

Temporal change of the crustal structure around Mt. Iwate as inferred from waveform correlation of the multiplet earthquakes

Teruo Yamawaki[1]; Takeshi Nishimura[2]; Hiroyuki Hamaguchi[3]

[1] Graduate School of Sci., Tohoku Univ.; [2] Geophysics, Science, Tohoku Univ.; [3] Res. Centr. Pred. Earthq. Volc. Erupt., Grad. Sch. Sci., Tohoku Univ.

Introduction

Correlation analysis of waveforms from repeated active seismic experiments detected temporal change of seismic velocity around Mt. Iwate associated with a M6.1 earthquake and volcanic activity. Although such experiments are very useful, they can't be used to detect changes for longer period due to the limited time span. In this study, we use the multiplet earthquakes to detect the temporal changes of the crustal structure around Mt. Iwate.

Analysis

We select 305 pairs of multiplet earthquakes that occurred at the Pacific plate boundary. Each pair of the earthquakes, which occurred at the same location, has time interval ranging from 4 days to 5 years. We analyze the data from December 1994 to October 2001. The epicentral distance from the summit of the Mt. Iwate ranges from 70 to 260 km. Magnitude of these earthquakes is distributed between 2.1 and 4.5. We use vertical component of waveforms with good signal to noise ratio. First, we apply a band-pass filter of 4 to 8 Hz to the waveforms from each pair of multiplet earthquakes at each station. Then we adjust the time axis of the two waveforms. Subsequently we calculate cross-correlation coefficients using 35-second time window from the onset of the P-wave.

Results

The cross-correlation coefficients calculated at most of the stations are distributed between 0.8 and 1.0. The average of all the data is 0.951. Two stations (IKG and GNB) show smaller station averages (0.815 and 0.903, respectively), which are situated within 10 km south west of the Mt. Iwate's summit. Data at IKG show many small coefficients less than 0.8 and the station has broad distribution of the coefficients between 0.63 and 0.96. Temporal change of the coefficient is examined from the data of pairs of multiplet earthquakes with time interval between 0.5 and 1.5 year. The result shows that IKG indicates small coefficients down to 0.6 from the end of 1997 to 2000, although the coefficients are larger than 0.8 for the other data before 1997 and after 2000. GNB also indicates small coefficients less than 0.8 after 1998.

Summary

The period of smaller coefficients observed at IKG and GNB is coincident with the period when strong seismic activity and significant crustal deformation were observed around Mt. Iwate. These two stations are located close to seismically active area and volcanic pressure source. These observations suggest that the smaller coefficients obtained at IKG and GNB were resulted from the temporal change of the crustal structure caused by volcanic and/or seismic activity.