

The mantle anisotropy obtained from shear-wave splitting in the region of 1891 Nobi earthquake

IIDAKA, Takashi^{1*}; HIRAMATSU, Yoshihiro²;
THE RESEARCH GROUP FOR THE JOINT SEISMIC, Observations at the nobi area¹

¹Earthquake. Res. Inst., University of Tokyo, ²Kanazawa University

The Nobi earthquake which occurred in 1891 was one of the largest inland earthquakes in Japan. The magnitude of the 1891 Nobi earthquake was 8. The magnitude is much larger than those of other inland earthquakes in Japan. To know the cause of Nobi earthquake and crustal structure of the area, a temporary seismic observation was conducted. The seismic structure of the crust and uppermost mantle around the 1891 Nobi earthquake area is very important. We researched shear-wave splitting analysis to obtain seismic image around the 1891 Nobi earthquake area including uppermost mantle structure. The earthquakes which occurred from 2009 to 2014 are used. All of the earthquakes used here are deep earthquakes with depths are deeper than 200 km. The seismic stations of Hi-net and temporary seismic network were used for the shear-wave splitting analysis.

Shear-wave splitting is usually expressed by two parameters, the fast polarization azimuth ϕ (in degrees), and the time-lag τ (in seconds), which is the delay time between the fast and slow components of a shear wave. We use the following techniques to determine the shear-wave splitting. We pick S waves from individual seismograms. We calculated the cross-correlation of the two horizontal seismogram components over a grid -90° to $+90^\circ$ for ϕ and a window of 4 sec for τ with increments of 1° and 0.01 sec., respectively. The time-lag τ (in seconds) and the fast polarization azimuth ϕ (in degree) are defined to be the values that yielded the maximum correlation.

The results suggested very interesting and remarkable pattern of the polarization directions. The northeastern part of the research area showed polarization direction of NE-SW. The eastern part of the research area suggested that the polarization directions are almost E-W. However, the polarization direction at the 1891 Nobi earthquake area was NW-SE. Most of the averaged time lag values are larger than 0.5 sec. The value is much larger than that of the maximum time-lag value cause by crustal anisotropy in this area (Hiramatsu et al. submitted to EPS). The maximum crustal anisotropy was considered to be less than 0.1 sec. We consider that the observed shear-wave splitting was caused by the mantle anisotropy. The shear-wave splitting of the mantle anisotropy was studied by previous studies. The polarization direction with E-W at the eastern part of the research and the polarization direction with NE-SW are consistent with the results of previous studies (e.g., Ando et al. 1983, Iidaka et al., 2009). The polarization direction can be explained by the preferred orientation cause by the mantle flow relating to the subducting Pacific and Philippine Sea plates. However, the polarization direction with NW-SE is not consistent with both of the subduction directions of oceanic plates. The cause of anisotropy is considered based on the two models. One is the model that the shear-wave splitting is caused by the heterogeneous structure which is related to the fluid or magma in the mantle wedge. The other model is that the shear-wave splitting is cause by some irregular mantle flow. The cause of the polarization direction will be discussed based on other observations.

Keywords: mantle, Splitting, Nobi earthquake