Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SSS31-P02 Room:Convention Hall Time:May 22 17:15-18:30

Index for simultaneous rupture assessment of active faults based on seismic velocity structure

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Tomographic inversion was carried out in the northern source region of the 1891 Nobi earthquake, the largest inland earthquake (M8.0) in Japan to detect subsurface structure which controls simultaneous rupture of active fault system. In the step-over between the two ruptured fault segments in 1891, a remarkable low velocity zone is found between the Nukumi and Ibigawa faults at the depth shallower than 3-5 km. The low velocity zone forms a prism-like body narrowing down in the deeper. Hypocenters below the low velocity zone connecting the two ruptured segments indicate the possibility of their convergence in the seismogenic zone. Northern tip of the Neodani fault locates in the low velocity zone. The results show that fault rupture is easy to propagate in the low velocity zone between two parallel faults. In contrast an E-W cross-structure is found in the seismogenic depth between the Nobi earthquake and the 1948 Fukui earthquake (M7.1) source regions. It runs parallel to the Hida gaien belt, a major geologic structure in the district at the northern margin. P-wave velocity is lower and the hypocenter depths are obviously shallower in the northern part. Since a few faults lie in E-W direction just above it, a cross-structure zone including the Hida gaien belt might terminate the fault rupture. The results indicate fault rupture is difficult to propagate beyond major cross-structure. The length ratio of cross-structure to fault segment (PL/FL) is proposed to use for simultaneous rupture assessment. Some examples show that fault ruptures never (PL/FL>3-4), sometimes (~1), and always (<1) cut through such cross-structures.

Keywords: Active fault system, Simultaneous rupture, The 1891 Nobi Earthquake, Seismic velocity structure, Cross-structure