

# Damage to houses in Mihara, Hiroshima, during 2001 Geiyo earthquake in light of surface geology and gravity basement structure

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## 1.Introduction

The 2001 Geiyo earthquake (M6.7) brought remarkable damage in Mihara city, compared to other adjacent cities in the eastern part of Hiroshima Prefecture. More than 2400 houses were damaged and JMA seismic intensity was estimated 5 Upper. We investigated the cause of such high intensity and serious damage to houses by taking account of surface geology and 3D gravity basement structure.

## 2.Distribution of seriously damaged houses

According to a document given by Mihara Municipal Office, 256 houses were so seriously damaged that a property tax on them was partly exempted. We analyzed this document to obtain a suffering rate (damaged houses/total houses) for each block of the city. As a result it was found that the rate was highest in Miyaoki block situated in the central part of city area. This is in accord with a damage survey map, produced by Mihara Fire Fighting Office, on which half destroyed houses are also plotted in one and the same block along its eastern border of N-S direction.

## 3.Spectral ratio of ground acceleration

Ground acceleration during the Geiyo earthquake was recorded at JMA and K-net stations. JMA station is located in the central part of city area, while K-net station at the foot of mountain to the north of the city. We estimated spectral ratio (JMA/K-net) of the horizontal components of acceleration, and found that ground motion at JMA station was 4 to 5 times larger than that at K-net station in the frequency ranges of 0.7 to 1.5Hz.

## 4. Surface geology

Most of urbanized area of Mihara city is situated inside the lower-lying land that was reclaimed and expanded during early Edo period to Showa era. A previous closing dike (embankment) used for reclamation remains as local slope, and runs in N-S direction along the border between the Miyaoki block on the west side and newly reclaimed one called 'En-ichi Shinkai' on the east side. The mountains surrounding the urbanized area are composed of granitoids, which are covered in places by roof rocks consisting of clay slate and rhyolite.

## 5.3D gravity basement structure

We made precise gravity measurement in the intervals of 200 to 300 m over the urbanized area and 500 to 1000 m on the surrounding mountains. Using totally 227 data thus obtained, we carried out 3D gravity inversion of basement relief. The resultant model shows that there is a graben-like depression extending northwestward from beneath the southeast corner of reclaimed area, where depth to the basement is largest and is about 60 m. It is to be noted that both the Miyaoki block and JMA station is located above the NE-side slope of the depression.

## 6.The cause of high seismic intensity and serious damage to houses

Since the epicenter of the Geiyo earthquake is at a back-azimuth of about S50W, the seismic waves radiated from the source is considered to have arrived at Mihara city in the direction nearly perpendicular to the long axis direction of graben-like depression. Therefore, taking the position of JMA station into account, it is highly probable that, beside the amplification by soil deposit, focusing of seismic energy due to the shape of basement was responsible for the remarkably high seismic intensity. On the other hand, the above mentioned fact that, half destroyed houses were distributed in the Miyaoki block along its eastern border, can be ascribed to the local surface topography associated with the previous closing dike and soft soil of reclaimed land.