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Possible aquifer near the fault plane of the 2007 Noto Peninsula Earthquake detected by the passive image interferometry

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The passive image interferometry technique is applied to the continuous seismic waveform data obtained around the source region of the 2007 Noto Peninsula Earthquake (Mw6.6), central Japan. We computed the autocorrelation function (ACF) of band-pass filtered seismic noise portion recorded with each short-period seismometer at several seismic stations for each one day. In some stations, comparison of each one-day ACF shows temporal evolutions of the ACF, which are interpreted as the change of seismic velocity structure in the volume considered.

At one station, which is closest to the source area and just above the fault plane, clear increase of the lag time of several phases of the ACF are observed after the mainshock. It is also seen that the time shift is smaller on phases of shorter lag time, and larger time shifts are observed on the phases of larger lag time. One possible interpretation is that it is likely attributed to the reverberation of the seismic wave in a particular layer, in which seismic wave velocity decreased. Multiple reflection in the particular layer causes the elongation of the time shift of each phase, which may show linearity to the lag time.

We plotted the time shift of each phases againset the lag time and found that three phases show this tendency. We adopted linear function to the lag time - time shift relation of these phases to obtain optimum time shifts of these phases. With simplified assumption, seismic wave velocity change of the whole volume and the particular layer as well as the depth of the bottom and thickness of the layer are estimated. We obtained 0.4 % of velocity decrease of the whole volume and 8 % decrease in the particular layer. If we assume average P-wave velocity of the whole volume to be 5.5 km/s, depth of the bottom of the layer is 13 km and the thickness is 1.5 km.

Although it is a rough estimation, velocity decrease of 8 % in a layer of depth at 13 km is extraordinary large compared to that of whole volume (0.4 %). This station is located just above the fault plane of the mainshock, whose dip angle is 60 degree, and many aftershocks occur at this depth range. Therefore large velocity decrease is probably attributed to the rapid injection of the fluid as well as the generation of damage and cracks near or on the fault plane of the mainshock.