SEISMIC NOISE MEASUREMENTS IN THE EASTERN PART OF HACHIMANTAI GEOTHERMAL AREA, NORTHEAST JAPAN

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1. Introduction

The previous studies (Saito et al. :1985, 1986, 1987a,1987b) showed that the seismic noise in the frequency band 2 - 15Hz was observed in an area centered in the recent development zone of Kakkonda geothermal area, which is generated by the stream of steam and hot water going upwards from a deeper geothermal reservoir to the surface.

Based on these facts, a seismic noise survey was carried out in the eastern part of Hachimantai geothermal area, northeast Japan, in 1987. The relation between the noise amplitude, distribution of dominant frequency and geothermal activity was investigated.

2. Location of observation sites

About 100 survey points are included in an area 11Km wide along the EW direction and 12Km long along the NS direction, including the Matsukawa geothermal plant, Toushichi hot springs and ruins of Matsuo mine as shown Fig.1. The Matsukawa geothermal plant is located at 7Km northeast from the Kakkonda geothermal plant.

3. Methods of measurement and analysis

The seismic noises were measured at sites in the above area by 3-component seismometers with a natural period of 1 sec. connected to amplifiers and data recorders in fields. The system has flat response to ground velocity in the frequency range of 1 to 40Hz. The data was analyzed in the laboratory with a micro computer. The original analog data was degitized at 0.01sec. Fourier spectra of 2048 selected samples were computed using the fast Fourier transform.

4. Results of investigations

Examples of wave forms are shown in Fig.3. All spectra of the seismic noise were classified into four types (A,B,C and D) for about 1.0Hz to 50Hz as shown in Fig.4. Type A has a single peak below 1.0Hz in spectra, type B has a single peak below 1.0Hz and some peaks from 2 to 15Hz, type C has some peaks from 2 to 15Hz and type D has many peaks above 15Hz.

Large amplitudes of seismic noise are observed in the southeastern part of observation area, in the neighbourhood of the Matsukawa hot spring and the Toushichi hot spring (Fig.5). The frequency of 2 - 15Hz is dominant in these areas (Fig.6 and 7), and spectral types are B and C (Fig.8).

Large amplitude in the southeastern part is caused by the stream of the Matsukawa river, human activity and existence of loose sediments. Activities of fumaroles and hot springs recognized near Toushichi hot spring, they seem to be the source of high frequency seismic noise. It is also assumed that the high frequency seismic noise observed in the neighbourhood of Matsukawa hot spring is caused by the activities of the power plant and the steam supply system.

On the other hand, the frequency of 2 - 15Hz is slightly dominant at several observation sites halfway between Matsukawa and Toushichi hot springs. According to the report of NEDO (NEDO,1981), middle temperature hot water shall be existent under these observation sites (Fig.9). Therefore it may be assumed that the high frequency waves are generated by deeper gerthermal activities. We will carry out a detailed seismic noise survey in this area, and investigate the relation between characteristics of seismic noise and geothermal activity.

Acknowledgement

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Reference

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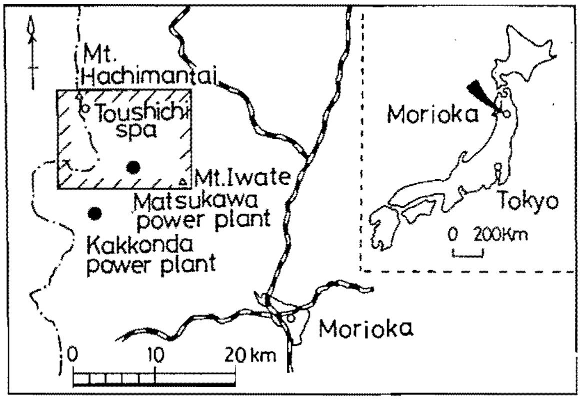


Fig.1 Map showing the area of investigation.

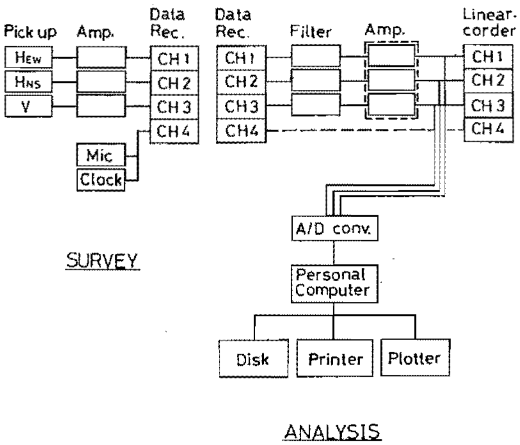


Fig.2 Block diagram of measurement and analysis systems.

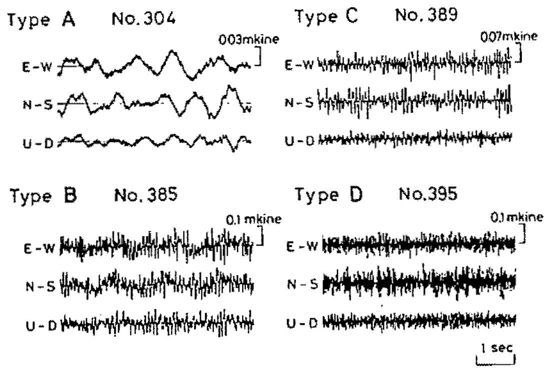


Fig.3 Examples of wave forms of seismic noise recorded in the eastern part of Hachimantai geothermal area.

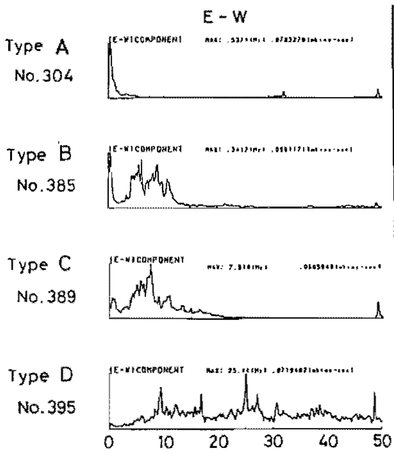


Fig.4 Classification of spectral pattern of seismic noise.

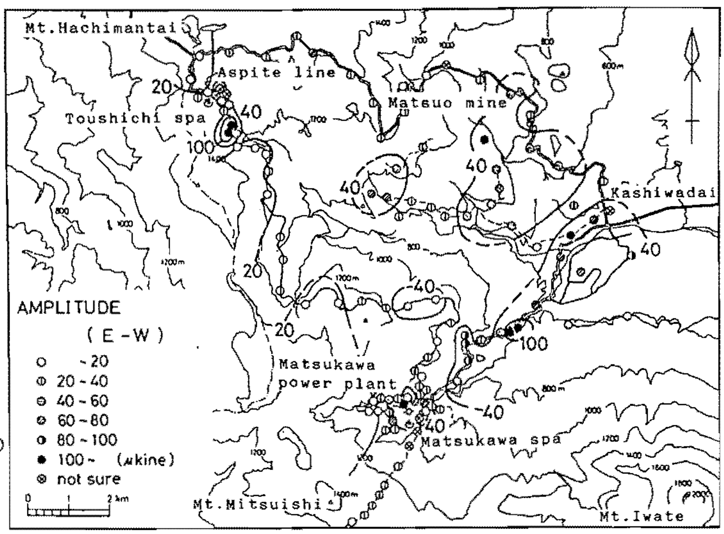


Fig.5 Distribution of average amplitude (E-W component).

Fig.6 Distribution of predominant frequency (E-W component).

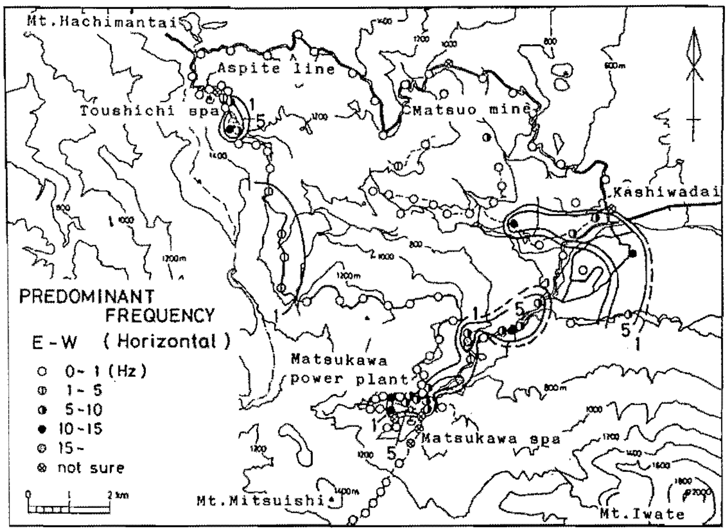


Fig.7 Distribution of sum total of Fourier amplitude of E-W component ranging 2 - 14Hz.

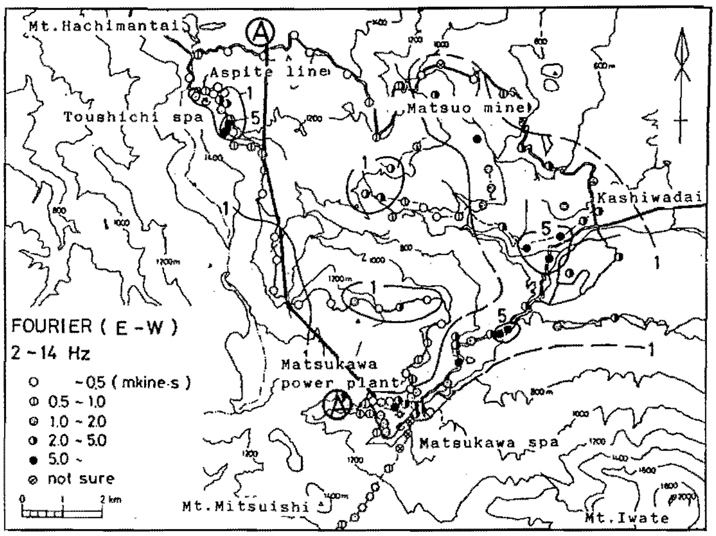
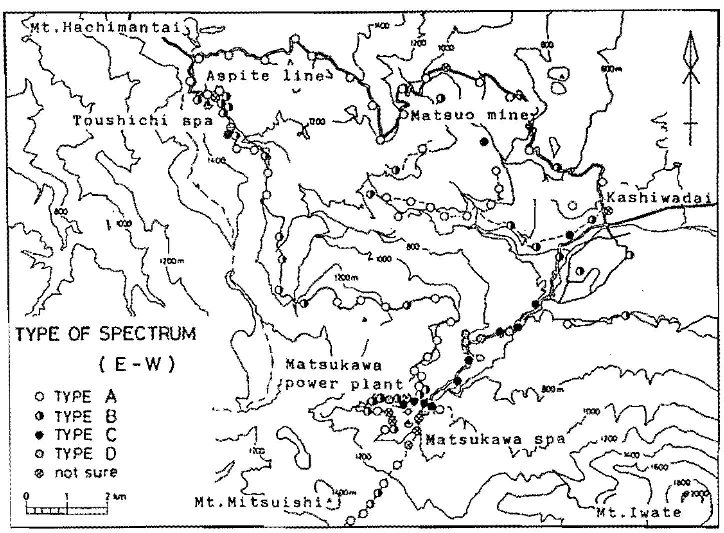


Fig.8 Distribution of spectral pattern (E-W component).



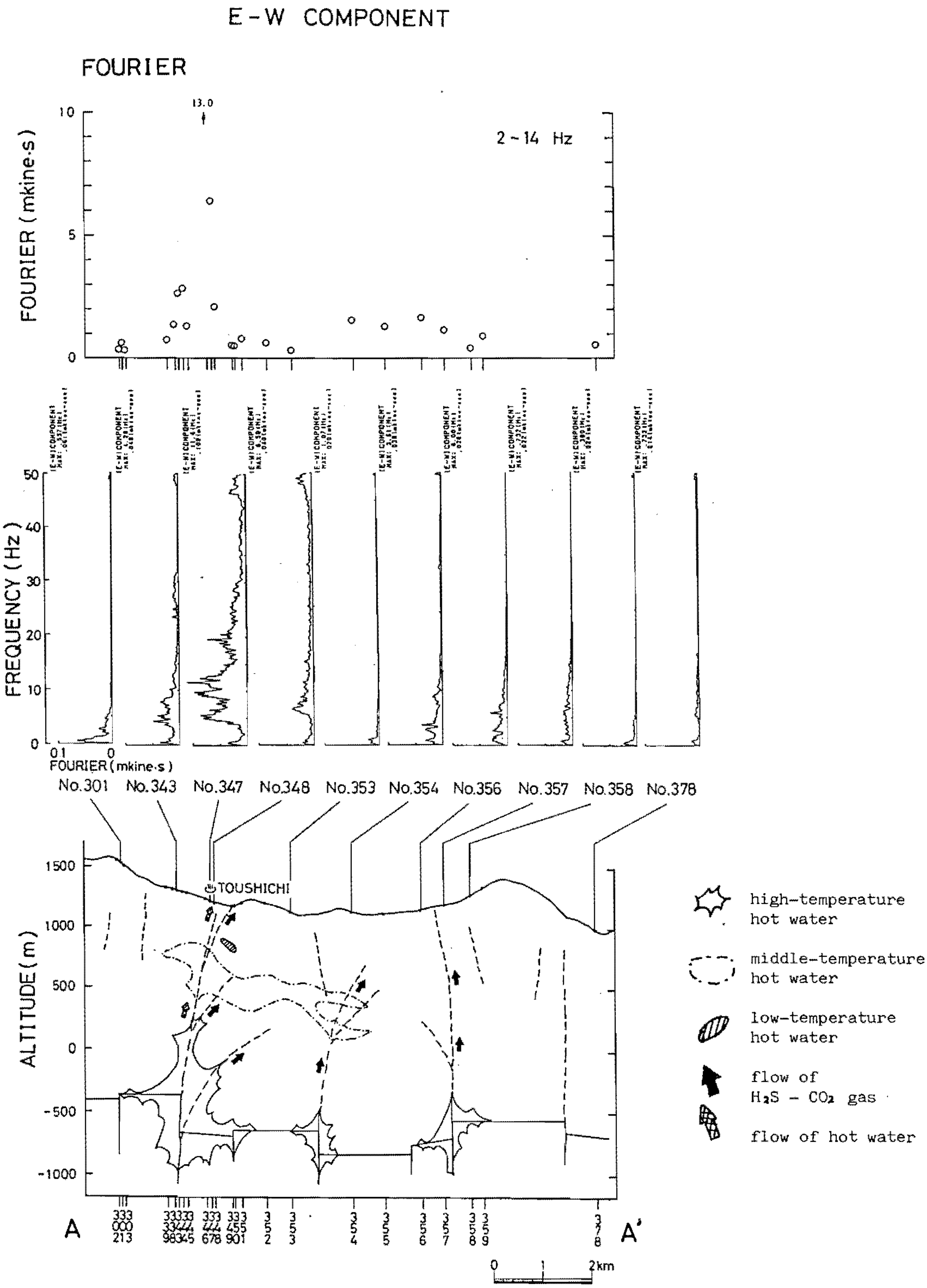


Fig.9 Profile of sum total of Fourier amplitude and examples of spectra along the line A - A' (E-W component). Conceptual geothermal system model is quoted from the report of NEDO (NEDO,1981).