Ground penetrating radar investigations across the active Uemachi fault, Osaka, Japan

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Ground penetrating radar (GPR) survey was conducted across the well-known Uemachi fault system in order to investigate the shallow geological structures in the vicinity of the fault zone. GPR method has been increasingly used for shallow subsurface mapping studies because its capability to precisely detect shallow underground discontinuity and heterogeneity. Since the mid-1980s, several GPR studies have been conducted for assessing the geological hazards associated with shallow ruptures in and near to large fault zones. It have been reported that geological hazards associated future ruptures are most likely to occur on the vicinity of the already existing weak zones. Large fault zones, such as Uemachi fault, are typical conditions for such seismic hazards. Getting precise image of the shallow structures in the vicinity of Uemachi fault zone can be used to mitigate the damages of possible future earthquakes, which are frequent in the area. It is also vital for implementing building codes and other land use and development plans in the surrounding area.

Field acquisition parameters were selected after conducting several test profiles to find out the most adequate gain, time range and frequency. Twelve GPR profiles and six wide-angle refraction reflection (WARR) profiles were conducted in the area. The interpreted GPR profiles clearly show the location and the geometry of subsurface fault scarp as well as several subsurface fault strands. Some of these fault strands extend for long distance that it could be easily traced from one profile to the next.

The field survey show that deformational structures are approximately concentrated within the central 100 meters around to the fault zone. The subsurface faults and fractures mainly trend in the north south direction, parallel to the strike of Uemachi fault plane. The intensity of fault strands increases with increasing depth and southward. The hazardous weak zone around the fault can be easily avoided as the weakness planes are concentrated near to the fault plane and completely disappear within less than 100 m away from the fault plane.

The GPR survey across Uemachi fault in Yamato River area has led to the following recommendations:

(1) Further studies for the shallow subsurface geology should be conducted in other locations across Uemachi fault. First priority should be given to locations south to the present study area as the intensity of faults has been found to increase towards south.

(2) The large number of the detected fault strands around the Uemachi fault zone and shallow depth up to which these strands affect necessitate caution while planning any new developments in the vicinity of the fault. The hazardous weak zone around the fault can be easily avoided, as the weakness planes are concentrated near to the fault plane.

(3) If data acquisition and processing done properly, GPR can provide precise image of the shallow structure in urban areas. However, test measurements should be conducted in early stage of the survey to find out the most adequate acquisition parameters, which can severely affect the quality of the collected data.