Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SSS28-26 Room:A04 Time:May 28 16:30-16:45

Ground penetrating radar survey across the surface rupture generated by the 2014 Northern Nagano Earthquake

NAKANO, Takayuki[1*] ; TOBITA, Mikio[1] ; NAKAJIMA, Hidetoshi[1] ; KAMIYA, Izumi[1]

[1]GSI of Japan

Surface ruptures emerged over 9 kilometers or more length intermittently along Kamishiro fault caused by the Northern Nagano Earthquake on November 22, 2014 (hereafter is "the 2014 Northern Nagano Earthquake") (Hirouchi et al., 2014; Kondo et al., 2014; Okada et al., 2014 etc.). The surface ruptures have about 90 and 40 centimeters vertical displacements in Hokujo Shiojima and Hokujo Ooide section, northern Hakuba Village respectively (Hirouchi et al., 2014), and these ruptures emerged linearly. On the other hand, crooked surface ruptures with horizontal shortening displacement emerged along topography around Kamishiro Iida and Kamishiro Horinouchi section in the southern Hakuba Village. The cause is presumed that dip angles of subsurface ruptures are high around the northern area and low around the southern area. At the Kamishiro Horinouchi section, Okumura et al. (1998) indicated almost horizontal active fault (subsurface rupture) by the past trench survey. In order to confirm these conditions, we tried to detect shallow underground structure of the surface ruptures by ground penetrating radar (GPR) survey at the Hokujo Ooide and Kamishiro Iida section.

The survey was conducted on December 2, 2014. At the Hokujo Ooide section, the GPR survey was performed along the Route 406 (Line Oi-1) and on the cultivated land 10 meters south from the Route 406 (Line Oi-2). At the Kamishiro Iida section, the GPR survey was performed on the path between the paddy fields (Line Id-1). The GPR device used, was "Noggin plus" with 250 MHz antenna manufactured by Sensors & Software Inc.

The GPR survey profile of Line Oi-1 showed the characteristics as follows. 1) A clear horizontal reflection patterns displaced near the position of surface rupture were approximately at the depth of 0.5-1.0 meter. These displacements had 20-30 centimeters uplift on the east side. The displacement tendency shown here roughly correspond to the vertical displacement of ground surface. 2) A vertical linear gap of reflection with displacement appeared at the position of 1-2 meters west from surface rupture and at the depth from 0.5 to 2 meters. It conforms to the reflection pattern at the active fault reported by Nakano and Sakai (2007). 3) A whole reflection intensity at the west side of surface rupture was strong, while reflection intensity at the east side of surface rupture was weak. It depends on a difference of the dielectric properties on both sides of the surface rupture.

The dip angle of subsurface rupture estimated from GPR survey profile is high at the Line Oi-1. However, similar pattern cannot be identified clearly on the GPR survey profile of Line Oi-2.

The pattern of subsurface rupture like the GPR survey profile of Line Oi-1 is not clear on the GPR survey profile of Line Id-1, although Okumura et al. (1998) reported almost horizontal active fault (subsurface rupture) about 4 meters deep by the past trench survey nearby Line Id-1. This is because the detectable depth (skin depth) of GPR survey at the Line Oi-1 was about 2 meters deep.

Consequently, the GPR survey could detect the subsurface rupture of high dip angle at the Hokujo Ooide section. However, the subsurface rupture of low dip angle could not be detected at the Kamishiro Iida section. In the future, it is preferable to perform the GPR survey by more survey lines and different antenna frequencies with simple boring.

Acknowledgement
We borrowed the GPR device from Prof. Yasuhiro Suzuki, Nagoya University. We appreciate his assistance very much.

Keywords: the 2014 Northern Nagano Earthquake, Kamishiro fault, surface rupture, Ground penetrating radar (GPR), shallow underground structure