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Distribution of Structural Damage in Nishinomiya City and the Eastward Suffered from the Great Hanshin (Hyogoken Nanbu) Earthquake of January 16, 1995

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A powerful earthquake was caused in the northern region of the Awajishima Island, Japan, on 16 January 1995, and many human lives, structures and facilities suffered fatal damage from the seismic motions in the Hanshin (Osaka-Kobe) region. The epicenter was located 20 kilometers below the ground surface and the seismic magnitude was 7.2 on Japan Meteorological scale. The aftershocks have been observed in a slender zone oriented to the northeast and stretching to a northern limit on the west-east trending Arima-Takatsuki fault line, which is analogous to the geological area accompanied with the tectonic collapse (Fig. 1).

The seismic damage on structures is distributed within a restricted corridor throughout Kobe city and its eastern neighboring of Ashiya city standing on the narrow alluvium, between the Rokko Mountains and the Osaka Bay shore extended east and west. The corridor, however, is branched out into several directions on the eastward district encompassing the cities of Nishinomiya, Amagasaki, Itami and Kawanishi in the Hyogo prefecture, and the cities of Toyonaka, Minoo and Suita in the Osaka prefecture, which is bounded by the Hokusetsu Mountains to the north, the Rokko Mountains to the west, Osaka Bay to the south, and the Osaka Plain to the east (Fig. 2).

On the southern foot of the Hokusetsu Mountains lie the low plains of the Itami river terrace in the west, composed of hardened sand and gravel deposits and the Senri Hills in the east, consisting of deposits from the diluvial epoch and commonly referred to as the Osaka layer group. The boundary between the low-lying ground and the Hokusetsu mountains is clearly defined by the Arima-Takatsuki fault line. Soft alluvial formations have developed along the Mukogawa and the Inagawa rivers flowing southward, become one as they approach the Osaka Bay side and connected with the Osaka plain to the east (Fig. 3).

In this eastern region hit by the tail of the earthquake, the most severe damage is concentrated inside three relatively narrow corridors based on the influence of regional geology and soil conditions. The first (I), which trends from west-southwest to east-northeast, goes through the southern portions of Ashiya and Nishinomiya cities and traverses the alluvial deposits in the lower reaches of the Mukogawa River. It is interrupted suddenly by the Itami river terrace, and there is relatively little damage in the portions underlain by the terrace deposits because these soils are much stiffer than the riverside alluvium. However, the damage associated with the first corridor surfaces again to the east, on the alluvial deposits of the Inagawa River. The second corridor (II) of damage stretches west-to-east from the downtown area of Takarazuka city toward Kawanishi city, patrallel to and south of the Arima-Takatsuki tectonic line. The third corridor (III) is amplified south-to-north in the alluvial basin formed by the Mukogawa River and sandwiched between the east end of the Rokko Mountains and the west of the Itami river terrace. The amplified damage is clustered on the left bank of the upper reaches passing through the southwest-to-northeast section AA', while the amplified trend is shown on the right bank of the lower reaches through the west-to-east section BB'. These amplified phenomena are associated with the site effects nearby topographic irregularities and the exciting conditions (Fig. 4).

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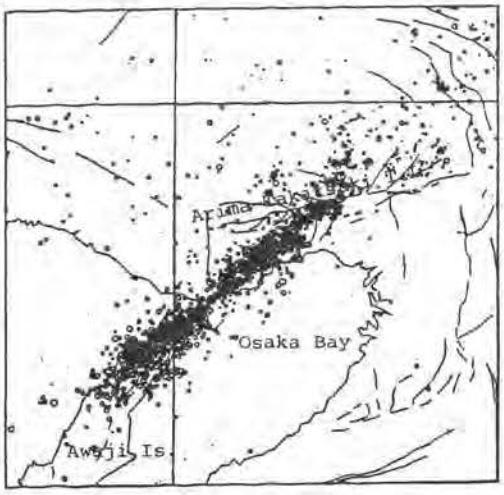


Fig. 1 Distribution of aftershocks

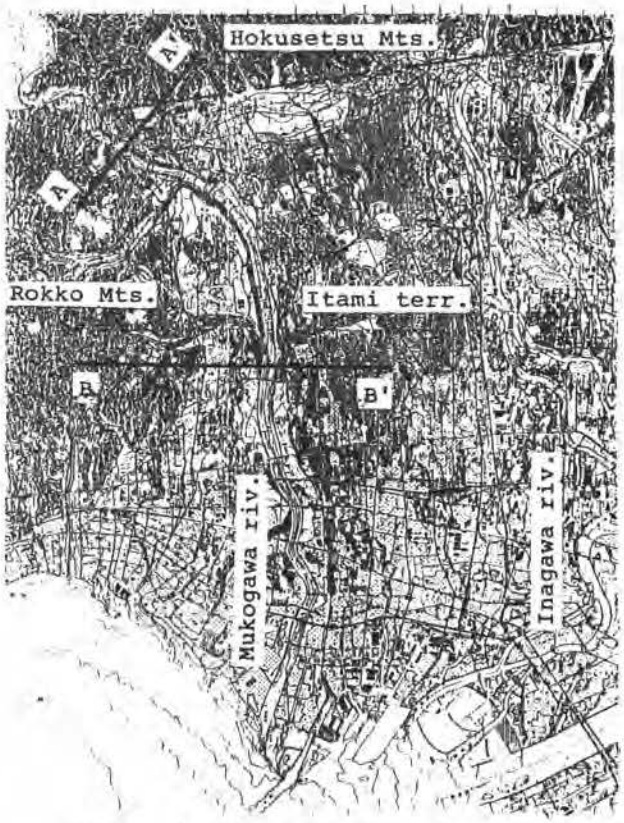


Fig. 3 Geological composition
(after Japan Meteorological Bureau)

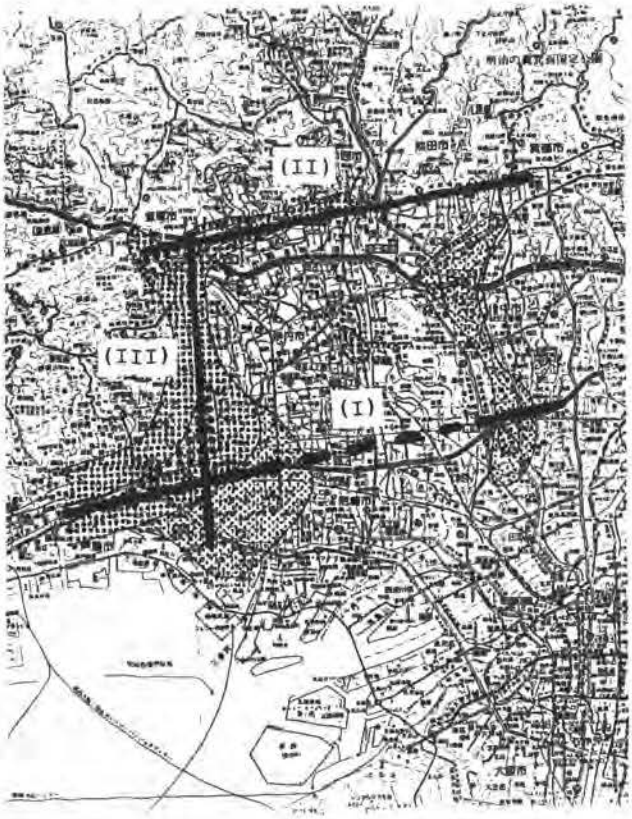
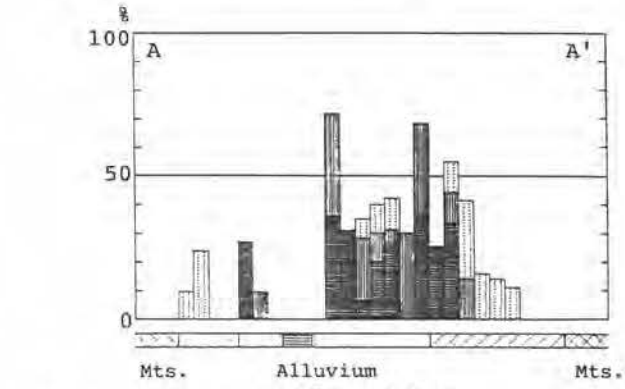
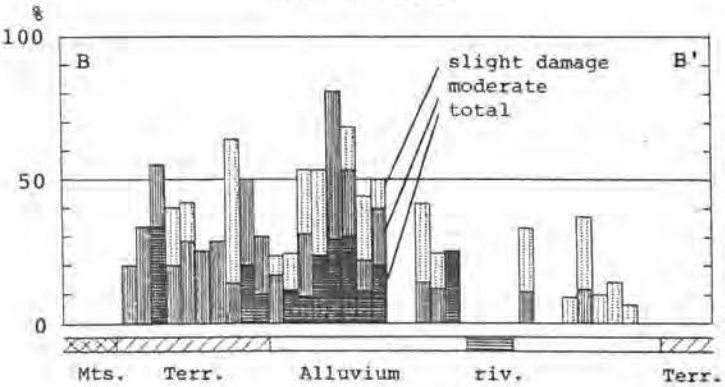


Fig. 2 Distribution of seismic damage



A-A' section



B-B' section

Fig. 4 Distribution of seismic damage
in the sections AA' and BB'