of the Negoro Fault, appeared in 1983 at the site 2

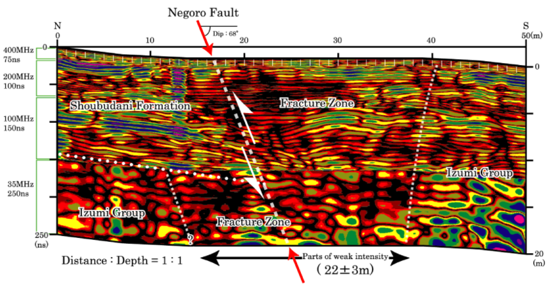


Fig. 4 Compound profile of ground -penetrating radar survey at the site 2.
Red arrows; Negoro Fault, White arrows; Direction of fault movement, Black arrows; Width of fracture zone, White broken lines; Boundary of lithofacies, White dotted line; Boundary of the unconformity.

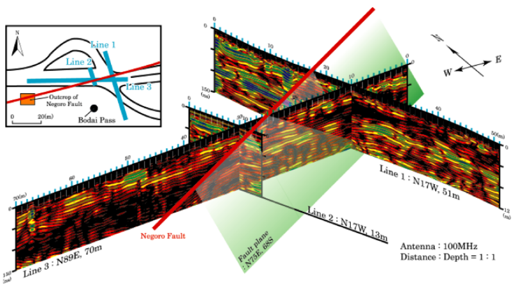


Fig. 5 Three-dimensional image from the ground-penetrating radar profiles at the site 2.
The upper map shows location of the GPR survey lines. Line 1; 100Mhz, 150ns, N17W, 51 m, Line 2; 100MHz, 150ns, N17W, 13 m, Line 3; 100MHz, 150ns, N89E, 70 m. Distance:depth = 1:1, Red line; A fault position projected on the ground surface. Green quadrilateral; Fault plane, having a strike of N75E and a dip of 68 S. The zone of week intensity is recognized at the hanging wall.

## Georadar Techunique

We chose six sites along the MTL and Negoro fault in western Kii Peninsula. The measurement of GPR exploration used a SIR-2 system with 100MHz, 200MHz, 400MHz and 35MHz frequency antennas. The GPR data were processed with software (RADAN). The general processing is distance normalization, horizontal scaling, range gain, stacking, high hass filter, low pass filter and migration.

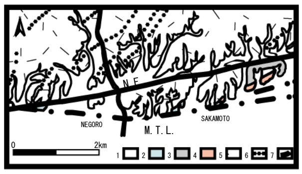

Fig. 2. Geological map of the Negoro area (Shinohara et al., 1983)
1: Recent alluvial deposits, 2: Terrace deposits, 3: Shobudani Formation, 4: Dikes, 5: Izumi Group, 6: Tuff (Izumi Group), 7: Fault (M.T.L: Median Tectonic Line, N.F: Negoro Fault).

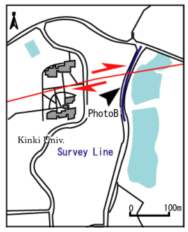


Fig. 5. Map of the site 4
Blue line is the GPR survey line. This line is a direction of N35° W-NS along the road. Red solid line is the Negoro Fault. Red arrows show the direction of fault movement. Black arrow shows a location of photograph.

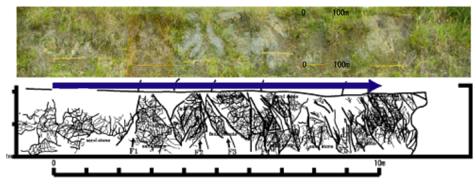

Fig. 5 Photograph and sketch of the Negoro Fault at the site 4.
The sandstones interbedded with mudstones of the Cretaceous Izumi Group are distributed along the outcrop. The fault breccia has a width of 4-5 m.

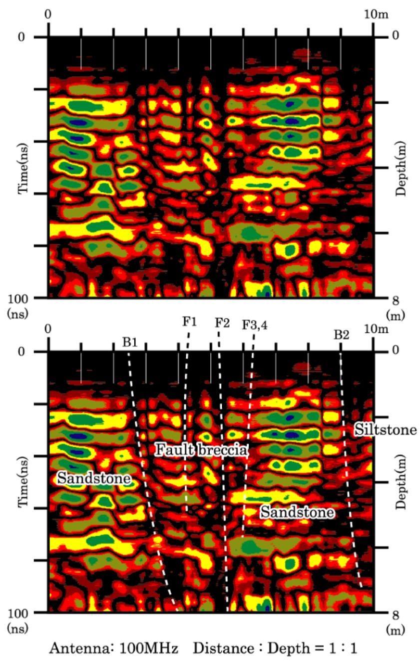


Fig. 6 Comparison between GPR image and outcrop observation at the site 4. The GPR image (upper) and its interpretation (lower) is shown in Fig. 6. The parts (0-2.5 m, 6.4-9 m) of the strong reflected intensity correspond to the sandstone, while the weak intensity part (4-5 m) corresponds to the fault breccia. The right weak intensity part (4-5 m) is the mudstone. Frequency of antenna; 100MHz, Travel times; 100ns, Distance; 10 m, Depth; 8 m, Distance:Depth = 1:1.

## Conclusions

The following results were obtained: (1) The detected amplitude anomalies with a weakly reflected signal were found at six survey lines across the MTL (main fault) and its subsidiary fault. (2) The zone of weak reflection on the georadar profiles can be imaged as the fracture zone. (3) The detected anomaly (70-120m wide) of the MTL is wider than that (c. 20m wide) of the subsidiary fault.

Judging from the GPR and geological data, these detected anomalies can be interpreted as fracture zones of the MTL active fault system. The detected anomaly of the MTL is wider than that the Negoro fault. The structural resolution from the GPR image corresponds to an outcrop scale in order of 1 m within the fracture zone. Therefore, it was found that the GPR is an effective tool for investigation of the wide fracture zone of an active fault. The georadar data of high-resolution obtained from the active