Free Oscillation Detected by Borehole Strain meter

Makoto OKUBO[1], tsuneo yamauchi[2]

[1] TRIES, [2] RCSV

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The Ishii-type multi-component borehole instrument (Ishii and Yamauchi, 1998) was installed below about 350 meters from earth's surface in 1997, and the new borehole instrument, which has smaller diameter, was installed below about 165 meters from surface in 1999, by Tono Research Institute of Earthquake Science (TRIES). These instruments are just located below the Mizunami crustal movement observation site of Nagoya University. The Nagoya University Mizunami observation site is the horizontal gallery type instrument (quartz tube extensometers) in the Tertiary layer, and the borehole instruments are installed in the granite. The strain distribution between sedimentary layer and granite are researched as main purpose of borehole instruments.

From February of 2001, for a strain seismograph, strains of these observation sites, (TGR350: three horizontal strain meters, TGR165: three horizontal, one vertical and two slanted strain meters, NAMZ: three extensometers), are recorded continuously at 1Hz sample. We reported, that long periodic earthquake motion was detected by the borehole strain meters and the extensometers, and verified usefulness as a strain seismograph by (OKUBO et al., abstracts of 2001, fall meeting, the seismological society of Japan). On the basis of the report above, in order to verify in long-term stability of the strain seismograph and detect the continuous free oscillation, north-southern, east-western and shear strain were calculated from the respective three horizontal components of sites, and those were analyzed on the frequency domain, respectively. In this study, on a first step, power spectrums were calculated from daily records (86400 seconds, 86400 data), respectively by FFT processing. And, 2001 and 2002 year's records were displayed respectively as the time series spectrum. In addition, these spectrums were processed the stacking through a year. And correlation function was calculated to detect the free oscillation modes, which have been excited continuously during observation period.

Many free oscillation mode peaks, which have similar spectrum intensities, were observed continuously. From these, it is suggested that continuous excited modes of the free oscillation were observed with the strain seismograph. In addition, modes of the continuous free oscillation, which were observed not only spheroidal oscillations but also torsional oscillations, were existed in a most of analysis frequency range.

In this study, both of the instruments, quartz tube extensometers and borehole strain meters, could detect the continuous free oscillation, but borehole strain meters are much stable in the time series and the signal intensity. From above result, it is led that borehole strain meters, which can install in the rigid base rocks, have been sticking with the around than the extensometers, which can install in only near the surface. In addition, because the borehole strain meters were installed in the deeper underground and the mass water exists above those, influence of atmospheric fluctuation and temperature changes became smaller than the extensometers