Seismic Velocity Structure around Segment Boundary of the Futagawa-Hinagu Fault zone

*Yasuhira Aoyagi[1], Haruo Kimura[1]

1. Central Research Institute of Electric Power Industry

The 2016 Kumamoto earthquake occurred along the Futagawa fault and northern part of the Hinagu fault, Takano-Shirahata segment. All kinds of data, such as crustal deformation, surface rupture distribution, and slip distribution on the source fault associated with the earthquake, indicate that the earthquake fault rupture does not spread to southern, the Hinagu segment. Rupture history prior to this event also shows the difference between the both segments (HERP, 2013). Accordingly the segment boundary has possibly terminated fault rupture as a structural barrier. In order to elucidate the character of seismic velocity structure in the segment boundary, we carried out a seismic tomography analysis using a dense temporary seismic stations. Thirty temporary stations had been deployed from the end of July to early September 2016 in the campaign. The network covers almost all aftershock area with a span of 5 km. We used 1710 earthquakes' combined arrival time data detected by the temporary stations and also by surrounding permanent stations into the double-difference tomography program, tomoDD (Zhang and Thurber, 2003). As a result, high resolution velocity distribution is acquired in the depth range of 2.5 km to 12.5 km, which is equivalent to seismogenic layer. The largest feature of the results is velocity anomaly stripes trending to ENE-WSW direction. The direction corresponds well with those of Ooita-Kumamoto Tectonic Line and Usuki-Yatsushiro Tectonic Line, therefore the velocity structure probably reflect such large geological structure in this area. Especially ENE-WSW trending velocity anomalies are remarkable over the boundary between the Takano-Shirahata segment (lower velocity) and the Hinagu segment (higher velocity) at all depth layers. The location and the direction of the boundary correspond well with the geological boundary of sedimentary rocks (Mifune sedimentary group) in north and metamorphic rocks in south. Therefore change of physical properties over the geological boundary probably plays a role of a structural barrier to control fault rupture. Similar suggestion has already shown by Matsumoto et al.(2016) based on their gravity anomaly analysis. But it should be noted that 80 % of the 1710 hypocenters locate in a specific range of velocity layer (Vp=5.9-6.3km/s, Vs=3.5-3.8km/s, Vp/Vs=1.62-1.74). Therefore we think the seismogenic layer is another basement rock under the Mifune sedimentary group. Granitic rocks are the most probable material of the seismogenic layer in comparison with laboratory velocity measurements on various rocks under high pressure (Christensen, 1996).

Keywords: Futagawa-Hinagu fault zone, Segment boundary, Seismic velocity structure

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