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STRONG GROUND MOTION OBSERVATION BY THE COMMITTEE OF EARTHQUAKE OBSERVATION AND RESEARCH IN THE KANSAI AREA (CEORKA)

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ABSTRACT: This paper shows activity of CEORKA (The Committee of Earthquake Observation and Research in the Kansai Area) on observing strong ground motion records and providing the data. A quasi-real time data acquisition and broadcasting system of strong motion information is maintained by CEORKA. Members of the committee who supports the CEORKA project can receive seismic intensity map and waveform plots via E-mail, and can access automatically up-loaded digital files on home page (http://www.ceorka.org/).

Key Words: Strong ground motion, Observed record, Quasi-real time, Committee

INTRODUCTION

The Committee of Earthquake Observation and Research in the Kansai Area (CEORKA) was established in December 1991 to make joint observation and research of strong ground motion by several general construction companies, earthquake engineering consultants, and researchers on seismology and earthquake engineering in universities (Toki et al. 1995).

CEORKA has deployed observation stations in the Kobe and Osaka area in April 1994 and constructed a system for quick data acquisition and for broadcasting of strong ground motion information through pagers. The distributed information contains peak ground velocity value and JMA scale seismic intensity. Near field records of the main shock and numerous aftershocks were obtained through the 1995 Hyogoken-Nambu (Kobe) Earthquake (M_J7.3) at 11 observation sites. After the earthquake, CEORKA got more supporting members and established additional observation sites in 1997.

At present, the data acquisition system broadcasts earthquake information via. e-mail and automatically update a home page (http://www.ceorka.org/) that contains seismic intensity map and digital data files for members.

ORGANIZATION OF CEORKA

CEORKA has three kinds of members: research members (mainly researchers in universities), assent members (mainly local governments), and supporting members (mainly private companies). At present there are 36 research members, 13 assent members, and 44 supporting members.

Four special interest groups are managed under general assembly of the committee. One group maintains observation sites and treats observed data, second group maintains and develops quasi-real time observation system, third group supports studies by members who are using CEORKA records, and last group accounts for public information.

Principal of the committee is Prof. Iemura in Kyoto University. Prof. Toki and Prof. Irikura are principals in the past. Geo-Research Institute acts as the secretariat of the committee and maintains the observation system.

CEORKA OBSERVATION

Fig. 1 shows location of the CEORKA observation sites. Sites 1 to 10 and 21 are the observation sites initially established before the 1995 Hyogoken-Nambu (Kobe) Earthquake. After the earthquake, CEORKA increased supporting members and distributed additional observation sites. They were set up and ran in1997. At present, CEORKA's maintains 25 observation sites, 20 sites that CEORKA established and 5 more sites that belong to members. Over 1,000 earthquakes have been recorded since the establishment of first network. SMY was used as an alternative site of DIG when construction noise around DIG site was remarkable. Not only near-field strong earthquake but also both long-distance damaging earthquakes and deep focus earthquakes were recorded well, because seismographs have servo-velocity type of sensors (Yokoi, 1992) that have high potential to record long-period ground motion. Fig. 2 shows example of recorded velocity waveforms due to the 2003 Off-Tokachi Earthquake (M_J8.0). High quality long period ground motions are observed due to large earthquakes even with the epicentral distance from each site more than 1,000 km.

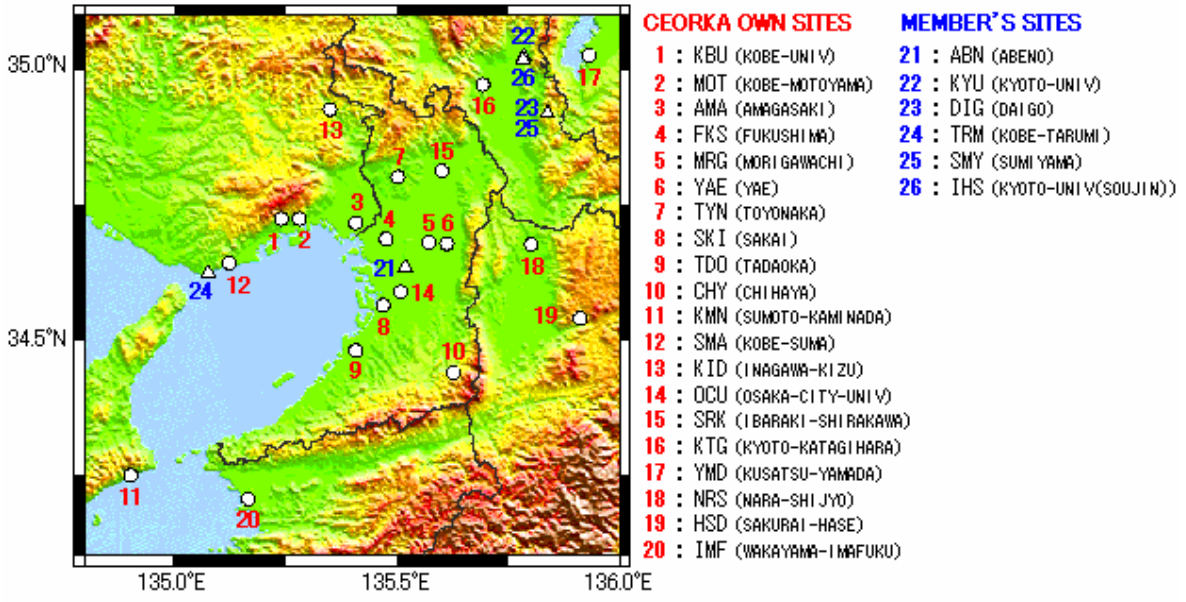

Fig. 1 Location of observation sites

CEORKA has developed quasi-real time automatic observation system. Operating flow of the system is as follows.

1) After recording ground motion data, recording system at each site calls center station.
2) After receiving dial-ups at least from one station, center system calls all stations almost simultaneously, using multiple digital telephone lines.
3) File header information is gathered from all stations and the e-mail message with the maximum amplitude information (PGV) is broadcasted by the center system.
4) The center system downloads ground motion data only from the sites that have observed records.
5) E-mail message with a digest wave trace figure is broadcasted by the center system.
6) E-mail with text information and seismic intensity (JMA intensity) map is broadcasted by the center system. An example is shown in Fig. 3.
7) The seismic intensity map and the digest wave trace figure are uploaded to the web server and home page is revised automatically. They are open for public.
8) Digital record files are automatically uploaded to the web server. CEORKA members can download the files from a certificated page.

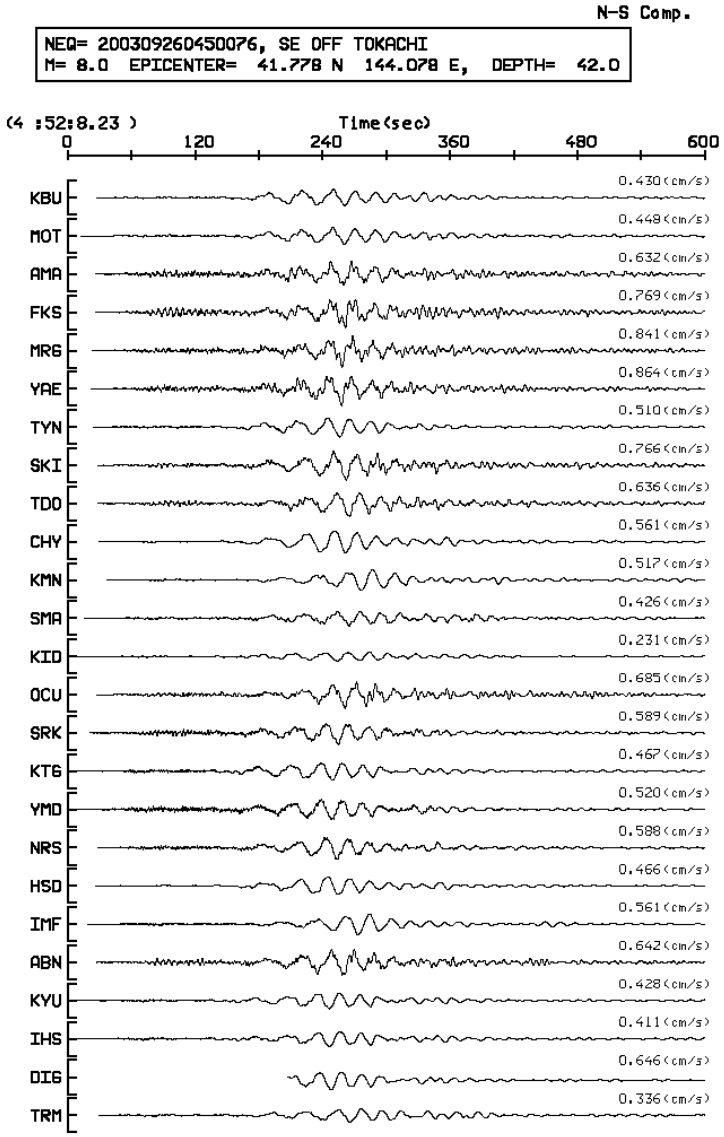

Fig. 2 Observed records due to the 2003 Off-Tokachi Earthquake

The procedure described above is generally completed within 30 minutes after an earthquake occurs. E-mail service is only provided for members. E-mail messages to mobile telephone are also available for the members.

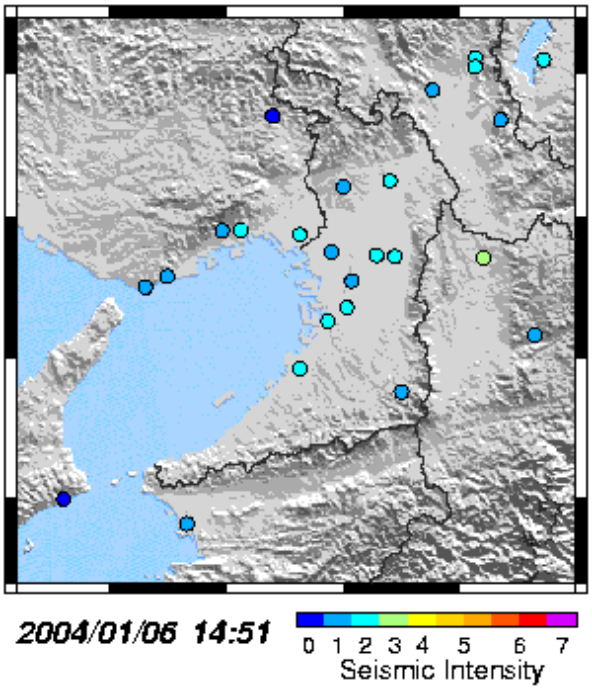

Fig. 3 Example of seismic intensity map

THE 1995 HYOGOKEN-NAMBU EARTHQUAKE

CEORKA obtained very important and useful data of the 1995 Hyogoken-Nambu (Kobe) Earthquake at 11 observation sites. Fig. 4 shows the records of main shock. Digital data set of the main shock was provided about two weeks after the event. They made much contribution to research concerning seismology and earthquake engineering.

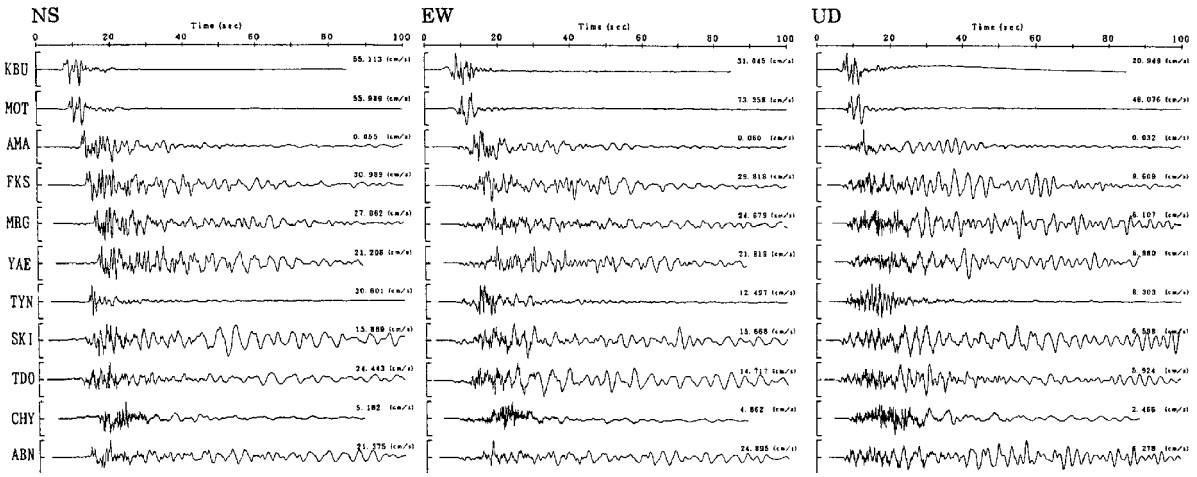

Fig. 4 Observed main shock records of the 1995 Hyogoken-Nambu (Kobe) Earthquake

At the time when the earthquake occurred, the center system sent messages to the pagers. At that time, e-mail service was not available. The secretariat member was able only to get information that the records were clipped on 40 cm/s, limitation of the sensors of those days, at Amagasaki (AMA) station (between Kobe and Osaka) and that the sites in Kobe City were closed for the communication through public telephone line. It was about 30 minutes after the event. The main shock record from the stations in the Kobe City could not be obtained even in the next morning due to the damage of public telephone line or electric power supply. The records were eventually gathered manually by a secretariat member who went to Kobe by bicycle from Osaka.

The records at Kobe University (KBU), Kobe Motoyama (MOT) and Amagasaki (AMA) sites were clipped, but then corrected by Kagawa et al. (1996). The digital records at Toyonaka (TYN) were disappeared through a chaotic communication, but were re-digitized from the paper printout (Toshinawa et al. 1997).

CEORKA AT PRESENT AND IN THE FUTURE

CEORKA annually provides CD-ROMs of observed record for convenience of the members. These data can be distributed payable to non-members two years behind the members. It also organizes a forum, concerning earthquake disaster prevention, annually. The forum is open for public.

Underground structures were explored at Kobe University (KBU), Chihaya (CHY), and Morigawachi (MRG) sites. Fig. 5 shows example of structure at the KBU site (Iwasaki et al., 1995).

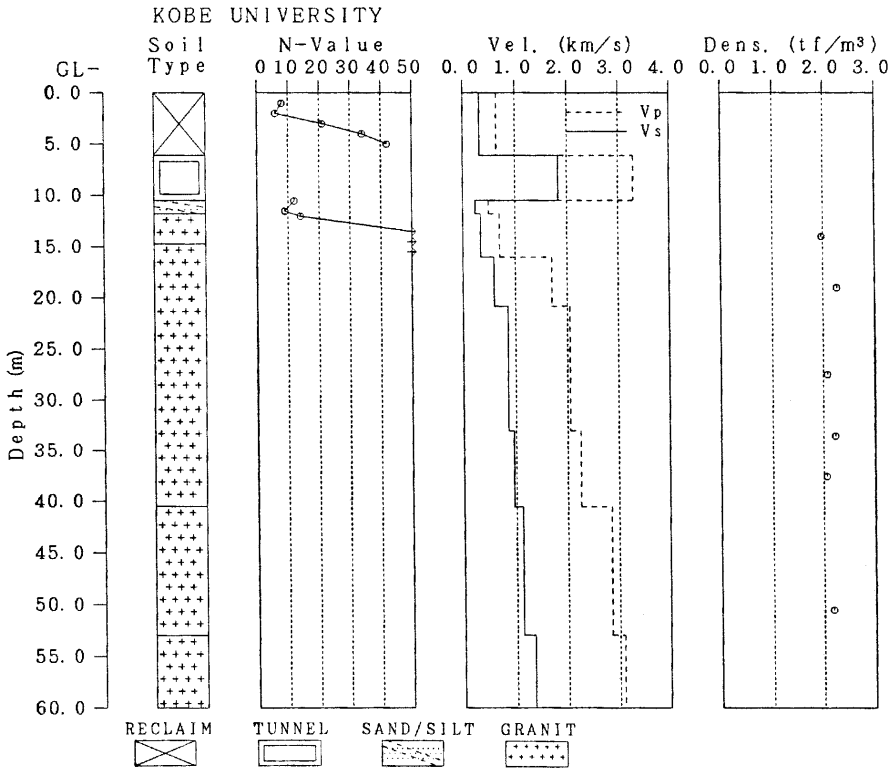

Fig. 5 Underground structure information at Kobe University (KBU) site

Maintenance of strong motion observation network under shrunken economy is not easy. We are scantily managing the project and advertising for additional supporting members. Of course, there are already established national strong motion observation sites such as K-NET. It is possible

to obtain the uniform observation data freely. However, the records of CEORKA's network have higher quality than those of other networks, especially in the long period range. We can obtain high quality characteristics of local ground motion in long period range. It allows us to make high precision simulation of the long period strong ground motion due to large earthquake in subduction zone that periodically hit the CEORKA's network area. We have to sustain this project until next subduction earthquake will occur, and we invite additional supporters to the CEORKA project.

CONCLUSION

CEORKA have maintained strong ground motion network in the Kinki Area using the velocity type sensors since 1992. A lot of treasurable ground motion records from over 1,000 earthquakes has been accumulated by the continuous activity of CEORKA. Many studies of the 1995 Hyogo-ken Nambu Earthquake have been conducted especially due to the data obtained by CEORKA. CEORKA maintains the stations every day and continuously store records. These data will contribute the studies in seismology and earthquake engineering. The information from the CEORKA's quasi-real time data acquisition and broadcasting system are now open for public (http://www.ceorka.org/). We hope they will contribute earthquake disaster mitigation for future earthquake. The payable digital record files are provided to researchers without membership, too.

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